



# Little Crow

*Solar Park*

*Little Crow Solar Park, Scunthorpe*

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## **APPLICANT'S RESPONSE TO EXQ3 QUESTION 3.1.3 – TECHNICAL APPENDICES**

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# **APPLICANT'S RESPONSE TO EXQ3 QUESTION 3.1.3 – TECHNICAL APPENDICES**

**ON BEHALF OF INRG SOLAR (LITTLE CROW) LTD**

**DEADLINE 6**

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ENERGY WHITE PAPER

# Powering our Net Zero Future

December 2020 | CP 337



**TOGETHER  
FOR OUR  
PLANET**



HM Government





The Energy White Paper

# Powering our Net Zero Future

Presented to Parliament  
by the Secretary of State for Business, Energy and Industrial Strategy  
by Command of Her Majesty

December 2020



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ENERGY WHITE PAPER

# Ministerial foreword



The government presents this white paper at a time of unprecedented peacetime challenge to our country.

Coronavirus has taken a heavy toll on our society and on our economy. But we will overcome COVID-19 and rebuild our economy, building back better and levelling up the country.

As we do so, we must address the inter-generational challenge of climate change. Unchecked, the impact of rising global temperatures represents an existential threat to the planet. So, building back better means building back greener.

The UK has set a world-leading net zero target, the first major economy to do so, but simply setting the target is not enough – we need to achieve it. Failing to act will result in natural catastrophes and changing weather patterns, as well as significant economic damage, supply chain disruption and displacement of populations.

Tackling climate change will require decisive global action and significant investment and innovation by the public and private sectors, creating whole new industries, technologies, and professions.

But fighting climate change offers huge opportunity for both growth and job creation. The global markets for low-carbon technologies, electric vehicles and clean energy are fast growing: zero emission vehicles could support 40,000 jobs by 2030, with exports of new technologies such as CCUS having the potential to add £3.6 billion GVA by 2030. The time is now to seize these opportunities.

This white paper puts net zero and our effort to fight climate change at its core, following the Prime Minister's Ten Point Plan for a Green Industrial Revolution. The Ten Point Plan sets out how government investment will leverage billions of pounds more of private investment and support up to 250,000 jobs by 2030.

This includes building on our leadership in offshore wind to target 40GW by 2030 – enough to power every home in the UK – which alone will support up to 60,000 jobs.

The way we produce and use energy is therefore at the heart of this. Our success will rest on a decisive shift away from fossil fuels to using clean energy for heat and industrial processes, as much as for electricity generation.

These are more than academic considerations; the shift to net zero will affect us all. This white paper presents a vision of how we make the transition to clean energy by 2050 and what this will mean for us as consumers of energy in our homes and places of work, or for how businesses use energy to produce goods and services.

It sets out the changes which will be required. We will reduce emissions through shifting from gas to electricity to heat our homes and by better insulating the buildings in which we live and work. We will end the sale of petrol and diesel cars and vans, and accelerate the transition to clean, zero tailpipe emission vehicles. We will start to capture carbon emissions from power generation and from industry. And we will switch to new, clean fuels such as hydrogen for heat, power and industrial processes.

As we leave fossil fuels behind us and increasingly rely on clean electricity, our experiences as energy consumers will be very different. Smart technologies are revolutionising how we can engage the market. Smart meters and a range of smart appliances, backed by new smart tariffs, will give us control about how we use energy and help us manage our bills – running the washing machine or charging the electric vehicle when demand is low and electricity is cheap, even selling surplus power back to the grid at a profit.

And we will do this with affordability at the front of our minds. The costs of renewables have fallen sharply over the last five years. Offshore wind prices in renewable Contracts for Difference auctions have fallen from £120/MWh in 2015 to around £40/MWh in last year's auction.

Greater competition and more innovation will drive down the costs of our energy system even further. We expect energy companies to ensure that the benefits of a more efficient system result in a fair deal for consumers. Where we use taxpayers' money to fund the transition to clean energy, we will leverage private capital as much as we can.

Across the board, as a result of our policies, energy bills will remain affordable over the 2020s. A major push on improving the energy efficiency of our homes will mean households can significantly reduce demand and save money on their bills.

We understand the effect that COVID-19 has had on household incomes, and therefore commit to protecting those who are particularly vulnerable. Lower income households can receive up to £10,000 to improve the energy efficiency of their homes via the Green Homes Grant scheme, saving up to £600 each year on bills on average. Through this white paper, we are expanding the Warm Home Discount to around three million homes to provide £150 a year off electricity bills, representing £1.9 billion of extra support for households in fuel poverty. This builds on the Ten Point Plan's commitment to extend the Energy Company Obligation to 2026.

This is an ambitious domestic agenda on which we will also seek to secure equally ambitious international action, through the UK's presidency of COP26, the UN's climate conference being held in Glasgow in November 2021. The actions we take as a result of this white paper, as part of our wider climate agenda, are intended to show leadership and vision and demonstrate to our partners around the world that now is the time to take the bold steps to tackle climate change. The UK is leading from the front in the transition to clean energy, while ensuring that we leave no one behind as we build back greener.

### **Rt Hon Alok Sharma MP**

Secretary of State for Business,  
Energy and Industrial Strategy

## INTRODUCTION

# We are on the cusp of a global Green Industrial Revolution.

The Prime Minister's Ten Point Plan has set out the measures that will help ensure the UK is at the forefront of this revolution, just as we led the first over two centuries ago.

As nations move out of the shadow of coronavirus and confront the challenge of climate change with renewed vigour, markets for new green products and services will spring up round the world. Taking action now will help ensure not just that we end our contribution to climate change by achieving our target of net zero emissions. It will help position UK companies and our world class research base to seize the business opportunities which flow from it, creating jobs and wealth for our country.

Following on from the Ten Point Plan and the National Infrastructure Strategy, the Energy White Paper provides further clarity on the Prime Minister's measures and puts in place a strategy for the wider energy system that:

- ▶ **Transforms energy**, building a cleaner, greener future for our country, our people and our planet
- ▶ **Supports a green recovery**, growing our economy, supporting thousands of green jobs across the country in new green industries and leveraging new green export opportunities
- ▶ **Creates a fair deal for consumers**, protecting the fuel poor, providing opportunities to save money on bills, giving us warmer, more comfortable homes and balancing investment against bill impacts

# THE COMPELLING CASE FOR TACKLING CLIMATE CHANGE

We are reminded on a daily basis why we need this Green Industrial Revolution: climate change is having a real effect on our planet.

The melting of glaciers and ice sheets is accelerating, contributing to rising sea levels across the globe, with melting rates of ice sheets in Greenland and Antarctica matching the Intergovernmental Panel on Climate Change's worst-case climate warming scenarios.<sup>1</sup> All ten of the warmest years in the UK's temperature record have taken place since 2002.<sup>2</sup> Rainfall over Scotland is up 10 per cent from the start of the 20th century.<sup>3</sup> The record-breaking European summer heatwave of 2003 resulted in at least 70,000 deaths across the continent,<sup>4</sup> and such heatwaves are projected to become the norm in the UK by the 2040s at current rates of warming.<sup>5</sup>

We need to act urgently. The future impacts of climate change depend upon how much we can hold down the rising global temperature. To minimise the risk of dangerous climate change, the landmark Paris Agreement of 2015 aims to halt global warming at well below 2°C, while pursuing efforts to limit it to 1.5°C, increasing measures to adapt to climate change, and aligning financial systems to these goals.<sup>6</sup>

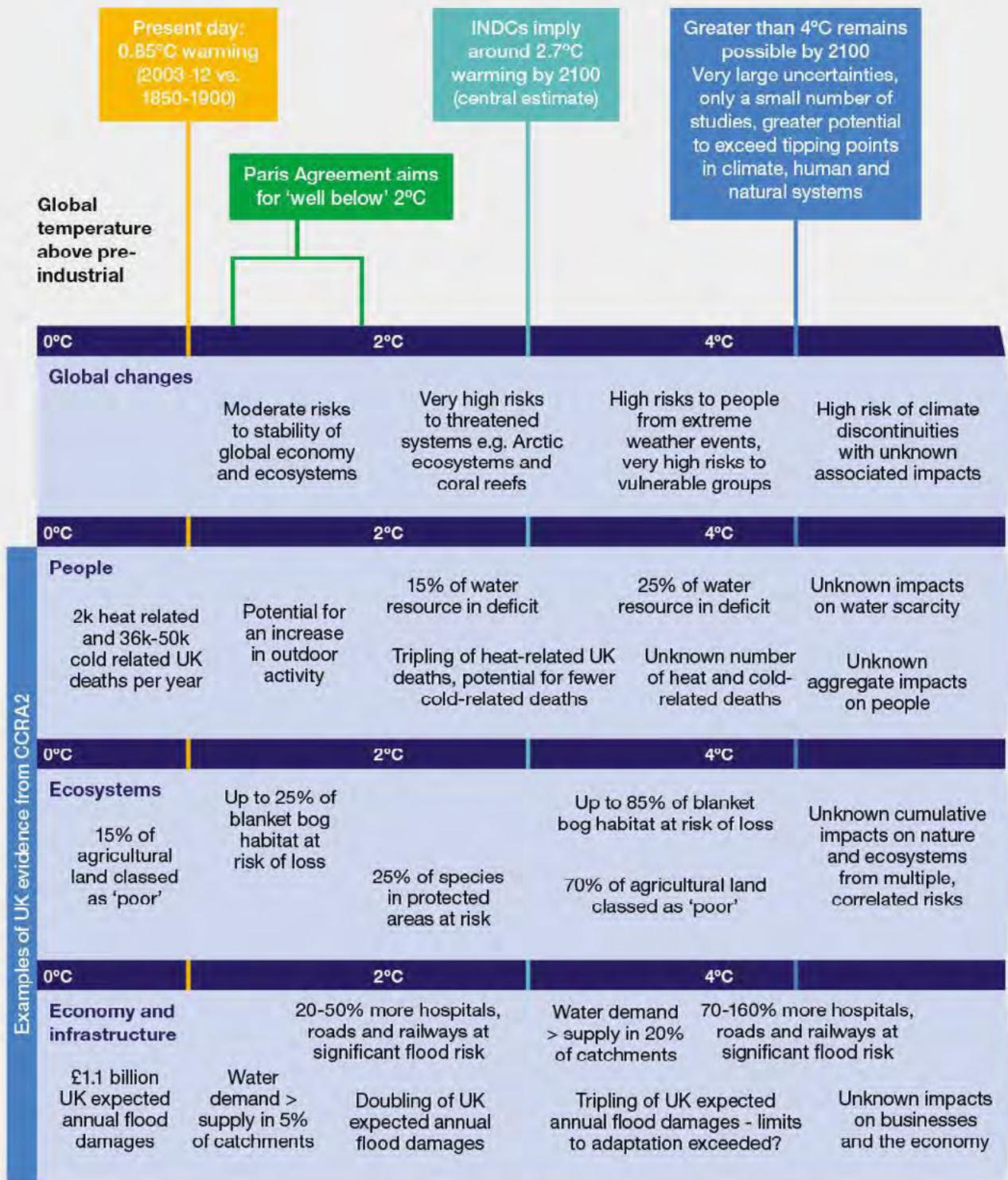
At the global scale, however, we are not presently on track to reach the temperature goal of the Paris Agreement. Based on current national pledges, and assuming the level of ambition does not change, the world is heading for around 3°C of warming by the end of the century.<sup>7</sup>

The cost of inaction is too high.<sup>8</sup> We can expect to see severe impacts under 3°C of warming. Globally, the chances of there being a major heatwave in any given year would increase to about 79 per cent, compared to a five per cent chance now.<sup>9</sup> Many regions of the world would see what is now considered a 1-in-100-year drought happening every two to five years.<sup>10</sup>

At 3°C of global warming, the UK is expected to be significantly affected, seeing sea level rise of up to 0.83 m.<sup>11</sup> River flooding would cause twice as much economic damage and affect twice as many people, compared to today,<sup>12</sup> while by 2050, up to 7,000 people could die every year due to heat, compared to approximately 2,000 today.<sup>13</sup> And, without action now, we cannot rule out 4°C of warming by the end of the century, with real risks of higher warming than that.<sup>14</sup> A warming of 4°C would increase the risk of passing thresholds that would result in large scale and irreversible changes to the global climate, including large-scale methane release from thawing permafrost and the collapse of the Atlantic Meridional Overturning Circulation.<sup>15</sup> The loss of ice sheets could result in multi-metre rises in sea level on time scales of a century to millennia.<sup>16</sup>

To meet the temperature goal of the Paris Agreement, the world must collectively and rapidly reduce global emissions to net zero over the next 30 years. Success will mean we are less exposed to flood and heat risks and preserve our national security, our prosperity, and our natural world which are threatened by the global disruption of climate change.

**FIGURE 1.1 – IMPACTS OF INCREASING TEMPERATURES ON UK** <sup>17</sup>



Source: CCC CCRA 2017

## OUR DOMESTIC AGENDA

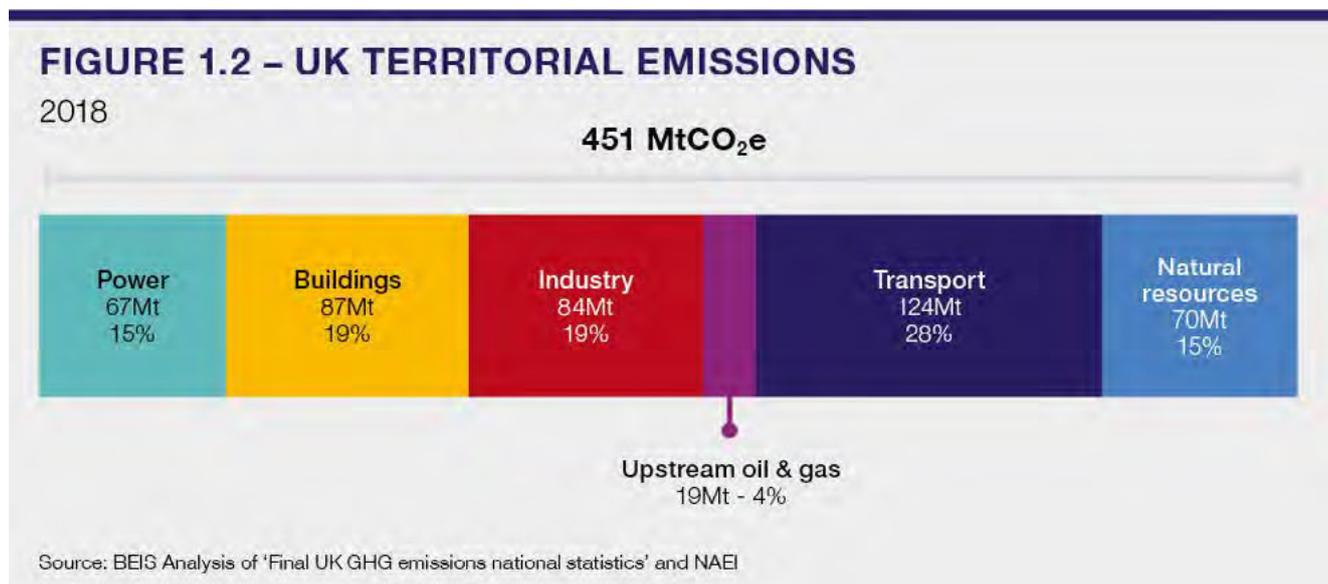
As we tackle climate change, we will have the interests of consumers at the front of our mind, now and for future generations.

We are committed to ensuring that the cost of the transition to net zero is fair and affordable. We have consistently balanced spending on measures that decarbonise the energy system with the need to help consumers save money on their bills. Thanks to early investment, many low-carbon technologies are now cheaper than their fossil fuel counterparts.

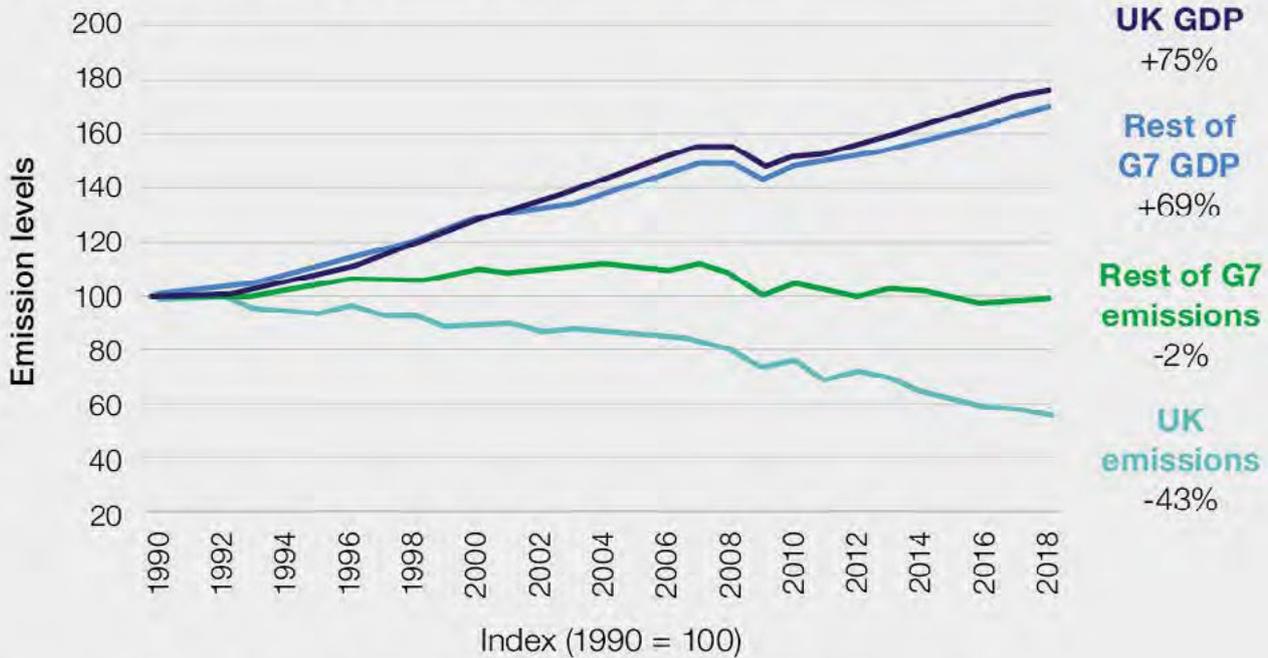
Our vision is of a system with consumers at its heart, able to make money or save on bills through using the new technologies net zero will require. So our approach means not just deploying measures that save energy and reduce bills, but also ensuring the energy system is fit for a net zero world, making markets efficient, incentivising people to move to clean energy solutions, or making sure system rules are agile and flexible to accommodate new technologies and new ways of doing things.

But affordability does not mean compromising our ambition. Achieving our 2050 goal requires action across the economy. The measures in this white paper will reduce emissions from power, buildings, industry, upstream oil and gas, and address the implications for the energy system of electrifying surface transport. We will publish our wider Transport Decarbonisation Plan in the spring.

Action on energy will be consistent with our wider environmental commitments, as we balance new technologies and the need for new infrastructure with protecting the environment, including air quality. Our 25 Year Environment Plan aims to improve the environment within a generation. Through the Environment Bill, we are placing this ambitious set of proposals on a legal footing, including a commitment to bring forward new legally binding environmental targets (on air quality, biodiversity, water, and resource efficiency and waste reduction) by October 2022.



**FIGURE 1.3 – UK VS REST OF G7 GDP AND EMISSIONS**



Source: World Bank, UNFCCC National Inventory Submissions, ONS, BEIS Greenhouse Gas Inventory 1990-2018.

Our National Adaptation Programme, which was updated in 2018, sets out the actions which the government is, and will be taking, to address the risks and opportunities posed by climate change in response to the Climate Change Risk Assessment. This includes a dedicated chapter on infrastructure, including actions to build the energy sector’s resilience to climate change.

No one doubts the challenge of achieving net zero emissions, but the UK is able to build on 30 years of successfully reducing emissions while simultaneously growing our economy. Between 1990 and 2018, emissions fell by 43 per cent while GDP rose by 75 per cent, with the UK decarbonising faster than any other G20 country since 2000 (Figure 1.3).<sup>18</sup>

Energy has led the way. In 2019, greenhouse gas emissions (MtCO<sub>2</sub>e) from electricity generation were down 13 per cent on 2018 levels and 72 per cent lower than 1990 levels,<sup>19</sup> as we have switched from

coal to gas and renewable power together with the continued contribution of nuclear. In April 2017, the UK experienced its first coal free day since the industrial revolution. From April to June 2020, the total coal-free period lasted 67 days.<sup>20</sup>

Over the past decade, and with government support, the amount of renewable capacity connected to the grid has increased from 8GW in 2009 to 48GW at the end of June this year, an increase of 500 per cent.<sup>21</sup> The share of low-carbon electricity generation has risen to 54 per cent in 2019, with renewables at a record 37 per cent.<sup>22</sup>

Through a mix of early policy action, increased competition, innovation, and growth in deployment, our sustained support for clean electricity has helped secure dramatic falls in the costs of some renewables and provided developers and private investors with long term certainty.

The cost of offshore wind projects contracted in 2019 fell by 30 per cent for example, relative to those contracted in 2018.<sup>23</sup> There are even early signs of some renewable technologies deploying without direct policy support.<sup>24</sup>

But there is still much more to do. Our energy system is dominated by the use of fossil fuels and will need to change dramatically by 2050 if we are to achieve net zero emissions (see figure 1.4).

Decarbonising the energy system over the next thirty years means replacing - as far as it is possible to do so - fossil fuels with clean energy technologies such as renewables, nuclear and hydrogen.

30

**years of successfully reducing UK emissions** while simultaneously growing our economy

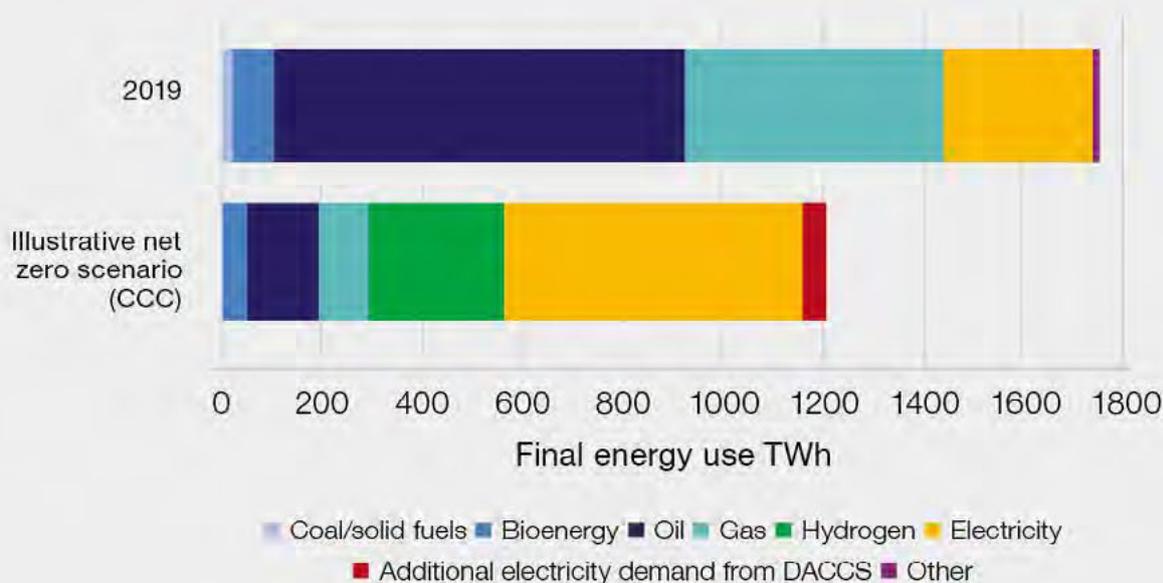
500%

**increase in the amount of renewable capacity** connected to the grid from 2009 to 2020

72%

**reduction in greenhouse gas emissions** from electricity generation between 1990-2019

**FIGURE 1.4 – ILLUSTRATIVE UK FINAL ENERGY USE IN 2050**



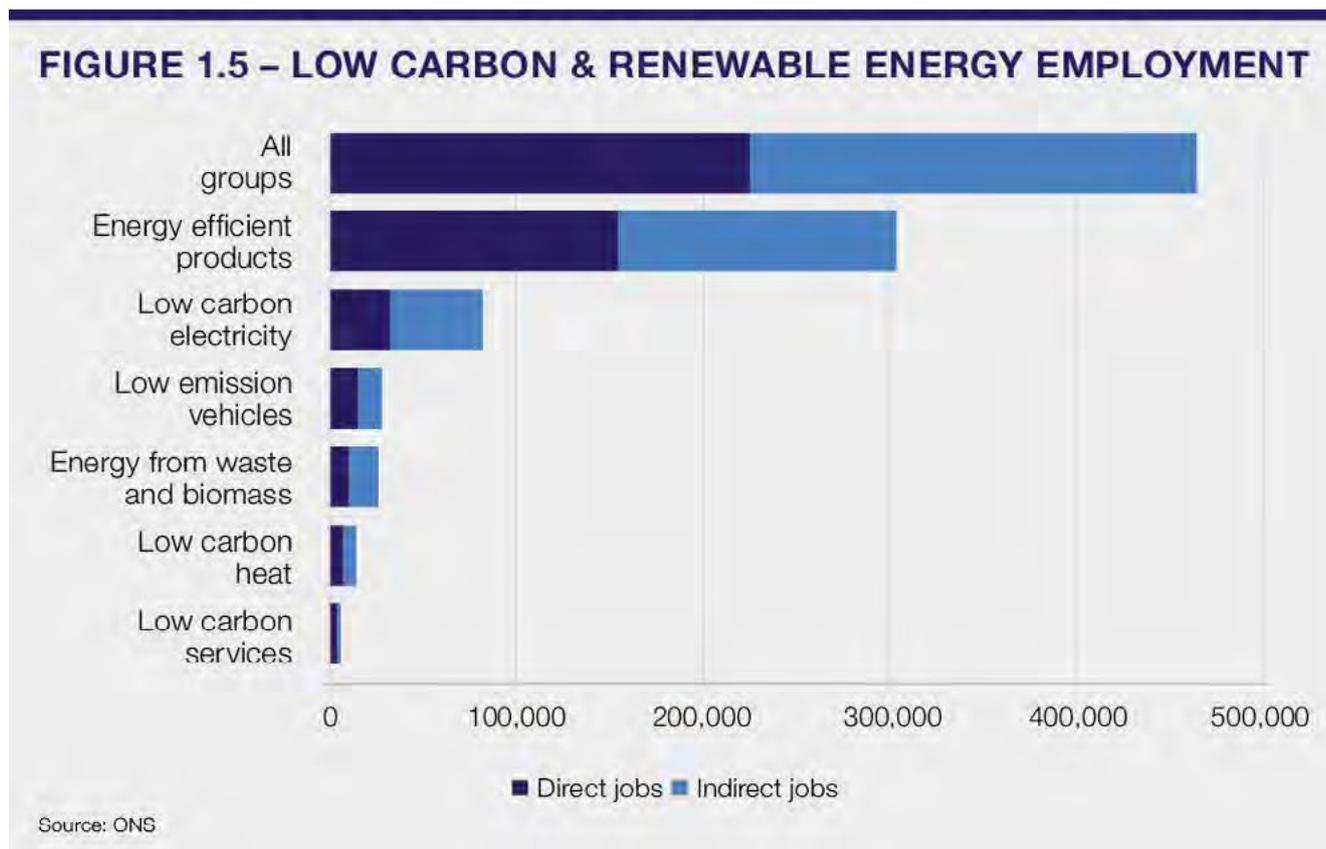
Source: Energy Trends table 1.2; CCC Net Zero Report



This is a significant and historic undertaking. It means ending our dependency on oil to power nearly half of our economy. It means largely eliminating the use of natural gas to heat our homes, and make them considerably more efficient – but as 20 per cent of homes currently overheat even in cool summers we will need to ensure that our homes are not just efficient, but adapted to the future climate.<sup>25</sup> This will apply throughout the system.

Clean electricity will become the predominant form of energy, entailing a potential doubling of electricity demand and consequently a fourfold increase in low-carbon electricity generation. We must secure this transition while retaining the essential reliability, resilience and affordability of our energy, as the bedrock of a modern, productive economy driving almost every facet of our home and working lives.

Delivering this transition will require billions of pounds of investment in clean energy infrastructure or new low-carbon technologies, and a major shift away from spending in fossil fuels. As set out in the National Infrastructure Strategy,<sup>26</sup> delivering this volume of private investment will require multiple policy levers and the right market frameworks to encourage competition and drive down costs. This challenge is set against the backdrop of an economy which has been hit by the largest recession in 300 years as a result of the COVID-19 pandemic. Our commitments to new and improved buildings, infrastructure and energy sources will support near-term investment and jobs in the UK. It will also establish world-leading capabilities in the new technologies which will be needed globally to tackle climate change, growing our capability to trade UK expertise around the world.



Across the UK almost half a million people are already employed in the low-carbon economy and its supply chains (Figure 1.5).<sup>27</sup> These jobs are frequently outside the South East of England, including electric vehicle manufacturing in the Midlands and North East, and reconditioning and recycling in the North East and West Midlands. The offshore wind sector supports an estimated 7,200 direct jobs as a whole, with a burgeoning industry on the north east coast of England, centred around the Humber and the Tees.

But this is just the beginning. In November 2020, the Prime Minister announced his Ten Point Plan to lay the foundations for a Green Industrial Revolution. We will start by supporting 90,000 jobs across the UK in this Parliament, and up to 250,000 by 2030. The response to the pandemic has been a reminder of the excellence of British science, a research and development (R&D) capability

which engineers, fitters, construction workers and many others will harness to develop the clean energy technologies of the future and forge new industries to service new markets at home and abroad.

We will generate new clean power with offshore wind farms, nuclear plants and by investing in new hydrogen technologies. We will use this energy to carry on living our lives, running our cars, buses, trucks and trains, ships and planes, and heating our homes while keeping bills low. And to the extent that we still emit carbon, we will pioneer a new British industry dedicated to its capture and return to under the North Sea. Together these measures will reinvigorate our industrial heartlands, creating jobs and growth, and pioneering world-leading SuperPlaces that unite clean industry with transport and power.

# THE PRIME MINISTER'S TEN POINT PLAN



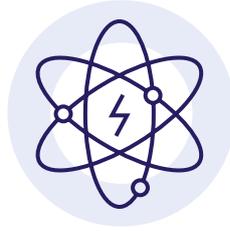
## GREEN PUBLIC TRANSPORT, CYCLING AND WALKING

We will accelerate the transition to more active and sustainable transport by investing in rail and bus services, and in measures to help pedestrians and cyclists. We will fund thousands of zero-emission buses and give our towns and cities cycle lanes worthy of Holland.



## HYDROGEN

Working with industry the UK is aiming for 5GW of low-carbon hydrogen production capacity by 2030. We are also pioneering hydrogen heating trials, starting with a Hydrogen Neighbourhood and scaling up to a potential Hydrogen Town before the end of this decade.



## NUCLEAR POWER

Nuclear power provides a reliable source of low-carbon electricity. We are pursuing large-scale nuclear, whilst also looking to the future of nuclear power in the UK through further investment in Small Modular Reactors and Advanced Modular Reactors.



## OFFSHORE WIND

By 2030 we plan to quadruple our offshore wind capacity so as to generate more power than all our homes use today, backing new innovations to make the most of this proven technology and investing to bring new jobs and growth to our ports and coastal regions.



## JET ZERO AND GREEN SHIPS

By taking immediate steps to drive the uptake of sustainable aviation fuels, investments in R&D to develop zero-emission aircraft and developing the infrastructure of the future at our airports and seaports, we will make the UK the home of green ships and planes.



## GREENER BUILDINGS

Making our buildings more energy efficient and moving away from fossil fuel boilers will help make people's homes warm and comfortable, whilst keeping bills low. We will go with the grain of behaviour, and set a clear path that sees the gradual move away from fossil fuel boilers over the next fifteen years as individuals replace their appliances and are offered a lower carbon, more efficient alternative, supporting 50,000 jobs.



## CARBON CAPTURE, USAGE & STORAGE (CCUS)

Our ambition is to capture 10Mt of carbon dioxide a year by 2030 - the equivalent of four million cars' worth of annual emissions. We will invest up to £1 billion to support the establishment of CCUS in four industrial clusters, creating 'SuperPlaces' in areas such as the North East, the Humber, North West, Scotland and Wales. We will bring forward details in 2021 of a revenue mechanism to bring through private sector investment into industrial carbon capture and hydrogen projects via our new business models to support these projects.



## PROTECTING OUR NATURAL ENVIRONMENT

We will safeguard our cherished landscapes, restore habitats for wildlife in order to combat biodiversity loss and adapt to climate change, all whilst creating green jobs.



## ZERO EMISSION VEHICLES

From 2030 we will end the sale of new petrol and diesel cars and vans, 10 years earlier than planned, and provide a £2.8 billion package of measures to support industry and consumers to make the switch to cleaner vehicles.



## GREEN FINANCE AND INNOVATION

We have committed to raising total R&D investment to 2.4 per cent of GDP by 2027 and in July 2020 published the UK Research and Development Roadmap. The next phase of green innovation will help bring down the cost of the net zero transition, nurture the development of better products and new business models, and influence consumer behaviour.

## LEADING GLOBAL ACTION

The UK accounts for less than one per cent of annual global emissions.<sup>28</sup> We therefore need to help other nations reduce their emissions in line with the Paris Agreement.

Our leadership is based on taking practical domestic action, which in turn creates business opportunities for the UK to export clean technology, skills and know-how.

We use our international partnerships and work through multilateral fora to influence international agreements on climate change and clean energy issues which help reinforce our domestic and international priorities. The principal vehicle we work through is the United Nations Framework Convention on Climate Change (UNFCCC), which delivered the Paris Agreement.

We will continue to demonstrate international leadership by building on the policies set out in the UK's National Energy and Climate Plan (NECP) and a number of other publications. This white paper goes even further than the ambitions set out in the NECP for renewables and energy efficiency.

Our presidency of the UN Climate Change Conference of the Parties (COP26), which will meet in Glasgow in November 2021, provides the opportunity to drive further ambitious action on climate change and unite the world on a path to a net zero economy, including through our COP26 Energy Transition Campaign and co-leadership of the Powering Past Coal Alliance.

**Around 120 countries** are committed to, developing plans or advancing consultations on **long-term climate or carbon neutral targets**



We are already seeing encouraging signs. In March, the European Union (EU) Commission proposed the first European Climate Law, which would commit the EU to achieving net zero greenhouse gas (GHG) emissions by 2050. In September, China announced that it would achieve carbon neutrality by 2060 and enhance its 2030 Nationally Determined Contribution (NDC). In October, both Japan and South Korea committed to achieving net zero by 2050. And thanks to the efforts of the UK, the EU, and other nations, there are now around 120 countries that are committed to, are developing plans or advancing consultations on long-term climate or carbon neutral targets.<sup>29</sup>

The countries delivering on these commitments will need to radically change their energy, transport, buildings and land use sectors. By driving forward UK action now, we can build companies that can win the lion's share of these new global markets in the future.

## WHAT THE WHITE PAPER DELIVERS – AND BEYOND

This white paper builds on the Prime Minister’s Ten Point Plan to set the energy-related measures the Plan announced in a long-term strategic vision for our energy system, consistent with net zero emissions by 2050.

It establishes our goal of a decisive shift from fossil fuels to clean energy, in power, buildings and industry, while creating jobs and growing the economy and keeping energy bills affordable. It addresses how and why our energy system needs to evolve to deliver this goal. And it provides a foundation for the detailed actions we will take in this Parliament to realise our vision.

We estimate the measures in this paper could reduce emissions across power, industry and buildings by up to 230MtCO<sub>2</sub>e in the period to 2032 and enable further savings in other sectors such as transport. In doing so, they will support up to 220,000 jobs per year by 2030. These figures include the energy measures from the Prime Minister’s Ten Point Plan as well as additional measures provided in this white paper.<sup>30</sup>

We recognise that more will need to be done to meet key milestones on the journey to net zero, including our ambition for Carbon Budget 6, which we will set next year, taking into account the latest advice from the Climate Change Committee. In the run-up to COP26 we will bring forward a series of sectoral strategies, and our overarching Net Zero Strategy, which will set out more detail on how we will meet our net zero target and ambitious carbon budgets.

**FIGURE 1.6 – ESTIMATED CUMULATIVE EMISSION SAVINGS TO 2032 FROM THE ENERGY WHITE PAPER**



Source: BEIS analysis

# Overview of key commitments

This white paper sets out the government's policies and commitments that will put us on course to net zero, levelling up the country and strengthening the union as we achieve this goal. We will:

## TRANSFORM ENERGY

Building a cleaner, greener future for our country, our people and our planet, by measures including:

- ▶ **Targeting 40GW of offshore wind by 2030**, including 1GW floating wind, alongside the expansion of other low-cost renewables technologies.
- ▶ **Supporting the deployment of CCUS in four industrial clusters** including at least one power CCUS project, to be operational by 2030 and putting in place the commercial frameworks required to help stimulate the market to deliver a future pipeline of CCUS projects.
- ▶ **Establishing a new UK Emissions Trading System**, aligned to our net zero target, giving industry the certainty they need to invest in low-carbon technologies.
- ▶ **Aiming to bring at least one large-scale nuclear project to the point of Final Investment Decision** by the end of this Parliament, subject to clear value for money and all relevant approvals.

- ▶ **Consulting on whether it is appropriate to end gas grid connections to new homes being built from 2025**, in favour of clean energy alternatives.
- ▶ **Growing the installation of electric heat pumps**, from 30,000 per year to 600,000 per year by 2028.
- ▶ **Building world-leading digital infrastructure for our energy system** based on the vision set out by the independent Energy Data Taskforce, publishing the UK's first Energy Data Strategy in spring 2021, in partnership with Ofgem.

## SUPPORT A GREEN RECOVERY FROM COVID-19

Growing our economy, supporting thousands of green jobs across the country in new green industries and creating new export opportunities, by measures including::

- ▶ **Increasing the ambition in our Industrial Clusters Mission four-fold**, aiming to deliver four low-carbon clusters by 2030 and at least one fully net zero cluster by 2040.

- ▶ **Investing £1 billion up to 2025 to facilitate the deployment of CCUS in two industrial clusters** by the mid-2020s, and a further two clusters by 2030, supporting our ambition to capture 10MtCO<sub>2</sub> per year by the end of the decade.
- ▶ Working with industry, **aiming to develop 5GW of low-carbon hydrogen production capacity by 2030.**
- ▶ **Assessing what market framework changes may be required to facilitate the development and uptake of innovative tariffs and products** that work for consumers and contribute to net zero, engaging with industry and consumer groups throughout 2021 before a formal consultation.
- ▶ **Ensuring the retail market regulatory framework adequately covers the wider market**, consulting by spring 2021 on regulating third parties such as energy brokers and price comparison websites.

## CREATING A FAIR DEAL FOR CONSUMERS

Protecting the fuel poor, providing opportunities to save money on bills, giving us warmer, more comfortable homes and balancing investment against bill impacts, by measures including:

- ▶ **Creating the framework to introduce opt-in switching**, consulting by March 2021 on how it should be designed, tested and incrementally scaled up.
- ▶ **Considering how the current auto-renewal and roll-over tariff arrangements could be reformed** to facilitate greater competition, consulting by March 2021 on how opt-out switching could be tested as part of any future reforms.
- ▶ **Establishing the Future Homes Standard** which will ensure that all new-build homes are zero carbon ready.
- ▶ **Consulting on regulatory measures to improve the energy performance of homes**, and are consulting how on how mortgage lenders could support homeowners in making these improvements.
- ▶ **Requiring that all rented non-domestic buildings will be Energy Performance Certificate (EPC) Band B by 2030**, barring lawful exceptions.
- ▶ **Extending the Energy Company Obligation to 2026** and expanding the Warm Home Discount to £475 million per year from 2022 to 2025/2026.

In addressing these issues we respect the devolution settlements with Scotland, Wales and Northern Ireland. All proposals in this white paper which touch on devolved matters will be progressed in accordance with those settlements.

CHAPTER 01

# Consumers

## OUR GOAL

We are committed to making the right reforms that will protect the interests of consumers and create opportunities to reduce bills and carbon emissions.

In partnership with the Office of Gas and Electricity Markets (Ofgem), we will:

- ▶ Create a **fair deal for consumers**
- ▶ **Protect the fuel poor**
- ▶ Provide **opportunities to make savings** on energy bills



CONSUMERS

# The strategic context



Energy is integral to everything we do, from work, to travel, to leisure, to just relaxing at home. Whether it be for heating and lighting our homes or powering appliances, we all rely on secure, affordable energy every day. But the way we use energy in the home is changing.

Smart technologies, enabled by our increasingly digital world, offer new products and services which help us to take control of our energy use and reduce bills. And, over the next 30 years, electricity will become a significant proportion of the energy we use at home, powering electric cars, replacing petrol and diesel, and enabling the installation of electric heat pumps which reduce the need for oil and gas to heat our homes.

Over the next 30 years, **electricity will become a significant proportion of the energy we use**



This transformation of energy in our homes will only accelerate over the coming decade. The government and Ofgem have an important role to play, making regulatory reforms which place fairness and affordability at the heart of our efforts to protect the interests of consumers and create opportunities to save money.

This means:

▶ **Creating a fair deal for consumers.**

We will increase competition throughout the energy retail market to benefit consumers and, as we transition to net zero, we will make sure the costs of doing so are distributed fairly;

▶ **Protecting the fuel poor.** We will offer additional protections to the vulnerable and fuel poor, through our Energy Company Obligation (ECO) and expanded Warm Home Discount (WHD) schemes and the Green Homes Grant, providing financial support of at least £6.7 billion over the next six years (see 'Buildings' chapter);

▶ **Providing opportunities to make savings on energy bills.** We will create opportunities for consumers to reduce bills and carbon emissions by upgrading the energy performance of homes (see 'Buildings' chapter), switching to clean energy, or using energy when it is cheapest thanks to smart technology.

## SMARTER, CLEANER ENERGY FOR ALL CONSUMERS

Traditionally, households have been passive consumers of energy from fossil fuels.

Smart technology is unlocking new opportunities to give consumers more control, choice and flexibility over their energy use. We are seeing retail offers that will help consumers engage in the market and save money in the process.

### SMART METERS

Smart meters are replacing traditional gas and electricity meters in homes and small businesses across Great Britain as part of an essential infrastructure upgrade to make the energy system more efficient and flexible, helping to deliver net zero emissions cost-effectively.

Smart meters are also modernising energy services by ending manual meter readings, delivering accurate bills and enabling prepayment customers to conveniently track their usage and top-up credit without leaving home. The In-Home Display (IHD), which households are offered when they have smart meters installed, gives accurate information about energy consumption and costs so consumers can easily understand how to save money on their bills.

The real-time information about energy use, recorded by smart meters, ensures that consumers are accurately charged by their suppliers. Smart meters also enable consumers to access innovative solutions such as smart tariffs, including 'time of use' tariffs. These tariffs reward consumers financially for using less electricity at peak times of demand or using more when overall demand is low and there is surplus generation available, for example on a sunny or windy weekend. This can reduce the cost of using clean electricity to power homes, businesses and electric vehicles, making the system more efficient and saving consumers money.

## SMART TARIFFS

Smart tariffs include: tariffs where costs vary by the time of use, based on the cost of electricity; export tariffs, for those with generation technology such as solar panels; load control tariffs that can manage when appliances are used to ensure consumers use the cheapest energy; and tariffs designed for consumers with low-carbon technology, for example, electric vehicles, to ensure they can charge at the cheapest times.

There are now new ways for households to find the best energy products and services to match their specific needs. This ensures consumers are getting the best deal available and can help them choose new ways to engage with the energy system.

Consumers can be rewarded for playing a bigger role in our energy system. There are plenty of ways to save money, from installing energy saving measures to making the most of new technologies, such as batteries, heating controls or smart washing machines and dishwashers. Consumers can also generate their own electricity through roof-top solar panels, store it in batteries, and even sell any excess power back to the grid to generate a profit at times of higher demand.

## CASE STUDY: SMART TARIFF COMPARISON TOOL

### Smarter Tariff – Smarter Comparison, Vital Energi

Vital Energi is leading a consortium of experts to develop a comparison tool that gives consumers an easy way to find the most suitable smart tariff. Smart tariffs are often not included on price comparison websites and consumers have little visibility of their benefits. For example, many electric vehicle owners are unaware that there are dozens of tariffs designed specifically for them.

Supported with government funding, the project is developing a tool which will help people find the best smart tariff to match their needs. Consumers can use their actual smart meter data as an input to get personalised, accurate comparisons and, after they switch, see if they have achieved the expected savings. It eliminates the need to manually provide estimated electricity bills and integrates time-of-use tariffs and use of low-carbon technologies in the tariff search. Consumer research indicates that many people would be more likely to use a smart comparison tool such as this.

At the end of the project in March 2021, the proof of concept will be free for anyone to reuse. This means that suppliers, comparison websites and others will be able to integrate it into their services or reuse it. The research findings will be made public so they can be used by innovators in the market.



## CASE STUDY: SMART TARIFF

### **Agile Octopus Tariff, Octopus Energy**

Agile Octopus is a 'time-of-use' tariff, which gives consumers access to half-hourly electricity prices, tied to wholesale prices, which are updated daily. So when energy prices drop, so could bills. Sometimes prices even go 'negative' - meaning that consumers can be paid to use energy during that period. Octopus also cap prices at 35p/kWh to protect consumers during price spikes.

Octopus calculate that, on this tariff, customers could save £120 a year by shifting electricity use outside of the 4pm to 7pm peak.<sup>31</sup> This is best suited for households with lots of electricity demand during those periods. For example, households with electric heating or electric vehicles.

## CASE STUDY: CONNECTED HOME

### Core4Grid, geo

Through the 'Core4Grid' trial, battery storage and smart meters have been installed in 24 houses that already had solar panels, electric heating or electric vehicle chargers. Using Core - its "energy brain" - the technologies have been integrated to run as a whole system within each home.

Core responds to signals from the electricity system to make decisions on when to use energy or charge the batteries, using either excess solar generated by the household's panels or grid electricity imported during cheaper periods.

The trial has been running since March, with participating homes sourcing over half of the energy they used from their solar and batteries. The houses have generated almost 30MWh of local generation (equivalent to ten times a typical dual fuel household's annual electricity use<sup>32</sup>) for the period.

Electric vehicles will accelerate this trend (see Transport breakout box). By using a smart charger when powering up their electric vehicle, consumers will play an essential role in helping manage electricity demand, avoiding the expensive peak periods. Increasingly, consumers will also be able to export energy from their electric vehicle back to the grid. In doing so, they could significantly reduce their energy costs and help maximise the amount of solar and wind energy used to charge their vehicle.

## CASE STUDY: SMART ELECTRIC CAR CHARGING AND 'VEHICLE-TO-GRID' TRIAL

### Project Sciurus, Kaluza, Ovo Energy

Project Sciurus is the largest domestic 'vehicle-to-grid' (V2G) demonstration in the world - with 323 V2G chargers supplying electricity to the grid at times of high energy demand. These operate on the 'Kaluza' platform, which receives live signals from the grid so that consumers can charge their vehicle when prices are low, and sell electricity back to the grid at times of peak demand.

The Sciurus project is part of a £30 million Innovate UK competition, with a diverse consortium of participants taking part. The majority of trial participants have found V2G capability to be valuable. Consumers have changed how and when they were charging their electric vehicles to help reduce costs for themselves and the grid, all while helping balance the energy system and saving money.

And some local communities are coming together to establish their own approach to managing energy demand in their areas. Smart local energy systems are community-based initiatives which bring together a range of energy issues, typically including heat, power and transport, to reduce emissions in an integrated way, while also promoting local jobs and businesses. Local Authorities are key to delivering these systems by combining energy into their wider statutory work on housing, transport, waste and planning, making delivery more cost-effective and preparing for a net zero future. Government provides funding for Local Authorities to deliver programmes that support decarbonisation and will continue to work with communities to enable projects to be tailored and delivered to meet local needs.

## **CASE STUDY: COMMUNITY ENERGY**

### **Energy Local Clubs, Energy Local**

Energy Local has designed a local energy market. Households and small renewable generators form a Local Energy Club, the first of which started in a small town called Bethesda, in North Wales back in 2016. Through this, households use their smart meters to show how much power they are using.

They agree a 'match' tariff with local generators that pays them a price for the power they produce when households are using it. This keeps more money local and offers consumers the chance to reduce household bills by using energy when it's cheaper. They also partner with a supplier (Octopus Energy) to buy more power when there's not enough locally.

It benefits suppliers, generators and communities, giving a fair price to renewable generators and developing a suitable package of improved energy controls in the home, particularly for those at risk of fuel poverty as the benefits of local generation can be shared with anyone who joins the Local Energy Club, without having to pay a high capital cost.

# HOUSEHOLD ENERGY BILLS

The average household’s dual fuel energy bill in 2019 was similar to 2010 (figure 2.1).

However, the underlying costs have changed. Over the past decade, electricity prices have gone up, because of rises in policy and network costs, while gas prices have fluctuated, reflecting movements in the wholesale gas price. However, consumers have used less energy, which has balanced out the cost increase.<sup>34</sup>

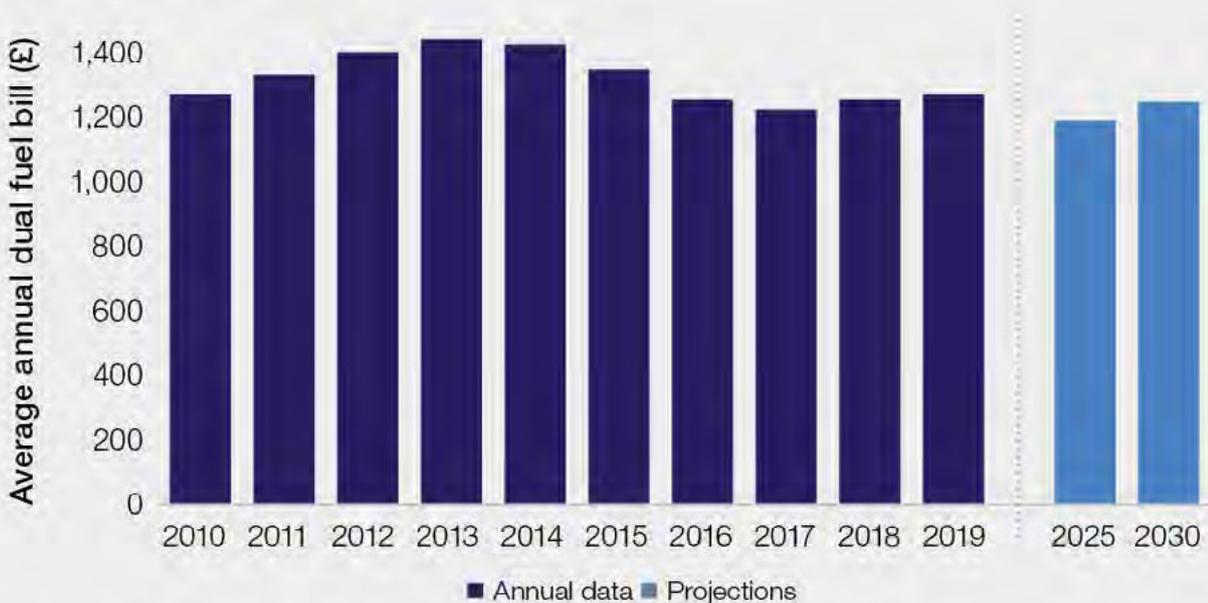
Overall, households who install energy saving measures will see significant savings and can offset the costs. Through targeting our energy saving schemes, such as extended ECO,<sup>35</sup> expanded WHD,<sup>36</sup> and the Green Homes Grant, many of the people making savings will be low-income or vulnerable

households on benefits, whose homes currently have poor energy efficiency ratings. For such households, energy represents a significant share of their outgoings, so these savings can have a significant impact on their disposable income.

Our ECO and expanded WHD schemes will provide at least £4.7 billion of extra support to low-income and vulnerable households between 2022 and 2026. Under the Green Homes Grant, we expect £500 million to be spent on low-income households through Local Authority Delivery. In addition, £500 million of the £1.5 billion voucher scheme is also intended for low-income households.

**FIGURE 2.1 – AVERAGE HOUSEHOLD DUAL FUEL BILL**

2010 to 2030 (2020 prices)



Source: BEIS analysis. This graph is based on a limited set of assumptions and shows average net costs. The cost of policies still being developed, such as heat pump deployment, are not included. Individual bills will vary depending on consumer characteristics and behaviour. See references for more detail. <sup>33</sup>



For example, a household in receipt of Universal Credit and living in an old, inefficient home could enjoy bill savings worth over £400, making them warmer, healthier and reducing their carbon emissions.

Over the next ten years, increases in network costs, along with funding for clean energy and supporting vulnerable households could push gas and electricity prices up. Based on the policies in this white paper with agreed funding, we estimate that household dual fuel bills will be, on average, broadly similar in both 2025 and 2030 to 2019 (figure 2.1). These policies are estimated to amount to a net increase of around two per cent on average,<sup>37</sup> though households who take up measures stand to make material net savings. This depends on a range of uncertain and variable factors, including future fossil fuel prices and how consumers use energy. We have used a central set of assumptions for these drivers.

## ENERGY BILL COMPONENTS

### Wholesale costs:

The amount energy suppliers pay to buy gas and electricity.

### Network costs:

The costs to build, maintain and operate the pipes, wires and cables that transport gas and electricity from producers to consumers.

### Supplier costs and margins

The administrative costs of running the supply business, including customer service, marketing, metering, plus profits.

### Policy costs:

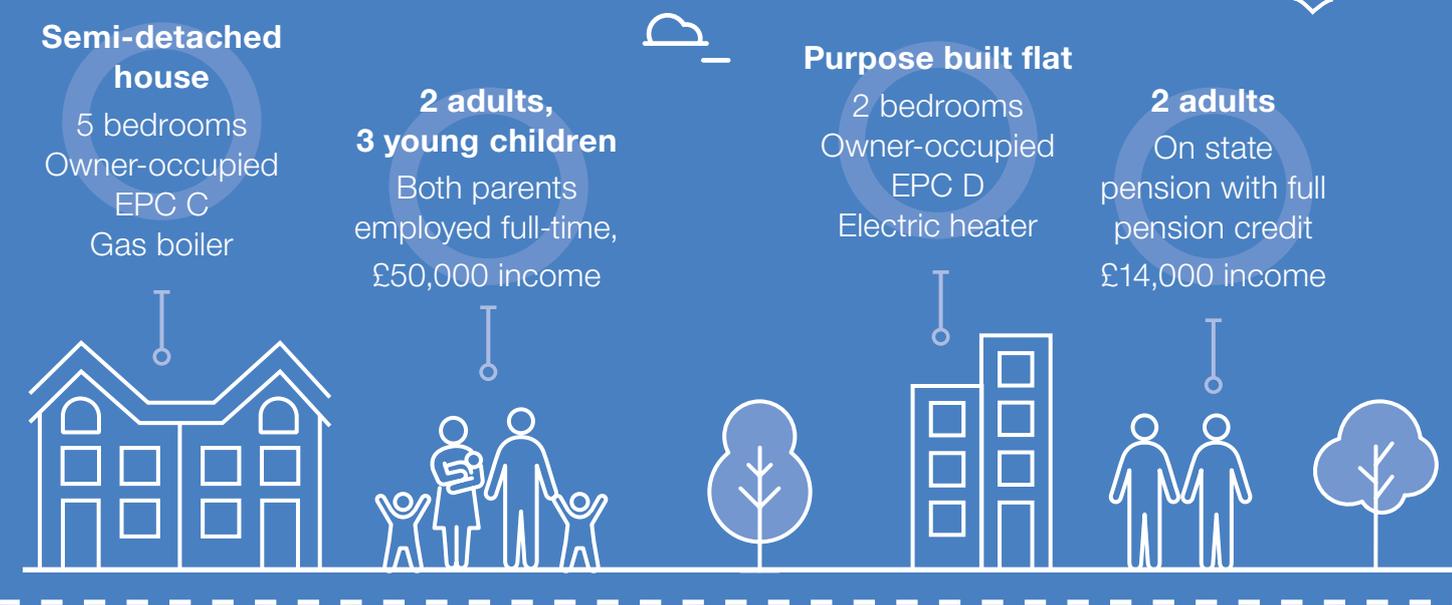
Cost of programmes to save energy, reduce emissions, and provide financial support to the fuel poor.

# ILLUSTRATIVE ANNUAL BILL SCENARIOS

Our assessment sets out the average picture. Underlying this, households could see net savings or costs depending on whether they take up measures. The graphic below sets out some illustrative case studies of how an individual household's bill may change because of the policies announced in this white paper.

## FAMILY 1

## FAMILY 2



### Illustrative measure

#### Green Home Grants

Floor insulation, delay start thermostat, time temperature zone control

### Illustrative measure

#### Warm Home Discount

A rebate of £150 on the annual electricity bill

### FAMILY 1 ANNUAL BILL



Prior to white paper	£1,100
With white paper impacts before savings	£1,200
Potential energy bill savings	£110
<b>WITH ENERGY BILL SAVINGS</b>	<b>£1,090</b>

### FAMILY 2 ANNUAL BILL



Prior to white paper	£1,300
With white paper impacts before savings	£1,390
Potential energy bill savings	£150
<b>WITH ENERGY BILL SAVINGS</b>	<b>£1,240</b>

Details are provided on the household's characteristics and the composition of the household, including income. These are designed to be hypothetical households that can take advantage of certain policies (either Green Home Grants, ECO or WHD). They are not a complete list of qualifying criteria, and both a household's eligibility for certain policies and its potential savings will vary according to its characteristics, composition, and, in some cases, whether the household proactively chooses to apply for a measure.

Example bills are for the year 2025. The exact measures or level of rebate available under the future ECO and WHD schemes are subject to future consultation. For households who access schemes, there are opportunities for saving to significantly outweigh upward pressure on bills. Access to these opportunities depends on the policy. Schemes such as ECO are targeted at fuel poor households whereas the Green Home Grants is open to applications from a wider set of households.

### FAMILY 3

#### Mid-terraced house

3 bedrooms  
Private rented  
EPC D  
Gas boiler

#### 1 adult, 2 young children

Unemployed, on  
Universal Credit  
£11,000 income



### FAMILY 4

#### Semi-detached house

3 bedrooms  
Owner-occupied  
EPC E  
Gas boiler

#### 1 adult, 2 young children

Employed part-time,  
on Universal Credit  
£14,000 income



#### Illustrative measure

#### Warm Home Discount

A rebate of £150 on the annual electricity bill

#### Illustrative measure

#### Energy Company Obligation

External solid wall insulation, hot water tank insulation, delay start thermostat, time temperature zone control

#### FAMILY 3 ANNUAL BILL



Prior to white paper	£1,200
With white paper impacts before savings	£1,230
Potential energy bill savings	£150
<b>WITH ENERGY BILL SAVINGS</b>	<b>£1,080</b>

#### FAMILY 4 ANNUAL BILL



Prior to white paper	£1,200
With white paper impacts before savings	£1,280
Potential energy bill savings	£500
<b>WITH ENERGY BILL SAVINGS</b>	<b>£780</b>

# Our key commitments

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## AFFORDABILITY AND FAIRNESS

It matters how much consumers pay for their energy, particularly when household budgets are tight.

The government will work with the regulator, Ofgem, to take the necessary steps to help households manage their bills. We have already introduced a price cap to ensure that the market does not excessively penalise consumers who do not frequently shop around for better deals.

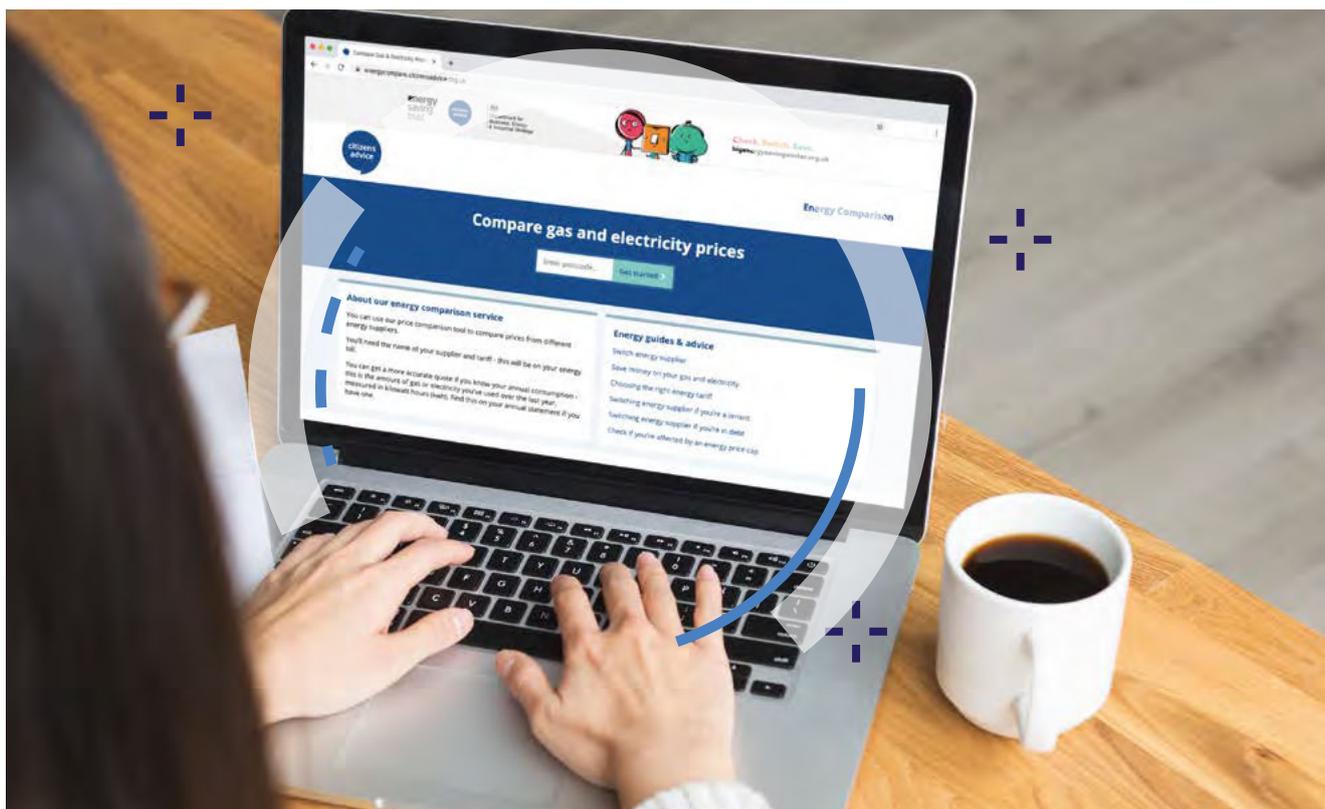
As we move to a clean energy system, fairness will be at the heart of our approach. Every household and business should be confident that everyone is paying their fair share of the costs of the transition. The members of the Climate Assembly UK identified “fairness within the UK, including for the most vulnerable” as one of the top two principles that should guide decisions around net zero.<sup>38</sup> We agree.

► **We will publish a call for evidence by April 2021 to begin a strategic dialogue between government, consumers and industry on affordability and fairness.**

We will work across the sector to identify existing distortions in the system and gain insights into the trade-offs involved in the distribution of energy costs. This will allow us to take decisions on how energy costs can be allocated in a way which is fair and incentivises cost-effective decarbonisation.

The nature of costs in a smart, clean energy system will be different. The largest part of our electricity bill is the cost to our energy supplier from buying power. This cost has traditionally been determined by the underlying price of gas or coal but this is changing. Gas will set the electricity price for some years to come but, over time, will do so less frequently, as more and more wind and solar connect to the electricity system. These are technologies which do not have a fuel cost. What we are paying for is the cost of building and operating the wind or solar farms, not the fuel cost. This trend fundamentally reshapes the costs of the system we must pay for. How consumers are charged will need to reflect this.

Ensuring that costs are fairly allocated between all consumers will be a central challenge for government. We need to strike the right balance between different households, between domestic consumers and businesses, including the big energy users in industry. The way that the costs are passed through to bills can incentivise or disincentivise certain types of consumer behaviour, including how the costs of decarbonising energy are apportioned between gas and electricity bills.



This can be a particular barrier to electrifying heat, which will be crucial for the transition to low-carbon buildings (see ‘Buildings’ chapter). It will be essential to ensure that price incentives are fair and help achieve our net zero target.

We are also mindful that, as we rightly encourage households to adopt new technologies such as roof-top solar and home energy storage, this change could affect how consumers pay for their energy in a way which is unfair to others. Households which self-generate electricity and store it, even sell it back to the grid, will be able to reduce how much they pay towards the fixed costs of the electricity system, while still relying on the system when they are not self-supplying. It could leave other consumers to pay a greater share, some of whom may not be able to take advantage of new technologies.

For all these reasons, the time is now right to reflect carefully on the nature of energy costs, who pays for them and how. HM Treasury has already launched a review of how the transition to net zero would be funded and where the costs would fall. An interim report will be published in December 2020, with a view to completing the review in spring 2021. This white paper sets out what we currently do to enshrine fairness in the way consumers are treated in the energy sector and puts forward new policy proposals to go even further. Building on this foundation, we will start a conversation with consumers and the energy industry about the fairness and affordability of the cost of moving to clean energy over the long-term. We are clear that the outcome of this work is a net zero world which continues to ensure a fair distribution of costs and maintains support in society and business for our climate goals.

## ROLLING OUT SMART METERS

It remains our ambition to achieve market-wide roll-out of smart meters as soon as practicable, enabling homes and small businesses to access digital energy services that put them in charge of their energy use.

Second generation smart meters – which are compatible with all energy suppliers from the point of install – are now being rolled out as standard across Great Britain, while the enrolment of first generation smart meters into the national communications system will ensure these stay smart when consumers switch energy supplier.

We have introduced a new smart meter obligation on suppliers, which will start in July 2021. This will drive consistent, long-term investment, by setting annual targets and providing regulatory certainty. We are committed to exploring ways to encourage consumer uptake.

We are working with industry and delivery partners to help energy suppliers develop successful strategies for consumer engagement which improve the installation and operational performance rates of new meters, while stimulating consumer demand.

To allow consumers to make the most of the data recorded by smart meters, it needs to be combined with half-hourly settlement for suppliers. This will allow households to access more real-time prices, should they wish. Most households are currently billed at a fixed price, based on an estimate of when they use electricity during the day. Half-hourly settlement provides the option for different prices in each 30-minute period of the day. Ofgem's analysis estimates that half-hourly settlement would bring net benefits for consumers of between £1.6 billion and £4.6 billion by 2045.<sup>39</sup> Ofgem intend to publish their final decision in spring 2021 on how and when to implement half-hourly settlement.

## FACILITATING COMPETITION AND TACKLING THE LOYALTY PENALTY

We are already seeing the value of innovation in smart controls and tariffs, as well as household batteries and solar panels.

To ensure that the growth in technological innovation goes from strength to strength, we need to ensure markets provide consumers with access to the services they want and offer fair value to all consumers. This is especially pressing as the system becomes more complex. Vulnerable consumers may need additional protections appropriate to their circumstances.

Consumers who have been automatically rolled onto a default tariff when their introductory tariff ends, or who start off on an auto-roll-over tariff, such as when they move into a new house, often pay much more for their energy, even when significantly cheaper alternatives are available. Over 50 per cent of consumers remain on default tariffs, despite almost all consumers knowing they can switch.<sup>40</sup> Many remain in this position for a long time, paying a 'loyalty penalty',<sup>41</sup> while other suppliers struggle to compete to provide these consumers with a better deal.

The price cap currently limits the extent of the loyalty penalty, but we believe competition is the most effective and sustainable way to keep prices low for all consumers over the long-term. Where the market and policy conditions for effective competition are not yet in place, we are prepared to ensure that proportionate price protection remains.

We have set out options for long term measures to protect consumers from the loyalty penalty in the joint government and Ofgem consultation ‘Flexible and responsive energy retail markets’ of July 2019.<sup>44</sup> With the measures set out in this white paper, we aim to address barriers to consumer engagement and the current nature of default tariff arrangements, the two leading causes of the loyalty penalty.

## OPT-IN SWITCHING

► **We will create the framework to introduce opt-in switching, consulting by March 2021 on how it should be designed, tested and incrementally scaled up.**

We know from today’s energy market that, for some consumers, the existence of cheaper deals is not sufficient in itself to drive consumer behaviour. Ofgem has found in recent trials that opt-in switching and similar tools can facilitate greater consumer engagement with the energy market.<sup>45</sup>

We will learn from these trials and create the framework to enable the introduction of opt-in switching by 2024. This will be implemented once we have reformed the exemption that smaller energy suppliers have from paying for energy efficiency measures (ECO) and from offering a discount for customers in fuel poverty (WHD).

### OPT-IN SWITCHING TRIALS

Since 2017, Ofgem has run trials to develop and test new prompts to increase consumer engagement. Ofgem found that customers who have not switched energy tariff for many years can be prompted to do so following simple, well designed letters and emails. The trials included over 1.1 million customers and resulted in over 94,000 of them switching to new energy tariffs, with most of them making an active choice about their energy tariff for the first time in years. In total, these customers have saved around £21.3 million between them.<sup>42</sup>

The most successful trials were the opt-in collective switching trials.<sup>43</sup> These removed as many steps as possible from the switching process and provided additional reassurances, such as independent support. Between 19-30 per cent of consumers switched their tariff – five to ten times higher than the control group, which had rates of 2.6 - 4.5 per cent.

## DEFAULT TARIFF ARRANGEMENTS AND OPT-OUT SWITCHING

- ▶ **We will consider how the current auto-renewal and roll-over tariff arrangements could be reformed to facilitate greater competition, consulting by March 2021 on how opt-out switching could be tested as part of any future reforms.**

Default or roll-over tariffs are important for ensuring continuous supply and service for consumers, even where they have not agreed a specific deal. However, these tariffs also enable passive engagement with the market, which limits competition and allows suppliers to charge such consumers excessive prices.

We want energy markets to be truly competitive. We do not think that energy suppliers should expect to roll over or continue contracts with customers indefinitely. Where consumers do not opt-out, reforms could move consumers on default tariffs to a new, cheaper contract through a competitive process. We will test how moving consumers to new contracts, with the option to opt-out, could work best for consumers, consulting by March 2021. We will engage closely with stakeholders to consider the design of the testing, including which consumers should be targeted, how the new tariff is determined and what safeguards should be in place to ensure beneficial outcomes.

## REMOVING MARKET DISTORTIONS

We will work with industry to reduce the barriers to consumer engagement so that more households make informed choices about the products and services they receive.

### TRANSPARENCY

- ▶ **We will ensure consumers are provided with more transparent and accurate information on carbon content when they are choosing their energy services and products, consulting on reforms in early 2021.**

Smart digital technology is not just giving consumers more control, choice and flexibility in their energy use. It allows consumers to make a personal contribution to delivering a clean energy system.

So, it is important that they have clear and easily accessible information on the options to do so. We will assess how effectively the market provides consumers with clear information on costs and clean energy choices.

This will be the key to helping consumers make informed decisions. We will consult in 2021 on how to ensure consumers receive transparent information when choosing an energy product, for example quantifying the additional environmental benefits of a tariff marketed as 'green'.

## POLICY OBLIGATIONS

We will consult on how:

- ▶ **The energy supplier thresholds of ECO can be removed without incurring disproportionate costs on suppliers, including potentially introducing a buy-out mechanism as part of reforms to the scheme beyond 2022.**
- ▶ **The energy supplier thresholds of WHD can be removed as part of reforms to the scheme beyond 2022 to ensure administrative simplicity and consistency.**

ECO and WHD are obligations on suppliers that tackle fuel poverty by providing targeted energy efficiency measures and discounts on bills (see 'Buildings' chapter for more detail).

Supplier thresholds for these schemes were introduced to avoid creating significant administrative barriers to market entry for new suppliers. The thresholds exempt suppliers with fewer customers from some of the costs to which their larger competitors are exposed. However, these thresholds may create market distortions as smaller suppliers are able to undercut other suppliers who still have to pay the costs.

For WHD, the threshold also creates barriers to switching for the fuel poor, as some suppliers are not required to offer the discount. We want to remove policy obligation thresholds but ensure that schemes can be extended, without creating significant administrative burdens for small suppliers. This will mean that fuel poor consumers who receive WHD can have greater confidence that switching to a cheaper tariff with an alternative supplier.

## RETAIL REGULATORY FRAMEWORK

- ▶ **We will assess what market framework changes may be required to facilitate the development and uptake of innovative tariffs and products that work for consumers and contribute to net zero, engaging with industry and consumer groups throughout 2021 before a formal consultation.**

Consumers can benefit and contribute more effectively to net zero through an energy retail regulatory framework that accommodates emerging and innovative business models. Consumers are best placed to decide which business models suit their needs through market participation, but they could include peer-to-peer trading; energy as a service, where customers buy an outcome for an agreed price, such as a guaranteed temperature at home or guaranteed level of heat pump performance, rather than paying for units of gas or electricity; or the bundling together of utilities, such as water and energy.

The market framework will need to enable innovation and competition, while protecting consumers. We will continue to review whether the current supply licence framework strikes this balance effectively. We will assess whether incremental changes, alongside wider sectoral initiatives, are sufficient or whether more fundamental changes are required.

# PROTECTING CONSUMERS AS TECHNOLOGIES AND SERVICES EVOLVE

Consumers must be able to benefit from robust and consistent protection when engaging the energy market, no matter where they obtain their products and services.

## THIRD PARTY ENERGY PRODUCTS AND SERVICES

- ▶ **We will ensure the retail market regulatory framework adequately covers the wider market, consulting by spring 2021 on regulating third parties such as energy brokers and price comparison websites.**

The energy market is evolving rapidly as technology advances and consumer behaviour changes. Consumers can engage in the market in new ways. When the current licensing framework was developed, the majority of consumers would engage directly with their new supplier when arranging a switch but this is less common now, as consumers increasingly use price comparison websites. Ofgem does not currently regulate third parties like energy brokers and price comparison websites and we need to ensure that consumers can be confident that they are protected when engaging with any energy product or service through these channels.

This principle of protection does not just apply to households. In its Microbusiness Strategic Review, Ofgem identified harms to microbusinesses from some brokers such as mis-selling and misrepresentation. Government and Ofgem will work together to ensure microbusinesses have appropriate protection from bad practices.

## SMART APPLIANCES

- ▶ **We will take powers to regulate smart appliances based on principles including interoperability, data privacy and cyber security, legislating when Parliamentary time allows.**

The market for smart appliances, such as smart fridges, washing machines and heating systems, is just emerging. Regulation of these devices, in particular relating to interoperability, data privacy, and cyber security, is required to support its development and to ensure that appropriate consumer protection is in place ahead of time. Devices should be able to link with any service provider's systems so that consumers cannot be locked into a single provider. It is also important that devices are cyber secure, to ensure consumers' data remains private and the energy system as a whole is protected. Industry is developing standards for smart appliances in line with these principles, which will be published by summer 2021.

We will ensure that the approach adopted for regulating smart appliances is compatible with the Department for Digital, Culture, Media and Sport's existing commitment to take powers to regulate the cyber security of consumer smart devices.

# Our key commitments



We will **publish a call for evidence by April 2021** to begin a strategic dialogue between government, consumers and industry on affordability and fairness.



We will **create the framework to introduce opt-in switching**, consulting by March 2021 on how it should be designed, tested and incrementally scaled up.



We will **consider how the current auto-renewal and roll-over tariff arrangements could be reformed** to facilitate greater competition, consulting by March 2021 on how opt-out switching could be tested as part of any future reforms.



We will **ensure consumers are provided with more transparent and accurate information on carbon content** when they are choosing their energy services and products, consulting on reforms in early 2021.



We will **consult on how the energy supplier thresholds of ECO can be removed** without incurring disproportionate costs on suppliers, including potentially introducing a buy-out mechanism as part of reforms to the scheme beyond 2022.



We will **consult on how the energy supplier thresholds of WHD can be removed** as part of reforms to the scheme beyond 2022 to ensure administrative simplicity and consistency.



We will **assess what market framework changes may be required to facilitate the development and uptake of innovative tariffs and products** that work for consumers and contribute to net zero, engaging with industry and consumer groups throughout 2021 before a formal consultation.



We will **ensure the retail market regulatory framework adequately covers the wider market**, consulting by spring 2021 on regulating third parties such as energy brokers and price comparison websites.



We will **take powers to regulate smart appliances** based on principles including interoperability, data privacy and cyber security, legislating when Parliamentary time allows.

CHAPTER 02

# Power

## OUR GOAL

Electricity is a key enabler for the transition away from fossil fuels and decarbonising the economy cost-effectively by 2050.

We will:

- ▶ **Accelerate the deployment of clean electricity generation** through the 2020s
- ▶ **Invest £1 billion in UK's energy innovation programme** to develop the technologies of the future such as advanced nuclear and clean hydrogen
- ▶ Ensure that the transformation of the electricity system **supports UK jobs and new business opportunities, at home and abroad**



POWER

# The strategic context



Decarbonising the power sector has led the UK's efforts to reduce greenhouse gas emissions.

In 1990, electricity generation accounted for 25 per cent of UK emissions. In 2018, it was only 15 per cent.<sup>46</sup> 30 years ago, fossil fuels provided nearly 80 per cent of electricity supply.<sup>47</sup> Today, the country gets over half of its power from low-carbon technologies.<sup>48</sup> The rapid growth of renewables has been a critical feature of this transformation. Renewable capacity has grown fivefold since 2010, driven by the deployment of wind, solar and biomass. The UK had 10GW of operational offshore wind by 2019, up from just over 1GW in 2010.<sup>49</sup>

>50%

of the UK's power comes from **low-carbon technologies** today

5x

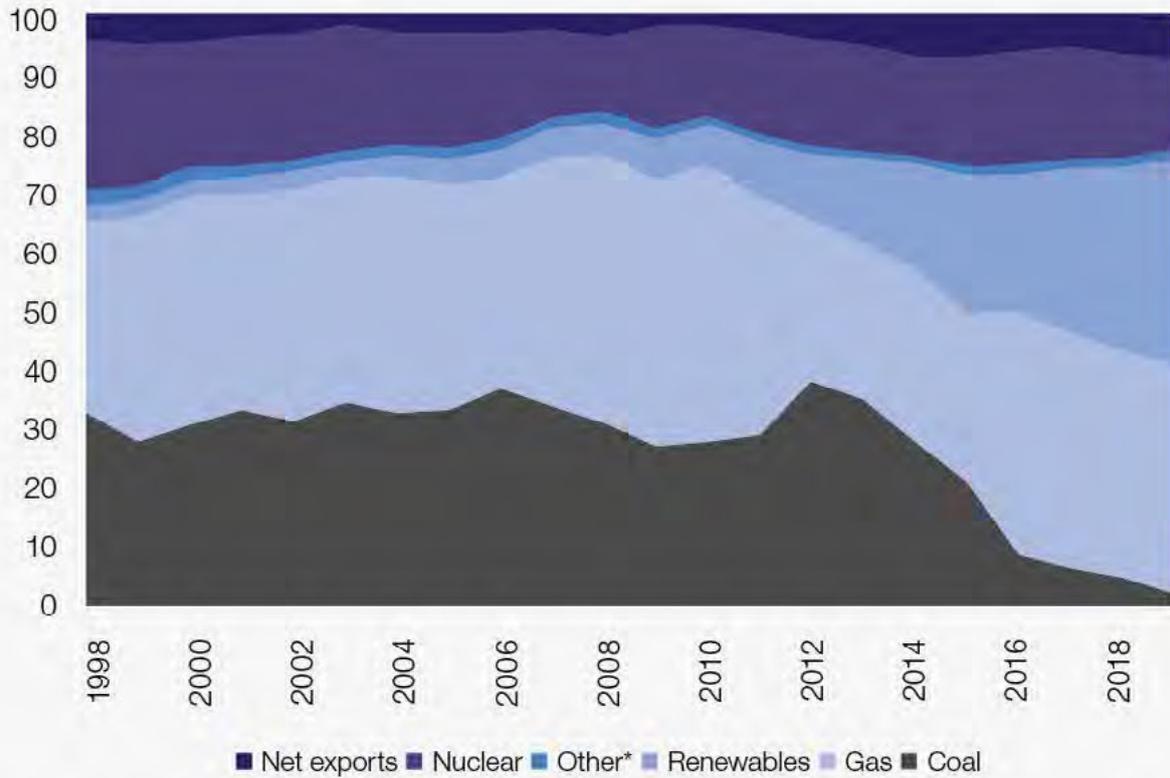
**renewables capacity has grown five-fold** since 2010

~9GW

**increase in operational offshore wind** since 2010

**FIGURE 3.1 - CHANGE IN POWER SUPPLY**

1998 - 2019



Source: Energy Trends, table 5.1. \*Other includes oil, pumped storage, and other thermal generation.

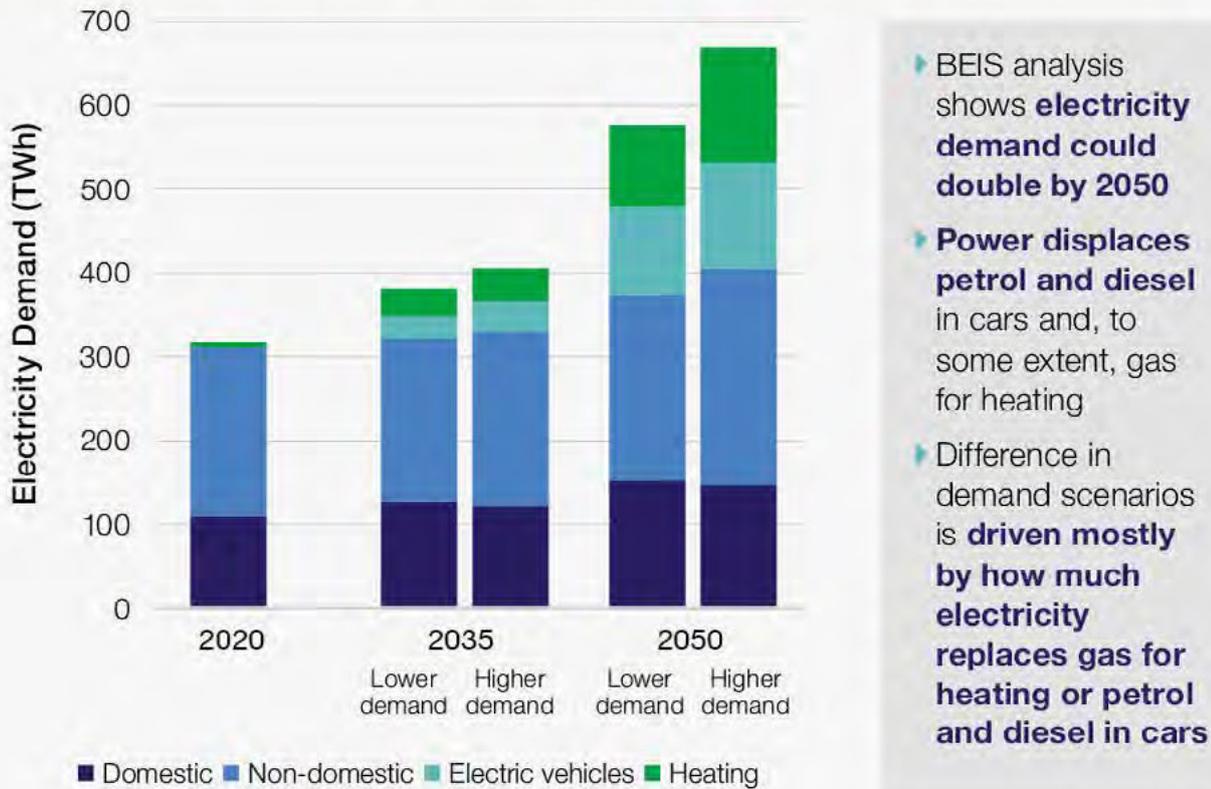
Renewables now account for over one third of electricity generation, up from seven per cent in 2010. Yet, this green revolution has been delivered without disruption to the reliability of our electricity supply and the scale of deployment has contributed to a significant reduction in the cost of renewables. Increasingly, green power is the cheapest power.<sup>50</sup>

Building on this foundation, we need to go further. With the exception of Sizewell B and Hinkley Point C, which is under construction, all of the existing nuclear power plants are due to have ceased generating by the end of 2030. We have already committed to ending coal in the electricity mix no later than 2025.

Today, as a signal of our further ambition and to encourage other countries along the path to phasing out coal, we are publishing a consultation over the option to bring forward our coal closure date to 2024.<sup>51</sup> Subject to this consultation, we will introduce legislation to give legal effect to the end date.

While retiring capacity will need to be replaced to keep pace with existing levels of demand, our modelling suggests that overall demand could double out to 2050. This is because of the electrification of cars and vans and the increased use of clean electricity replacing gas for heating. As a result, electricity could provide more than half of final energy demand in 2050, up from 17 per cent in 2019.<sup>52</sup>

**FIGURE 3.2 - ELECTRICITY DEMAND, NET ZERO SCENARIOS**



Source: BEIS analysis

This would require a four-fold increase in clean electricity generation with the decarbonisation of electricity increasingly underpinning the delivery of our net zero target.

Given the pivotal role of electricity in delivering net zero emissions, we must aim for a fully decarbonised, reliable and low-cost power system by 2050. Low emissions in power does not necessarily mean higher costs. Carbon intensity, the amount of CO<sub>2</sub> emitted to generate 1kWh of electricity, can fall to very low levels without costs rising significantly. This will depend on the level of demand, and the cost and availability of other low-carbon technologies, particularly low-cost clean hydrogen.

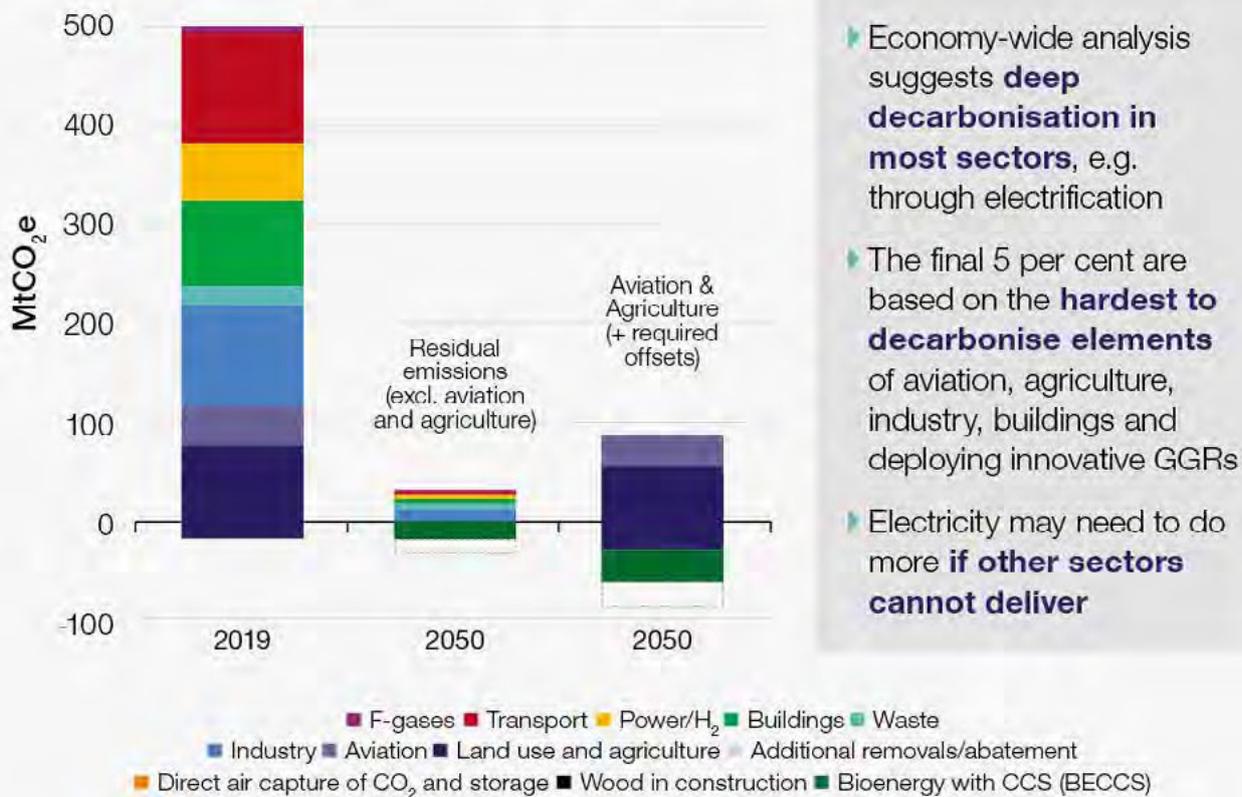
Our understanding of what is required from the electricity sector to support the delivery of net zero emissions will change over time.

Our views will be informed by what we learn about the costs of decarbonising other sectors of the economy and by the costs and availability of negative emissions technologies, such as Bioenergy with Carbon Capture and Storage (BECCS) or Direct Air Carbon Capture and Storage (DACCS).

We are not targeting a particular generation mix for 2050, nor would it be advisable to do so. We have already reduced power sector emissions 58 per cent between 2010 and 2018,<sup>53</sup> and to stay on a course for a fully decarbonised system we will continue that progress through the 2020s and have an overwhelmingly decarbonised power system in the 2030s.

The electricity market should determine the best solutions for very low emissions and reliable supply, at a low cost to consumers.

### FIGURE 3.3 - UK EMISSIONS, NET ZERO SCENARIO



Source: CCC 2020 Progress Report.

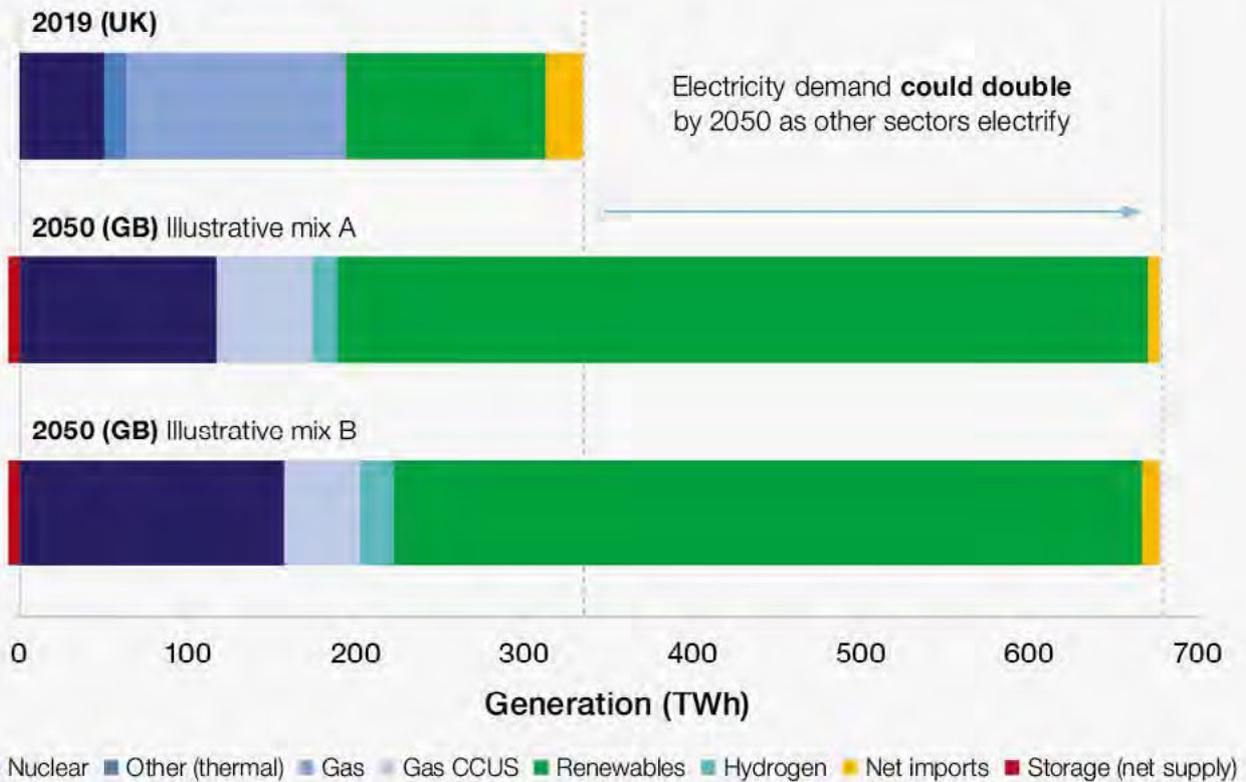
- ▶ Economy-wide analysis suggests **deep decarbonisation in most sectors**, e.g. through electrification
- ▶ The final 5 per cent are based on the **hardest to decarbonise elements** of aviation, agriculture, industry, buildings and deploying innovative GGRs
- ▶ Electricity may need to do more **if other sectors cannot deliver**

Competition should be a spur to greater investment in technologies which are cheaper and more efficient; or to the innovation which will reduce the costs of existing options. We have seen very rapid falls in the costs of renewables over the last five years and want to maintain the market conditions which stimulate these cost reductions. The government's role is to ensure a market framework which promotes effective competition and delivers an affordable, secure and reliable system, consistent with net zero emissions by 2050. This market framework should enable the deployment of the most efficient, low-cost technologies and mitigate delivery risk associated with a particular technology. We will intervene to address any potential market failures, as government did through the introduction of the Capacity Market, to ensure enough supply at periods of peak demand.

We will continue to invest in innovation which helps commercialise new technologies and reduce overall technology costs.

While we are not planning for any specific technology solution, we can discern some key characteristics of the future generation mix. A low-cost, net zero consistent system is likely to be composed predominantly of wind and solar. But ensuring the system is also reliable, means intermittent renewables need to be complemented by technologies which provide power, or reduce demand, when the wind is not blowing, or the sun does not shine. Today this includes nuclear, gas with carbon capture and storage and flexibility provided by batteries, demand side response, interconnectors (see 'Energy system' chapter) and short-term dispatchable generation providing peaking capacity, which can be flexed as required.

**FIGURE 3.4 - ELECTRICITY MIX TODAY & ILLUSTRATIVE 2050 MIXES**



Source: Energy Trends, table 5.1 and 6.1; BEIS analysis.

By 2050, we expect low-carbon options, such as clean hydrogen and long-duration storage, to satisfy the need for peaking capacity and ensure security of supply at low cost, likely eliminating the reliance on generation from unabated gas.

Figure 3.4 illustrates how the system could meet a doubling of demand, while reducing emissions. It shows just two of many scenarios which decarbonises electricity to very low levels of emissions at low cost. It serves to emphasise how much additional generation capacity we will need to build and how much electricity it produces to satisfy high levels of demand. Very different mixes can also provide low-cost solutions for the same demand scenario.

We are publishing the details of our electricity system analysis alongside this white paper.<sup>54</sup> We have modelled almost 7,000 different

electricity mixes in 2050, for two different levels of demand and flexibility, and 27 different technology cost combinations. It has produced a dataset comprising of over 700,000 unique scenarios, allowing us to identify common features of a low emissions, low-cost electricity system.

The analysis allows us to better prepare for an electricity system which is consistent with net zero emissions, even if we do not know the precise generation mix in 2050. It informs the actions we need to take to support the deployment of clean electricity technologies, including how we can direct our innovation support most effectively. We can target the technologies which have a key role in the system of the future, such as low-carbon peaking capacity and long-duration storage, which enable us to integrate high volumes of low-cost intermittent generation.

# Our key commitments

## AFFORDABLE CLEAN ELECTRICITY

This white paper sets out the actions which we are taking to put the country on the path to a low-cost, clean electricity system by 2050.

It will comprise the technologies which allow us to drive deep reductions in carbon emissions at a low cost, while maintaining the reliability and resilience of the system. Our actions are a strong signal to project developers and the wider investor community about the government's commitment to delivering clean electricity. This should stimulate the continued deployment of key low-carbon technologies in the near term, while encouraging innovation in the technologies of the future which offer the greatest potential to reduce costs.

### RENEWABLES

► **We will target 40GW of offshore wind by 2030, including 1GW floating offshore wind, alongside the expansion of other low-cost renewable technologies.**

A highly competitive Contracts for Difference (CfD) allocation round in 2019 led to the procurement of 5.5GW of offshore wind and 275MW of remote island wind, at strike prices around £40/MWh (2012 prices) for projects expected to start generating electricity by 2024.<sup>55</sup> This contrasts with prices for offshore wind of £150/MWh for projects which became operational in 2017.<sup>56</sup>

Our ambition is to have **40GW offshore wind by 2030**, a fourfold increase on today's installed capacity



As announced in the Prime Minister's Ten Point Plan for a Green Industrial Revolution, we will continue to hold regular CfD auction rounds every two years to bring forward a range of low-cost renewable technologies. The next auction in late 2021 will be open to onshore wind, solar photovoltaics and other established technologies, as well as offshore wind. Subject to sufficient projects coming through the planning pipeline to maintain competitive tension, we plan to double the capacity awarded in the last round with the aim to deploy around 12GW of low-cost renewable generation. Onshore wind and solar will be key building blocks of the future generation mix, along with offshore wind. We will need sustained growth in the capacity of these sectors in the next decade to ensure that we are on a pathway that allows us to meet net zero emissions in all demand scenarios.



Following our recent Call for Evidence on the potential of marine energy projects, we have set an ambition of deploying 1GW of floating offshore wind by 2030, supported by CfDs and innovation funding. Acting now will drive higher volumes of deployment in the 2030s and beyond, subject to cost reductions. We will work closely with the devolved administrations, the Crown Estate and Crown Estate Scotland to address issues such as seabed leasing and protecting the marine environment and to ensure the UK captures the economic benefits of deploying the technology. This will provide the foundation for a sustainable, competitive supply chain and enable floating offshore wind projects to scale up and accelerate cost reduction.

We will consider the role of wave and tidal energy, following further evaluation of the commercial and technical evidence. We will also identify and utilise synergies between hydrogen and the deployment of offshore wind.

It is vital that CfDs offer value for money to consumers and continue to deliver low prices. We will structure the 2021 and future auctions to keep the CfD allocation process highly competitive, supported by a number of technical changes to the auction. Alongside this white paper, we are issuing a new Call for Evidence seeking views on how the CfD scheme could evolve beyond the 2021 auction, including how longer-term changes to the CfD or wider electricity market design can enable the effective integration of increasing renewables capacity.<sup>57</sup>

We want to understand how generators can best be exposed to market signals which stimulate innovation and incentivise generators to minimise the overall system costs of large amounts of renewables. We will also be asking about the broader evolution of the electricity market (see ‘Energy system’ chapter). We will seek a balance between options for further reform of the market with maintaining the success of the CfD in deploying low-cost renewables at scale.

We will establish a Ministerial Delivery Group, which brings together the relevant government departments to oversee the expansion of renewable power in the UK. This group will provide the cross-government coordination and collaboration necessary to achieve our ambition for renewable electricity. It will tackle barriers such as the impact of wind turbines on radar systems, maintaining a flourishing and biologically diverse marine environment and the development of appropriate network infrastructure to support future renewables deployment. We will also work to reduce consenting delays and ensure that planning guidelines and environmental regulations are fit for purpose. The Ministerial Delivery Group will make use of existing cross-government mechanisms, such as the Offshore Wind Enabling Actions programme, a £4.3 million initiative to be run jointly by Defra and BEIS and funded by HM Treasury (HMT).

## POWER CCUS

► **We will support the deployment of at least one power CCUS project, to be operational by 2030, and put in place the commercial framework required to help stimulate the market to deliver a future pipeline of power CCUS projects.**

In the power sector, gas-fired generation with CCUS can provide flexible, low-carbon capacity to complement high levels of renewables. These characteristics mean that deployment of power CCUS projects will play a key role in the decarbonisation of the electricity system at low cost.

We will support at least one power CCUS plant to come forward and be operational by 2030 and will put in place a commercial framework which will enable developers to finance the construction and operation of a power CCUS plant and stimulate a pipeline of projects. This will enable at least one power CCUS project to be developed in one of the four industrial clusters as part of our mission to decarbonise them (See ‘Industrial energy’ chapter). Following the publication of the government response to our CCUS business models consultation in August 2020,<sup>58</sup> we will introduce a business model based on the existing CfD framework, adapted so that price signals incentivise power CCUS to play a role in the system, which complements renewables. We set out our plans for the deployment of transport and storage infrastructure in the ‘Industrial energy’ chapter.

► **We will consult on steps to ensure that new thermal plants can convert to low-carbon alternatives.**

Since 2009, our Carbon Capture and Readiness requirements have ensured that planning consent is only granted to thermal plants for which it will be technically and economically feasible to retrofit CCUS. However, we believe the current 300MW minimum threshold creates a costly market distortion, by disincentivising the deployment of gas plants larger than 300MW, which tend to be more efficient. The threshold also means that the requirements only apply to a small proportion of new build thermal plants. Furthermore, the requirements do not reflect recent technological advances, including alternative options for decarbonising gas plants, such as conversion to firing clean hydrogen. Therefore, we intend to consult in early 2021 over proposals to update the requirements to reflect technological advances and apply them more broadly, by removing the 300MW threshold.

**NUCLEAR**

► **We will aim to bring at least one large-scale nuclear project to the point of Final Investment Decision (FID) by the end of this Parliament, subject to clear value for money and all relevant approvals.**

Nuclear power continues to be an important source of reliable clean electricity, currently supplying around 16 per cent of our needs.<sup>59</sup> It is an energy-dense technology which provides large volumes of power from very little land area and can reduce system costs at low levels of emissions. In 2016, the government agreed contracts related to the first new nuclear power station in a generation.



of the country's current electricity needs will be **delivered by Hinkley Point C**



**jobs could be supported** during construction of a large-scale nuclear power plant



expected **reduction in the cost of nuclear new build projects** by 2030

Hinkley Point C is due to commission in the mid-2020s and will deliver around seven per cent of the country's current electricity needs - enough to power the equivalent of around six million homes.<sup>60</sup> But, with the existing nuclear fleet largely retiring over the next decade, we propose to go further. Our analysis suggests additional nuclear beyond Hinkley Point C will be needed in a low-cost 2050 electricity system of very low emissions. We must be ready for this.

We aim to bring at least one further large-scale nuclear project to the point of FID by the end of this Parliament, subject to clear value for money for both consumers and taxpayers and all relevant approvals.

As noted in the Ten Point Plan, a large-scale nuclear power plant could support a peak of around 10,000 jobs during construction.<sup>61</sup> We will remain open to further projects later if the nuclear industry demonstrates that it is able to reduce costs and deliver to time and budget.



We expect the sector to deliver the goal it set for itself in our Nuclear Sector Deal, published in 2018,<sup>62</sup> to reduce the cost of nuclear new build projects by 30 per cent by 2030.

Last year, we consulted on a Regulated Asset Base (RAB) model for private investment in new nuclear generation.<sup>63</sup> Today we are publishing a summary of the responses which have indicated that a RAB model remains credible for funding large-scale nuclear projects.<sup>64</sup>

The government will continue to explore this, alongside a range of financing options, with the developer of the next large-scale project in the pipeline and other relevant stakeholders, including other nuclear developers. Raising enough private capital to finance a nuclear power station is challenging given the significant investment needed for a developer to reach a point of FID. In considering the financing options, we will examine the potential role of government finance during construction, provided there is clear value for money for consumers and taxpayers.

## ADVANCED NUCLEAR INNOVATION

- ▶ We will provide up to £385 million in an Advanced Nuclear Fund for the next generation of nuclear technology aiming, by the early 2030s, to develop a Small Modular Reactor (SMR) design and to build an Advanced Modular Reactor (AMR) demonstrator.

The UK continues to be a leader in the development of nuclear technologies.

SMRs have the potential to provide cost-competitive nuclear power as early as the 2030s. Pending regulatory approval, innovative manufacturing techniques and modular construction could mean that SMRs are faster to build than large-scale nuclear plants and are potentially suitable for deployment in a wider number of sites across the country.

### SMALL MODULAR REACTOR

Small Modular Reactors (SMRs) are usually based on proven water-cooled reactors similar to current nuclear power station reactors, but on a smaller scale. They use nuclear fission to generate low-carbon electricity. SMRs are called modular reactors as their components can be manufactured in factories using innovative techniques and then transported to site to be assembled.

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**£385m** Advanced Nuclear Fund created

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**£400bn** estimated worth of SMRs and AMRs by 2035

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Subject to future HMT Spending Reviews, we have provided a £385 million in an Advanced Nuclear Fund with up to £215 million investment to develop a domestic SMR design that could potentially be built in factories and then assembled on site. It is expected to unlock up to £300 million private sector match-funding.

To help bring advanced nuclear technologies to the market, we will also invest an additional £40 million in developing the regulatory frameworks and supporting UK's supply chain. As the first major commitment of the programme, in 2021 we will open the Generic Design Assessment to SMR technologies, the regulatory process through which developers can obtain approval for their proposed design approach.

Supporting the development of our supply chain now will increase our chances of having indigenous expertise capable of leading the world in developing the nuclear technologies of the future - SMRs and AMRs - a global market estimated by some to be worth approximately £250 billion to £400 billion by 2035.<sup>65</sup>

## ADVANCED MODULAR REACTOR

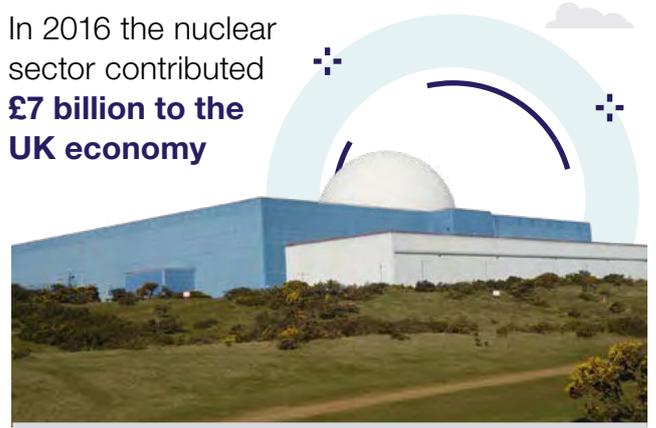
Advanced Nuclear Reactors (AMRs) are reactors which use novel cooling systems or fuels and may offer new functionalities (such as industrial process heat). These reactors could operate at over 800°C and the high-grade heat could unlock efficient production of hydrogen and synthetic fuels.

We are also committing up to £170 million of the Advanced Nuclear Fund to a R&D programme on AMRs – the next generation of nuclear technologies. Our aim is to build a demonstrator by the early 2030s at the latest to prove the potential of this technology and put the UK at the cutting edge against international competitors.

► **We aim to build a commercially viable fusion power plant by 2040.**

Fusion energy would offer low-carbon, continuous, and effectively unlimited power generation. The basic science and engineering involved in the production of fusion energy is now well advanced and fusion energy is expected to play an important role over the longer term to decarbonise global energy production.

In 2016 the nuclear sector contributed **£7 billion to the UK economy**



The UK is a world leader in the most promising fusion technologies with research capabilities across the technical challenges of fusion. This means that the UK is uniquely well-placed to lead the future commercialisation of this technology. The government has already committed over £400 million towards new UK fusion programmes. The aims are to develop a concept design for the Spherical Tokamak for Energy Production (STEP) – expected to be the world’s first compact fusion power plant, to be built in the UK by 2040 – and to invest in facilities and infrastructure to make the UK a global fusion industry hub. In December 2020, the STEP programme published an open call for communities across the UK to apply to be the host site for STEP.<sup>66</sup>

# NET ZERO INNOVATION PORTFOLIO

The Ten Point Plan announced a new £1 billion Net Zero Innovation Portfolio that will help bring down the cost of the net zero transition, nurture the development of better products and new business models, and influence consumer behaviour.

A £1 billion Net Zero Innovation Portfolio aims to accelerate the commercialisation of innovative low-carbon technologies, systems and processes in power, buildings and industry to set the UK on the path to net zero and create world-leading industries and new jobs. The portfolio will focus on ten priority areas to decrease the costs of decarbonisation and underpin innovation across the whole energy system.

As well as accelerating the commercialisation of novel clean energy technologies, innovation also plays an important role in driving economic growth, anchoring new technology to the UK, delivering levelling-up across the country and reducing our significant exposure to the risks of climate change.

An ambitious and well-designed energy innovation strategy could, by 2050, annually generate £54 billion of business opportunities for the UK.<sup>67</sup>

The current BEIS £505 million Energy Innovation Programme is delivering some of the UK’s most significant advances in low-carbon technologies, leveraging £200 million industry investment:

- ▶ **The UK’s first CCUS plant** at Tata Chemicals, Cheshire (£17 million total investment)
- ▶ **The world’s largest “Cryogenic” energy storage plant** at Manchester (over £70 million total investment)
- ▶ **The UK’s largest innovative heat pump trial** (750 homes, over £15 million total investment)
- ▶ **The UK’s first Venture Capital fund solely focussed on Cleantech** (over £40 million total investment).

## NET ZERO INNOVATION PORTFOLIO - PRIORITY AREAS



**Advanced Modular Reactors**



**Floating offshore wind**



**Hydrogen**



**Bioenergy**



**Industrial fuel switching**



**Advanced CCUS**



**Homes**



**Disruptive technologies**



**Direct air capture**



**Energy storage and flexibility**

## BIOENERGY INNOVATION

- ▶ **By 2022, we will establish the role which BECCS can play in reducing carbon emissions across the economy and, as part of a wider biomass strategy, set out how the technology could be deployed.**

Biomass is unique amongst renewable technologies in the wide array of applications in which it can be used as a substitute for fossil-fuel based products and activities, from power generation to hydrogen production and even new forms of plastics. Along with its ability to deliver negative emissions, this makes biomass one of our most valuable tools for reaching net zero emissions.

### BIOMASS

**Biomass refers to any material of biological origin (including wastes) which is used as a fuel for bioenergy (conventional combustion, gasification, energy from waste and low-carbon fuels like hydrogen) or in products (such as chemicals, bio-plastics and timber for construction).**

In the government's response to Climate Change Committee's (CCC) latest annual progress report to Parliament, we announced that we will publish a new Biomass Strategy in 2022. As part of this strategy, we will set out the results of a review of the amount of sustainable biomass available to the UK, and how this resource could be best utilised across the economy to help achieve our net zero greenhouse gas emissions target by 2050.

Our review will assess the UK's current biomass sustainability standards, which are already some of the world's most stringent, to see where and how we can improve them even further. Our review will also consider the role biomass can play in delivering our wider environmental targets, including on air quality.

We will shortly issue a call for evidence: 'Biomass for net zero', to inform the development of our strategy. We will issue a preliminary position paper by summer 2021, once the evidence has been reviewed.

Critical to our consideration will be the role of BECCS in our energy system. BECCS plants could deliver negative emissions, by capturing the carbon released during biomass combustion, gasification and other processes, provided supply chain emissions are sufficiently low. There are a number of applications for BECCS across the economy, including clean hydrogen production, power generation, waste management and in heat for industrial processes and we need to ensure that it is deployed where it has the greatest value in reducing emissions.

For example, current support for electricity generation, which converted from coal to using biomass as a fuel source, expires in 2027. BECCS could provide a long-term future for this capacity.



## THE POTENTIAL OF GREENHOUSE GAS REMOVAL (GGR) TECHNOLOGIES

Greenhouse gas removal technologies actively remove greenhouse gases from the atmosphere and are diverse, ranging from engineered to nature-based solutions. The CCC has been clear that, in order to achieve net zero by 2050, GGRs will be necessary to balance residual emissions from some of the most difficult to decarbonise sectors, such as parts of the agriculture and aviation sectors. The CCC has estimated 75MtCO<sub>2</sub> of negative emissions could be required annually in order to reach net zero greenhouse gas emissions by 2050.<sup>68</sup>

The government is already taking steps to accelerate the development and deployment of GGRs in the UK.

In June 2020, we announced up to £100 million of funding for research and development of DACCS and other GGR methods.<sup>69</sup> This funding seeks to demonstrate feasible GGR approaches at scale, as well as better our understanding of governance and ethics of GGRs. We have also published a call for evidence earlier in December,<sup>70</sup> which seeks views on mechanisms and governance principles to help bring GGR technologies like DACCS to deployment in the UK. Alongside this, both BEIS and the National Infrastructure Commission will conduct research projects to develop the evidence based on GGRs in order to support future policy in this area.

# A PLANNING FRAMEWORK FOR ENERGY INFRASTRUCTURE

- ▶ **We will complete a review of the existing energy National Policy Statements (NPS), with the aim of designating updated NPS by the end of 2021.**

The suite of energy NPS establish the need for new energy infrastructure and set out a framework for the consideration of applications for development consent. We have decided that it is appropriate to review the NPS, to ensure that they reflect the policies set out in this white paper and that we continue to have a planning policy framework which can deliver the investment required to build the infrastructure needed for the transition to net zero. Work on this review will start immediately, with the aim of designating updated NPS by the end of 2021.

This white paper shows that the need for the energy infrastructure set out in energy NPS remains, except in the case of coal-fired generation. While the review is undertaken, the current suite of NPS remain relevant government policy and have effect for the purposes of the Planning Act 2008. They will, therefore, continue to provide a proper basis on which the Planning Inspectorate can examine, and the Secretary of State can make decisions on, applications for development consent. Nothing in this white paper should be construed as setting a limit on the number of development consent orders which may be granted for any type of generating infrastructure set out in the energy NPS. Other restrictions outside the planning regime (in particular the Emissions Performance Standard) mean that no new coal infrastructure projects can come forward.

# THE ECONOMIC BENEFITS OF CLEAN ELECTRICITY

The UK should harness more of the economic benefit from the accelerated deployment of renewable technologies. This will help position the whole of the UK to reap economic benefits.

- ▶ **We will support the delivery of the industry's target of 60 per cent UK content in offshore wind projects by 2030, through more stringent requirements for the CfD supply chain plan process.**

We will invest in the growth of the UK's offshore wind manufacturing infrastructure to create jobs and opportunity in the UK supply chain. We will use our Offshore Wind Sector Deal with the renewables sector to ensure that domestic deployment creates jobs and raises skills levels across the country, and to support overseas trade and investment opportunities for UK-based companies. We will require developers who are awarded a CfD, to honour their supply chain plans.

► **We have announced a £160 million scheme and launched a competitive process in early December to support the development of offshore wind manufacturing infrastructure.**

The £160 million funding announced in October 2020 and the competitive process launched in early December will support the development of major port-side infrastructure hubs, strengthening UK offshore wind manufacturing. This will have a major impact on our ability to develop a competitive UK supply chain for domestic and overseas markets.<sup>71</sup> It will help attract inward investment to manufacturing in the UK and increase our global competitiveness and expertise. The investment will support major new offshore wind manufacturing capacity which is needed to develop a competitive industrial base capable of servicing UK and international markets. Our Ten Point Plan set out how the investment alongside 40GW offshore wind will support the industry’s target to achieve 60 per cent UK content by 2030.<sup>72</sup> And we will use it as the platform to target a five-fold increase in exports of offshore wind goods and services to at least £2.6 billion a year by 2030. The sector could bring £3 billion GVA a year by 2030, of which £1 billion is export related.<sup>73</sup>

This new investment, could create around 2,000 construction jobs, representing high quality employment opportunities in many coastal regions around the country. This investment alongside other offshore wind commitments will enable the offshore wind sector to support up to 30,000 direct jobs and 30,000 indirect jobs in ports, factories and the supply chains by 2030.<sup>74</sup>

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**£2.6bn** **target annual exports** of offshore wind goods and services by 2030

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**£7bn** **contributed by the nuclear sector** to the UK economy in 2016

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**60,000** **direct and indirect jobs** could be supported by the offshore wind sector by 2030

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The nuclear sector also makes a significant contribution to the UK economy - some £7 billion GVA in 2016.<sup>75</sup> The nuclear industry currently employs around 60,000 people.<sup>76</sup> Building, operating and decommissioning our nuclear assets takes place in some of the most remote areas of the UK. Developing the domestic supply chain for the sector has the potential to transform the prosperity of these regions. It provides high-value and skilled employment opportunities, unlocking investment to support infrastructure projects and growing manufacturing and industrial capability.



## CASE STUDY: GRIMSBY PORT REVIVAL

North East Lincolnshire is home to the Port of Immingham which is the UK's largest port by tonnage - handling around 11 per cent of the UK's cargo.<sup>77</sup> It serves a diverse range of industries and is an international gateway.

Today Grimsby sits in the 10 per cent of England's most deprived regions,<sup>78</sup> however it has strong maritime history and the wider strengths in the energy sector. Its location close to the majority of the UK's offshore wind farm developments presents a major opportunity for the Port of Grimsby and the town with around £10 million being invested in the port and facilities.<sup>79</sup>

Since the first wind farms, notably Lincs and Lynn and Inner Dowling were built in 2009,<sup>80</sup> the Port of Grimsby has developed and is now recognised as the centre for operations and maintenance (O&M) services to the offshore wind farms. It is a major base for businesses such as Ørsted, E.ON, Innogy and GLID/Siemens

These global leaders in offshore renewable energy offer many high skilled jobs for the area. The rapid growth of the renewable energy industry in the UK has presented new economic opportunities for Grimsby in the last decade. Ørsted recently opened its expanded O&M base, creating the world's largest O&M base, employing 350 people (83 per cent workers live within one hour's distance<sup>81</sup>), – with the port estimating that over 650 are employed on offshore wind O&M services.<sup>82</sup>

In addition, the Offshore Renewable Energy Catapult project, now based in Grimsby's Port Offices, plan to create a Centre of Excellence. This will serve as a leading testing facility for the development of next generation technologies benefiting the whole of the UK. Direct industry input into projects at the Operations and Maintenance Centre of Excellence is expected to be £90 million over the next 10 years.<sup>83</sup>



At Hinkley Point C, the developer expects that 64 per cent of the construction contracts, by value, will go to UK-based companies.<sup>84</sup> But the potential for the domestic supply chain beyond Hinkley Point C is greater than this, given the capability of UK companies across the nuclear lifecycle; from enrichment and fuel fabrication, through new-build construction, plant operation, world leading R&D, future nuclear technologies to waste management and decommissioning and final disposal.

In the Nuclear Sector Deal, we committed to help the UK supply chain become more productive and competitive.<sup>85</sup> This includes supporting established companies to strengthen their ability to compete for high-value work and we will reduce barriers to entry for innovative companies, especially Small and Medium-sized Enterprises. We are working with the sector to develop a national and regional supply chain productivity improvement programme to achieve these objectives and target at least £2 billion of domestic and export contracts for UK companies by 2030.

# Our key commitments



We will **target 40GW of offshore wind by 2030**, including 1GW floating wind, alongside the expansion of other low-cost renewable technologies.



We will **support the deployment of at least one power CCUS project**, to be operational by 2030, and put in place the commercial frameworks required to help stimulate the market to deliver a future pipeline of power CCUS projects.



We will consult on steps to **ensure that new thermal plants can convert to low-carbon alternatives**.



We will **aim to bring at least one large-scale nuclear project to the point of FID** by the end of this Parliament, subject to clear value for money and all relevant approvals.



We will **provide up to £385 million in an Advanced Nuclear Fund** for the next generation of nuclear technology aiming, by the early 2030s, to develop a SMR design and to build an AMR demonstrator.



We aim to **build a commercially viable fusion power plant** by 2040.



By 2022, we will **establish the role which BECCS can play in reducing carbon emissions across the economy** and, as part of a wider biomass strategy, set out how the technology could be deployed.



We will **complete a review of the existing energy NPS** and designate updated NPS by the end of 2021.



We will **support the delivery of the sector's target of 60 per cent UK content in offshore wind projects by 2030**, through more stringent requirements for the CfD supply chain plan process.



We have announced a £160 million scheme and launched a competitive process in early December to **support the development of offshore wind manufacturing infrastructure**.

EXPLAINER

# Modelling energy



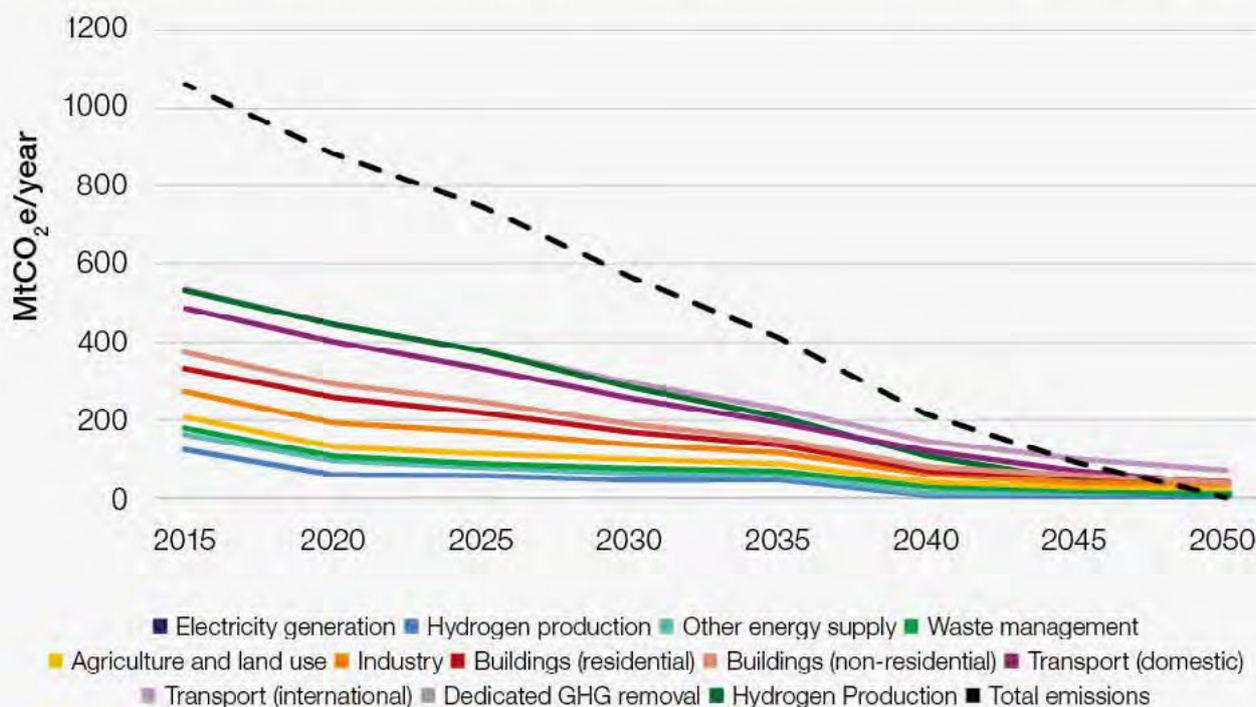
## SETTING THE SCENE

Developing the policies we need to achieve net zero is challenging. We need to manage uncertainties ranging from the cost of fuel, when and whether certain technologies will be available, and how people will behave when they are asked to use new ways of heating their homes.

To help us do so, we can use models of the economy and the energy system. These digital tools help us understand the linkages and interdependencies between different parts of the system and how our policies impact consumers.

The models we use perform functions ranging from strategic analysis of long-term decarbonisation to improving our understanding of how proposed policies will work in practice. For example, our Mackay Carbon Calculator provides illustrative pathways to reaching net zero by 2050 (figure 4.1).<sup>86</sup>

It is important that the results from models are understood and used correctly. This means reflecting uncertainties, being clear on assumptions and combining modelling evidence with, and testing it against, other forms of evidence.

**FIGURE 4.1 – ILLUSTRATIVE PATHWAY TO NET ZERO EMISSIONS**

Source: Mackay Carbon Calculator

Many of our models have been developed in-house and in close collaboration with academia. We now want to increase our ability to access the best modelling expertise available. We will implement a new modelling strategy that will increase transparency and collaboration. This will improve our insights and increase confidence in policy. We will build on the recommendations of the Energy Data Taskforce,<sup>87</sup> and have published the Mackay Carbon Calculator and the National Household Model.<sup>88</sup>

## OUR LAST MODELLING STRATEGY

- ▶ **Consolidated and simplified** the “modelling landscape” by developing models that can support more than one policy;
- ▶ **Built collaboration** by
  - Developing academic links for long term energy modelling;
  - Publishing our 2050 Calculator & National Household Model;
- ▶ **Improved how we treat the many inputs** to our models; and,
- ▶ **Implemented standard quality assurance processes.**<sup>89</sup>

# TRANSFORMING OUR MODELLING

Our modelling strategy will ensure our suite of models, data, assumptions and management processes are:

- ▶ **Effective** in supporting evidence-based policy making;
- ▶ **Accessible** for policy teams, open to all and trusted by the department and wider stakeholders;
- ▶ **Coherent** and coordinated;
- ▶ **Consistent** and / or transparent in the use of assumptions;
- ▶ **Efficient** in the use of resources; and
- ▶ **Robust** - capable of being maintained and meeting quality standards.

## THE NEXT PHASE

The next phase of our modelling strategy will improve our approach to modelling:

- ▶ **Transparency:** We will set up and test a protocol for publishing our models. There will be specified exemptions such as models in development or models including with sensitive commercial or security information commercially.
- ▶ **Intra-energy system modelling:** We will review and update our long term, whole energy system models and their inter-operation with sector specific models, taking in the latest ideas from Digital Twins.<sup>90</sup>

- ▶ **Infrastructure:** We will develop and implement our IT strategy to make it easier for analysts, contractors and collaborators to develop and maintain models by harmonising development languages and providing a development environment for our partners.

## THIS APPROACH WILL:

- ▶ Increase the **agility** of government decision and ensure policies to reflect the **best evidence** by:
  - Collaborating with a range of stakeholders on our modelling approaches and
  - Ensuring our models and their inputs adapt to a fast-changing market.
- ▶ Ensure our we **use the latest methodologies, software and technology** by continuing to invest in partnering to develop models of our energy systems.
- ▶ Stimulate **innovation**.

## TO EXECUTE OUR STRATEGY:

- ▶ **We will improve and test the proposition of open sourcing models** by:
  - Developing a protocol for releasing our models
  - Developing an Open Modelling Environment to share modelling capability in a trusted space;



- Investigating providing an open access data source for the National Household Model;
- Opening access to a new version our long term energy systems model; developed in collaboration with University College London, and;
- Running modelling improvement competitions to leverage 3rd party knowledge - initially running a competition to improve econometric equations at the heart of BEIS Energy Demand Model – used to produce our Energy and Emissions Projections.<sup>91</sup>

- ▶ **We will establish a protocol for regular publication of quasi-statistical publications** such as Energy and Emissions Projections using voluntary application of the Code of Practice for Statistics.<sup>92</sup>
- ▶ **We have published an updated energy calculator.** The new calculator is named in honour of the late David Mackay. The Calculator was his brainchild. One important new feature will be the ability to alter start and finish dates for each lever. This is an important contribution for the global calculator community.

CHAPTER 03

# Energy system

## OUR GOAL

To deliver energy reliably, while ensuring fair and affordable costs and accelerating our transition to clean energy, we need to create investment opportunities across the UK to enable a smarter, more flexible energy system, which harnesses the power of competition and innovation to the full.

In partnership with the Office of Gas and Electricity Markets (Ofgem), we will:

- ▶ **Work to minimise the costs to consumers** of getting energy to homes and businesses, by promoting more innovation and competition in networks and in national and local energy markets
- ▶ **Ensure electricity networks are able to integrate increasing renewable generation** and more electric vehicles (EVs), while controlling system costs
- ▶ **Make sure that energy system information about supply and demand is used to drive greater efficiency and lower costs**, as well as promote more innovation and new services for consumers
- ▶ **Ensure that the system's rules and governing institutions support the transition away from fossil fuels** to clean energy



ENERGY SYSTEM

# The strategic context



The UK's energy system is one of the most developed and successful anywhere in the world.

It was designed and built for the age of fossil fuels which, even today, are predominant in final energy use. Though they are now at record low levels, fossil fuels, primarily petroleum products and natural gas, still accounted for just over 79 per cent of energy supply in 2019, with electricity representing only 17 per cent of final energy use by consumers.<sup>93</sup>

This dependency on fossil fuels will change dramatically over the next 30 years. By 2050, electricity could provide over half of final energy demand, as it displaces petrol and diesel in cars and light vehicles and, to some degree, gas for heat in homes. As we set out in the 'Power' chapter, this could mean that electricity demand doubles from today's 345TWh.<sup>94</sup>

This change necessitates a very different approach, and not just because the energy system must support the deployment of clean energy technologies. It will also have to adapt to a world in which energy is far more decentralised.

## FIGURE 5.1 - UK ELECTRICITY NETWORKS AND DISTRIBUTION AREAS

### Electricity network

- Major powerlines
- Other selected powerlines

### Network operators

- Electricity North West
- Northern Powergrid
- Scottish Power
- Scottish & Southern
- UK Power Networks
- Western Power



Source: DUKES July 2020<sup>95</sup>

## ELECTRICITY DISTRIBUTION NETWORKS

Smaller regional networks that transport electricity from the transmission lines and small-scale generators, into our homes and businesses – the ‘A and B roads’ of our energy network. There are 14 licenced distribution network operators (DNOs), owned by six different groups.

## ELECTRICITY TRANSMISSION NETWORKS

The high-voltage networks that transport electricity across Britain and nearby offshore waters – the ‘motorways’ of our energy network. Owned and maintained by three different Transmission Owners (TOs) for England and Wales; southern Scotland; and northern Scotland and the Scottish islands groups, and by individual Offshore Transmission Owners (OFTOs) for the connections between offshore windfarms and the onshore grid.

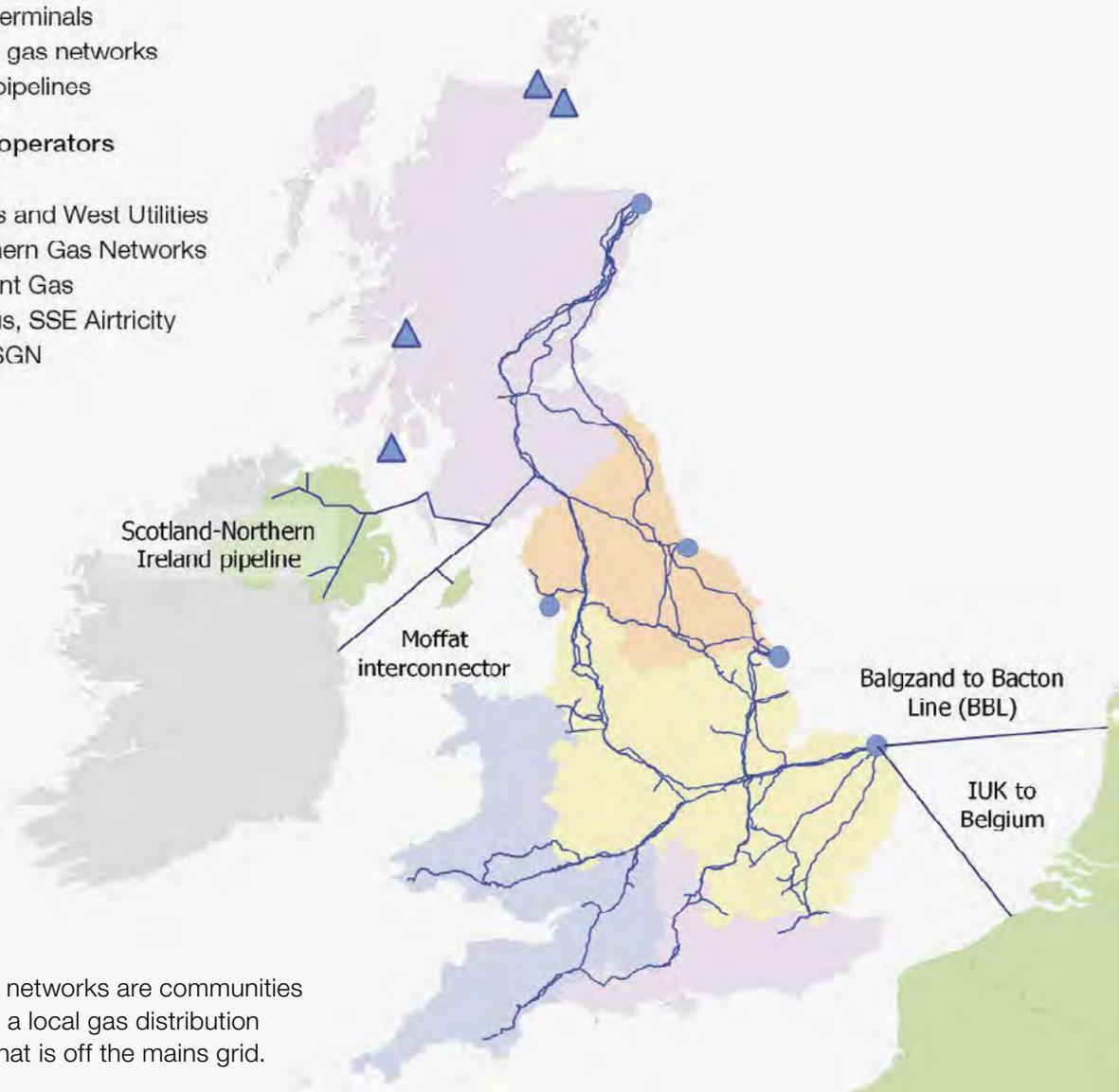
**FIGURE 5.2 - UK GAS NETWORKS AND DISTRIBUTION AREAS**

**Gas network**

- Gas terminals
- ▲ Local gas networks
- Gas pipelines

**Network operators**

- SGN
- Wales and West Utilities
- Northern Gas Networks
- Cadent Gas
- Firmus, SSE Airtricity and SGN



Local gas networks are communities served by a local gas distribution network that is off the mains grid.

**GAS DISTRIBUTION NETWORKS**

Smaller regional networks that transport gas from the transmission pipes, into our homes and businesses. There are eight licenced gas distribution networks (GDNs), owned by four different groups.

**GAS TRANSMISSION NETWORK**

The high-pressure pipes that transport gas to smaller networks, or directly to gas power stations and large industrial consumers. Owned and operated by National Grid Gas plc (NGG).

Gas currently represents almost **30 per cent of final energy consumption** and 40 per cent of electricity generation



**79%**

of **energy supply** in 2019 came from **fossil fuels**

**17%**

of consumers **final energy use** was **electricity**

**>50%**

of final energy demand could be **provided by electricity** by 2050

Demand will be satisfied as much by local solutions as by a nationally organised and operated system. Smart technologies, enabled by pervasive digitalisation, are already opening new possibilities, facilitating a transformation to faster and more efficient solutions which will only accelerate over the coming decade.

The switch to clean electricity has particularly profound implications. Separate networks for electricity, gas for heating and petrol or diesel for cars and vans, which today run independently of each other, will increasingly merge into one system, as electricity becomes the common energy currency. It puts new demands on electricity, to reflect how we use heat and power our cars and will require a new approach to how the system is managed. And the energy system will have to adapt further, to accommodate the production and use of clean hydrogen or the transport and storage of carbon dioxide from industry or power generation.

The costs of transporting energy and managing the balance between supply and demand make up around 25 per cent of an average household's energy bill currently.<sup>96</sup> As we move to clean energy, the system will comprise a more complex series of functions which it will need to discharge while keeping costs affordable.

The prize is an energy system which is not only cleaner but also smarter; one that gives customers more control, delivering the energy we need efficiently, and at a fair cost.

Securing this outcome requires a comprehensive approach, with evolution across all elements of the energy system so that it is fit for the future. It is not just about ensuring a cost-effective and resilient network of pipes and wires, critical though this is. It means exploiting a new digital infrastructure which will complement the system's physical infrastructure to liberate the potential of smart, flexible technologies.

# THE SMART ELECTRICITY SYSTEM

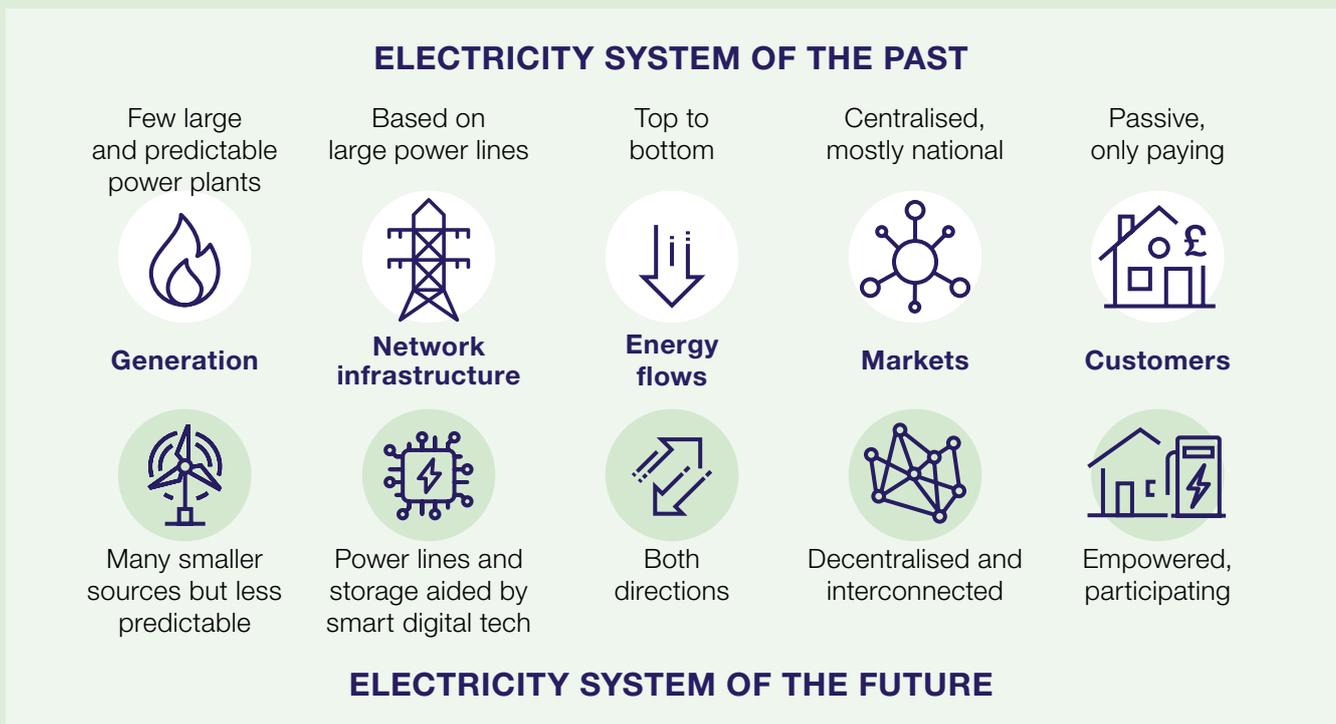
The electricity network is now becoming more decentralised.

This means there will be more numerous and smaller sites of generation across the country, not just the large, centralised power stations with which we are familiar. There will be new sources of demand, as millions of EVs and heat pumps connect to the system. A previously one-directional system is transforming into something more dynamic.

But it is not a matter of adding ever more generating capacity and cables. The transformation of the electricity system is an opportunity to exploit new forms of system flexibility in how energy is generated and consumed. This flexibility allows supply and demand to be shifted in time or location, so they are matched in the most efficient way – keeping costs down for consumers. For example, smart technology and time-of-use tariffs can help consumers charge EVs during off-peak periods – when energy is cheaper and cleaner.

Our analysis suggests that a smarter, more flexible system could unlock savings of up to £12 billion per year by 2050 (2012 prices), compared to a system with low levels of flexibility<sup>97</sup> – primarily because being able to respond more quickly and shift electricity around more easily means less generation and network needs to be built. This will lower costs for the customer of the future.

By 2050, the domestic market for smart systems and flexibility solutions, including EV smart chargers and smart network equipment, could contribute almost £1.3 billion to the nation’s economy, with exports of these products and services adding a further £2.7 billion (2020 prices). The domestic market for smart systems equipment and related services could support 10,000 jobs by 2050, with a further 14,000 jobs supported by export markets.<sup>98</sup>

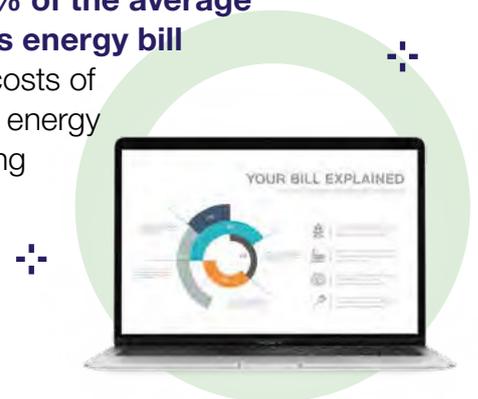




We have to instil competition deep into the operation of our energy markets to drive cost reductions and open the system to innovative new services for the benefit of consumers, while also incentivising the significant private sector investment that will make it possible to update our energy system. And we need an approach to managing the operation of the system which is flexible and responsive, and aligned to the demands of a net zero future.

**Around 25% of the average consumer's energy bill**

is from the costs of transporting energy and balancing supply and demand



# Our key commitments

## EFFICIENT ELECTRICITY MARKETS

Electricity markets need to adapt as the deployment of renewable generation increases.

Balancing supply and demand becomes more complex because most renewables are, by their nature, intermittent and generate electricity only when the wind blows or the sun shines.

Gas-fired power stations have traditionally provided the flexibility needed to match supply to demand at peak hours, or when renewables output is low. Increasingly, flexibility will come from new, cleaner sources, such as energy storage in batteries, increased interconnected capacity from neighbouring electricity markets, or from consumers using smart technologies to reduce how much energy they use or shift when they use the energy to different times in the day. New forms of flexibility could lower future costs for consumers, by minimising expensive network reinforcement or reducing the need for additional generation, especially peaking capacity which needs to be deployed quickly to meet spikes in demand.

### ELECTRICITY SYSTEM OPERATOR

The whole transmission system is operated by a single Electricity System Operator (ESO), who is responsible for keeping it stable and secure. National Grid ESO perform this function.

- ▶ **We will publish a new Smart Systems Plan in spring 2021, jointly with Ofgem, and define electricity storage in law, legislating when Parliamentary time allows.**

We need open, competitive markets which harness the full value of flexibility. In 2017, the government and Ofgem published the first Smart Systems and Flexibility Plan.<sup>99</sup> We have implemented two-thirds of the policies in the plan and are on track to deliver it in full by 2022, removing barriers to energy storage, enabling smart homes and businesses and properly rewarding providers of flexibility services. But we are now ready to take the next step in driving flexibility deep into the energy system.



In partnership with Ofgem, we will publish a new Smart Systems Plan in spring 2021, which will include a new framework for monitoring flexibility across electricity markets. We will legislate when Parliamentary time allows to define electricity storage in law, removing another barrier to flexibility.

► **Through the Net Zero Innovation Portfolio, we will launch a major competition to accelerate the commercialisation of first-of-a-kind longer duration energy storage, as part of our £100 million investment in storage and flexibility innovation, with delivery from spring 2021.**

Storing excess low-carbon generation over longer periods of time could enable us to decarbonise the energy system more deeply at lower costs.

Novel energy storage technologies show promising cost reductions<sup>100</sup> but some have yet to be demonstrated at scale. First-of-a-kind demonstrations are required to enable cost reduction and de-risk private investment. The Prime Minister's Ten Point Plan announced a further £100 million to address energy storage and flexibility innovation challenges, one of the key priority areas in the over £1 billion Net Zero Innovation Portfolio.

To promote energy storage innovation, we will further accelerate the commercialisation of innovative technologies, excluding proven technologies such as lithium ion and pumped hydro storage. Our support will build on the success of previous funding under the current Energy Innovation Programme.

It will focus on long-duration storage technologies that could be deployed at large scale and provide novel services or system benefits. The first competition to address energy storage and flexibility innovation challenges will be launched in spring 2021 with stakeholder engagement and information days.

Some flexibility solutions could be better delivered through local markets, in which organisations with a more in-depth knowledge of their communities can provide solutions to local need more quickly than responses at the national level. But local and national actions need to complement one another. We will work towards a market framework which ensures that national and local electricity markets are fully co-ordinated and satisfy the full suite of system requirements. We look to the Electricity System Operator (ESO), Distribution Network Operators (DNOs) and market participants to work closely together to facilitate this enhanced co-ordination, and government will keep progress on this under review to ensure the system enables optimal levels of flexibility.

DNOs, the companies which own the regional electricity networks, are already creating local flexibility markets. In 2020, they awarded contracts for around 1.2GW of flexibility services, including the first contracts to provide local services which pay households for using the aggregated electricity capacity from a collection of domestic batteries.<sup>101</sup> We will encourage more local solutions and open up as many services as possible to competition. We expect network operators to go much further, fully opening their networks to flexibility technologies while mitigating real or perceived conflicts of interest.

## CASE STUDY

### Creating New Marketplaces

Piclo Flex is an independent flexibility marketplace which allows DNOs and flexibility providers to find and contract with each other. It enables distributed resources such as electric vehicles or battery energy storage to identify where flexibility is needed via a dashboard, receive notification of relevant auctions, and bid for DNO payments. Overall, the platform helps to identify flexibility market opportunities and lowers barriers for entry for flexibility providers.

As part of the £505 million BEIS-funded Energy Innovation Programme, Piclo is now expanding its platform to support trading with the ESO, as well as trading between flexibility providers. Another competition winner, Electron, are also creating innovative digital solutions for flexibility trading.

Actions should include steps to implement standardised flexibility products as soon as possible and ensure that distributed flexibility is able to participate in all markets. We will keep open the option of legislating in support of local flexibility markets, should DNOs fail to make sufficient progress.

Due to the unique characteristics of electricity, there is a need to match supply and demand on a second-by-second basis. The government works in partnership with the ESO and Ofgem to ensure the reliable operation of the system and the security of electricity supplies. Security of supply will always be a priority, but our approach must also adapt to reduce carbon emission and costs.

Our markets should also incentivise the integration of the different types of energy assets which are now connecting to the energy system. We expect Ofgem and the ESO to ensure existing balancing services are fully transparent and competitively procured, while enabling new markets to emerge. We support the steps which they are taking to facilitate wider access to balancing services and embed more efficient processes into the operation of balancing markets, including establishing closer-to-real time markets and enabling greater automation.

As well as making sure the system is stable on a day-to-day basis, we need the assurance over the course of each year that there is enough generation capacity to satisfy even exceptional periods of demand or to back-up renewables when the wind does not blow, or the sun is not shining. The Capacity Market (CM) is our primary policy mechanism for delivering this security of electricity supply. It provides generators and flexibility providers with a payment for reliable capacity to ensure they deliver more electricity, or reduce demand, when required.

To date, the CM has supported investment in over 10GW of new capacity, including smart technologies such as battery storage and demand-side response.<sup>102</sup> We have made a number of reforms since its introduction in 2014, such as allowing certain renewables to participate and implementing carbon emissions limits in future auctions. In our five-year review, published in 2019, we committed to retaining the CM as a guarantee of system reliability and to making further incremental improvements to its design.<sup>103</sup> The next review will take place by 2024. We will ensure that the mechanism acts in concert with other markets to incentivise investment in the right type of capacity, in the right place at the right time.

Over the longer term, as generation moves towards a predominantly renewables mix, we want electricity markets to incentivise the right behaviours from generators and offer value for money to consumers, while continuing to ensure low-carbon solutions can deploy at the scale needed for net zero emissions. Our current market framework emphasises the cost of fuels such as gas and coal, but renewable technologies, such as wind, do not use fuel at all. It is also poor at valuing some services which will become increasingly important to the system, such as local balancing.

Increasing levels of renewable generation are likely to impact wholesale market prices and the ways in which markets determine which assets can most efficiently dispatch power, or reduce use, to balance the system. We need markets to incentivise both significant levels of new investment and efficient operation, in a system which mixes existing generation with increasing levels of renewables and the flexible technologies which complement them. We will support the technologies required for this transition and look for ways to adapt our policies to reflect emerging market dynamics; for instance, through our call for evidence on the future of renewable support schemes, published alongside this white paper, and in our new Smart Systems Plan, to be published in spring 2021. Beyond this, we will consider how our policies should continue to evolve, developing our approach as required in consultation with industry and other stakeholders.

## NETWORK INFRASTRUCTURE

Electricity and gas transmission networks transport energy large distances around the country, while regional distribution networks connect our homes and places of work to the grid.

The vast majority of households are connected to the electricity network. The relatively few homes that are off grid, have their own electricity generator and might self-generate, using solar photovoltaics for example. Britain's gas network is one of the most efficient, resilient and advanced operations in the world, connecting over 23 million users through 284,000 km of pipelines.<sup>104</sup> Around four million households live off the gas grid, many of them in remote locations and using stored oil or gas for heating and for hot water.<sup>105</sup>

Britain has been at the forefront of introducing competition to networks and regulating these natural monopolies. This approach has served consumers well, promoting innovation, and lowering costs. Since privatisation, our gas and electricity networks have become more resilient and delivered better value for customers. The cost of transporting a unit of electricity has fallen by 17 per cent since the mid-1990s, while investment has increased. Reliability and customer service have improved, and the number of power cuts has almost halved.<sup>106</sup>

The transformation of our energy system will require growing investment in physical infrastructure, to extend or reinforce the networks of pipes and wires which connect energy assets to the system and maintain essential resilience and reliability. As well as creating a low-carbon system we need enhanced preparedness for climate risks. Government is supporting the efforts of key stakeholders in this important endeavour.

Under the Climate Change Act's Adaptation Reporting Power over 90 organisations have committed to report on their preparatory actions by the end of 2021, including those responsible for electricity generation, and the transmission and distribution of gas and electricity.<sup>107</sup>

While the gas network will need continual updating, the electricity network faces a complete step-change in approach and scale. Working with Ofgem, we need to deliver investment in our existing electricity network at the lowest possible cost to consumers while ensuring the network can keep pace with burgeoning demand for power, for example, from the accelerated adoption of EVs and heat pumps.

► **We will legislate, when Parliamentary time allows, to enable competitive tendering in the building, ownership and operation of the onshore electricity network.**

We need market and regulatory frameworks which promote greater competition and more innovation in the construction and operation of energy networks. Competition in network assets is key to reducing network costs. Since 2009, awarding the ownership and operation of offshore wind network connections through a competitive tender process is estimated to have saved consumers in excess of £800 million.<sup>108</sup> We now need a similar competitive regime for onshore networks, where currently only incumbent network operators can build, own and operate network assets.

**Britain's gas network connects 23 million users**

through 284,000 km of pipelines



Allowing other parties to compete for onshore network projects will deepen the pool of capital available for the significant amount of investment needed in our networks as we transition to clean energy. Competitive pressure in these networks will improve efficiency, saving consumers more money, and encourage further innovations in system design and operation. It will also provide Ofgem with better price information, which it can utilise in setting its periodic price control mechanism.

We therefore intend to introduce legislation, when Parliamentary time allows, to enable competitive tendering for building, owning and operating onshore electricity network assets. We intend the legislation to allow the Secretary of State to appoint an appropriate party to run the tender processes. We propose that competitive tendering could be opened up at the distribution network level, as well as in the transmission network, should evidence suggest that this will secure value for consumers. This competitive regime will extend widely, addressing network constraints across Wales, Scotland and England. We also intend to open network innovation funding to third parties and encourage more whole-system innovation in gas and electricity networks. We will consider amending legislation to achieve this, should it be necessary.

- ▶ **We will support the rollout of charging and associated grid infrastructure along the strategic road network, to support drivers to make the switch to EVs ahead of the phase out of the sale of new petrol and diesel cars and vans by 2030, and hybrids with significant zero emission capability by 2035.**

Following extensive consultation with car manufacturers and dealers, the Prime Minister has confirmed that the UK will end the sale of new petrol and diesel cars and vans by 2030, ten years earlier than planned. The sale of hybrid cars and vans that can drive a significant distance with no carbon emissions will continue until 2035.

This accelerated transition requires scaling-up the rollout of EV chargepoints and, in turn, an associated expansion in electricity generation and network capacity, to meet the increase in demand for power. With the necessary investment in new infrastructure and the adoption of smart charging, we are confident that the system will cope with the transition.

As part of a £2.8 billion package announced in the Prime Minister's Ten Point Plan, the government will provide funding of £1.3 billion to accelerate the rollout of chargepoints for EVs in homes, workplaces, streets and on motorways across England, so people can more easily and conveniently charge their cars. We will invest £950 million of this funding in future proofing grid capacity along the strategic road network, to prepare ahead of need for 100 per cent take-up of zero emissions cars and vans.



## CASE STUDY

### EV Charging on the Strategic Road Network

Over 95 per cent of people in England use the Strategic Road Network at least once a year.<sup>109</sup> We will support the roll out of charging infrastructure along England's Strategic Road Network by investing £950 million in future proofing grid capacity at motorway and major A road service areas. This will ensure the private sector can continue to expand the charging network at pace in the 2020s.

By 2030, we expect the network to be extensive and ready for more people to benefit from the switch to electric cars. We are planning for there to be around 2,500 high powered chargepoints across England's motorways and major A roads. By 2035 we expect around 6,000 high powered chargepoints across England's motorways and major A roads.<sup>110</sup> This will be a vital investment for our future, and key to reducing consumer anxiety about long-distance journeys.

We expect the mass uptake of EVs to create significant new demand for power, but it also represents an opportunity for enhanced system flexibility. Smart charging can help mitigate peak demand; for example, charging overnight rather than in the early evening when an EV owner might plug in their vehicle after returning home from work but also the time when electricity demand tends to peak. Vehicle-to-grid technology can then utilise the electricity stored in car batteries to supply power or services to the grid during periods of high demand. To capture these system benefits, the deployment of charging infrastructure needs to run ahead of the uptake of EVs. Only then will consumers have the confidence that they can charge their vehicles conveniently and cost-effectively.

The Prime Minister's Ten Point Plan also set an ambition to reach 600,000 electric heat pump installations per year by 2028, as one option to accelerate the decarbonisation of heating. Along with the rollout of EVs, the electrification of heat will further drive the need for anticipatory investment in the network but equally create opportunities to exploit system flexibility. Deployed in conjunction with storage and smart meters, heat pumps are able to avoid periods of high demand, benefitting the grid, and reducing running costs.

We are working closely with Ofgem to ensure that the regulator's network price control mechanism enables the investment needed in EV charging infrastructure, heat pumps and other low-carbon technologies. Price control must be as agile as possible in approving future network upgrade projects when the need becomes clear, while keeping costs down, now and in the future.

Given the key role of electricity distribution networks in being able to accommodate low-carbon technologies such as EVs and heat pumps, the government wrote to Ofgem in October 2020 to outline relevant policy in advance of Ofgem setting its final methodology for the next distribution price control, which covers the period 2023 to 2028.<sup>111</sup> Our letter highlighted the importance of appropriate investment to enable timely connection of new low-carbon technologies, and gathering and sharing the data needed to optimise the use of networks. We are also working with Ofgem, and partners across the energy and transport systems to address barriers which can prevent the efficient connection of chargepoints to the electricity grid. This will include ensuring there is easily accessible and accurate information for commercial customers on the costs and opportunities of rolling out chargepoints in different locations, to give them confidence to make informed choices around the switch to EVs.

Interconnection increases the ability of the GB electricity market to trade with other markets, enhances the flexibility of our energy system and has been shown to have clear benefits for decarbonisation. Alongside this white paper, we are publishing a report into the impact of interconnectors on decarbonisation, which demonstrates how a higher level of interconnector capacity could decrease cumulative emissions in Great Britain by up to 199MtCO<sub>2</sub>e by 2050, as well as reducing total system costs.<sup>112</sup>

We will work with Ofgem, developers and our European partners to realise at least 18GW of interconnector capacity by 2030. This represents a three-fold increase from current levels and will position us as a potential net exporter of excess green energy, helping to keep wind turbines generating even when GB electricity demand has been met.

► **To minimise the impact on local communities, we will implement a more efficient approach to connecting offshore generation to the mainland grid.**

The current regime for connecting offshore wind farms to the onshore grid has encouraged single point-to-point connections. Each project has a separate cable route and associated onshore infrastructure. We recognise the impact this is having on the coastal communities which host this infrastructure and will act quickly to take the necessary steps to address the situation, particularly given our ambition to have 40GW offshore wind by 2030. We have launched the Offshore Transmission Network Review to improve the delivery of transmission connections for offshore wind generation.<sup>113</sup> This will consider the full impacts on affected communities, particularly on the east coast of England, while making sure the whole of the UK benefits from a more strategic approach.

The review will seek the appropriate balance between environmental, social and economic costs. It will also consider the potential of hybrid, multi-purpose interconnectors, which are already being explored by developers in the UK and the Netherlands, to get the most from our offshore wind and transmission assets. These hybrid projects could integrate the transmission links we need to connect offshore wind to our grid with interconnectors to neighbouring markets.

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**40GW**

**offshore wind by 2030** is our ambition

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**£6bn**

**in consumer savings** could be delivered by 2050

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These projects would allow us to sell excess green power in other markets, or, when our wind output is low, import electricity through cross-border trade.

Initial outputs from the ESO, delivered as part of the review, have shown that taking a more coordinated approach could deliver up to £6 billion in consumer savings by 2050, significantly reducing environmental and social impacts on coastal communities.<sup>114</sup> This analysis showed benefits not just for the east of England, but also Scotland and Wales. We are working closely with the Scottish and Welsh Devolved Administrations through the review.

In order to start delivering these benefits, we will encourage projects already in development, where early opportunities for coordination exist, to consider becoming pathfinder projects. This will help inform the design of the enduring regime. We will consider changes to the current regulatory framework which enable developers to implement innovative approaches, including on anticipatory investment. For the 2030s and beyond, we will redesign the current regime to incentivise more extensive coordination and minimise environmental, social and economic costs.

## DIGITAL INFRASTRUCTURE

We need a modern digital infrastructure to underpin markets and optimise physical networks. This requires new ways of creating, collecting, analysing and sharing energy data from different sources.

► **We will build world-leading digital infrastructure for our energy system, based on the vision set out by the independent Energy Data Taskforce, publishing the UK's first Energy Data Strategy in spring 2021, in partnership with Ofgem.**

Data will help us to discover cheaper ways of delivering the energy we need by making information available to those who can provide solutions to reduce costs and improve services to consumers. For example, better data can help local authorities make the best decisions about where to install chargepoints for EVs.

Open and secure data is also essential to the efficient integration of low-carbon technologies, such as solar panels, heat pumps and batteries, into our electricity networks. Information about the scale and nature of demand, the capability of networks, or the location and size of generation and storage capacity will enable markets to optimise the use of assets across the system. This information can be combined with data from transport, homes and commercial buildings to enable whole-system strategic planning and investment decisions. Smart meter data can help DNOs to identify system constraints and enable them to direct investment more efficiently, including where network reinforcement is required to support an increase in heat pumps or EVs.

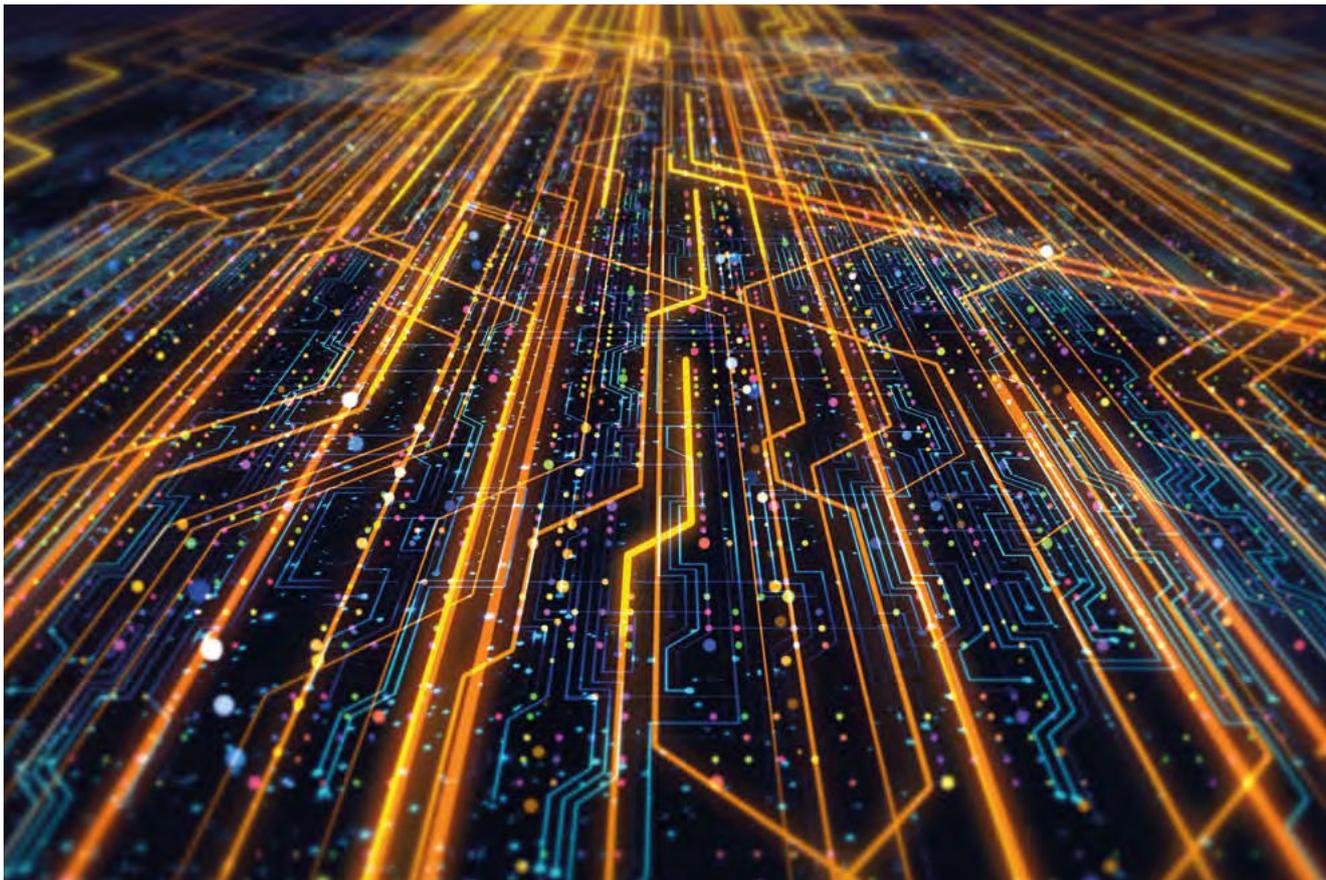
In all such activities, we will ensure that new technologies are introduced in a way that empowers consumers and protects their data at all times.

### CASE STUDY

#### Batteries and Machine Learning

Habitat Energy are using artificial intelligence and machine learning to provide optimisation and trading services to owners of battery storage and other flexible energy assets. Habitat uses algorithms to process data from individual assets and trading platforms to optimise the batteries across multiple markets.

This data-driven approach maximises the revenue that can be achieved while also carefully managing the degradation of the battery to preserve asset life. Improved co-ordination between markets and better quality data about network condition and performance enable innovators like Habitat to optimise assets to meet system needs, thereby reducing costs for consumers.



In 2018, the government and Ofgem launched the independent Energy Data Taskforce. The Taskforce's final report in 2019 highlighted how the move towards a modern, digital energy system is being hindered by poor quality or missing data, while data which is valuable can be hard to find or subject to restricted access.<sup>115</sup> The report set out a strategy to fill data gaps, improve the quality of data and make data more open.

We are implementing all of the Taskforce's recommendations through 'Modernising Energy Data', a joint programme with Ofgem and Innovate UK. We will publish an energy data and digitalisation strategy jointly with Ofgem in spring 2021. The strategy will set out the progress that we have made against specific recommendations and show how better use of data is realising our objective of a fully digital and clean energy system.

Our approach will be aligned with the overarching principles set out in the National Data Strategy and aims to help establish the energy sector's role in growing the UK's data economy.<sup>116</sup>

The Taskforce showed that a lack of access to energy data creates a barrier to innovation in the new technologies and services required to achieve net zero emissions. We are therefore creating a national energy data catalogue to make data more visible and reduce the costs of accessing this information. A prototype of the service will be launched by summer 2021. Market participants will be able to use this data to identify opportunities for creative new solutions, such as supplying more efficiently groups of customers who have similar needs.

Data owners often default to not sharing the information they create. We will develop a 'data triage' process which provides practical support to energy companies for making data more readily available, while ensuring cyber-security and data privacy. It will represent a clear guide for market participants on how to share data appropriately. Ofgem will consult on this guidance and associated licence conditions by summer 2021. It will complement the digitalisation strategies of the network companies which have recently been published to set out operators' plans for improving the use of data.

We will also develop the tools and processes which allow innovators to make full use of the data once they have access to it. The Modernising Energy Data innovation competitions will enable providers of new services to link energy data with information from other sectors such as transport, heat and buildings, integrating the UK's different infrastructure.<sup>117</sup>

For example, the £2 million Modernising Energy Data Access competition will help develop the digital structures needed for innovators to build new apps and products that are compatible across different systems and sectors. The early outputs from these competitions are expected to be available by autumn 2021.

As the energy system becomes increasingly reliant on digital technologies, cyber security will be ever more important for the stability and security of the energy system. Our smart metering system has already been developed with security experts from government and industry and we will continue to ensure cyber security plays a key role in the actions we are taking to facilitate a smart, digital and secure energy system.

## OUR COMMITMENTS TO MODERNISE ENERGY SYSTEM DATA



### Getting data into the open

A clear new process to guide industry



### Making sure data is easy to find

Open-access Energy Data Catalogue



### Fully harnessing the value of data

Government-funded Modernising Energy Data innovation competitions

**UK's first Energy Data and Digitalisation Strategy**

## THE ROLE OF NATURAL GAS

Gas currently represents almost 30 per cent of final energy consumption and 40 per cent of electricity generation.<sup>118</sup>

We will continue to rely on natural gas for some years, even as we work to largely eliminate carbon emissions from the entire energy system including those from gas.

► **We will consult on updates to the Gas Act to ensure we decarbonise gas supplies while continuing to provide the right price signals to market participants.**

We will therefore make sure the natural gas markets and networks evolve in a way which enables continued investment and ensure secure supplies but also promotes the use of low-carbon options, wherever possible. This will reduce emissions now and help build the networks of the future which will need to accommodate technologies such as hydrogen and Carbon Capture, Usage and Storage. We will need investment in the gas network to support the ambition set out in the Prime Minister's Ten Point Plan for a potential Hydrogen Town before the end of the decade.

But while natural gas continues to play a role in powering and heating our homes, we will need to maintain security of supply and ensure network operators have the right market and regulatory signals to ensure the necessary levels of investment in resilient, efficient infrastructure.

### GAS SYSTEM OPERATOR

**The whole transmission system is operated by a single Gas System Operator (GSO), who is responsible for keeping it stable and secure. National Grid Gas Transmission (NGGT) perform this function.**

Our gas markets operate effectively but it is important they continue to provide the right incentives consistent with our overall strategic goals. We will therefore review the overarching market framework set out in the Gas Act to ensure the appropriate powers and responsibilities are in place to facilitate a decarbonised gas future. This will include a review of gas quality standards to enable the widest range of gasses to be used to decarbonise energy. We will work with Ofgem to remove distortions within the gas market, such as reviewing the Domestic Load Connection Allowance which acts as a subsidy for extensions to the gas grid rather than allowing competition with other lower carbon options. These changes are important to make sure the right price signals are in place to maintain security of supply while also enabling the decarbonisation of gas.

Starting in 2021, through a series of workshops and consultation, we will work with network operators, suppliers and consumer groups on the future of gas as we transition to a clean energy system. Our dialogue with stakeholders will also consider the implications for networks, gas wholesale and retail markets and for final energy use by consumers.



## ENERGY SYSTEM INSTITUTIONS AND GOVERNANCE

The markets and networks that deliver our energy are governed by a series of standards and rules.

Our current standards are geared to the safety of our energy system and the rules we have in place protect customers and ensure fair competition. This process is overseen by institutions including Ofgem, and the system operators who keep supply and demand in balance.

► **We will ensure that the institutional arrangements governing the energy system are fit for purpose for the long term, consulting in 2021 over organisational functions, including system operation and energy code governance.**

Our approach to system governance needs to evolve. The roles of Ofgem, the electricity and gas system operators and the transmission and distribution network operators still largely reflect the model from 30 years ago and need to be updated. As we decarbonise the energy system, the regulator, networks, industry and government will need to work together to consider the potential solutions.

Interactions within the energy system are becoming more complex. The system operators need to take on new responsibilities and the regional network owners need to play a more proactive role in delivering an open, flexible and efficient system.

We need the operation of national and local energy markets to be managed impartially, without conflict of interest, ensuring they are fully open to competition. We need a robust process for setting and enforcing system rules, an approach which ensures that the rules promote competition and innovation, not act as a barrier to change. There is also a need for a greater co-ordination to drive collaboration between different parts of the energy system which are currently too siloed.

We need to consider, at both the transmission and distribution level, whether the roles which discharge these functions are undertaken by government, Ofgem, industry parties such as the system operator, or by an entirely new body. We will review the right long-term role and organisational structure for the ESO, in light of the reforms to the system operator instituted in April 2019. It is possible that there will need to be greater independence from the current ownership structure, should it be appropriate to confer additional roles on the system operator.

These new roles should help the system achieve our net zero ambitions and meet consumers' needs. Without them, we risk having an energy system which makes less effective investment and operational decisions, resulting in excessive costs for consumers or a failure to reduce emissions in line with our net zero target.

The detailed technical and commercial rules of the energy system, established in a collection of codes and engineering standards, also need an overhaul to ensure that they are fit for purpose as we transition to a clean energy system. Many rules have only seen minimal change since the 1950s.

We will consider the best future framework for energy codes and consult on options for reform in 2021, building on the government and Ofgem's joint review of code governance<sup>119</sup> and the work of the independent panel on engineering standards.<sup>120</sup>

Ofgem is clear that helping to deliver a clean energy system consistent with net zero emissions protects consumers' interests, which is Ofgem's principal statutory objective. However, as the pace of this transformation accelerates, it will be important that Ofgem has clear sight of the government's policy priorities for the decarbonisation of energy, including how we approach the electrification of road transport and heat.

► **We will set out our vision for energy as a guide to Ofgem, by consulting in 2021 on a Strategy and Policy Statement for the regulator.**

The Strategy and Policy Statement will set out the strategic priorities of our energy policy, the outcomes we seek to achieve and the roles of government, Ofgem and other parties which are collectively responsible for delivering these goals. Subject to Parliamentary approval, the Strategy and Policy Statement will require the Secretary of State and Ofgem to carry out their regulatory functions in a manner which is consistent with securing the government's policy outcomes, including delivering a net zero energy system while ensuring secure supplies at lowest cost for consumers. This will enable not just Ofgem, but energy consumers and industry as well, to better understand the government's ambitions for the energy sector.

# Our key commitments



We will **publish a new Smart Systems Plan in spring 2021**, jointly with Ofgem, and define electricity storage in law, legislating when Parliamentary time allows.



Through the Net Zero Innovation Portfolio, we will **launch a major competition to accelerate the commercialisation of first-of-a-kind longer duration energy storage**, as part of our £100 million investment in storage and flexibility innovation, with delivery from spring 2021.



We will legislate, when Parliamentary time allows, **to enable competitive tendering** in the building, ownership and operation of the onshore electricity network.



We will **support the roll out of charging and associated grid infrastructure along the strategic road network**, to support drivers to make the switch to EVs ahead of the phase out of the sale of new petrol and diesel cars by 2030, and hybrids by 2035.



To minimise the impact on local communities, we will **implement a more efficient approach to connecting offshore generation to the mainland grid**.



We will **build world-leading digital infrastructure for our energy system**, based on the vision set out by the independent Energy Data Taskforce, publishing the UK's first Energy Data Strategy in spring 2021, in partnership with Ofgem.



We will **consult on updates to the Gas Act**, ensuring we decarbonise gas supplies while continuing to provide the right price signals to market participants.



We will **ensure that the institutional arrangements governing the energy system are fit for purpose for the long term**, consulting in 2021 over organisational functions, including system operation and energy code governance.



We will **set out our vision for energy as a guide to Ofgem**, by consulting in 2021 on a Strategy and Policy Statement for the regulator.

EXPLAINER

# Transport



## SETTING THE SCENE

Transport is an important aspect of our everyday lives and fundamental in connecting us together.

Our cars, buses, trains and planes allow us to travel long distances to meet with our families, friends and colleagues; and our lorries, vans, and ships ensure our goods and mail are delivered safely to our businesses and homes.

Yet while transport helps to connect people and places, boosting economic growth and opportunity, it now contributes over a quarter (28 per cent) of UK domestic greenhouse gas (GHG) emissions.<sup>121</sup>

Over 90 per cent of these emissions come from our roads, with passenger cars, heavy goods vehicles and light duty vehicles contributing the most. Despite dramatic progress to improve fuel efficiency of new passenger cars, emissions reductions have been largely offset by their increased use.<sup>122</sup>

The Department for Transport will publish its plan to decarbonise the UK's entire transport system in spring 2021, putting us on a pathway to reach net zero. The Transport Decarbonisation Plan is focused on six strategic priorities.



**FIGURE 6.1 - DOMESTIC AND ROAD TRANSPORT EMISSIONS**

**Domestic transport emissions 2018**



**Road transport emissions 2018**



Source: BEIS Analysis

## SIX STRATEGIC PRIORITIES FOR THE TRANSPORT DECARBONISATION PLAN, TO DELIVER A NET ZERO TRANSPORT SYSTEM



### ACCELERATING MODAL SHIFT TO PUBLIC AND ACTIVE TRANSPORT

- ▶ Help make **public transport and active travel** the natural first choice for daily activities
- ▶ **Support fewer car trips** through a coherent, convenient and cost-effective public network; and explore how we might use cars differently in future
- ▶ **Encourage cycling and walking** for short journeys
- ▶ Explore how to best **support the behaviour change** required



### PLACE-BASED SOLUTIONS

- ▶ **Consider where, how and why emissions occur** in specific locations
- ▶ Acknowledge a single solution will **not be appropriate for every location**
- ▶ **Address emissions at a local level** through local management of transport solutions
- ▶ **Target support for local areas**, considering regional diversity and different solutions



### DECARBONISING HOW WE GET OUR GOODS

- ▶ **Consider future demand** and changing consumer behaviour for goods
- ▶ **Transform 'last-mile' deliveries** - developing an integrated, clean and sustainable delivery system
- ▶ **Optimise logistics efficiency** and explore innovative digitally-enabled solutions, data sharing and collaborative platforms



### DECARBONISATION OF VEHICLES

- ▶ **Support the transition to zero emission road vehicles** through:
  - Regulatory framework
  - Strong consumer base
  - Market conditions
  - Vehicle supply
  - Refuelling and recharging infrastructure
  - Energy system readiness
- ▶ **Maximise benefits** through investment in innovative technology development and development of sustainable supply chains



## UK AS A HUB FOR GREEN TRANSPORT TECHNOLOGY AND INNOVATION

- ▶ Utilise the UK's world-leading scientists, business leaders and innovators to position the UK as an internationally recognised leader of environmentally sustainable technology and innovation in transport
- ▶ Build on expertise in the UK for technology development and capitalise on near market quick wins



## REDUCING CARBON IN A GLOBAL ECONOMY

- ▶ Lead international efforts in transport emissions reduction
- ▶ Recognise aviation and maritime are international by nature and require international solutions
- ▶ Harness the UK as a global centre of expertise, driving low-carbon innovation and global leadership, boosting the UK economy



# THE ELECTRIC VEHICLE REVOLUTION IS ALREADY UNDERWAY

The emissions from passenger cars and light goods vehicles make up over two thirds of all transport emissions, so decarbonising those forms of transport is a priority.

Following extensive consultation with car manufacturers and sellers, the Prime Minister has confirmed that the UK will end the sale of new petrol and diesel cars and vans by 2030, ten years earlier than planned. From 2035, all new cars and vans must be zero emissions at the tailpipe. Between 2030 and 2035, any new cars and vans sold that emit from the tailpipe must have significant zero emission capability, for example plug in and full hybrids. The meaning of ‘significant zero emission capability’ will be defined by consultation in 2021. The government has also committed to providing a delivery plan in 2021 to realise these new ambitious phase out dates. The delivery plan will provide key milestones, and government will work with stakeholders to ensure these phase out dates can be met.

The UK car industry already manufactures a significant proportion of Europe’s electric vehicles (EVs), including one of the most popular models in the world.

To support this acceleration, the Prime Minister has announced:

- ▶ **£1.3 billion to accelerate the rollout of chargepoints for EVs** in homes, workplaces, streets and on motorways across England, so people can more easily and conveniently charge their cars.
- ▶ **£582 million in grants for those buying zero or ultra-low emission vehicles** to make them cheaper to buy and incentivise more people to make the transition.

- ▶ **Nearly half a billion to be spent in the next four years for the development and mass-scale production of electric vehicle batteries** (gigafactories) and other strategic technologies, as part of our commitment to provide up to £1 billion to support development of the electric vehicle supply chain, boosting investment in the automotive sector, including existing clusters of activity in the Midlands and North East.

In 2019, the UK was the third largest market for ultra-low emission vehicles (ULEVs) in Europe and is a global leader in their development and manufacture.<sup>123</sup> Nearly 10 per cent of zero emission cars bought in Europe in 2019 were built in the UK.<sup>124</sup> As at 30 June 2020, there were nearly 320,000 ULEV vehicles registered in the UK, up from just over 140,000 at the end of 2017. The vast majority of those ULEVs are cars, accounting for nearly 300,000 vehicles.<sup>125</sup>

EVs will create significant new demand for electricity, and we are already taking action to ensure the energy system now, and in the future, is ready for this shift. The transition to mass uptake of EVs will also have a big impact on how households consume energy. This is why the government has established the Electric Vehicles Energy Taskforce, to ensure consumers are placed at the heart of this journey.

We expect the mass uptake of EVs to create significant new demand for power but also offer opportunities for enhanced system flexibility. As discussed further in the ‘Energy system’ chapter smart charging and vehicle-to-grid technology can provide benefits for the consumer and the grid.

**320,000** ultra low emission vehicles registered in the UK as of June 2020

**#3**

In 2019 the **UK was the third largest market for ULEVs** in Europe

Under the Automated and Electric Vehicles Act 2018 government have the powers to mandate all smart functionality for chargepoints, enabling consumers to drive home from work, plug their car in, and automatically charge when electricity is cheaper, or greener, rather than in the evening, when it is more expensive. We intend to bring forward regulations in 2021 to mandate that private EV chargepoints must be smart, and in the ‘Buildings’ chapter we discuss the ongoing work to introduce chargepoints into all new homes and non-residential buildings. Consumers will need to access accurate, trusted information to enable them to make an informed decision about electric vehicle charging. Government wants consumers to have confidence that they will be offered choice, convenience, and appropriate protections.

Information from these chargepoints will inform planning and operation of electricity systems, and help customers save money. Government is working to ensure security and privacy measures are in place to protect chargepoint users.

As well as building new network infrastructure where needed, it is important that we use the existing network to enable the deployment of chargepoints at the lowest cost to the consumer. The ‘Energy system’ chapter sets out how we will further support the roll out of charging infrastructure along the strategic road network.

## CASE STUDY

### Bus2Grid

In January 2018, the Office for Low Emission Vehicles and the Department for Business, Energy and Industrial Strategy awarded almost £30 million, through an Innovate UK vehicle-to-grid programme, where EVs can supply electricity to the grid at times of high energy demand.

Bus2Grid is part of this programme and is exploring the commercial value and social benefits to the energy and passenger transportation systems. The project will develop services to support National Grid, local Distribution Network Operators (DNOs), bus operators and transport authorities and at the same time will consider bus fleet consumer engagement approaches necessary for its commercial implementation. Bus2Grid claims to be developing the “world’s largest bus to grid site” and is bolstered by a diverse project consortium, including: SSE Enterprise, automotive manufacturer Build Your Dreams (BYD), the Distribution Network Operator UK Power Networks (UKPN) and the University of Leeds.

The project is a first of a kind large scale, multi-megawatt, demonstration of vehicle-to-grid technology in electric bus depots located in London. This process is managed by an aggregation platform that enables the 28 e-bus batteries to interact with the energy system by charging or exporting energy to support the grid in times of high energy demand.<sup>126</sup>

## ALTERNATIVES FOR HEAVY DUTY VEHICLES

After passenger cars, heavy goods vehicles (HGVs) are the biggest contributor to domestic transport emissions in the UK, and zero emissions solutions for HGVs, particularly the heaviest vehicles, are much less developed by comparison.

The Prime Minister's 'Ten Point Plan for a Green Industrial Revolution' announced that we will consult on a date for phasing out the sale of new diesel HGVs.

Battery Electric Vehicles (BEVs) are well placed to deliver the bulk of decarbonisation for cars and vans and now also smaller HGVs in short distance and medium weight applications, such as urban distribution. However, the solution for larger, long-haul, road freight vehicles is not yet clear and so we will invest £20 million next year in freight trials to pioneer hydrogen and other zero emission truck technologies to support industry to develop cost-effective, zero emission HGVs in the UK.

In our 'Oil and gas' chapter we mention the work being undertaken in the downstream oil and gas sector on low-carbon fuels, and we are continuing to explore alternatives, including through a £40 million innovation programme looking at the best fuel/vehicle combinations to decarbonise construction, mining and other off-road heavy vehicles by 2030.

We are also supporting the decarbonisation of buses. Early next year, the Department for Transport will publish a National Bus Strategy, which will set out ambitious plans to transform the sector, including delivering higher frequency of service, simpler fares, improved routes and more green buses.

As set out in the Ten Point Plan and the Spending Review 2020, the government will invest £120 million in 2021/22 to start the delivery of the 4,000 zero emission buses announced by the Prime Minister in February. Government will support both battery electric buses and hydrogen buses where the market favours their use.

## RAIL DECARBONISATION

For areas of the rail network with significant freight flows or long-distance high-speed services, electrification is a proven technology that is able to support these service types.

Analysis suggests that electrification may also be the best whole-life cost solution for more intensively used areas of the network. Away from these areas of operation the deployment of emerging technologies such as battery traction and hydrogen rolling stock on both an interim and permanent basis may offer alternative solutions to help in achieving decarbonisation of rail at a lower cost.

## AVIATION AND MARITIME

We are making the UK the home of green ships and planes.

We have established the Jet Zero Council to accelerate the development and adoption of new technologies to help develop our strategy to reach net zero aviation, along with investing £15 million into FlyZero as well as running a £15 million competition to support the production of sustainable aviation fuels in the UK.

As we are preparing the Transport Decarbonisation Plan, which will also include actions to get the maritime sector on track to net zero, we continue to implement the commitments in Clean Maritime Plan, building on the government's ambitious vision for the future of UK zero emission shipping. This includes the launch of a £20 million Clean Maritime Demonstration Competition, which will support the UK design and development of clean maritime technology, including hydrogen, and will lay the foundation for a network of real-world projects.

On 16 November, the Department for Transport published the Union connectivity review: call for evidence.<sup>127</sup> The review, led by Sir Peter Hendy, will look at how the quality and availability of transport infrastructure can support quality of life in communities across the UK while also aiding economic recovery and will consider the environmental impact of current and future infrastructure. Sir Peter is expected to publish his final recommendations in summer 2021.

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**£20m**

competition to support the design and development of **clean maritime technology**

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**£15m**

competition to support the production of **sustainable aviation fuels in the UK**

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**40,000**

**new jobs supported** by accelerating the shift to zero emission vehicles

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As we decarbonise across transport, energy requirements will change in many sectors, from trains, to boats and planes. This will create new demands on our energy systems. Accelerating the shift to zero emission vehicles could support around 40,000 new jobs by 2030. More details on ensuring all modes of transport are on a pathway to net zero will be set out in the forthcoming Transport Decarbonisation Plan.

CHAPTER 04

# Buildings

## OUR GOAL

Delivering our net zero target means largely eliminating emissions from domestic and commercial buildings by 2050.

We will:

- ▶ **Drive greatly improved energy performance** in both existing and new buildings to reduce consumption and help keep bills affordable
- ▶ **Support the transformation of heating for homes and workplaces** from oil and gas to clean energy sources
- ▶ **Use the switch to clean energy to support up to 50,000 jobs** across the UK by 2030





BUILDINGS

# The strategic context



We need the energy we use to heat or cool our homes and workplaces to be reliable and affordable, and support comfortable, healthy surroundings in which to live and work.

But emissions from homes and from commercial and public sector buildings account for 19 per cent of total UK greenhouse gas emissions.<sup>128</sup> It makes buildings the second largest source of emissions after transport. Buildings also indirectly contribute to power sector emissions through electricity-using products in our homes.

#2

buildings are the **second largest source of emissions in the UK**

90%

**of homes in England currently use fossil fuels** for heating, cooking and hot water

66%

of homes are at **Energy Performance Certificate D or worse**

**FIGURE 7.1 - UK TERRITORIAL EMISSIONS** <sup>129</sup>

2018



Source: BEIS Analysis of 'Final UK GHG emissions national statistics' and NAEI

Our challenge is to transform how buildings use energy in line with our net zero target. We need to minimise the disruption to consumers as we go through this change and keep bills affordable, while safeguarding the quality of the environment in our building stock.

Almost 90 per cent of homes in England currently use fossil fuels, predominantly for heating but also for cooking and hot water.<sup>130</sup> The vast majority of these homes, some 85 per cent, are connected to the gas grid.<sup>131</sup> Those that are not connected use mostly oil, liquified propane gas or electricity, or are connected to a shared heat network. While proportions differ between Scotland, Northern Ireland, Wales and England, fossil fuels dominate heating across the UK.<sup>132</sup>

The installation of energy efficiency measures and tighter building regulations have improved the energy performance of buildings, lowering consumption and helping to reduce household dual fuel bills by an average of £30 to £40 per year over the last 10 years.<sup>133</sup> Emissions from buildings across the UK have fallen by 18MtCO<sub>2</sub>e, 17 per cent, over the last 30 years.<sup>134</sup> But we need to go further and secure a reduction in emissions by 2050 five times greater than we have achieved over this period.

## ENERGY PERFORMANCE CERTIFICATE

**Energy Performance Certificates** (EPCs) are required in the UK to provide a prospective owner or tenant with information on the energy performance of a building and recommendations for improvement. EPCs for homes use an A-G rating scale based on the modelled energy bill costs of running the building.

The energy performance of too many existing homes is not good enough. Around 16 million homes in England, 66 per cent of the total, are at Energy Performance Certificate D or worse.<sup>135</sup> In the private rental sector, existing legislation requires that all buildings have a minimum standard of energy performance only of Band E at the point of rental. The modelled annual energy cost of the average Band C rated home is around £750 less than the average Band E rated home, assuming both homes are being adequately heated (see figure 7.2).<sup>136</sup>

There are about 1.8 million non-domestic properties in England and Wales.<sup>137</sup> Buildings in the commercial and public sectors account for around a third of the total final energy consumed for buildings purposes (i.e. excluding industrial, agricultural or transport).<sup>138</sup> Large premises of 1,000 square meters or larger represent only 10 per cent of commercial and industrial buildings but emit over half of all the carbon from the building stock.<sup>139</sup>

90%

said it is important or very important that the UK makes a **full transition towards greener heating systems**

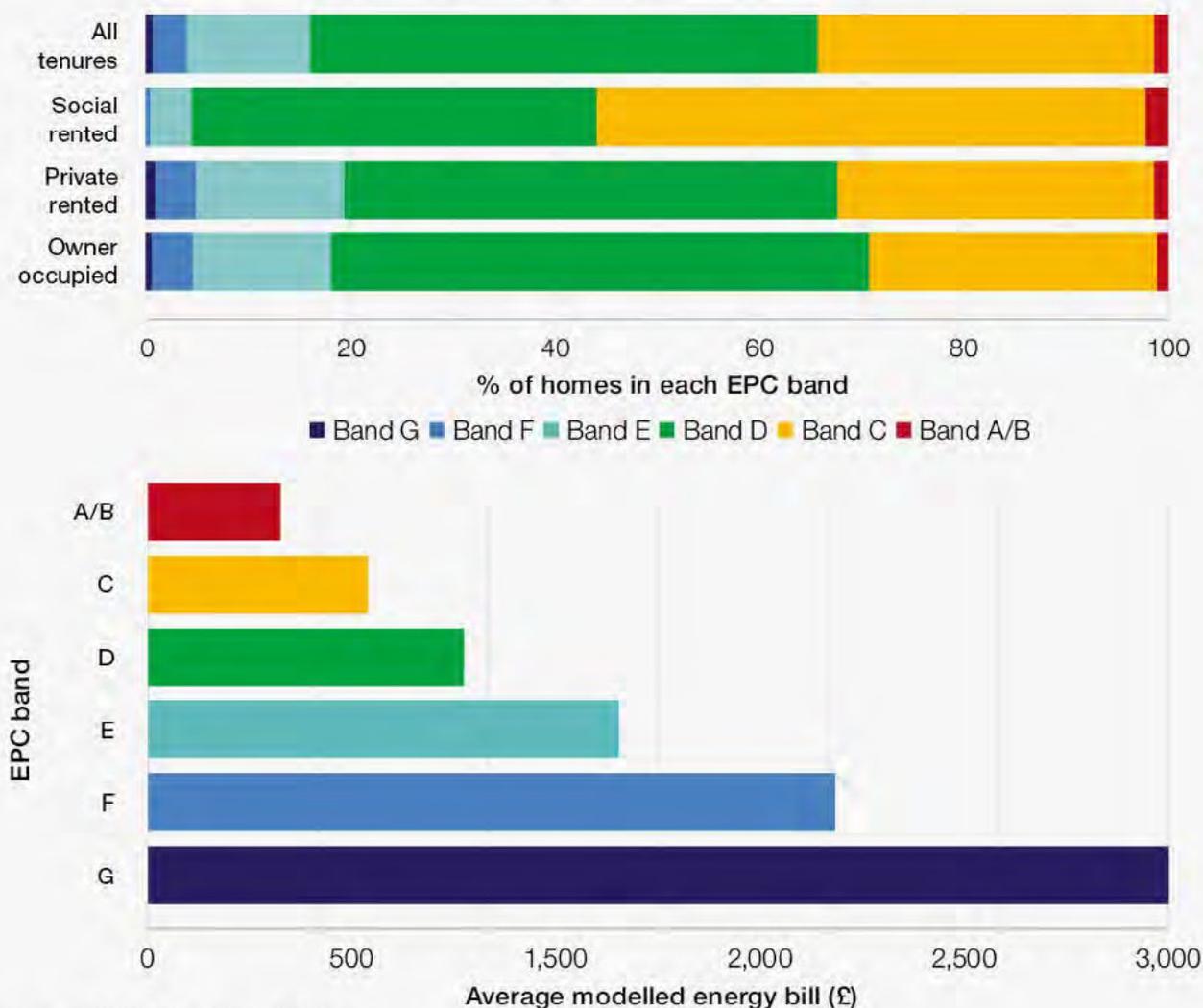
£9.2bn

**commitment to invest in the energy efficiency** of homes, schools and hospitals

Public awareness is low about the connection between climate change and how we heat homes and workplaces. Research by BEIS suggests that the majority of the population has not heard of low-carbon heating technologies.<sup>140</sup> Almost a third of gas-users stated they were on 'environmentally-friendly heating', suggesting a general under-appreciation of what the transition to low-carbon heating could mean in practice. Encouragingly, however, the survey shows that there is strong support for carbon reduction policies. Almost 90 per cent of respondents said it is important or very important that the UK makes a full transition towards greener heating systems.

Tackling emissions from buildings will take many years to deliver but it is a journey which must start now. The 2020s must be a decade of action to put the country on the path to net zero emissions by 2050. Depending on fossil fuels for heat or tolerating wasteful loss of energy in poorly insulated buildings is not sustainable. Action now will put us on a pathway to affordable, green and healthier buildings. Inaction will mean more disruption when we do eventually address the challenge, as well as higher bills and a lower quality of life in our homes and places of work.

**FIGURE 7.2 - EPC RATING OF HOMES IN ENGLAND AND AVERAGE MODELLED ENERGY BILL BY EPC BAND**



This white paper builds on our Manifesto commitment to invest £9.2 billion in the energy efficiency of homes, schools and hospitals. It sets out concrete actions to reduce how much energy we use and to support the move to low-carbon heat. We will publish a dedicated Heat and Buildings Strategy in early 2021 which will set out our ambitious plans in further detail, including the suite of policy levers that we will use to encourage consumers and businesses to make the transition.

Offices, retail space, hospitality and industrial buildings account for **around 80 per cent of private sector buildings energy demand**



# Our key commitments

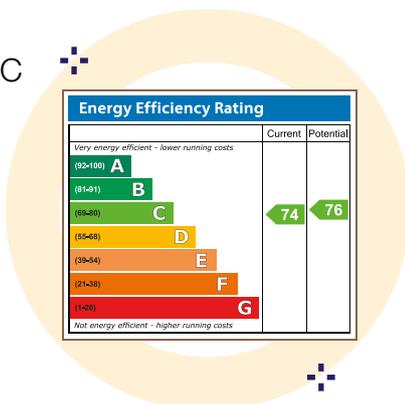
## IMPROVED BUILDING ENERGY PERFORMANCE

Ensuring our homes and workplaces use energy efficiently makes good financial sense, as well as supporting better health and well-being.

Energy efficiency measures help bill payers to reduce consumption and keep bills affordable. The asset value of homes can increase based on improved energy performance. Conversely, poor energy performance means that too many bill payers pay more than they should to heat or cool their homes and workplaces comfortably.

In November 2020, the Prime Minister announced £1 billion of funding to continue our support for the decarbonisation of buildings through improved energy efficiency. This will be allocated across several existing government schemes, including the Green Homes Grant Voucher Scheme, the Public Sector Decarbonisation Scheme and Social Housing Decarbonisation Fund.

Upgrading all UK homes to EPC C could provide **annual energy bill savings of £7.5 billion**



### NEW BUILDINGS

► **The Future Homes Standard will ensure that all new-build homes are zero carbon ready.**

The Future Homes Standard will require new-build homes to be fitted with low-carbon heating, and high levels of energy efficiency. Homes built to the Future Homes Standard will be zero carbon ready and have 75 to 80 per cent lower carbon emissions than those built to current standards. We will seek to implement the standard as soon as possible. As a stepping stone to the Future Homes Standard, we have consulted on an interim uplift in standards which would result in a 31 per cent reduction in carbon emissions from new homes compared to current standards.<sup>141</sup> We will publish the government response to the consultation and set out a roadmap to the Future Homes Standard, as soon as possible.

We have separately published guidance for drafting building specifications to support the installation of smart meters in new build homes to avoid the need for costly retrofitting. We will work with the industry to incorporate smart technologies, such as heating controls, into the methodology for assessing the energy performance of homes.



This will give occupants the ability to manage their energy consumption easily, reduce their energy bills and maximise the use of energy from renewable sources.

We have committed to consulting on mitigating overheating risk in new homes and a range of methods will be considered to demonstrate compliance with new requirements.

We will consult shortly on increased standards for non-domestic buildings so that new buildings have high levels of energy efficiency and low-carbon heating. We are also taking action on introducing new building regulations to require electric vehicle chargepoints in all new homes and in non-residential buildings.<sup>142</sup> We will respond to the consultation in early 2021.

## EXISTING HOMES

- ▶ **We want as many existing homes as possible to hit EPC Band C by 2035, where practical, cost-effective and affordable.**

While we face the huge challenge of preparing almost 27 million existing homes for a clean energy future, we have already taken significant steps to reduce the carbon footprint of homes, in line with our Manifesto pledge. The Green Homes Grant Voucher and Local Authority Delivery schemes, together worth £2 billion, were launched in September 2020 and the Prime Minister's Ten Point Plan confirmed that the schemes will be extended for another year, helping to support the development of the supply chain and grow the market ahead of the introduction of regulatory measures later in the 2020s.

The £1.5 billion voucher element offers homeowners and landlords a voucher covering up to two thirds of the cost of upgrading energy performance, to a maximum of £5,000. A voucher of up to £10,000 is available for low-income households, with no contribution required. Low-income households can also benefit from the £500 million of the Green Homes Grant that has been ringfenced for Local Authority Delivery.<sup>143</sup>

The schemes could enable more than 600,000 homes in England to be more energy efficient, saving these households up to £600 year on their energy bills.<sup>144</sup> Vouchers can be spent on a range of measures from cavity wall and loft insulation and air-source heat pumps, to draught proofing and replacing single glazing with double or triple glazing.

We will also take action to improve the energy efficiency of homes in the private rental sector. In September 2020, we issued a consultation on proposals for an estimated 2.8 million privately rented homes to meet a minimum energy performance standard of EPC Band C by 2028, where practical, cost-effective and affordable.<sup>145</sup> These proposals could reduce energy bills by an average of £230 per property annually, cutting fuel poverty, saving 9.5MtCO<sub>2</sub>e by 2032 and supporting 80,000 jobs in the energy sector annually between 2025 and 2028.<sup>146</sup>

44 per cent of all social rented homes in England, approximately 1.8 million, have an EPC Rating below C.<sup>147</sup> In our manifesto, we committed to invest in upgrading a significant number of these homes to at least EPC Band C. In July 2020, the government announced £50 million for 2020/21 to kickstart delivery of this ambition, piloting innovative retrofit projects across the UK and committed further funding in the Prime Minister's Ten Point Plan, announced in November.<sup>148</sup>



£50m

to support delivery of **upgrading homes to meet EPC band C**



£2bn

**Green Homes Grant voucher scheme**, plus further funding this year

- ▶ **We will consult on regulatory measures to improve the energy performance of owner occupied homes, and are consulting on how mortgage lenders could support homeowners in making these improvements**

Meeting our commitments to decarbonise and improve the energy performance in buildings will require the mobilisation of around £100 billion of capital across homes, businesses and the public sector over the 2020s alone.<sup>149</sup> It is investment that must come principally from businesses and homeowners, and from landlords of domestic and commercial premises. Growing the market for green finance products will be essential to leveraging this scale of private capital and demands a partnership between the financial services sector and suppliers, manufacturers and energy services companies. We are consulting on how mortgage lenders can help homeowners to improve the energy performance of their homes. The proposals are intended to kickstart the green home finance market and support homeowners to improve the energy efficiency of their homes as we move towards our target of reaching as many existing homes as possible at EPC Band C or above by 2035.<sup>150</sup>

## CASE STUDY

### Whole House Retrofit Grant

In summer 2019, the government launched the Whole House Retrofit Grant competition as part of the government's £505 million Energy Innovation Programme. The aim of the programme was to demonstrate the importance of taking a 'whole house retrofit' approach to improving the energy performance of the UK's buildings and in doing so, tackle one of the most challenging components of our decarbonisation agenda. The competition is based around an innovative 'fabric first' approach, while also introducing some low-carbon heating elements.

As an initial push towards achieving the government's Buildings Mission target of halving the cost of retrofits by 2030, the Whole House Retrofit programme also seeks to achieve cost reductions through process innovations and economies of scale and scope. Ultimately this will make it both cheaper and easier for all homeowners to improve the energy performance of their properties.

Retrofits should also deliver improvements in the health and well-being of occupants, including reduction of risk to summertime overheating and damp or mould growth.

The three projects selected are led by Local Authorities. More than 300 houses will be retrofitted in total, with a focus on socially rented properties across a range of housing archetypes. The projects are aiming to achieve retrofit cost reductions of between 5 and 20 per cent per property, making the properties not only warmer and more comfortable to live in, but less costly to run as well. The work will help pave the way for further cost reductions, and mass deployment of the whole-house approach as we head towards 2030.

At the same time as driving down install costs, a further objective of the competition is to increase expertise in the workforce and build capability of the supply chain, while ensuring resident health and comfort is placed at the centre of the whole house retrofit process.

Alongside a package of incentives, we can create a long-term regulatory framework to improve the energy performance of homes. We will seek primary powers to enable this. This will provide certainty to the market and clear signals to homeowners. We will consult in 2021 on options for these measures.

In September 2020, the government launched the Energy Performance Certificates Action Plan, which set out a pathway to improve the EPC system. The Action Plan will help to increase the energy efficiency of the building stock by exploring ways to increase the quality of EPCs, build consumer trust and increase engagement.

It will support policies which strengthen regulatory compliance and ensure that the data infrastructure underpinning EPCs is fit for the future. We anticipate that changes may be needed to the Energy Performance of Buildings (England and Wales) Regulations 2012 to deliver progress. We will need a new primary power to change the legislation after the Transition Period ends on 1 January 2021, which we will seek through an appropriate legislative vehicle in 2021, if Parliamentary time allows.

We also need to make energy-using products, such as household appliances, more efficient, helping to reduce bills and encourage innovation. Policies to increase the energy efficiency of products have been an effective lever and represent one of the most cost-effective ways to reduce energy bills and carbon emissions. The findings from our recent call for evidence will help to inform a best-in-class regulatory framework for energy-using products.

Our current estimates show that, taken together with related energy labelling requirements, ecodesign requirements will lead to emissions reductions of 8MtCO<sub>2</sub>e to 2020.<sup>151</sup> Through our world-class energy-related products policy, to be launched in spring 2021, we will push for greater energy and carbon savings. This year the government published a Call for Evidence and Consultations for ecodesign and energy labelling regulations across a range of products. We are currently reviewing the scope of our powers for achieving our energy efficiency ambition and, if necessary, will look to take additional powers through legislation.

## COMMERCIAL & INDUSTRIAL PROPERTIES

### ► All rented non-domestic buildings will be EPC Band B by 2030, where cost-effective.

Offices, retail space, hospitality and industrial buildings account for around 80 per cent of private sector buildings energy demand.<sup>152</sup> Around a half of all energy consumed in commercial and industrial buildings in England and Wales is in the rented sector, placing the onus on landlords to make energy efficiency and heating improvements.<sup>153</sup> We will therefore tighten minimum standards for this sector to reach EPC Band B by 2030 where cost-effective.

We will consult shortly on improving the implementation and enforcement of this target. This will reduce carbon emissions, help make businesses more productive and grow the energy efficiency market.

We are proposing a performance-based rating scheme for large commercial and industrial buildings to provide businesses and their investors with more information on how to reduce energy consumption and lower both carbon emissions and energy bills. We will consult in early 2021 on how the scheme will work and plan to launch the first phase by 2022/23.

Improving energy efficiency is one of the most cost-effective mechanisms for businesses to reduce their energy bills, while reducing their carbon emissions. But a lack of information and the upfront capital costs of installation can deter investment by small businesses in measures such as insulation and energy management systems. We will continue to explore how we can stimulate a thriving market for business energy efficiency through the proposed new energy efficiency scheme focused on small businesses. As well as providing access to advice, the scheme will facilitate the installation of efficiency measures through either an auction process or an energy efficiency obligation so they can improve the energy performance of their premises. We will consult on our proposals in 2021.

The Energy Savings Opportunity Scheme aims to drive energy and carbon savings in businesses by improving the quality of the audits of the energy used by their buildings, industrial processes and transport. We will consult in 2021 on strengthening the scheme, taking forward options identified in the comprehensive scheme evaluation and Post Implementation Review published in February 2020.



## PUBLIC SECTOR BUILDINGS

► **As announced in the Prime Minister's Ten Point Plan, we will extend the Public Sector Decarbonisation Scheme for a further year**

Public sector buildings account for nine per cent of emissions from buildings.<sup>154</sup> There is a particular onus on the public sector to demonstrate leadership by improving the energy performance of its building stock. By doing so, it can support a growing private sector energy services sector, helping to support jobs and new business opportunities.

As part of our Manifesto commitment to reduce emissions from the public sector, the Chancellor has already committed the first £1 billion of our funding pledge to upgrade schools, hospitals and other

buildings. The Public Sector Decarbonisation Scheme, which was launched at the end of September 2020, will help the public sector play its part in delivering net zero emissions, with improved energy efficiency and clean heat investment.<sup>155</sup>

The £1 billion first tranche of funding is expected to cut emissions by up to 1.3MtCO<sub>2</sub>e by 2032, equivalent to taking nearly 45,000 cars off the road. In addition to catalysing green investment in the public sector, the scheme will support the supply chain, providing clean energy jobs in communities throughout UK.

## A FAIR AND AFFORDABLE TRANSITION

The benefits of well-insulated homes, on health and well-being and on bills, should not be the preserve of households which can afford to pay for energy efficiency measures.

People in fuel poverty will not be left behind. Indeed, our support will mean that fuel poor homes will be amongst the first beneficiaries of the energy transition. In line with our net zero goal, we will reduce energy consumption and lower energy bills by upgrading homes, focusing on the least energy efficient housing stock first.

There is currently no minimum energy efficiency standard which applies in the social rented sector except the requirement in the Decent Homes Standard which stipulates that homes should provide a reasonable degree of thermal comfort and be free of excess cold. This expectation is broadly equivalent to EPC Band F. The government has committed to a review of the Decent Homes Standard to consider how it can better support the decarbonisation and energy performance of homes, particularly with regard to the ambition set out in the Clean Growth Strategy that all homes should meet EPC C by 2035, where practical, cost-effective and affordable. We will work closely with the housing sector to carry out this review.

The government has also committed to further funding for the Social Housing Decarbonisation Fund, which will upgrade a significant amount of the social housing currently below EPC Band C to at least that standard.

Details of our multi-billion-pound plan to transform the poorest quality housing will be set out in our updated Fuel Poverty Strategy for England, due to be published in early 2021.

### FUEL POVERTY

The government definition of fuel poverty is where a household has fuel costs that are above average and, were they to pay that amount, would be left with a residual income below the official poverty line.

Building on ‘Cutting the Cost of Keeping Warm’, our 2015 strategy, this refreshed update will set out our approach to tackling fuel poverty in the context of net zero emissions and the nation’s recovery from the COVID-19 pandemic. In addition to outlining our plan for reducing fuel bills through improved energy efficiency, the new strategy will set out how we will ensure the fuel poor benefit from a fair and functioning energy market. We will also provide details of our guiding principles for future fuel poverty policies.

### ENERGY COMPANY OBLIGATION

#### ► We will extend the Energy Company Obligation from 2022 to 2026 to support fuel poor consumers.

The current Energy Company Obligation (ECO) is an obligation on larger energy suppliers to provide energy efficiency and heating measures for fuel poor consumers across Great Britain. Since the programme began in 2013, nearly 2.9 million measures have been installed in over 2.1 million homes.<sup>156</sup> Eligible households can save up to £300 on their energy bills, compared to an identical household.<sup>157</sup> Households are eligible if they receive certain benefits or live in the least efficient social housing, or if they are referred by their local authority.

We will continue to prioritise low-income and vulnerable households and focus on those living in the least efficient homes to make their dwellings warmer and healthier. The next iteration of ECO will run from 2022 to 2026 and will focus primarily on improving the worst-quality homes across Great Britain, complementing the upcoming Home Upgrade Grant scheme in England and equivalent schemes in the Devolved Administrations. The Home Upgrade Grant scheme will upgrade the energy performance of the worst-quality off-gas grid homes in England by supporting the installation of energy efficiency measures and low-carbon heating. Both schemes will focus support on low-income households.

## WARM HOME DISCOUNT

- ▶ **We will expand the Warm Home Discount to around three million low-income households until at least 2025/26 and will consult on reforms to the scheme to better target fuel poverty.**

It can be a challenge for fuel poor households simply to pay their bills. The Warm Home Discount, currently worth £350 million per year, is a key policy to alleviate fuel poverty. Now in its tenth year, the scheme continues to provide £140 off electricity bills to over

two million low-income and vulnerable households each winter, when they need it the most. Over £2.7 billion of direct assistance has been provided by participating energy suppliers under the scheme.

Government recently concluded a consultation on extending the current scheme until March 2022. Further to this, we will extend the scheme from 2022 to 2025/26 and expand the total spending envelope from £350 million to £475 million<sup>158</sup> per annum to support around 750,000 additional households in or at risk of fuel poverty with paying their energy bills and almost three million households in total. This represents £1.9 billion of extra support for households in or at risk of fuel poverty.

We will also consult on reforms to improve fuel poverty targeting, such as using government data to provide automatic rebates to most recipients - making the scheme administratively simpler - and allowing smaller suppliers to participate at lower cost. Better targeting of Warm Home Discount will support a fair transition to a clean energy future for fuel poor households. It will contribute to our fuel poverty interim milestone for as many fuel poor households as reasonably practicable to achieve a minimum energy efficiency rating of Band D by 2025.

## CLEAN HEAT TECHNOLOGIES

As well as tackling energy performance, we need to decrease the emissions from heating and cooling our buildings.

We stand on the verge of a major transformation as clean energy alternatives replace fossil fuels. We need to complete this transformation while ensuring households continue to enjoy a reliable heating system and a comfortable, healthy and affordable home environment.

To achieve net zero emissions, we will have to transition completely away from traditional natural gas boilers for heating homes on the gas grid. There are currently around 1.7 million fossil fuel boiler installations every year<sup>159</sup> but by the mid-2030s we expect all newly installed heating systems to be low-carbon or to be appliances that we are confident can be converted to a clean fuel supply. There is no single technology alternative to fossil fuels.

Electric heat pumps and hydrogen, green gas and shared heat networks all have their part to play. So, while we are clear on the eventual outcome, we will be flexible in how we achieve it, always looking for the most cost-effective, consumer-friendly approach and open to innovative solutions.

We want to give households, suppliers, installers and equipment manufacturers long lead times to prepare for this transition. We will target the point of least disruption to consumers and minimise the impact on the housing market and will therefore look to use natural trigger points, such as the replacement cycle for existing heating systems. And we need to ensure consumers are receiving fair value as they switch to clean heat, which means working with the market to reduce costs and addressing barriers to the deployment of new technologies.

► **We will consult on whether it is appropriate to end gas grid connections to new homes, in favour of clean energy alternatives.**

We need to ensure that the right legislation is in place to support the heating market through the transition to net zero. We will review the overarching regulatory framework set out in the Gas Act 1995 to ensure the appropriate powers and responsibilities are in place to facilitate a decarbonised gas future. In particular, to ensure the Gas Act is in line with the Future Homes Standard, we will seek views on the feasibility of ending the connection of new build homes to the natural gas grid.

## ELECTRIFICATION

► **As announced in the Prime Minister's Ten Point Plan, we will grow the installation of electric heat pumps from 30,000 per year to 600,000 per year by 2028, supporting up to 20,000 jobs by 2030.**

Heat pumps are a proven and commercially viable way to transform heat in buildings, which is also available now. Currently, however, fewer than one per cent of homes in England use a heat pump.<sup>160</sup>

### HEAT PUMP

A very efficient electrically-driven device that extracts heat from the air, ground or water and concentrates it to a higher temperature and delivers it elsewhere, for example to a central heating system. It can replace fossil fuel heating, such as a gas or oil boiler.

We want to open the market of homes not on the gas grid to heat pumps or other clean energy alternatives, representing some 50,000 to 70,000 installations a year.<sup>161</sup> We will therefore consult in early 2021 over new regulations to phase out fossil fuels in off-grid homes, businesses and public buildings, including a backstop date for the use of any remaining fossil fuel heating systems.

In setting a clear target for deploying the technology, there is an opportunity to expand the existing UK heat pump manufacturing base and exploit future export potential. The UK has a growing expertise in heat network design and is already home to several manufacturers of heat pumps. Annual global heat pump sales are expected to roughly double between 2019 and 2030 from 11.4 million to 20.8 million units.<sup>162</sup>

We need to take advantage of future export opportunities, particularly to markets in north-western Europe where high demand is expected.

But electrification is not just a solution for off-grid buildings. We believe that significantly increasing the deployment of heat pumps for on-gas grid homes through the 2020s, on a voluntary basis, will be beneficial, whatever the eventual mix of technologies for clean heat in 2050. We recognise that, to achieve this, we will have to increase business and public confidence in heat pump technology.

In April 2020, we launched our proposal for a Clean Heat Grant, due to launch in 2022, as a successor scheme to the domestic Renewable Heat Incentive. We will publish a government response in 2021. The Clean Heat Grant will be targeted at households and small, non-domestic buildings to support the installation of heat pumps and, in certain circumstances, biomass. The scheme will build upon the Green Homes Grant which provides support for heat pump deployment in the near-term.

Reducing emissions from buildings will require an annual market for heat pumps by 2028 at least 20 times the size of today's market, a scale which can help realise the economic benefits of a domestic supply chain. We will work with equipment manufacturers, wholesalers and installers to ramp up supply chain capacity and reduced technology and installation costs. In early 2021, we will consult on policy approaches to underpin the development of the UK heat pump market, including voluntary up-take by consumers in current on-gas-grid homes.

The electrification of heat has implications for the GB electricity system, given the increased demand for power and the prospect of different demand patterns which arise from using power for heat.

We need to electrify heat in buildings in a way which reduces the need for additional generation and network capacity. This could mean using thermal, hot water or battery storage, potentially in combination with a smart time of use tariff, enabled by smart metering, to shift heating demand away from more expensive peak periods. Managing this transition is a key priority for the development of our plans for low-carbon electricity generation, detailed in the 'Power' chapter, and a smart energy system, as set out in the 'Energy system' chapter.

We are also considering how to further reduce market barriers to the deployment of energy efficiency, and how demand reduction is rewarded for the benefits it provides to the energy system. We want permanent electricity demand reduction to be a viable alternative to simply building more generation or network capacity. We will explore options to achieve this goal, building on the response to our call for evidence on Facilitating Energy Efficiency in the Electricity System, launched in July 2019.

## GREEN GAS

### ► We will increase the proportion of biomethane in the gas grid.

Biomethane is currently the only green gas commercially produced in the UK. It can be injected into the gas grid to accelerate the decarbonisation of gas supplies.

#### BIOMETHANE

A form of gas that is produced by processing biomass. It can be used for the same purposes as natural gas, like producing electricity or heat, and can use the same infrastructure for transmission and end-user equipment.

Budget 2020 confirmed that a green gas levy imposed on gas suppliers will fund a new support scheme to achieve this goal, the first of its kind applied to gas in Britain. The costs of the levy are expected to be passed onto gas bill payers. We are considering the responses to our consultation on the green gas levy design and intend to publish a government response in early 2021.

Subject to the outcome of the consultation, we expect the Green Gas Support Scheme (GGSS) to launch in autumn 2021 and run for four years. It will support continued deployment of anaerobic digestion biomethane plants in order to increase the proportion of green gas in the grid. We anticipate that the GGSS could deliver annual generation of 2.8TWh of renewable heat in 2030/31,<sup>163</sup> the equivalent of the gas requirements roughly 230,000 homes.<sup>164</sup> This scheme will be designed to minimise any associated negative environmental impacts from the anaerobic digestion process, such as ammonia emissions.

We believe that through these new measures, building on the success of existing government policies, we have the potential to treble the amount of biomethane in the grid between 2018 and 2030.

## CLEAN HYDROGEN

▶ **As announced in the Prime Minister's Ten Point Plan, we will work in partnership with industry to evaluate hydrogen as an option for heating our homes and workplaces and develop plans for a possible pilot hydrogen town before the end of the decade.**

Clean hydrogen could potentially provide a way to decarbonise our gas supplies on a much larger scale than reliance on biomethane alone.

This could offer consumers a future heating option which works for them in a very similar way to natural gas today, but no carbon emissions. However, unlike electric heat pumps and heat networks, the feasibility of using hydrogen for clean heat needs further testing and development. The practicalities and cost of safely converting or replacing existing networks and appliances to operate with pure hydrogen need to be fully evaluated.

The UK is already a world leader in investigating the use of hydrogen for heating. Both the government and the gas industry are currently running major studies and testing projects. We will increase the funding available for testing and trialling projects, working with the industry to ensure that the overall programme of work is comprehensive and fully coordinated. A range of further Research and Development (R&D) and testing projects are required, including an assessment of the options for major new hydrogen infrastructure, such as gas transmission networks and inter-seasonal storage.

Trials of hydrogen will also be key to evaluating the practicalities of converting existing boiler appliances and the way in which consumers experience hydrogen for heating in their own homes and workplaces. The Prime Minister's Ten Point Plan for a Green Industrial Revolution set out key milestones for a pioneering programme of trials. We will support industry to begin a Hydrogen Neighbourhood trial by 2023, and a large Hydrogen Village trial by 2025. The knowledge and experience gained in delivering trials in communities, together with the results of our wider R&D and testing programme, will enable a strategic decisions around the mid-2020s over the long-term role of hydrogen for heating and develop a plan for a potential Hydrogen Town before the end of the decade.



► **We will consult on the role of ‘hydrogen ready’ appliances in 2021.**

In advance of strategic decisions on the role of hydrogen for heating, we will assess the case for encouraging, or requiring, new gas boilers to be readily convertible to hydrogen, so-called ‘hydrogen-ready’ boilers, in preparation for any future conversion of the gas network. We are already supporting the development of prototype ‘hydrogen-ready’ boilers, cookers and fires, through the Hy4Heat programme, which is due to conclude in summer 2021. Subject to the results of Hy4Heat, we plan to issue a call for evidence later in 2021 to seek views from stakeholders.

To facilitate the transition and development of the gas network, we will continue to work with the Health and Safety Executive to enable up to 20 per cent hydrogen blending on the network by 2023. This is subject to the success of testing and trials.

## HEAT NETWORKS

We will use a new Heat Network Transformation Programme to co-ordinate our support for the roll out of district heating systems, including the switch to low or zero-carbon heat sources.

► **We are committing £122 million of funding towards a new Heat Network Transformation Programme and will implement local authority zoning by 2025.**

### HEAT NETWORK

A heat network, sometimes called district heating, is a system of insulated pipes that takes heat and cooling generated from a central source and distributes it to a number of domestic and non-domestic buildings.



Around half a million households in the UK take heat and hot water from shared heat networks.<sup>165</sup> These systems lend themselves particularly well to densely populated towns and cities. Networks with low-carbon heat sources, such as waste-heat recovery, large heat pumps, solar thermal or possibly hydrogen boilers, will reduce emissions from heating and can help consumers with lower energy bills. We are currently investing up to £320 million through the existing Heat Networks Investment Project (HNIP), using grants and loans to accelerate the growth of the market. This scheme will come to an end in 2022.

As part of our new Heat Network Transformation Programme, we are committed to funding the Green Heat Network Fund as the successor to HNIP.

This will deliver additional low-carbon networks, particularly focusing on the recovery of waste heat and the use of heat pumps. We published a consultation on the design of the scheme in November 2020. In addition, we will fund a widespread improvement in the performance of legacy networks and boost supply chains and workforce skills, as the basis of a comprehensive transformation programme for heat networks.

We intend to legislate in this Parliament for the regulation of heat networks to protect consumers and reduce carbon emissions. We will take powers to reduce the 90 per cent reliance on natural gas in heat networks, as well as enable consumer protection for heat network customers.

## CASE STUDY

### Tolent Construction

The UK's first large scale mine energy district heating system is being developed at Seaham, County Durham by Tolent Construction, with the help of the North East Local Energy Hub and in partnership with Durham County Council and the Coal Authority. The project has secured investment of £175 million with construction starting in December 2020.

The government has provided financial support to the council to develop the heat scheme through £3.8 million of Heat Network Investment Programme funding, £150,000 Garden Village grant and technical support from the Coal Authority, stimulating over £170 million of private sector funding.

The project is set to create 960 new jobs. A training academy will be established on site and will give young people apprenticeship opportunities to develop their skills to become trades men and women, as well as other professions.

The district heating will be made up of 1,500 homes, a primary school, shops and an innovation centre all heated by mine water heating, pumped using solar photovoltaics for carbon free heat. One quarter of properties in the UK sit on the coalfields giving huge potential to mine water heating as a low-carbon sustainable heat source.

£320m

invested to 2022 through the existing **Heat Networks Investment Project**

£270m

further funding from 2022 through the **Green Heat Network Fund**

£122m

allocated to the **Heat Network Transformation Project**

These powers will require heat networks to switch to low-carbon fuel sources as part of a natural replacement cycle, thereby minimising disruption to consumers connected to a network.

We will support Local Authorities to designate new heat network zones, no later than 2025. Zoning entails the identification of areas which can be readily connected to a low-carbon heat network and mandating connection unless it is not cost-effective to do so. The certainty of connection for projects, which zoning affords, will ensure that heat networks are better able to grow and deliver lower-cost, clean heat for consumers. We will consider how local heat network zoning can be most effectively integrated with wider local area planning for the environment, infrastructure and place. We will work with local authorities to optimise delivery of this and related interventions by working with local authorities and through our consultation due to be published in spring 2021.

# THE ECONOMIC BENEFITS OF TRANSFORMING ENERGY IN BUILDINGS

Upgrading the energy performance of our building stock cuts energy bills and, for businesses, helps to reduce other day-to-day operating costs which they face.

The Energy Efficiency Infrastructure Group estimates that upgrading all UK homes to EPC C could provide annual energy bill savings of £7.5 billion.<sup>166</sup> Better energy efficiency can therefore support a persistent uplift in productivity and consumer spending to drive economic growth, particular as the country recovers from the COVID-19 pandemic.

And transforming the nation's homes with improved energy performance and new clean heat solutions will also grow the UK's manufacturing base and construction industry. It offers the prospect of hundreds of thousands of high-quality green jobs right across the UK. Building projects are typically labour intensive so scaling up delivery will support more jobs per pound spent than in most other areas of the transition to net zero emissions. The measures announced by the Chancellor in July 2020, worth £3.05 billion, will alone support up to 140,000 jobs over the next year.<sup>167</sup>

Improving the quality of our building stock will contribute substantially to our agenda to level up the country. Wales and, in England, the North East, the West Midlands, the North West and the Yorkshire and the Humber region have the highest per capita energy efficiency investment need across the UK.

► **We will develop a strategy for upskilling through the 'Green Jobs Taskforce' and a National Skills Fund, to be launched in 2021.**

Analysis by the London School of Economics estimates that over six million people have skills which will be affected by the transition to clean energy, representing 21 per cent of current jobs.<sup>168</sup> This is a major opportunity to develop new skills across a range of career pathways and ensure key sectors, such as construction, which employs around 2.2 million people, are fit for a clean energy future.<sup>169</sup> Principally, we will need more installers to retrofit existing buildings with energy efficiency and clean heat measures or ensure new-build homes are zero carbon ready. In September 2020, we launched the Green Homes Grant Skills Training Competition to provide £6.9 million funding to a range of energy efficiency and low-carbon heat skills providers and support delivery of the Green Homes Grant scheme.<sup>170</sup>

We are establishing a Green Jobs Taskforce with key industry bodies to produce an action plan for net zero skills across a range of sectors with the goal of two million net zero jobs by 2030. The taskforce will pinpoint the skills needed now and over long term. It will support high quality green jobs and a diverse workforce, and manage the transition for people working in high carbon industries. The action plan will be published in spring 2021.

# Our key commitments



The Future Homes Standard will **ensure that all new-build homes are zero carbon ready**.



We want as many **existing homes as possible to hit EPC Band C by 2035**, where practical, cost-effective and affordable.



**All rented non-domestic buildings will be EPC Band B by 2030**, where cost-effective.



We will **consult on regulatory measures to improve the energy performance of homes**, and are consulting how on how mortgage lenders could support homeowners in making these improvements.



We will **extend the Public Sector Decarbonisation Scheme** for a further year.



We will **extend Energy Company Obligation from 2022 to 2026** to support fuel poor consumers.



We will **expand the Warm Home Discount to around three million low income households** until at least 2025/26 and will consult on reforms to the scheme to better target fuel poverty.



We will **consult on whether it is appropriate to end gas grid connections to new homes** being built from 2025, in favour of clean energy alternatives.



We will **grow the installation of electric heat pumps** from 30,000 per year to 600,000 per year by 2028, supporting up to 20,000 jobs by 2030.



We will **work in partnership with industry to evaluate hydrogen as an option for heating** our homes and workplaces and develop plans for a possible pilot hydrogen town before the end of the decade.



We will **increase the proportion of biomethane in the gas grid**.



We will **consult on the role of 'hydrogen ready' appliances** in 2021.



We are **committing £122 million of funding towards a new Heat Network Transformation Programme** and will implement local authority zoning by 2025.



We will **develop a strategy for upskilling through a 'Green Jobs Taskforce'** and a National Skills Fund, to be launched in 2021.

CHAPTER 05

# Industrial energy

## OUR GOAL

By 2050, emissions from industry will need to fall by around 90 per cent from today's levels.<sup>171</sup>

We will:

- ▶ **Create a sustainable future for UK manufacturing industry** through improved energy efficiency and the adoption of clean energy technologies
- ▶ **Establish the UK as a world leader in the deployment of CCUS and clean hydrogen**, supporting up to 60,000 jobs by 2030
- ▶ Ensure that the transformation of our industrial sectors **supports jobs, higher skills and new business opportunities** across the country
- ▶ **Introduce a UK Emissions Trading Scheme** which will be the world's first net zero emissions trading scheme, and will underpin the decarbonisation of energy in the UK



INDUSTRIAL ENERGY

# The strategic context

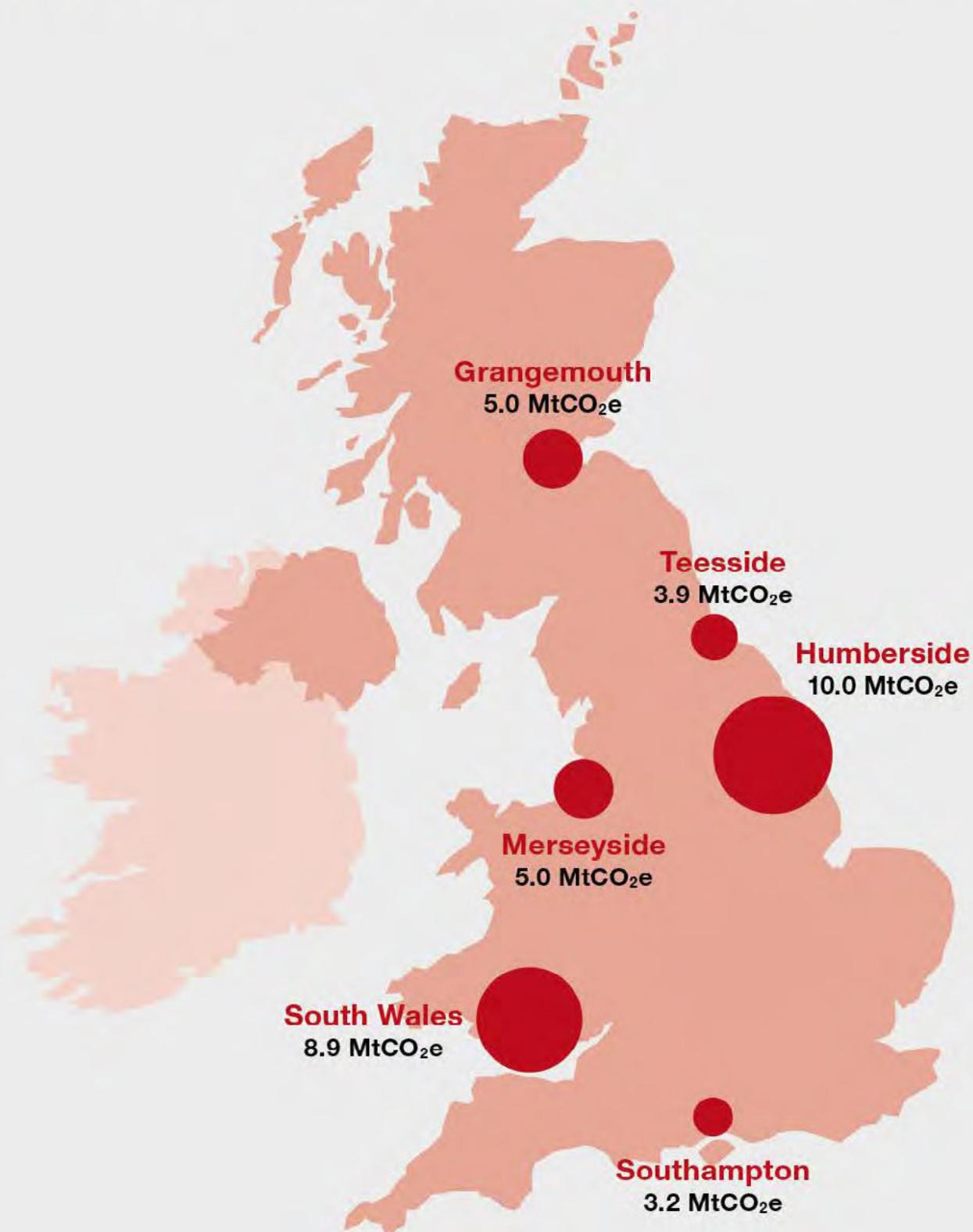


Manufacturing industry drives the UK economy. In 2018, the industrial sector contributed £170 billion to Gross Value Added (GVA), 42 per cent of British exports and employed 2.6 million people across the country.<sup>172</sup>

Almost all industry is located outside London and the South East and provides high value jobs across the four nations.<sup>173</sup> Investment in low-carbon technologies and renewing our industrial infrastructure will therefore help level up the UK and promote a green economic recovery.

Manufacturing and refineries, which form the bulk of industrial emissions, still account for around 16 per cent of the UK's greenhouse gas emissions.<sup>174</sup> Although emissions from industrial activity have fallen by half since 2000,<sup>175</sup> driven partially by greater energy efficiency in industrial processes, the sector will need to achieve significant decarbonisation over the next 30 years.

About half of emissions from manufacturing and refining are concentrated in the UK's major industrial clusters (see Figure 8.1).<sup>176</sup> These hubs are critical drivers of local and regional economic activity and a vital component of the UK's national economy.

**FIGURE 8.1 - LOCATIONS OF CLUSTERS AND 2018 EMISSIONS**

Source: NAEI Emissions from NAEI large point sources 2018. Clusters defined as all large emitters within 30km of a cluster centre

Improved efficiency in the energy performance of buildings and industrial processes will lay the groundwork for the transformation of industrial energy. But we cannot rely on energy efficiency alone to reduce emissions in line with our 2050 goal. Manufacturing industry will need to capture their carbon for onward storage and switch from using fossil fuels to low-carbon alternatives.

The successful decarbonisation of industry will mean overcoming a number of obstacles in manufacturing sectors which operate in highly competitive international markets and, in some cases, on tight profit margins. Lowering emissions and adopting clean energy technologies requires capital investment and could impact operating costs. It will be necessary to build additional infrastructure, such as the pipes and storage to transport captured carbon from industrial processes. Long lead-times to plan, design and install emissions-capture technologies, coupled with limited opportunities to undertake construction works, could present further barriers to businesses, even when they wish to act.

We will work with businesses to overcome these challenges and deliver the successful transformation of our vital industrial base. Markets are best placed over the long run to implement the most cost-effective solutions which deliver net zero industrial emissions, supported by a long term carbon price signal. But, for now, we cannot rely on market forces alone to see industry through the transition.

Manufacturing and refineries still account for around **16 per cent of the UK's greenhouse gas emissions**



The UK's industrial sectors need our continued support, particularly through the initial phase of decarbonisation, in which the risks and costs are highest. Our approach during the 2020s will be to stimulate action, investing in the critical infrastructure which enables the deployment of low-carbon technologies. We will support industry with the costs of improving energy performance and reducing emissions. We will maintain the ability of UK-based companies to compete and win in global markets and ultimately position them to capitalise on new commercial opportunities arising in a global net zero economy.

The cost of energy impacts the competitiveness of UK-based industry. We have taken steps to protect the manufacturing sectors which are most exposed to the impact of the UK's relatively higher electricity prices, compared to other major European markets. In 2019, we provided around £442 million to support qualifying energy intensive industries, including reductions in the policy costs of the transition to renewable electricity and compensation to partly offset the indirect impacts on electricity prices from the European Union Emissions Trading System (EU ETS) and the Carbon Price Support (CPS).

# Our key commitments

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## A NEW STRATEGIC APPROACH TO CLEAN INDUSTRIAL ENERGY

In the 2030s, markets will be best placed to determine the most efficient approach to decarbonising industrial emissions. Our actions in the 2020s will create the right conditions to enable this transition.

► **We will publish an Industrial Decarbonisation Strategy in spring 2021 to set out the details of how the government will support the decarbonisation of manufacturing industry.**

Our strategy will set out a vision for a prosperous, low-carbon UK industrial sector in 2050. Working closely with our partners in the devolved administrations, we will establish how the transition to clean energy will support the UK's industrial competitiveness and a resilient, green economic recovery, including opportunities to exploit new markets at home and abroad.

A low-carbon and more resource efficient economy is not just about transforming existing industries and enabling a long-term sustainable future. It is the basis for new industrial sectors to flourish. It will catalyse innovation for new technologies, boost UK manufacturing and support thriving construction and operations sectors. It is a transformation which can help all the UK's manufacturing regions to become centres for the production of low-carbon goods. It will enhance long-term regional competitiveness, support a green recovery and insulate businesses from the impacts of a rising carbon price.

Domestic action is a platform for the UK's global leadership on climate change. With our leading role in industrial decarbonisation, we will be able to export technology, know-how and skills to the rest of the world. If global industry were to reduce emissions by around 70 per cent by 2050, relative to 2012 levels, UK exports of clean energy technologies in 2050 could support around £1.4 billion in annual GVA and support 18,000 jobs.<sup>177</sup>



► **In line with the increased ambition set out in the Ten Point Plan we will increase the Industrial Clusters Mission to support the delivery of four low-carbon clusters by 2030 and at least one fully net zero cluster by 2040.**

We will start with a focus on the UK's industrial clusters – centres where related industries have congregated and can benefit from utilising shared clean energy infrastructure, such as carbon capture utilisation and storage (CCUS) and low-carbon hydrogen production and distribution. Decarbonisation in clusters will enable economies of scale, reducing the unit cost for each tonne of carbon abated. Clusters provide high quality jobs which tend to pay above the UK average wage.<sup>178</sup>

Transitioning to clean energy will bring opportunities to all four UK nations. Many clusters are located in regions in need of economic revitalisation and decarbonising those clusters can act as a driver of prosperity for the surrounding areas. Investments in key technologies like hydrogen and CCUS, together with broader interventions, such as through helping people to retrain, will be crucial to enhancing local economic growth and creating jobs. These actions will also deliver wider environmental benefits such as improved air quality. We will work with local government and businesses to consider how an integrated strategic approach can most effectively be developed to enable local places to capitalise on this opportunity to build back greener. Supporting the delivery of four low-carbon clusters will enable greater decarbonisation, leading the way for a more sustainable industry.

# CARBON CAPTURE UTILISATION & STORAGE (CCUS)

The deployment of CCUS is fundamental to the decarbonisation of energy intensive industries such as steel, cement, oil refining and chemicals. CCUS can help secure the long-term future of these industries and enable production of clean hydrogen at scale.

- ▶ **We will invest £1 billion up to 2025 to facilitate the deployment of CCUS in two industrial clusters by the mid-2020s, and a further two clusters by 2030, supporting our ambition to capture 10MtCO<sub>2</sub> per year by the end of the decade.**

The UK is in a strong position to become a global technology leader in CCUS. We have the opportunity to develop a domestic supply chain by utilising the expertise of our existing oil and gas industry. Innovative start-up companies, spun out of the UK's world-class academic institutions, are focused on driving cost reductions and creating new UK-based innovative carbon capture technologies. With the potential to store more than 78 billion tonnes of carbon dioxide,<sup>179</sup> we can be a global leader in carbon storage services.

Deployment of CCUS could create new markets for UK businesses, at home and abroad, as other countries look to meet their emissions reduction commitments. Action now can harness the UK's strengths in engineering, procurement, construction, and management services, with export opportunities from CCUS estimated at £3.6 billion by 2030.<sup>180</sup>

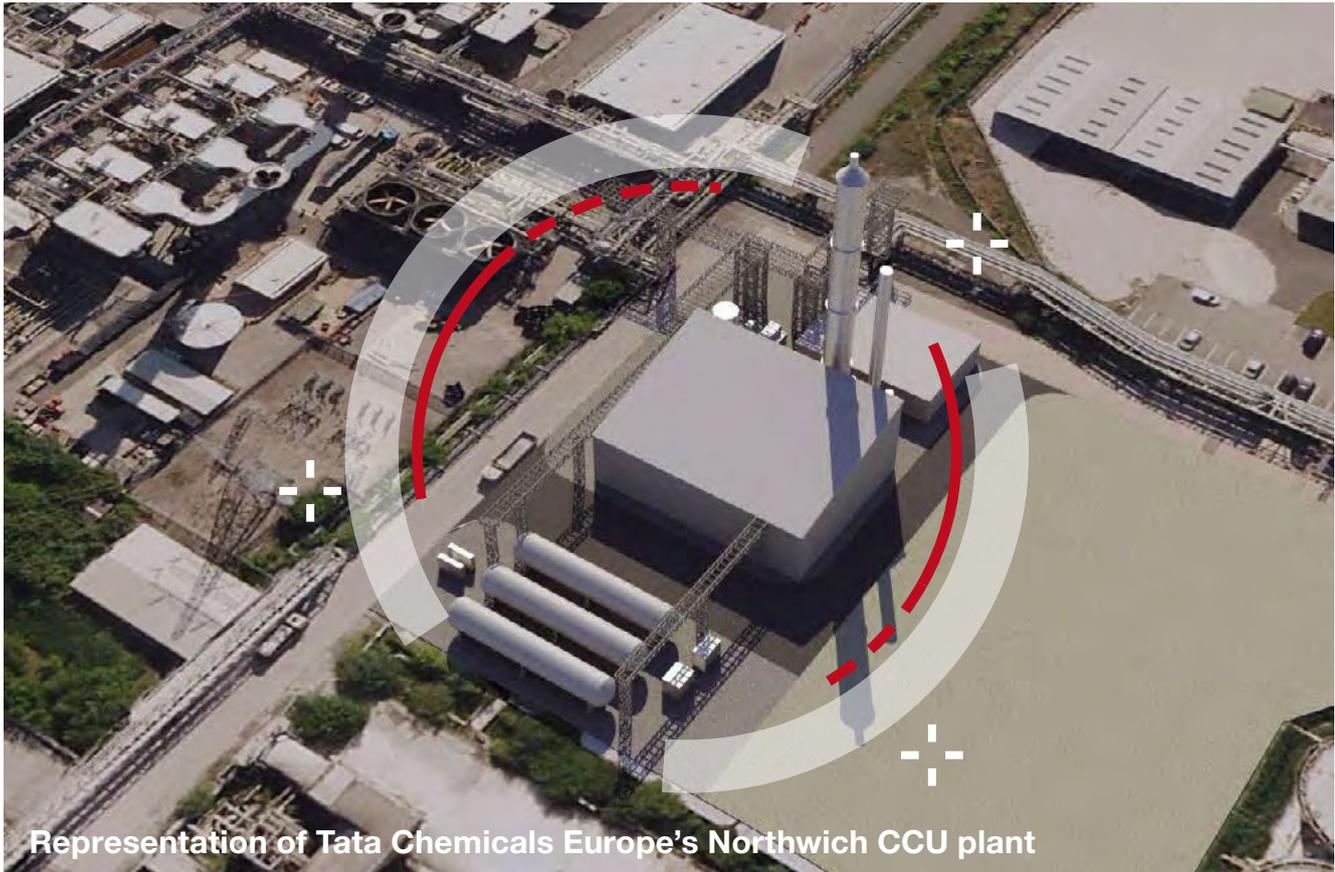
## CCUS

**The process of capturing carbon dioxide from industrial processes, power generation, certain hydrogen production methods and greenhouse gas removal technologies such as bioenergy with carbon capture and storage and direct air capture. The captured carbon dioxide is then either used, for example in chemical processes, or stored permanently in disused oil and gas fields or naturally occurring geological storage sites.**

## CASE STUDY

### Tata Carbon Capture and Utilisation (CCU)

Tata Chemicals Europe (TCE) are constructing, with the support of a £4.2 million grant from the Energy Innovation Programme, the UK's first industrial-scale CCU demonstration plant at their site in Northwich, for the manufacture of high purity sodium bicarbonate. The plant will be commissioned in 2021 and will be capable of capturing up to 40,000tCO<sub>2</sub>e per year, and will reduce carbon emissions at the plant by 11 per cent. TCE exports 60 per cent of its sodium bicarbonate production in the UK to over 60 countries across the globe. The CCU project will be a springboard for TCE to unlock further expansion into its export markets.<sup>181</sup>



Representation of Tata Chemicals Europe's Northwich CCU plant

We have created the Carbon Capture and Storage (CCS) Infrastructure Fund to commit the investment needed to realise this opportunity. In his Budget of March 2020,<sup>182</sup> the Chancellor committed at least £800 million through the Fund to support CCUS deployment. As announced in the Prime Minister's Ten Point Plan, we are now raising our commitment to £1 billion up to 2025 to facilitate the UK's deployment of operational CCUS in four industrial clusters by the end of the decade. This new carbon capture industry could support up to 50,000 jobs in the UK by 2030.<sup>183</sup> Developing carbon transport and storage infrastructure will require large upfront capital expenditure, to construct offshore and onshore pipelines and develop storage sites and wells. We will help to put in place this critical network, as the foundation for the scaling up of CCUS across the UK.

For the majority of industrial sectors, CCUS is not yet a viable investment. The market currently does not provide a sufficiently robust price signal to make industrial carbon capture viable. In addition, low-carbon products do not attract a price premium, making investment harder to justify without a support mechanism. It can be hard for early investors to fully reap the benefits of learning and innovation which is generated from backing this first-of-a-kind technology. This is why we are designing and implementing a business model to provide revenue support and improve companies' confidence for investing in carbon capture solutions. We aim to finalise a new commercial framework by 2022.

## CLEAN HYDROGEN

The production and use of clean hydrogen will be important in achieving net zero emissions by 2050.

As a gas that can be used as a fuel without emitting harmful greenhouse gasses, hydrogen will be critical in reducing emissions from heavy industry, as well as in power, heat and transport. When heavy goods transport or a process such as steel production relies on fuel for energy, hydrogen can provide a crucial, low-carbon alternative to fossil fuels.

► **We will publish a dedicated Hydrogen Strategy in early 2021 which positions the UK as a world leader in the production and use of clean hydrogen.**

Around 95 per cent of global hydrogen production is fossil-fuel based.<sup>184</sup> A complete switch to clean hydrogen is required, together with a major increase in production capacity. The UK currently makes up to 27TWh annually.<sup>185</sup> The Climate Change Committee (CCC) suggest we may need a ten-fold increase by 2050, with the option to go further depending on the scale of hydrogen use in heat, transport and power.<sup>186</sup>

### CLEAN HYDROGEN

**Hydrogen that is produced with significantly lower greenhouse gas emissions compared to current methods of production** – methods include reacting methane with steam to form hydrogen and then capturing the carbon dioxide by-product (steam methane reformation with CCUS) or using renewable electricity to split water into hydrogen and oxygen (electrolysis).

### CASE STUDY

#### ITM Gigastack

ITM Power are a manufacturer of PEM (proton exchange membrane) electrolysers, a technology which enables the generation of hydrogen from water. The company is based in Sheffield, UK. Coupled with a renewable energy supply, this production method is capable of producing zero carbon hydrogen. The Gigastack project explores the potential to scale up electrolyser size and integrate those units with offshore wind facilities. BEIS is currently supporting a consortium led by ITM Power along with Ørsted, Phillips 66, and Element Energy, funded as part of the £505 million Energy Innovation Programme.

**£240m**

available through  
**Net Zero Hydrogen Fund** up to 2024/25

**5GW**

**aim for low-carbon hydrogen production capacity by 2030**

**42TWh**

**annual low-carbon hydrogen production by 2030**

A variety of production technologies will be required to satisfy the level of anticipated demand for clean hydrogen in 2050. This is likely to include methane reformation with CCUS, biomass gasification with CCUS and electrolytic hydrogen using renewable or nuclear generated electricity.

► **Working with industry, our aim is for the UK to develop 5GW of low-carbon hydrogen production capacity by 2030.**

The exact mix of different end uses for clean hydrogen in 2050 will depend on a variety of factors including cost, availability and technical application. Action is needed now to enable hydrogen to be deployed flexibly in the future. We will need production at scale by the mid-2020s to provide assurance on safety, security, cost and the potential for emissions reduction, before we scale up even further during the 2030s. To put the UK on this pathway, we are aiming for 5GW of clean hydrogen production capacity in 2030, equating to 42TWh, and supporting up to 8,000 jobs by 2030 across our industrial heartlands and beyond.<sup>187</sup> We hope to see 1GW of hydrogen production capacity by 2025 on route to our 2030 goal.

Action now to deploy hydrogen during the 2020s will stimulate domestic supply chains, enabling UK businesses to capture increasing international demand for hydrogen goods and services. Ensuring this happens will be an important part of our upcoming Hydrogen Strategy.

► **We will create a Net Zero Hydrogen Fund to support low-carbon hydrogen production, providing £240 million of capital co-investment out to 2024/25.**

The Net Zero Hydrogen Fund will deliver a major boost to production capacity, ensuring that clean hydrogen can be utilised for decarbonising industrial clusters and play its role delivering net zero.

The Fund will help establish the technology and will ensure that existing mechanisms, such as the Renewable Transport Fuel Obligation, provide an appropriate level of support for renewable hydrogen. However, achieving our 2030 ambition for clean hydrogen will also require the right commercial frameworks which encourage sustained private sector investment. We will put the necessary building blocks in place now to provide confidence that clean hydrogen can be produced reliably and cost-effectively. We will introduce a commercial framework by 2022, which enables project sponsors of all types of clean hydrogen to finance their projects. We will consult on our preferred model in 2021.

## A UK EMISSIONS TRADING SCHEME

Creating a new UK carbon market will be the foundation on which the UK achieves net zero emissions cost-effectively.

► **We will implement the world's first net zero carbon cap and trade market, the UK Emissions Trading Scheme.**

The UK has been a pioneer of emissions trading since 2002. The European Union adopted our cap-and-trade approach to carbon pricing, and other countries around the world have followed our lead. There are now 28 trading systems operating across four continents.<sup>188</sup> Having left the EU, we are ready to lead the world again.

We will establish a UK Emissions Trading Scheme (ETS) to replace the UK's participation in the EU ETS. The UK ETS will be a market-based measure which will provide continuity for businesses. A cap is set on the greenhouse gases that businesses can emit (via the total number of allowances in circulation), which will decrease over time. Businesses then buy and sell emissions allowances through government auctions or secondary markets. The UK ETS will initially apply to energy-intensive industries, electricity generation and aviation.

### EMISSIONS TRADING SCHEME (ETS)

A method of putting a price on emissions. A cap is set on the total amount of certain greenhouse gases that can be emitted by participants. The cap is reduced over time so that total emissions fall. Within the cap, companies receive or buy emission allowances, which they can trade with one another as needed.

This mechanism of carbon pricing supports businesses to decarbonise at the least cost. Businesses who can abate cheaply will do so, and those that cannot purchase additional allowances to cover their emissions. Knowing that the ceiling on emissions will lower transparently over time enables business to plan and invest to decarbonise, while at the same time protecting the competitiveness of businesses and minimising the risk of carbon leakage.

Following the introduction of the UK ETS, we will consult in due course on how to align the cap with an appropriate net zero trajectory, meaning the system will significantly contribute to ensuring the UK meets our commitment to net zero emissions by 2050. The operation of the cap will provide certainty about the decarbonisation trajectory over the long term. It will deliver a robust carbon price signal; giving businesses the confidence to mobilise the scale of capital investment necessary to deploy clean energy technologies; and to capture new trade opportunities on the back of the energy transition.

The UK ETS will also allow us to expand carbon pricing across the economy and encourage innovation in emerging decarbonisation technologies. We have committed to exploring expanding the UK ETS to the two thirds of uncovered emissions, and will set out our aspirations to continue to lead the world on carbon pricing in the run up to COP26. This will also include how the UK ETS could incentivise the deployment of greenhouse gas removal technologies. In addition to this, the UK is open to linking the UK ETS internationally in principle and we are considering a range of options, but no decision on our preferred linking partners has yet been made.

## SUPPORT FOR BUSINESSES

Our strategy includes providing capital support to help industry become more energy efficient and to bring down the costs and risks of key decarbonisation technologies.

This investment will bring forward the date at which technologies such as CCUS and hydrogen can be commercially deployed in industry. However, we recognise that investors need revenue visibility of revenue, delivered by new business and commercial models, for the lifetime of a project, if they are to finance the upfront capital costs of decarbonisation projects.

► **We will bring forward details in 2021 of a revenue mechanism to bring through private sector investment into industrial carbon capture and hydrogen projects via our new business models to support these projects.**

The government is already providing capital support through a number of schemes for industry to decarbonise. The £18 million Industrial Heat Recovery Support programme is helping businesses reuse heat which would otherwise be wasted. The Climate Change Agreements Scheme reduces the amount of a tax that industry pays on energy, called the Climate Change Levy. It has supported industry with an estimated £200 million in tax discounts a year, in return for meeting agreed energy or carbon reduction targets and has now been extended by a further two years until March 2025.<sup>189</sup> The Industrial Energy Transformation Fund (IETF) was launched this year, with funding worth £315 million, to help businesses with high energy use to cut their bills and reduce carbon emissions.

Additionally, the £250 million Clean Steel Fund was announced in 2019 and is designed to support the resilience and longevity of the steel sector by supporting it onto a decarbonisation pathway consistent with net zero. We will also develop user-friendly digital services to improve access to funding for our stakeholders.

In addition, we intend to provide longer-term certainty to industry which goes beyond the need for time-bound support schemes dependent on direct government funding. Over the long term, cost reductions in low-carbon technologies, coupled with a robust carbon price signal and a thriving market for low-carbon products, will drive investment. In the near term, we will bring forward details of a revenue mechanism to bring through private sector investment in emerging technologies. Providing this visibility will enable industry to invest in new technologies, such as CCUS and clean hydrogen at scale, accelerating the decarbonisation of the sector and the economic opportunities which come with it.

Recognising this, we will bring forward further details in 2021 on the revenue mechanism which will encourage private sector capital into the new business models we are creating to support deployment of industrial carbon capture and clean hydrogen.

# Our key commitments



We will **publish an Industrial Decarbonisation Strategy in spring 2021** to set out the details of how the government will support the decarbonisation of manufacturing industry.



In line with the increased ambition set out in the Ten Point Plan we will **increase the Industrial Clusters Mission to support the delivery of four low-carbon clusters by 2030** and at least one fully net zero cluster by 2040.



We will **invest £1 billion up to 2025 to facilitate the deployment of CCUS in two industrial clusters** by the mid-2020s, and a further two clusters by 2030, supporting our ambition to capture 10MtCO<sub>2</sub> per year by the end of the decade.



We will **publish a dedicated Hydrogen Strategy in spring 2021** which positions the UK as a world leader in the production and use of clean hydrogen.



Working with industry, our **aim is for the UK to develop 5GW of low-carbon hydrogen production capacity** by 2030.



We will **create a Net Zero Hydrogen Fund** to support low-carbon hydrogen production, providing £240 million of capital co-investment out to 2024/25.



We will **implement the world's first net zero carbon cap and trade market**, the UK Emissions Trading Scheme.



We will bring forward details in 2021 of a **revenue mechanism to bring through private sector investment into industrial carbon capture and hydrogen projects** via our new business models to support these projects.

CHAPTER 06

# Oil and gas

## OUR GOAL

Delivering our net zero target by 2050 means transforming the oil and gas sector in the UK.

We will:

- ▶ Work with the sector to **transform the UK Continental Shelf to be a net zero basin** by 2050
- ▶ Provide **opportunities for oil and gas companies to repurpose their operations away from unabated fossil fuels to abatement technologies** such as carbon capture, utilisation and storage (CCUS) or clean energy production such as renewables and hydrogen
- ▶ Agree a **transformational North Sea Transition Deal** to deliver new business opportunities, jobs and skills as the sector, as well as protect the wider communities which rely on the oil and gas sector
- ▶ Ensure that the licensing of domestic oil and gas exploration and production **continues to be compatible with our climate change ambitions**



OIL AND GAS

# The strategic context



The UK's domestic oil and gas industry has a critical role in maintaining the country's energy security and is a major contributor to our economy

Much of the crude oil from the North Sea basin is exported, with the UK making extensive use of strong trading links to meet domestic refinery demand. Domestic production still met 46 per cent of the country's supply of gas in 2019, with the vast majority of this supplied from North Sea offshore production with a smaller proportion from the onshore oil and gas sector.<sup>190</sup>

145k

**jobs supported** directly or indirectly across the UK in 2018

80%

**drop in production of natural gas** (compared to 2017) could be possible by 2050

0.9%

**of 2019 UK GVA** was contributed by the offshore oil and gas sector

The offshore oil and gas sector contributed about 0.9 per cent to the UK's GVA in 2019 and has paid around £350 billion in production taxes since 1970/71.<sup>191</sup> The sector is a source of high-quality jobs, supporting directly or indirectly around 147,000 jobs in total across the UK in 2018.<sup>192</sup> Many jobs supported by the sector are located in Scotland, particularly in Aberdeen, a global hub for the oil and gas industry. Critical supply chain clusters have grown in the North, East and South East of England. These jobs and the additional 113,000 induced by the sector help support the wider UK economy.

While the Oil & Gas Authority (OGA) estimates that there are still around 10 to 20 billion barrels of oil equivalent remaining in the UK Continental Shelf,<sup>193</sup> domestic production has more than halved since 2000.<sup>194</sup> The Climate Change Committee (CCC) estimates that production of natural gas could drop by up to 80 per cent by 2050, compared to levels in 2017.<sup>195</sup> However, the projections for demand for oil and gas, though much reduced, is forecast to continue for decades to come.

The UK's offshore oil and gas sector and the smaller onshore sector have both been severely affected by COVID-19. The pandemic led directly to the global collapse in demand for oil and resulted in a roughly 65 per cent drop in the price of Brent Crude between January and April 2020.<sup>196</sup> Oil and Gas UK (OGUK) estimate that the UK sector will respond by cutting expected capital expenditure by around 30 to 40 per cent and operating expenditure by around 10 to 20 per cent compared with anticipated expenditure at the start of the year, while maintaining production levels.<sup>197</sup> During the early months of the UK lockdown, staffing on offshore rigs was reduced by more than a third compared to early March.<sup>198</sup>

The OGA estimates that there are still around **10 to 20 billion barrels of oil remaining in the UK Continental Shelf**



We have supported the oil and gas sector to bounce back from COVID-19 but a return to 'business as usual' is no longer an option. Government support is in the context of delivering our net zero target. The sector is already coming under significant pressure from investors and the public more widely to respond to the challenge. Shareholders, for example, are increasingly requiring listed companies to price carbon into their business models and demonstrate how they can reduce emissions from their operations or support the wider decarbonisation of the economy.<sup>199</sup>

Many oil and gas companies are now responding to the challenge. Their investment decisions are beginning to anticipate a world without fossil fuels beyond 2050.<sup>200</sup> There is great potential for the sector to play an important part in the energy transition and retain vital skills across key regional hubs around the country, supporting the CCUS and hydrogen "SuperPlaces" clusters announced in the Prime Minister's Ten Point Plan.<sup>201</sup>

## HOW UK COMPANIES ARE RESPONDING TO THE NET ZERO CHALLENGE

There is great potential for traditional oil and gas businesses to take advantage of the opportunities provided by the energy transition and transform their operating model, whether they are exploration and development companies, service providers, supermajors or independent companies.

Supermajors such as bp and Shell have set out major changes of strategy to achieve net zero by 2050, including addressing emissions that result of the use of their products. All have set aggressive emissions reductions targets. Other approaches include rebalancing their portfolios to increase their renewable energy holdings; investing in and partnering with renewable energy companies; investing in carbon dioxide sequestration, and expanding their consumer-facing offer, such as electric vehicle charging. Privately backed companies, such as Chrysaor, have also set out their emissions reductions targets, while investing in carbon capture and hydrogen in the UK.

We will continue to push for a high level of ambition amongst oil and gas companies, challenging them to go further to reduce their emissions consistent with our net zero target, while transitioning their operations into emerging energy technologies.

We expect to see the supply chain reflect this shift as well.

### Wood

Wood Plc has taken substantial steps to transform its business from a traditional oilfield services provider into broader engineering and consultancy work operating across the energy sector. In 2014, 96 per cent of Wood's revenue was derived from oil and gas work including 65 per cent from upstream activity compared with 2020 where upstream activity now accounts for just one third of its total revenue.<sup>202</sup>

Today, Wood offers a blend of consulting, projects and operations solutions including a fast-growing renewables business. It has been involved in solar projects, increasing global wind capacity as well as CCUS studies and has an increased presence in the hydrogen market. In parallel, the company has continued its commitment to the oil and gas sector through helping partners achieve their own energy transition goals.



A recent survey by OGUK revealed that more than half of its members had already diversified into other energy sectors, even as oil and gas remained their primary source of income.<sup>203</sup> The UK Petroleum Industry Association has set out scenarios and the technology pathways for how the refining and downstream sector can play an active part in achieving net zero emissions.<sup>204</sup> Many supply chain companies are diversifying into other energy sectors.

Reducing emissions from oil and gas will need careful management to avoid disruption to our daily lives and minimise rising costs, as well as to mitigate wider economic impacts. It requires a policy and regulatory framework which continues to promote good environmental practice, alongside effective stewardship of the North Sea by both regulators and oil and gas operators. To achieve this, we expect industry to respond effectively to the net zero challenge but will encourage continued healthy levels of investment. Ensuring that the UK remains an attractive destination for global capital is the best way to secure an orderly and successful transition away from traditional fossil fuels.

# Our key commitments

## A NET ZERO BASIN BY 2050

It is critical that the sector focuses on cutting the emissions associated with offshore oil and gas production.

- ▶ **Working with the regulators, we will drive the reduction of greenhouse gas emissions from all offshore oil and gas operations to make the UK continental shelf a net zero basin by 2050.**

In 2018, upstream oil and gas activities in the UK accounted for four per cent of UK greenhouse gas emissions.<sup>205</sup> According to OGUK, in order to meet net zero, the oil and gas sector will need to reduce its emissions from offshore production and operations to 0.5MtCO<sub>2</sub>e by 2050, from 19MtCO<sub>2</sub>e today.<sup>206</sup> Methane will be a special focus, given its potency as a greenhouse gas.

The industry has signed up to the OGUK-led ambition to achieve net zero emissions across all its upstream activities, as set out in the OGUK's Roadmap 2035.<sup>207</sup> It has already set itself the challenge of becoming a net zero basin by 2050, with a 50 per cent absolute emissions reduction by 2030 and 90 per cent by 2040.<sup>208</sup> The sector was amongst the first industrial sectors in the UK to make such a commitment. We expect real and ambitious change from industry to deliver this commitment. We want the industry to go further and faster, wherever possible.

The World Bank estimated that, in 2019, global levels of gas flaring had increased to approximately 150 billion cubic metres of natural gas, emitting about 400MtCO<sub>2</sub>e, in addition to the waste of the valuable resource.<sup>209</sup>

- ▶ **We will commit the UK to the World Bank's 'Zero Routine Flaring by 2030' initiative and will work with regulators towards eliminating this practice as soon as possible in advance of this date.**

The World Bank's 'Zero Routine Flaring by 2030' initiative invites governments and industry to put an end to the operational practice of routine flaring by 2030. Some UK Continental Shelf operators have reduced routine flaring but much more can be done to drive down the practice, notwithstanding the challenges posed by the maturity of the basin and its assets. The OGA will take a more robust stance to push for reductions in flaring and venting and the resulting greenhouse gas emissions, through its consents, field development process and project stewardship role.<sup>210</sup> As part of our discussions with the sector on emissions reduction in the North Sea Transition Deal, we will seek to end this practice before 2030.

We will also tackle regulatory and policy barriers to the use of clean electricity, such as offshore wind, to power offshore oil and gas facilities, as opposed to the current practice of using diesel or gas generators on platforms.

In addition to reducing emissions from direct operations, known as Scope 1 and 2 emissions, we will challenge the sector to address embodied emissions from the consumption of their products or from supply chain activities, so-called Scope 3 emissions.

## SCOPE 1,2 AND 3 EMISSIONS

The Greenhouse Gas Protocol Corporate Standard classifies a company's GHG emissions into three scopes:

- ▶ **Scope 1:** emissions directly from owned or controlled sources
- ▶ **Scope 2:** indirect emissions from the generation of purchased energy
- ▶ **Scope 3:** indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions

Many of the larger companies are already setting out plans for taking on this challenge. This will largely be achieved through changes to their corporate strategies to focus their business on abatement of emissions, and new low-carbon energy sources. The approach will vary according to the size and structure of individual companies. Any future government support is dependent on the sector adopting meaningful measures which reduce emissions and report transparently on progress, for example through adhering to the recommendations of the Taskforce on Climate-Related Financial Disclosures.

As we face the challenge of decommissioning end-of-life oil and gas infrastructure in the UK Continental Shelf, we will take account of the potential to use existing infrastructure in CCUS transport and storage supporting carbon capture from industry, power generation and hydrogen production. This will require giving appropriate consideration to responsible management of decommissioning costs.

- ▶ **We will support the UK oil and gas sector to repurpose its existing infrastructure in support of clean energy technologies.**

Using oil and gas assets at the end of their existing commercial life could realise significant cost savings in the deployment of CCUS and prove instrumental in getting the technology operational by the mid-2020s. Upfront capital cost savings for the developers of some CCUS projects could be in excess of £100 million, compared to the cost of building new offshore pipelines and associated infrastructure.<sup>211</sup> The re-use of existing assets can also lower the carbon footprint of the construction process.

In August 2020, we published our response to a consultation on the re-use of oil and gas assets for CCUS projects.<sup>212</sup> Our review has identified assets which could have the greatest potential for re-use in CCUS. We will now work with industry and regulators to provide clarity on the regulations for re-purposing assets and to develop technical guidance on how this can be done safely and securely.

# A REGULATORY REGIME WHICH INCENTIVISES THE SWITCH TO CLEAN ENERGY

It is vital that our regulators are well positioned to address the net zero basin challenge and help deliver our ambition.

We will work closely with the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) and the Oil & Gas Authority, the principal offshore oil and gas regulators, to ensure that their roles, powers and priorities reflect the government's policy for delivering net zero emissions, without imposing significant additional regulatory burdens.

► **We will undertake a review of the Offshore Petroleum Regulator for Environment and Decommissioning to ensure that it is fully equipped to drive up environmental standards in its regulatory role, as well as supporting the sector's progress towards net zero emissions.**

OPRED is the environmental and decommissioning regulator for offshore oil and gas, gas storage and offshore carbon capture and storage activities. OPRED will increase its focus on the further reduction of greenhouse gas emissions from all offshore oil and gas operations and will put in place a regulatory framework to support emerging decarbonisation technologies. This will include OPRED utilising its existing data collection system to track progress on emissions reduction.

The total **value of UK subsea output in 2019 stood at almost £7.8 billion**, with over 45,000 people employed in the sector.



The principal objective of the OGA, the upstream licensing regulator, is to maximise the economic recovery of petroleum from the UK Continental Shelf, a statutory goal established in the wake of the oil price crash in 2014. The OGA has supported the production of oil and gas in the most cost-effective way possible but its focus has been evolving.

► **We aim to lay a new strategy for the Oil & Gas Authority before the end of 2020 to bolster the regulator's ability to focus the sector on helping deliver net zero emissions.**

The OGA consulted over the summer of 2020 about its intention to refresh its core aim, including a requirement for industry to take appropriate steps to support the delivery of the government's net zero target.<sup>213</sup> We agree with the OGA's assessment that the sector must go considerably faster in reducing its own carbon footprint or risk losing its social licence to operate. The changes proposed in the OGA's consultation have the potential to make a significant contribution to achieving our goal.



The industry has the skills, technology and capital to unlock innovative solutions which could be instrumental in helping to deliver net zero emissions successfully for the whole economy. It can play a critical role in the deployment of CCUS, hydrogen production and renewable electricity generation, particularly offshore wind. The OGA is clear that consideration of the sector's contribution to this goal is a proper part of Maximising Economic Recovery.

The OGA will take wide ranging action to implement its revised strategy. This will include benchmarking greenhouse gas emissions to drive performance and creating a new asset stewardship expectation for net zero. The OGA will update its guidance and its economic assessments, which support regulatory decisions, to include full carbon costs.

A new strategic approach will allow the OGA to take a much greater role in driving the sector's contribution to the clean energy transition. It will further enhance the OGA's role as an environmentally responsible steward.

To respond to the changing landscape in which the UK oil and gas sector is operating, we are currently undertaking a review of policy on the future licensing of domestic offshore oil and gas exploration and production. This review seeks to ensure the continued compatibility of the UK's licensing regime with our climate obligations and delivering our net zero target by 2050. This review is an opportunity for the UK to demonstrate that effective climate leadership can be compatible with maintaining a strong economy and robust energy security.



► **To ensure that licensing continues to be compatible with our climate change ambitions over the coming decades, we are considering formalising aspects of our existing process.**

As we develop our policy options, we believe that a sensible step for the UK may be to develop the existing checkpoints in our processes before proceeding with future licensing rounds. Such a step could involve regularly seeking independent advice on how proceeding with future licensing would impact our climate and energy goals.

This could serve to further formalise existing processes and provide an extra layer of assurance that oil and gas licensing remains consistent with our future policy objectives. We will assess what added benefit such a move would bring as part of our review.

In addition to this measure, we are considering a spectrum of options to ensure that the regime continues to be consistent with our wider aims. We will assess all options against a range of factors, including our energy transition goals; emissions reductions; and impacts on the supply chain and jobs. We expect to publish our conclusions in early 2021.

## A NEW PARTNERSHIP BETWEEN GOVERNMENT AND INDUSTRY

In our Manifesto, the government committed to agreeing a Sector Deal with the offshore oil and gas industry which secures the sector's long-term future consistent with net zero.

- ▶ **We will agree a transformational North Sea Transition Deal with the industry during the first half of 2021, focused on the economic opportunities of net zero and providing support for the people and communities most affected by the move away from oil and gas production.**

The proposed North Sea Transition Deal represents a quid pro quo partnership between the government and industry for taking long-term action which transforms the sector and delivers the energy transition. We are negotiating the substance of the deal with the sector and aim to reach agreement by the first half of 2021. We will use the deal as a vehicle to create new jobs as well as trade and investment opportunities. The deal will also set out how we can retain existing skills and capabilities in the sector, many of which are of vital regional and national significance and which could give the UK first mover advantage in emerging low-carbon sectors.

The Prime Minister's Ten Point Plan included ambitious commitments on supporting the delivery of clean energy technologies such as hydrogen and CCUS. Given the proximity of UK oil and gas hubs – particularly Scotland and the North East of England, this presents a great opportunity for the sector to unlock additional funding through the North Sea Transition Deal. The sector can contribute meaningfully to the Green Industrial Revolution by providing essential skills across key regions of the UK economy.

### NORTH SEA TRANSITION SECTOR DEAL

#### Key deliverables



**Cleaner energy production** through rigorous emissions reductions;



Supporting the **delivery of CCUS**;



**Diversification of the oil and gas supply chain** into new energies;



Supporting the **development of hydrogen production**; and



**Safeguarding existing jobs and establishing tens of thousands of new high-quality jobs** across the sector in diversified energy technologies.

# SECURING NEW TRADE AND INVESTMENT OPPORTUNITIES

Through the UK’s international leadership on climate change action, we will seek new opportunities in overseas markets to export our expertise in subsea engineering, decommissioning and other supply chain capabilities.

- ▶ **We will use our North Sea Transition Deal to support the UK-based oil and gas supply chain to secure new low-carbon export opportunities in overseas markets, capitalising on the global reach of the UK’s world-class trade promotion and diplomatic resources.**

The UK’s offshore oil and gas supply chain sells a range of products, services and expertise to domestic and world markets. With innovative providers of oil field services and capability across all sub-sectors, including marine and sub-sea operations, it had an estimated turnover in 2018 of £27 billion and employs around 116,000 people.<sup>214</sup> Many of these capabilities are readily exportable to new markets, as the world decarbonises.

The UK is forecast to become the largest decommissioning market globally over the next decade, with decommissioning expenditure forecast to be around £1.5 billion per year for the next ten years.<sup>215</sup> This will enable the UK supply chain to develop a world-leading decommissioning industry. If the sector can decommission our offshore infrastructure in a safe, efficient and environmentally responsible manner, while also meeting the OGA’s ambitious cost reduction targets, it will be well-positioned to service the global market, by one estimate worth around £80 billion in the next decade<sup>216</sup> and near £270 billion from 2022 onwards.<sup>217</sup>

**£27bn**

**estimated turnover** of the UK’s offshore oil and gas supply chain in 2018

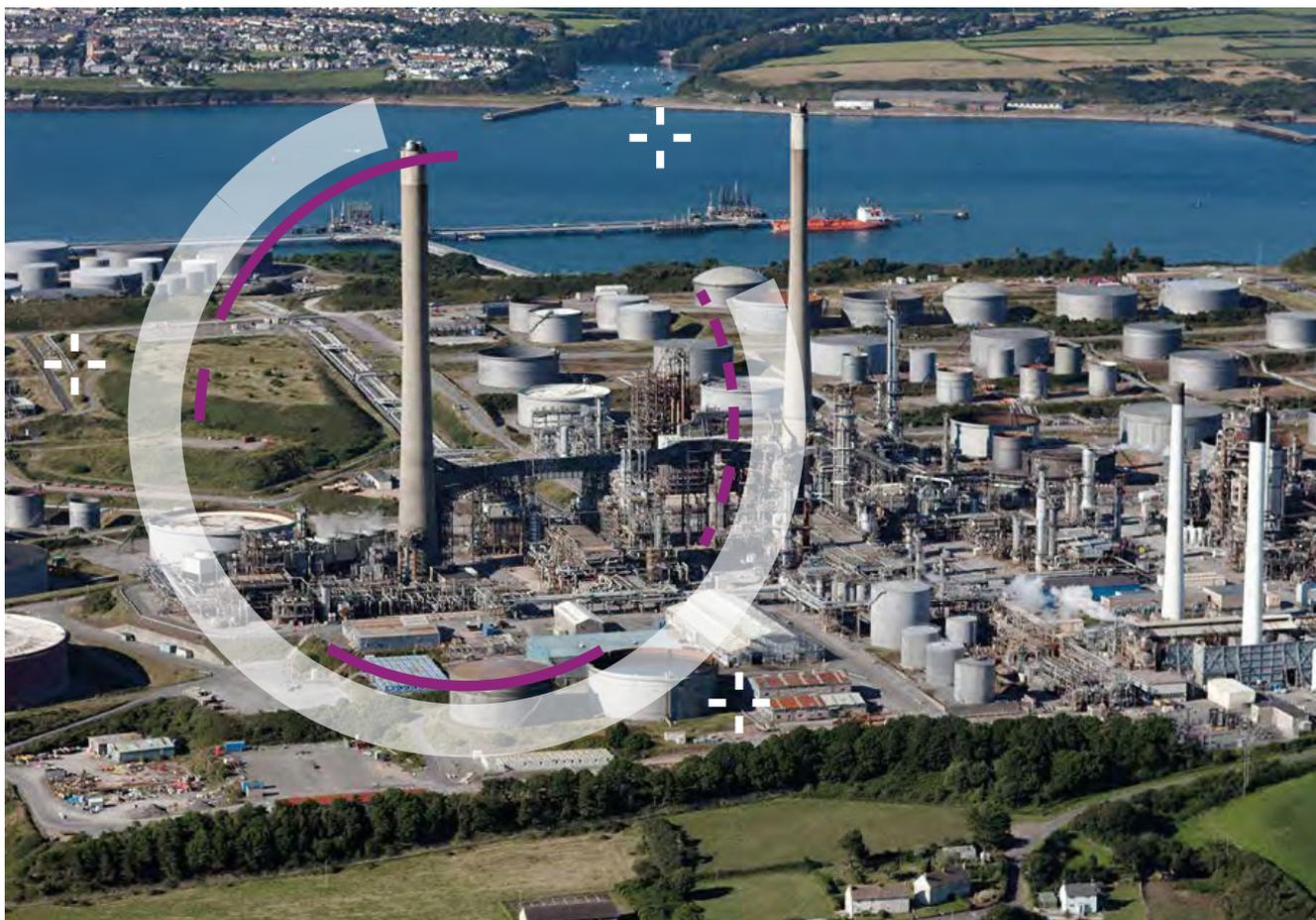
**£8bn**

**total value of UK subsea output** in 2018/19

**<1%**

UK contribution to **overall global greenhouse gas emissions**

**As announced in the 2020 Spending Review, we will commit funding towards the Global Underwater Hub in Aberdeen with satellites in North East England And Southern England.** This new economic development hub will take a strategic approach to growing our world-leading subsea engineering, technology and services sector as the global subsea market diversifies away from oil and gas and shifts towards supporting new marine growth sectors such as renewables.



In parallel with this white paper, we will publish proposals for helping develop decommissioning opportunities, both domestically and in overseas markets.

The UK's world-leading subsea engineering industry is already positioned for global growth across a range of diversified sectors which make up the so-called 'Blue Economy', economic activities relating to the world's oceans and coastlines. The total value of UK subsea output in 2018/19 stood at around £8 billion, with over 45,000 people employed in the sector.<sup>218</sup>

The UK contributes less than one per cent to overall global greenhouse gas emissions<sup>219</sup> so we must leverage our role as a world leader on climate change and ensure we use all available levers to support global clean growth opportunities.

This is why in January 2020 the Prime Minister announced that the UK government will no longer provide any new direct support for thermal coal mining or coal power plants. To bolster our commitment to supporting a clean energy transition, The Prime Minister has now announced that the UK government will no longer provide direct financial or promotional support for the fossil fuel energy sector overseas. Both announcements extend to any new official development assistance, investment, export credit and trade promotion activity. For oil and gas activities there will be a few - tightly bound - exemptions allowed for activities that support health and safety improvements, form part of wider clean energy transitions, support decommissioning, or are associated with a humanitarian response.

A public consultation process will take place on the implementation date for this policy and to help align government's support for clean technologies. The consultation will close in February 2021 and its findings will help form the North Sea Transition Deal. Our ambition is to lead by example, working towards establishing the UK at the forefront of the global supply chain and capitalising on the skills of the UK sector while working in close partnership with those seeking to transition to a cleaner future.

We will identify the international clean growth projects and emerging clean technology sectors in the UK which can benefit from our export finance mechanisms, from innovation to export, with a particular focus on technologies where the UK has first mover advantage. We will also help UK based companies to diversify and take advantage of the opportunities in emerging energy technologies.

## DOWNSTREAM OIL RESILIENCE

The downstream oil sector provided 96 per cent of the energy used in the transport sector in 2019.<sup>220</sup> It will continue to play a vital role in the transition to a net zero economy, delivering fuels to consumers.

The sector is already actively exploring the potential for low-carbon liquid fuels, particularly in aviation, shipping and heavy goods vehicles, which are more challenging to decarbonise.

We will work with industry to promote innovation and remove regulatory barriers which hinder the switch from fossil fuels. The Department for Transport will shortly publish a consultation over the use of fuels produced from non-biogenic waste, which is currently incinerated. It offers the potential to convert non-recyclable plastic and industrial waste gases to jet fuel or substitute for diesel and petrol in cars and vans.

As we make the transition away from fossil fuels, we must maintain secure supplies of fuel to the people and businesses whose livelihoods depend upon it.

### ► We will take powers to ensure we maintain a secure and resilient supply of fossil fuels during the transition to net zero emissions.

Our net zero future undoubtedly represents a challenge to the downstream oil sector, which has already been hit hard by falling demand and reduced refining margins resulting from the COVID-19 pandemic. We believe that it is necessary for government to have powers to monitor the resilience of the fuel supply market and, should it be necessary, to intervene to ensure there is an orderly transition to clean energy supplies. We will explore options for delivery and look to publish a draft Downstream Oil Resilience bill while we seek an opportunity to introduce these measures to Parliament

# Our key commitments



Working with the regulators, we will make **the UK continental shelf a net zero basin** by 2050.



We will **commit the UK to the World Bank's 'Zero Routine Flaring by 2030'**.



We will **support the UK oil and gas sector to repurpose its existing infrastructure** in support of clean energy technologies.



We will **undertake a review of the Offshore Petroleum Regulator for Environment and Decommissioning** to drive up environmental standards in its regulatory role, and support the sector's progress towards net zero emissions.



We aim to **lay a new strategy for the Oil & Gas Authority before the end of 2020** to bolster the regulator's ability to focus the sector on helping deliver net zero emissions.



To **ensure that licensing continues to be compatible with our climate change ambitions** over the coming decades, we are considering **formalising aspects of our existing process**.



We will **agree a transformational North Sea Transition Deal** with the industry during the first half of 2021.



We will use our North Sea Transition Deal to **support the UK-based oil and gas supply chain to secure new low-carbon export opportunities** in overseas markets.



We will take powers to **ensure we maintain a secure and resilient supply of fossil fuels during the transition** to net zero emissions.

# Glossary

Phrase	Meaning
<b>Advanced Nuclear</b>	Includes Small Modular and Advanced Modular Reactors.
<b>Advanced Nuclear Reactors</b>	Reactors which use novel cooling systems or fuels and may offer new functionalities (such as industrial process heat).
<b>Balancing</b>	Matching supply with demand, which is important to keep the gas and electricity systems within safe operating limits. For electricity this needs to be done on a second-by-second basis.
<b>Balancing services / balancing market</b>	The tools and markets that are used to make sure it is possible to match supply with demand.
<b>Bioenergy with Carbon Capture and Storage</b>	Refers to bioenergy processes (such as burning it for electricity) during which carbon is captured and stored. If carefully managed, using sustainable biomass, BECCS can generate ‘negative emissions’ because while providing energy it also captures and stores the atmospheric CO <sub>2</sub> that is absorbed by plants as they grow.
<b>Bioenergy</b>	Refers to heat or electricity produced using biomass or gaseous and liquid fuels with a biological origin such as biomethane produced from biomass.
<b>Biomass</b>	Refers to any material of biological origin used as a feedstock for products (e.g. wood in construction to make chemicals and materials, like bio-based plastics), or as a fuel for bioenergy (heat, electricity and gaseous fuels such as biomethane and hydrogen) or biofuels (transport fuels).
<b>Biomethane</b>	A form of gas that is produced by processing biomass. It can be used for the same purposes as natural gas, like producing electricity or heat, and can use the same infrastructure for transmission and end-user equipment.
<b>Capacity market</b>	Is our primary policy mechanism for delivering security of electricity supply. It provides generators and flexibility providers with a payment for firm (reliable) capacity to ensure they deliver electricity generation or demand reduction, when required.
<b>Carbon intensity</b>	The amount of CO <sub>2</sub> emitted when generating a unit of electricity, measured in gram of CO <sub>2</sub> per kWh of electricity produced.

Phrase	Meaning
<b>Carbon capture readiness</b>	Is a requirement imposed on thermal plants (such as coal and gas plants) to enable future capturing and storing of carbon following a plant upgrade. Such plants currently emit CO <sub>2</sub> directly into the atmosphere.
<b>Carbon Capture Utilisation and Storage (CCUS)</b>	The process of capturing carbon dioxide from industrial processes, power generation, certain hydrogen production methods and greenhouse gas removal technologies such as bioenergy with carbon capture and storage and direct air capture. The captured carbon dioxide is then either used, for example in chemical processes, or stored permanently in disused oil and gas fields or naturally occurring geological storage sites.
<b>Carbon Leakage</b>	Refers to the situation that may occur if, for reasons of costs related to climate pricing policies, businesses were to transfer production or reallocate future investments to other countries with laxer emission constraints or carbon pricing. This could lead to an increase in total global carbon emissions.
<b>Carbon Price</b>	A cost applied to carbon pollution to encourage polluters to reduce the amount of greenhouse gases they emit into the atmosphere.
<b>Clean Electricity</b>	Types of electricity generating technologies that emit little or no fossil fuel derived greenhouse gas from generation.
<b>Competitive tendering</b>	A process inviting eligible organisations to compete to carry out work or supply services, with the winner decided by who can offer the best price and quality.
<b>Contracts for Difference Scheme (CfD)</b>	The main support mechanism for large scale low-carbon electricity generation projects. Successful projects are awarded a long-term contract which secures a price to which they will either be topped up if electricity prices are low, or pay back to if electricity prices are high.
<b>Contract for Difference allocation round</b>	The competitive allocation process of CfD contracts. Participants bid the strike price they require to build their project with the cheapest ones winning on a pay-as-clear system.
<b>Data triage</b>	A logical step by step process to ensure energy data can be made openly available when it is secure and safe to do so.
<b>Decarbonisation</b>	A process of reducing the amount of carbon dioxide we release into the atmosphere.

Phrase	Meaning
<b>Demand Side Response (Solutions)</b>	Is when consumers adjust their energy usage in response to an external signal. Examples include either reducing it, delaying it, or using on-site generation or storage. DSR was historically provided by large industrial and commercial consumers, but technology development is making it easier for smaller consumers to provide these services for example by charging their electric car with a smart charger.
<b>Digitalisation</b>	Is the integration of digital technologies into a process, organisation, or system. For example, smart meters which automatically send meter readings to energy suppliers, meaning more accurate bills for customers.
<b>Direct Air Carbon Capture and Storage</b>	Use of engineered processes to capture carbon dioxide (CO <sub>2</sub> ) directly from the atmosphere, for storage or use.
<b>Dispatchable generation</b>	Is electricity generation that can be turned on, off, up or down as needed.
<b>Dispatch signals</b>	A pricing mechanism designed to encourage power stations to produce and send electricity to the grid when it is needed
<b>Distribution networks</b>	Regional networks that transport gas or electricity into homes and businesses and import electricity from small-scale generation.
<b>Distributed flexibility</b>	Technologies that can deliver flexibility (see flexibility) that are connected to the distribution network across the country.
<b>Domestic Load Connection Allowance</b>	The duty that network owners have to provide the first 10 metres of a gas connection free of charge to customers.
<b>Downstream Oil and Gas</b>	The industries and processes in which oil and gas are converted into finished products
<b>Electricity Capacity</b>	The amount of electrical power a generator can produce when it is running at maximum output.
<b>Electricity Generation</b>	Is the total electrical energy created over a period of time.
<b>Electricity System</b>	A system consisting of generators, interconnectors, transmission and distribution networks, and storage that deliver electricity to the final consumer (businesses, industry, public sector and homes). As well as the markets and control infrastructure such as smart and digital technologies, that play a key role in making sure the system balances supply and demand.
<b>Electrification</b>	Switching from using fuels such as gas or petroleum, to using electricity. For example, switching from a petrol car to an electric car.

Phrase	Meaning
<b>Emissions Trading System (ETS)</b>	A method of putting a price on emissions. A cap is set on the total amount of certain greenhouse gases that can be emitted by participants. The cap is reduced over time so that total emissions fall. Within the cap, companies receive or buy emission allowances, which they can trade with one another as needed.
<b>Energy codes</b>	The detailed technical and commercial rules of the energy system.
<b>Energy data</b>	Historical, current, and future information covering things such as how, where and when energy is generated, transported, used, and stored.
<b>Energy efficiency</b>	When something performs better using the same amount of energy, or delivers the same performance for less. The principle of energy efficiency can be applied to many things: buildings, products, appliances, manufacturing processes, to name a few.
<b>Energy Performance Certificate</b>	Energy Performance Certificates (EPCs) are required in the UK to provide a prospective owner or tenant with information on the energy performance of a building and recommendations for improvement. EPCs use an A-G rating scale based on the modelled energy bill costs of running the building.
<b>Engineering standards</b>	The specifications to which the energy system is designed and operated.
<b>Flaring</b>	The controlled burning of unwanted or excess natural gases.
<b>Flexibility</b>	The ability to change generation and/or demand in response to an external signal (e.g. price or contract terms). Flexibility enabling technologies include batteries, demand side response, interconnectors and fossil fuel generators.
<b>Fossil fuels</b>	Oil (and fuels derived from oil), coal and natural gas
<b>Fuel poverty</b>	The government definition of fuel poverty is where a household has fuel costs that are above average and, were they to pay that amount, would be left with a residual income below the official poverty line.
<b>Gas quality standards</b>	Are rules to ensure that the gases we use, including natural gas, biogas and hydrogen, meet all of the specifications needed to be safe and effective as an energy source.
<b>Gas system</b>	A system consisting of gas producers, refineries, interconnectors, transmission and distribution networks that delivers gas from its original sources to the final consumer (businesses, industry, public sector and homes). As well as the physical infrastructure, markets play a key role in making sure the system balances supply and demand.

Phrase	Meaning
<b>Generation mix</b>	A mix of technologies designed to meet electricity demand.
<b>Greenhouse Gas Emissions</b>	Addition to the atmosphere of gases that are a cause of global warming, including carbon dioxide, methane and others.
<b>Greenhouse Gas Removal Technologies (or negative emissions)</b>	Methods that actively remove greenhouse gases from the atmosphere, ranging from engineered to nature-based solutions.
<b>Gross value added (GVA)</b>	Gross value added is the value generated by any unit engaged in the production of goods and services.
<b>Heat network</b>	A heat network, sometimes called district heating, is a system of insulated pipes that takes heat or cooling generated from a central source and distributes it to a number of domestic and non-domestic buildings.
<b>Heat pump</b>	A device that extracts heat from the air, ground or water and concentrates it to a higher temperature and delivers it elsewhere, for example to a central heating system. It can replace traditional fossil fuel heating, such as a gas or oil boiler. Heat pump systems are designed to extract a greater amount of heat energy from the surrounding environment than the energy they consume in doing so, therefore they can act as a more efficient source of heat than a conventional electric heater, producing two to three times (or more for very efficient systems) as much heat output as they consume in electricity input.
<b>Hybrid interconnector projects</b>	Projects that combine electricity generation with the ability to feed electricity to two (or more) different markets. For example, an offshore wind project that has multiple connections and is able to provide electricity to both the UK market and to European markets.
<b>Hydrogen for heat</b>	The combustion of hydrogen produces no long-lived greenhouse gas emissions at point of use, making it a possible low-carbon replacement for natural gas as a fuel source for heating homes and other buildings.
<b>Clean hydrogen</b>	Hydrogen that is produced with significantly lower greenhouse gas emissions compared to current methods of production – methods include reacting methane with steam to form hydrogen and then capturing the carbon dioxide by-product (steam methane reformation with CCUS) or using renewable electricity to split water into hydrogen and oxygen (electrolysis).
<b>Industrial Sector</b>	Businesses and organisations involved in manufacturing, refining, coke production and mining.

Phrase	Meaning
<b>Interconnection</b>	Interconnectors are cables or pipes, that transport electricity or gas between different markets internationally. As Great Britain is an island our interconnectors tend to run underneath the sea.
<b>Low-carbon electricity generating technologies</b>	Types of electricity generating technologies that emit little or no carbon, which include renewables, nuclear, CCUS.
<b>Long-duration storage</b>	Storage technologies capable of storing energy for days, weeks or even seasons.
<b>Negative Emission</b>	Achieved by removing greenhouse gases from the atmosphere, for example, through direct air capture or bio-energy production with carbon capture.
<b>Net zero</b>	Refers to a point at which the amount of greenhouse gas being put into the atmosphere by human activity in the UK equals the amount of greenhouse gas that is being taken out of the atmosphere.
<b>Nuclear fusion</b>	Is the process that powers the sun: the fusing of hydrogen atoms into helium, which releases large amounts of energy. Scientists are developing technology to use this process to provide fusion energy, which could be clean, safe and inexhaustible with no long-lived radioactive waste.
<b>Ofgem</b>	The Office for Gas and Electricity Markets (Ofgem) is the independent GB energy regulator for gas and electricity. Its role is to protect consumers now and in the future by working to deliver a greener, fairer energy system.
<b>Peaking Capacity</b>	Electricity generators that don't normally operate but are ready to do so when needed at times of peak demand or low generation.
<b>Policy costs</b>	Cost on energy bills of programmes to save energy, reduce emissions, and provide financial support to the fuel poor.
<b>Price signals</b>	Changes in market price that send messages to consumers and producers about whether to enter or leave a market. For example, rising prices give a signal to consumers to reduce demand, and at the same time they give a signal to potential producers to increase supply.
<b>Real-time markets</b>	In the context of energy this is a market which has no, or very little, time between the finalisation of all trading activity and the physical delivery of energy to the customer. This is very difficult to achieve so the phrase "closer-to-real-time" is often used to indicate a direction of travel.

Phrase	Meaning
<b>Refineries</b>	Industrial facilities which converts crude oil and gas into specific products such as jet fuel or diesel.
<b>Renewable Energy</b>	Energy that is collected from resources which are naturally replaced in human timescales such as sunlight, wind, rain, tides and waves.
<b>R&amp;D</b>	Research and development: thinking up new ideas and applying them.
<b>Regulated Asset Base (RAB)</b>	A type of economic regulation typically used in the UK for monopoly infrastructure assets such as water, gas and electricity networks. The return on a RAB is regulated by an economic regulator.
<b>Small Modular Reactors (SMRs)</b>	SMRs are usually based on proven water-cooled reactors similar to current Nuclear Power station reactors, but on a smaller scale. They use nuclear fission to generate low-carbon electricity. SMRs are called modular reactors as their components can be manufactured in factories using innovative techniques and then transported to site to be assembled.
<b>Smart charging</b>	Connecting an electric vehicle to the electricity grid using a charging device which includes a data connection. This allows electric vehicles that are plugged in using smart chargers to be charged when it is the most efficient, in terms of cost for the consumer and/or from the point of view of balancing supply and demand across the electricity system.
<b>Smart meters</b>	The next generation of gas and electricity meters, which use a secure smart data network to automatically and wirelessly send meter readings to energy suppliers, enable remote topping up of balances for pre-payment customers and near real time energy consumption and expenditure to be visible to domestic energy consumers via an In-Home Display. Smart meters also enable innovations such as time of use tariffs which will help support delivery of our net zero objectives.
<b>Strike price</b>	The price a generator bids into a CfD allocation process. The strike price of the last successful project becomes the clearing price, which all successful generators are awarded in their contracts.
<b>Suppliers (retail energy suppliers)</b>	Licensed companies that buy gas and electricity primarily in the wholesale market and sell it to energy users including domestic and non-domestic consumers.
<b>System constraint</b>	A limit or restriction, which the current system does not have the ability to go beyond. For example, when electricity from a particular location is unable to be transported to the location of demand, due to restrictions on the network.

Phrase	Meaning
<b>System cost</b>	The annualised costs of building and operating the energy system, including generation, transmission and distribution, balancing and carbon costs.
<b>System operators</b>	Manage the whole energy system and keep it in balance so that gas and electricity are available when needed.
<b>Transmission networks</b>	National networks that transport gas and electricity long distances across Great Britain; the motorways of our energy network.
<b>Unabated (gas) generation</b>	Electricity generation where carbon from burning natural gas is not captured and stored.
<b>Upstream Oil and Gas</b>	The industries and processes involved in exploration and extraction of oil and gas
<b>Vehicle-to-grid</b>	Technologies that allow electric vehicles (and their charging equipment) to export energy back to the electricity grid in response to communications to and from the electricity network.
<b>Wholesale costs</b>	The amount energy companies pay to buy gas and electricity

# References

- 1 Slater, T., Hogg, A.E. & Mottram, R. (2020), 'Ice-sheet losses track high-end sea-level rise projections'. *Nat. Clim. Chang.* 10, 879–881. <https://doi.org/10.1038/s41558-020-0893-y>
- 2 Kendon, M., McCarthy, M., Jevrejeva, S., Matthews, A., Sparks, T. and Garforth, J. (2020), State of the UK Climate 2019. *Int J Climatol*, 40: 1-69. <https://doi.org/10.1002/joc.6726>
- 3 CCC (2017), 'UK Climate Change Risk Assessment 2017: Synthesis Report: priorities for the next five years' <https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/synthesis-report/>
- 4 Robine et al. (2008), 'Death toll exceeded 70,000 in Europe during the summer of 2003', *Comptes Rendus Biologies*: <https://www.sciencedirect.com/science/article/pii/S1631069107003770?via%3Dihub>
- 5 CCC (2017), 'UK Climate Change Risk Assessment 2017: Synthesis Report: priorities for the next five years' <https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/synthesis-report/>
- 6 Paris Agreement (2015), <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>
- 7 UN Environment Programme (2019), 'Emissions Gap Report 2019', <https://www.unenvironment.org/resources/emissions-gap-report-2019>
- 8 HM Treasury (2006), 'Stern Review: The Economics of Climate Change', [https://webarchive.nationalarchives.gov.uk/20100407172811/http://www.hm-treasury.gov.uk/stern\\_review\\_report.htm](https://webarchive.nationalarchives.gov.uk/20100407172811/http://www.hm-treasury.gov.uk/stern_review_report.htm)
- 9 Arnell, N.W., Lowe, J.A., Challinor, A.J. et al. Global and regional impacts of climate change at different levels of global temperature increase. *Climatic Change* 155, 377–391 (2019). <https://doi.org/10.1007/s10584-019-02464-z>
- 10 Naumann, G., Alfieri, L., Wyser, K., Mentaschi, L., Betts, R. A., Carrao, H., et al. (2018). Global changes in drought conditions under different levels of warming. *Geophysical Research Letters*, 45, 3285–3296. <https://doi.org/10.1002/2017GL076521>
- 11 Figure based on RCP4.5 projection for London from the UKCP18 Marine Projections. Projections for RCP6.0 (a 3°C scenario) are very similar and not reported for this reason in UKCP18 (see UKCP18 Overview Report, and Chapter 13, IPCC Fifth Assessment Report, Working Group 1). <https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf>
- 12 Alfieri, L.; Dottori, F.; Betts, R.; Salamon, P.; Feyen, L. Multi-Model Projections of River Flood Risk in Europe under Global Warming. *Climate* 2018, 6, 6., <https://www.mdpi.com/2225-1154/6/1/6#cite>
- 13 ASC (2016) UK Climate Change Risk Assessment 2017 Synthesis Report: priorities for the next five years. Adaptation Sub-Committee of the Committee on Climate Change, London.
- 14 IPCC, 2014. Section TS 5.5.1. Technical Summary. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the IPCC.*
- 15 European Commission, 'Final Report Summary - HELIX (High-End cLimate Impacts and eXtremes)', <https://cordis.europa.eu/project/id/603864/reporting>, accessed 07/12/2020
- 16 IPCC, 2019. Chapter 4- Executive Summary. *Special Report on the Ocean and Cryosphere in a Changing Climate.*
- 17 CCC (2017), 'UK Climate Change Risk Assessment 2017 Evidence Report', <https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/synthesis-report/>
- 18 Data. World Bank, UNFCCC National Inventory Submissions, ONS, BEIS Greenhouse Gas Inventory. Note: Data are provided for 1990-2018.
- 19 The 2019 figures are provisional estimates. BEIS (2020), 'Provisional UK greenhouse gas emissions national statistics 2019', <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2019>
- 20 Elexon Portal, <https://www.elexonportal.co.uk/article/view/7324?cachebust=0hmjytr3qx>, accessed 26/08/2020
- 21 BEIS (2020), Energy Trends table 6.1, <https://www.gov.uk/government/statistics/energy-trends-section-6-renewables>
- 22 BEIS (2020), Energy Trends table 5.1, <https://www.gov.uk/government/statistics/electricity-section-5-energy-trends>
- 23 BEIS (2020), 'Contracts for Difference (CfD) Allocation Round 3: results', <https://www.gov.uk/government/publications/contracts-for-difference-cfd-allocation-round-3-results>. Reduction of clearing prices calculated using AR1 and AR3 clearing prices.
- 24 EnergieKontor (2018), 'Energiekontor realises Witherwick II – the first wind project without state

- subsidies in the UK', <https://www.energiekontor.de/en/news/energiekontor-realises-withernwick-ii-the-first-wind-project-without-state-subsidies-in-the-uk.html> accessed 01/12/2020
- 25 CCC (2018), 'UK Housing: fit for the future?', <https://www.theccc.org.uk/publication/uk-housing-fit-for-the-future/>
- 26 HM Treasury (2020), 'National Infrastructure Strategy', <https://www.gov.uk/government/publications/national-infrastructure-strategy>
- 27 ONS (2020), 'Low Carbon and Renewable Energy Economy (LCREE) Survey direct and indirect estimates of employment, UK, 2014 to 2018', <https://www.ons.gov.uk/economy/environmentalaccounts/adhocs/11120lowcarbonandrenewableenergyeconomylcreeesurveydirectandindirectestimatesofemploymentuk2014to2018>
- 28 Climate Watch, Historical GHG Emissions, <https://www.climatewatchdata.org/ghg-emissions?regions=WORLD%2CGBR> accessed 14/10/20
- 29 COP25, Climate Ambition Alliance Press Release, <https://cop25.mma.gob.cl/en/climate-ambition-alliance/>, accessed 14/10/2020
- 30 The Ten Point Plan additionally covers jobs created in public transport, aviation, shipping and natural environment sectors. We have not included these in our estimates, instead focusing on jobs created directly or indirectly within energy.
- 31 Quoted savings based on a medium consumption as defined by Ofgem (3,100 kWh of electricity, 12,000 kWh of gas). Consumption savings based on shifting 75 per cent of electricity consumption to off peak times. <https://octopus.energy/agile/>
- 32 Ofgem, 'Typical Domestic Consumption Values', <https://www.ofgem.gov.uk/gas/retail-market/monitoring-data-and-statistics/typical-domestic-consumption-values>, accessed 13/10/2020.
- 33 Figure 2.1 – Average domestic dual fuel bills. Additional costs from the White Paper include: CfD uplift costs from increased renewables ambition; network reinforcement costs; Energy Company Obligation 4; Green Gas Levy; Warm Home Discount extension; Green Home Grants; Home Upgrade Grants; Social Housing Decarbonisation Fund; and changes to regulations in the housing lending and rented sectors. The impact of additional heat pump deployment has not been included as policy detail is still being developed; the bills impact of financing new nuclear beyond Hinkley Point C has not been included while our approach is in development. This also assumes that ECO support costs continue beyond 2026 despite the policy landscape still under development and additional efficiency benefits beyond ECO 4 have not been quantified. This is a central scenario based on an electrified system as the costs of hydrogen are considered too uncertain at present to include in future estimates of household bills. Figures will differ depending on several variables including wholesale gas prices, behavioural changes, outcomes of future Capacity Market and CfD auctions and additional policy decisions. This is based on an average bill for a dual fuel household – actual bills will vary depending on household characteristics and energy behaviour.
- 34 BEIS (2020), 'Annual Domestic Energy bills', tables 2.2.5 and 2.3.5, <https://www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics>.
- 35 The Energy Company Obligation is an energy efficiency scheme under which obligated suppliers must mainly promote measures which improve the ability of low income, fuel poor and vulnerable households to heat their homes.
- 36 The Warm Home Discount is an obligation on energy suppliers with at least 150,000 customer accounts to provide £150 energy bill rebates to eligible low income and vulnerable households each winter.
- 37 BEIS Analysis, based on an average domestic dual fuel bill in 2030
- 38 Climate Assembly UK (2020), 'The path to net zero: Underpinning Principles', <https://www.climateassembly.uk/report/read/underpinning-principles.html>
- 39 Ofgem (2020), 'Electricity Retail Market-wide Half-hourly Settlement: Draft Impact Assessment Consultation', <https://www.ofgem.gov.uk/publications-and-updates/electricity-retail-market-wide-half-hourly-settlement-draft-impact-assessment-consultation>
- 40 Ofgem, 'Number of domestic gas customer accounts by supplier', <https://www.ofgem.gov.uk/data-portal/number-domestic-gas-customer-accounts-supplier-excluding-pre-payment-customers-standard-variable-fixed-and-other-tariffs-gb>
- 41 It should be noted that there are some consumers on default tariffs who actively choose to stay on these tariffs with their current supplier.
- 42 A summary of these findings and links to the individuals trials is available here: <https://www.ofgem.gov.uk/publications-and-updates/what-works-icreasing-engagement-energy-tariff-choices>
- 43 <https://www.ofgem.gov.uk/publications-and-updates/ofgems-collective-switch-trials> The (DECC run) Government's 2013 Cheaper Energy Together fund also showed the success of Collective Switching schemes: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/253862/Helping\\_Customers\\_Switch\\_Collective\\_Switching\\_and\\_Beyond\\_final\\_\\_2\\_.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/253862/Helping_Customers_Switch_Collective_Switching_and_Beyond_final__2_.pdf)
- 44 Ofgem and BEIS (2019), 'Flexible and responsive energy retail markets', <https://www.>

- gov.uk/government/consultations/flexible-and-responsive-energy-retail-markets
- 45 <https://www.ofgem.gov.uk/publications-and-updates/what-works-increasing-engagement-energy-tariff-choices>
- 46 BEIS analysis of BEIS (2020), Final UK greenhouse gas emissions national statistics: 1990 to 2018, <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>
- 47 BEIS (2020), DUKES, table 5.1.3, <https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes>
- 48 BEIS (2020), Energy Trends, table 5.1, <https://www.gov.uk/government/statistics/electricity-section-5-energy-trends>
- 49 BEIS (2020), Energy Trends, table 6.1, <https://www.gov.uk/government/statistics/energy-trends-section-6-renewables>
- 50 BEIS (2020), BEIS Electricity Generation Costs, <https://www.gov.uk/government/publications/beis-electricity-generation-costs-2020>
- 51 BEIS (2020), 'Early phase out of unabated coal generation in Great Britain', <https://gov.uk/government/consultations/early-phase-out-of-unabated-coal-generation-in-great-britain>
- 52 BEIS (2020), Energy Trends, table 1.3, <https://www.gov.uk/government/statistics/total-energy-section-1-energy-trends>
- 53 BEIS (2020), 'Final UK greenhouse gas emissions national statistics: 1990 to 2018', <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>
- 54 BEIS (2020), 'Modelling 2050: Electricity System Analysis', <https://gov.uk/government/publications/modelling-2050-electricity-system-analysis>
- 55 BEIS (2019), 'Contracts for Difference (CfD) Allocation Round 3: results', <https://www.gov.uk/government/publications/contracts-for-difference-cfd-allocation-round-3-results>
- 56 DECC (2013), 'Record investments of £40 billion in renewable electricity to bring green jobs and growth to the UK' <https://www.gov.uk/government/news/record-investments-of-40-billion-in-renewable-electricity-to-bring-green-jobs-and-growth-to-the-uk>
- 57 BEIS (2020), Call for Evidence on Renewable Support, <https://www.gov.uk/government/consultations/enabling-a-high-renewable-net-zero-electricity-system-call-for-evidence>
- 58 BEIS (2020), 'Business models for carbon capture, usage and storage: government response', <https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models>
- 59 BEIS (2020), Energy Trends, table 5.1, <https://www.gov.uk/government/statistics/electricity-section-5-energy-trends>
- 60 BEIS (2018), 'Hinkley Point C wider benefits realisation plan' <https://www.gov.uk/government/publications/hinkley-point-c-wider-benefits-realisation-plan>
- 61 BEIS (2020), Ten point plan for a green industrial revolution, <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>
- 62 BEIS (2018), Nuclear Sector Deal, <https://www.gov.uk/government/publications/nuclear-sector-deal>
- 63 BEIS (2019), 'Regulated Asset Base (RAB) model for nuclear', <https://www.gov.uk/government/consultations/regulated-asset-base-rab-model-for-nuclear>
- 64 BEIS (2020), Government response to RAB model consultation on nuclear <https://www.gov.uk/government/consultations/regulated-asset-base-rab-model-for-nuclear>
- 65 National Nuclear Laboratory (2014), 'Small Modular Reactors (SMR) Feasibility Study', <https://namrc.co.uk/wp-content/uploads/2015/01/smr-feasibility-study-december-2014.pdf>
- 66 UK Atomic Energy Authority (2020), STEP, <https://step.ukaea.uk/>
- 67 Estimate updated to 2020 prices. Vivid Economics (2019), 'Energy Innovation Needs Assessment: overview', <https://www.gov.uk/government/publications/energy-innovation-needs-assessments>
- 68 CCC (2019), 'Net Zero – Technical Report', <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>
- 69 Prime Minister's Office, 10 Downing Street (2020), 'PM: A new deal for Britain', <https://www.gov.uk/government/news/pm-a-new-deal-for-britain>
- 70 BEIS (2020), Greenhouse gas removals: call for evidence, <https://www.gov.uk/government/consultations/greenhouse-gas-removals-call-for-evidence>
- 71 BEIS (2020), Offshore wind manufacturing investment support scheme, <https://www.gov.uk/government/publications/offshore-wind-manufacturing-investment-support-scheme>
- 72 BEIS (2020), Offshore Wind Sector Deal, <https://www.gov.uk/government/publications/offshore-wind-sector-deal/offshore-wind-sector-deal>
- 73 BEIS analysis of Vivid Economics (2019), 'Offshore



- 100 <https://www.gov.uk/government/publications/storage-cost-and-technical-assumptions-for-electricity-storage-technologies>
- 101 Kaluza, 'Kaluza Intelligently Controls Home Batteries to Support Local WPD Network in UK First', <https://www.kaluza.com/kaluza-intelligently-controls-home-batteries-to-support-local-wpd-network-in-uk-first/> The Association for Decentralised Energy, 'Kiwi Power and Social Energy join UK Power Networks' Flexibility portfolio', <https://www.theade.co.uk/news/market-news/kiwi-power-and-social-energy-join-uk-power-networks-flexibility-portfolio>
- 102 National Grid ESO, Capacity Market Registers, <https://www.emrdeliverybody.com/CM/Registers.aspx>, accessed 04/10/2020
- 103 BEIS (2019), 'Capacity Market: Five-year Review (2014 to 2019)', <https://www.gov.uk/government/publications/capacity-market-5-year-review-2014-to-2019>
- 104 Figures published by the Energy Networks Association as part of their Gas Goes Green programme (2020), <https://www.energynetworks.org/newsroom/gas-networks-set-to-slash-grid-emissions-as-new-figures-show-equivalent-of-500-000-cars-to-be-taken-off-the-road>
- 105 BEIS (2019), 'Sub-national estimates of properties not connected to the gas network', <https://www.gov.uk/government/statistics/sub-national-estimates-of-households-not-connected-to-the-gas-network>
- 106 Ofgem (2018), 'Network Price Controls and you: Fast facts', <https://www.ofgem.gov.uk/publications-and-updates/network-price-controls-and-you-fast-facts>
- 107 <https://www.gov.uk/government/publications/climate-change-adaptation-reporting-third-round>
- 108 Based on the lower range of savings from counterfactual #3, with values updated to 2020 prices from 2014/15 prices. Ofgem (2016), 'Evaluation of OFTO Tender Round 2 and 3 Benefits', <https://www.ofgem.gov.uk/publications-and-updates/evaluation-of-to-tender-round-2-and-3-benefits>
- 109 Highways England (2017), 'Strategic Road Network Initial Report', <https://www.gov.uk/government/publications/highways-englands-strategic-road-network-initial-report>
- 110 OLEV (2020). 'Government Visions for the rapid chargepoint network in England'. <https://www.gov.uk/government/publications/government-vision-for-the-rapid-chargepoint-network-in-england/government-vision-for-the-rapid-chargepoint-network-in-england>
- 111 BEIS (2020), 'Letter to Ofgem on RII0 Ed 2 related energy policies', <https://gov.uk/government/publications/letter-to-ofgem-on-riio-ed2-related-energy-policies>
- 112 Aurora as commissioned by BEIS, (2020), 'The impact of interconnectors on decarbonisation', <https://www.gov.uk/government/publications/the-impact-of-interconnectors-on-decarbonisation>
- 113 BEIS (2020), 'Offshore transmission network review', <https://www.gov.uk/government/publications/offshore-transmission-network-review>
- 114 National Grid ESO (2020) 'Offshore Coordination Consultation: <https://www.nationalgrideso.com/document/177296/download>
- 115 Energy Data Taskforce (2019), 'A strategy for a Modern Digitalised Energy System', <https://es.catapult.org.uk/reports/energy-data-taskforce-report/>
- 116 DCMS (2020), 'UK National Data Strategy', <https://www.gov.uk/government/publications/uk-national-data-strategy>
- 117 Modernising energy data access (MEDA): <https://innovateuk.blog.gov.uk/2020/05/29/modernising-energy-data-access-and-the-winners-are>, and Modernising energy data applications (MEDApps) <https://innovateuk.blog.gov.uk/2020/10/05/modernising-energy-data-applications>
- 118 Final energy use: BEIS (2020), Energy Trends, Table 1.3, <https://www.gov.uk/government/statistics/total-energy-section-1-energy-trends>  
Electricity generation: BEIS (2020), Energy Trends, Table 5.1, <https://www.gov.uk/government/statistics/electricity-section-5-energy-trends>
- 119 2019 Consultation on Reforming Energy Codes, <https://www.gov.uk/government/consultations/reforming-the-energy-industry-codes>. This consultation was published as part of the joint BEIS and Ofgem Energy Codes Review, <https://www.ofgem.gov.uk/publications-and-updates/energy-codes-review>
- 120 BEIS (2020), 'Electrical engineering standards: Independent review', <https://www.gov.uk/government/publications/electrical-engineering-standards-independent-review>
- 121 BEIS (2020), '2018 UK greenhouse gas emissions: final figures - data tables', <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>
- 122 DfT (2020), 'Decarbonising Transport: Setting the Challenge', <https://www.gov.uk/government/publications/creating-the-transport-decarbonisation-plan>
- 123 ACEA (2020), <https://www.acea.be/press-releases/article/fuel-types-of-new-cars-petrol-47.5-hybrids-12.4-electric-9.9-market-share-t> - accessed 23/11/2020
- 124 EAFO (2020), <https://www.eafo.eu/vehicles-and-fleet/m1> - accessed 23/11/2020 To access

- the data, please select 'Electricity' for the fuel filter, 'EU+UK+EFTA+Turkey' for the region/countries filter, and '2019' for the Date filter. Then, scroll down to the pie chart titled 'TOP 10 MODELS NEW REGISTRATIONS Electricity (2019)' and select 'BEV' in the categories filter
- 125 DfT (2020), 'Ultra-low emissions vehicles (ULEVs) - VEH0130', <https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01>
- 126 SSE Enterprise (2020), 'Bus2Grid', <https://www.sseutilitiesolutions.co.uk/products/bus2grid-2/> - accessed on 02/12/2020
- 127 DfT (2020), 'Union connectivity review: call for evidence', <https://www.gov.uk/government/consultations/union-connectivity-review-call-for-evidence/union-connectivity-review-call-for-evidence#about-the-call-for-evidence>
- 128 BEIS analysis of BEIS (2020), 'Final UK greenhouse gas emissions national statistics: 1990 to 2018', <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>
- 129 BEIS analysis of BEIS (2020), 'Final UK greenhouse gas emissions national statistics: 1990 to 2018', <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>
- 130 MHCLG (2020), 'English Housing Survey 2018: energy report' <https://www.gov.uk/government/statistics/english-housing-survey-2018-energy-report>
- 131 BEIS (2019), 'Sub-national estimates of properties not connected to the gas network', <https://www.gov.uk/government/statistics/sub-national-estimates-of-households-not-connected-to-the-gas-network>
- 132 BEIS (2019), 'Sub-national electricity and gas consumption summary report 2018', <https://www.gov.uk/government/statistics/sub-national-electricity-and-gas-consumption-summary-report-2018>
- 133 BEIS analysis
- 134 BEIS (2020), Final UK greenhouse gas emissions national statistics: 1990 to 2018, <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>
- 135 MHCLG (2020), English Housing Survey 2018: stock condition, <https://www.gov.uk/government/statistics/english-housing-survey-2018-stock-condition>
- 136 MHCLG (2020), 'English Housing Survey 2018: energy report, table AT1.5, <https://www.gov.uk/government/statistics/english-housing-survey-2018-energy-report>
- 137 BEIS (2016), 'Building Energy Efficiency Survey (BEES)', <https://www.gov.uk/government/publications/building-energy-efficiency-survey-bees>
- 138 BEIS (2018), Digest of UK Energy Statistics, Table 1.1, <https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes>: Commercial+public administration+miscellaneous sectors, as a share of 'Other' final energy consumption
- 139 BEIS (2016), 'BEES Overarching Tables', tables C.1 and B.4, <https://www.gov.uk/government/publications/building-energy-efficiency-survey-bees>
- 140 BEIS (2020), Transforming heat: public attitudes research, <https://www.gov.uk/government/publications/transforming-heat-public-attitudes-research>
- 141 MHCLG (2019), 'The Future Homes Standards: changes to Part L and Part F of the Building Regulations for new dwellings', <https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings>
- 142 DfT (2019), 'Electric vehicle chargepoints in residential and non-residential buildings' <https://www.gov.uk/government/consultations/electric-vehicle-chargepoints-in-residential-and-non-residential-buildings>
- 143 BEIS (2020), 'Green Homes Grant Local Authority Delivery scheme, Phase 1B: entering a bid', <https://www.gov.uk/government/publications/green-homes-grant-local-authority-delivery-scheme-entering-a-bid>
- 144 BEIS (2020), 'Greener homes, jobs and cheaper bills on the way as government launches biggest upgrade of nation's buildings in a generation', <https://www.gov.uk/government/news/greener-homes-jobs-and-cheaper-bills-on-the-way-as-government-launches-biggest-upgrade-of-nations-buildings-in-a-generation>
- 145 BEIS (2020), 'Improving the energy performance of privately rented homes', <https://www.gov.uk/government/consultations/improving-the-energy-performance-of-privately-rented-homes>
- 146 Updated to 2020 prices from 2018 prices. BEIS (2020), 'Improving the energy performance of privately rented homes in England and Wales: Consultation Stage Impact Assessment', <https://www.gov.uk/government/consultations/improving-the-energy-performance-of-privately-rented-homes>
- 147 MHCLG (2020), English Housing Survey 2018: energy report, table AT2.7, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/859758/2018-19\\_Section\\_2\\_Housing\\_Stock\\_Annex\\_Tables.xlsx](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/859758/2018-19_Section_2_Housing_Stock_Annex_Tables.xlsx)
- 148 HM Treasury (2020), 'A Plan for Jobs 2020', <https://www.gov.uk/government/publications/a-plan-for-jobs-documents/a-plan-for-jobs-2020>
- 149 BEIS analysis

- 150 BEIS analysis
- 151 BEIS estimates – savings in relation to having no products policy measures
- 152 BEIS (2016), 'Building Energy Efficiency Survey (BEES)', table 3.9, <https://www.gov.uk/government/publications/building-energy-efficiency-survey-bees>
- 153 BEIS (2016), 'Building Energy Efficiency Survey (BEES)', table 3.11, <https://www.gov.uk/government/publications/building-energy-efficiency-survey-bees>
- 154 BEIS (2020), 'Final UK greenhouse gas emissions national statistics: 1990 to 2018', <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>
- 155 BEIS (2020), 'Public Sector Decarbonisation Scheme (PSDS)', <https://www.gov.uk/government/publications/public-sector-decarbonisation-scheme-psds>
- BEIS (2020), 'Household Energy Efficiency Statistics, headline release November 2020', <https://www.gov.uk/government/statistics/household-energy-efficiency-statistics-headline-release-november-2020>
- 156 BEIS (2020), 'Household Energy Efficiency Statistics, headline release November 2020', <https://www.gov.uk/government/statistics/household-energy-efficiency-statistics-headline-release-november-2020>
- 157 BEIS (2018), 'ECO3: 2018-2022 - final stage Impact Assessment', <https://www.gov.uk/government/consultations/energy-company-obligation-eco3-2018-to-2022>
- 158 The scheme will be worth £475 million in 2020 prices, rising with inflation.
- 159 BSRIA (2020). 'UK Domestic boilers market analysis', [https://www.bsria.com/uk/product/nEJGED/domestic\\_boilers\\_world\\_market\\_for\\_heating\\_boilers\\_2020r2019\\_8a707622/](https://www.bsria.com/uk/product/nEJGED/domestic_boilers_world_market_for_heating_boilers_2020r2019_8a707622/)
- 160 MHCLG (2020), Table AT2.1, 'English Housing Survey 2018: energy report' <https://www.gov.uk/government/statistics/english-housing-survey-2018-energy-report>
- 161 Assuming replacement rate of once every 15-20 years with a total stock of 1.1m households in England using fossil fuel heating off the gas grid
- 162 BEIS (2020), 'Heat Pump Manufacturing Supply Chain Research Project', <https://gov.uk/government/publications/heat-pump-manufacturing-supply-chain-research-project>
- 163 BEIS (2020), 'Consultation Stage IA: Future Support for Low Carbon Heat', <https://www.gov.uk/government/consultations/future-support-for-low-carbon-heat>
- 164 Ofgem, 'Typical Domestic Consumption Values', <https://www.ofgem.gov.uk/gas/retail-market/monitoring-data-and-statistics/typical-domestic-consumption-values>, accessed 21/10/2020
- 165 BEIS (2018), 'Energy Trends: March 2018, special feature article - Experimental statistics on heat networks', <https://www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks>
- 166 Energy Efficiency EEIG (2020), 'Rebuilding for resilience: Energy efficiency's offer for a net zero compatible stimulus and recovery', <https://www.theeeig.co.uk/news/starstarnew-reportstarstar-rebuilding-for-resilience-energy-efficiency-s-offer-for-a-net-zero-compatible-stimulus-and-recovery/>
- 167 HM Treasury (2020), 'Chancellor's Plan for Jobs to help the UK's recovery', <https://www.gov.uk/government/news/rishis-plan-for-jobs-will-help-britain-bounce-back>
- 168 Grantham Research Institute on Climate Change and the Environment (2019), 'Policy brief: Investing in a just transition in the UK', [https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2019/02/Investing-in-a-just-transition-in-the-UK\\_policy-brief\\_8pp-1.pdf](https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2019/02/Investing-in-a-just-transition-in-the-UK_policy-brief_8pp-1.pdf)
- 169 ONS (2020), 'EMP14: Employees and self-employed by industry', <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employeesandselfemployedbyindustryemp14>
- 170 BEIS (2020), 'Green Homes Grant skills training competition', <https://www.gov.uk/government/publications/green-homes-grant-skills-training-competition>
- 171 CCC (2019), Net Zero - Technical Report, <https://www.theccc.org.uk/publication/net-zero-technical-report/>. Reduction based on the 'Further Ambition' scenario for industry.
- 172 GVA and employment statistics: ONS (2020), 'Non-financial business economy, UK: Sections A to S', <https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/datasets/uknonfinancialbusinesseconomyannualbusinesssurveysections> as Export statistics: ONS (2020), 'UK trade: goods and services publication tables', tables 1 and 3, <https://www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/datasets/uktradegoodsandservicepublicationtables>. Industry is defined as SITC 5-8.
- 173 ONS (2019), 'Business Register and Employment Survey', <https://www.nomisweb.co.uk/query/construct/summary.asp?mode=construct&version=0&dataset=189>
- 174 BEIS analysis of BEIS (2020), 'Supplementary tables: 2018 UK greenhouse gas emissions by Standard Industrial Classification (alternative format)', <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018> 'Manufacturing and Refining' are defined as group c; refining; coke; and mining and quarrying.

- 175 BEIS (2018), 'Energy Consumption in the UK' table 4.08 <https://www.gov.uk/government/statistics/energy-consumption-in-the-uk>
- 176 National Atmospheric Emissions Inventory, <https://naei.beis.gov.uk/data/map-large-source>, accessed 16/10/2020 Vivid Economics (2019), 'Industry (EINA sub-theme)', <https://www.gov.uk/government/publications/energy-innovation-needs-assessments>
- 177 TCE (2019), 'News Release: Tata Chemicals Europe to Build UK's Largest Carbon Capture & Use Plant', <https://www.tatachemicalseurope.com/news-release-tata-chemicals-europe-build-uks-largest-carbon-capture-use-plant>
- 178 BEIS analysis comparing potential CCUS salaries with ONS stats on salaries for 'energy plant operatives', and 'chemical and related process operatives'. Vivid Economics (2019), 'Carbon capture, usage and storage (EINA sub-theme)', <https://www.gov.uk/government/publications/energy-innovation-needs-assessments>. ONS (2020), 'Employee earnings in the UK: 2020', Figure 6, <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/annualsurveyofhoursandearnings/2020>
- 179 Energy Technologies Institute (2017), 'Taking stock of UK CO<sub>2</sub> Storage', [https://www.eti.co.uk/insights/taking-stock-of-uk-CO<sub>2</sub>-storage](https://www.eti.co.uk/insights/taking-stock-of-uk-CO2-storage)
- 180 BEIS analysis based on EINA methodology Vivid Economics (2019), 'Energy Innovation Needs Assessments', <https://www.gov.uk/government/publications/energy-innovation-needs-assessments>
- 181 TCE (2019), 'News Release: Tata Chemicals Europe to Build UK's Largest Carbon Capture & Use Plant', <https://www.tatachemicalseurope.com/news-release-tata-chemicals-europe-build-uks-largest-carbon-capture-use-plant>
- 182 HM Treasury (2020), 'Budget 2020', <https://www.gov.uk/government/publications/budget-2020-documents>
- 183 BEIS analysis based on EINA methodology. Vivid Economics (2019), 'Carbon capture, usage and storage (EINA sub-theme)', <https://www.gov.uk/government/publications/energy-innovation-needs-assessments>
- 184 CCC (2018), 'Hydrogen in a low-carbon economy', <https://www.theccc.org.uk/publication/hydrogen-in-a-low-carbon-economy/>
- 185 Energy Research Partnership (2016), Role of hydrogen in the UK Energy System, <http://erpuk.org/wp-content/uploads/2016/10/ERP-Hydrogen-report-Oct-2016.pdf>; CCC (2018), Hydrogen in a low-carbon economy, <https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf>
- 186 CCC (2019), 'Net Zero – Technical Report', <https://www.theccc.org.uk/publication/net-zero-technical-report/>
- 187 BEIS analysis based on EINA methodology. Vivid Economics (2019), 'Hydrogen and fuel cells (EINA sub-theme)', <https://www.gov.uk/government/publications/energy-innovation-needs-assessments>
- 188 World Bank, Carbon Pricing Dashboard, [https://carbonpricingdashboard.worldbank.org/map\\_data](https://carbonpricingdashboard.worldbank.org/map_data), accessed 02/11/2020
- 189 HMRC (2020), 'Non Structural Tax Reliefs', <https://www.gov.uk/government/statistics/main-tax-expenditures-and-structural-reliefs>
- 190 BEIS (2019) Energy Trends Table 4.1, <https://www.gov.uk/government/statistics/gas-section-4-energy-trends>
- 191 GVA: ONS (2020), 'GDP output approach – low-level aggregates', tab CVM £million, <https://www.ons.gov.uk/economy/grossdomesticproductgdp/datasets/ukgdpolowlevelaggregates>  
Taxes: OGA (2020), Government revenues from UK oil and gas production in 2019-2020 prices <https://www.ogauthority.co.uk/exploration-production/taxation/government-revenues-from-uk-oil-and-gas-production/>
- 192 OGUK (2019), Workforce report, <https://oilandgasuk.co.uk/wp-content/uploads/2019/08/Workforce-Report-2019.pdf>
- 193 OGA (2020), UK Oil and Gas Reserves and Resources 2018, <https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/reserves-and-resources/>
- 194 OGA (2020), OGA oil and gas production projections, table 4Others, <https://www.ogauthority.co.uk/media/6407/oga-production-and-beis-demand-projections-february-2020.xlsx>
- 195 CCC (2019), Net Zero – The UK's contribution to stopping global warming, <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>
- 196 Bloomberg tracker for Brent Crude
- 197 OGUK (2020), Business Outlook Report: Activity and Supply chain, <https://oilandgasuk.co.uk/wp-content/uploads/2020/05/OGUK-Business-Outlook-2020-Report-Activity-and-Supply-Chain.pdf>
- 198 OGUK (2020), Workforce insight <https://oilandgasuk.cld.bz/Workforce-Insight-2020/4/>
- 199 Multiple sources <https://www.ft.com/content/83b4ba6b-bef9-45d3-a6fb-087ef3143a43>; <https://www.dw.com/en/oil-giants-face-shareholder-pressure-on-climate-emissions-greenhouse-gas-targets/a-48802418>; <https://www.theguardian.com/environment/2020/jan/09/blackrock-joins-pressure-group-taking-on-biggest-polluters>;

- <https://www.reuters.com/article/us-climate-change-oil-shareholders-idUSKBN1YJ0OR>
- 200 bp, Shell and Equinor strategies [last accessed 06/11/2020] <https://www.bp.com/en/global/corporate/who-we-are/our-ambition.html> ; <https://www.shell.com/energy-and-innovation/new-energies.html> ; <https://www.equinor.com/en/what-we-do/renewables.html>
- 201 BEIS (2020), 'The Ten Point Plan for a green industrial revolution', <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>
- 202 Woodplc (2014) Annual report, [https://www.woodplc.com/\\_\\_data/assets/pdf\\_file/0023/36266/John-Wood-Group-Plc-Annual-Report-and-Accounts-2014.pdf](https://www.woodplc.com/__data/assets/pdf_file/0023/36266/John-Wood-Group-Plc-Annual-Report-and-Accounts-2014.pdf) Woodplc (2020) Half year report, [https://www.woodplc.com/\\_\\_data/assets/pdf\\_file/0018/130068/Half-Year-Report-2020.pdf](https://www.woodplc.com/__data/assets/pdf_file/0018/130068/Half-Year-Report-2020.pdf)
- 203 OGUK (2019), 'Business Outlook Report 2019', <https://oilandgasuk.co.uk/wp-content/uploads/2019/03/OGUK-Business-Outlook-Report-2019.pdf>
- 204 UKPIA (2020) Transition, Transformation, and Innovation: Our role in the Net-Zero Challenge, <https://online.flippingbook.com/view/111037/Woodplc> (2014) Annual report, [https://www.woodplc.com/\\_\\_data/assets/pdf\\_file/0023/36266/John-Wood-Group-Plc-Annual-Report-and-Accounts-2014.pdf](https://www.woodplc.com/__data/assets/pdf_file/0023/36266/John-Wood-Group-Plc-Annual-Report-and-Accounts-2014.pdf) Woodplc (2020) Half year report, [https://www.woodplc.com/\\_\\_data/assets/pdf\\_file/0018/130068/Half-Year-Report-2020.pdf](https://www.woodplc.com/__data/assets/pdf_file/0018/130068/Half-Year-Report-2020.pdf)
- 205 NAEI, <https://naei.beis.gov.uk/data/>, accessed 03/11/2020. Estimate based off of all activities from Upstream Oil & Upstream Gas.
- 206 OGUK (2019), 'Economic Report 2019', <https://oilandgasuk.co.uk/product/economic-report/>
- 207 OGUK, 'Roadmap 2035', <https://roadmap2035.co.uk/>
- 208 OGUK (2020), Pathway to a Net-Zero Basin: Production Emissions Targets, <https://oilandgasuk.cld.bz/OGUK-Pathway-to-a-Net-Zero-Basin-Production-Emissions-Targets-Report-2020>
- 209 World Bank and NOAA (2020), 'Global Gas Flaring Tracker Report', <http://pubdocs.worldbank.org/en/503141595343850009/WB-GGFR-Report-July2020.pdf>
- 210 OGA (2020), UKCS Flaring and Venting 2020 report, <https://ogauthorityreports.wixsite.com/ukcs-f-v-report-2020>
- 211 Acorn Project (2019), Infrastructure Reuse and Decommissioning, [https://actacorn.eu/sites/default/files/Infrastructure\\_Poster2.pdf](https://actacorn.eu/sites/default/files/Infrastructure_Poster2.pdf)
- 212 BEIS (2020), Re-use of oil and gas assets for carbon capture, usage and storage projects – government response <https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-projects-re-use-of-oil-and-gas-assets>
- 213 OGA (2020), 'Consultation on new OGA Strategy', <https://www.ogauthority.co.uk/news-publications/consultations/2020/consultation-on-new-oga-strategy/>
- 214 Turnover: Adjusted to 2020 prices. EY (2020), Review of the UK oilfield services industry, [https://assets.ey.com/content/dam/ey-sites/ey-com/en\\_uk/news/2020/02/ey-review-of-the-uk-oilfield-services-industry.pdf](https://assets.ey.com/content/dam/ey-sites/ey-com/en_uk/news/2020/02/ey-review-of-the-uk-oilfield-services-industry.pdf) Employment: OGUK (2019), Workforce report, Figure 1 <https://oilandgasuk.co.uk/wp-content/uploads/2019/08/Workforce-Report-2019.pdf>
- 215 OGUK (2018), Decommissioning Insight, <https://oilandgasuk.co.uk/wp-content/uploads/2019/11/OGUK-Decommissioning-Insight-2019.pdf>
- 216 Wood Mackenzie (2018), Upstream decommissioning – where's next and who pays? <https://www.woodmac.com/reports/upstream-oil-and-gas-upstream-decommissioning-wheres-next-and-who-pays-22918>
- 217 Wood Mackenzie (2017), US\$32 billion of decommissioning worldwide over the next five years: is the industry ready? <https://www.woodmac.com/reports/upstream-oil-and-gas-us32-billion-of-decommissioning-worldwide-over-the-next-five-years-is-the-industry-ready-9599>
- 218 Subsea UK (2019), Into the Blue – UK Subsea Business Activity Review, <https://www.subseauk.com/documents/documents2019/uk%20subsea%20business%20activity%20review%202019%20-%20full%20report.pdf>
- 219 Climate watch (2020), Global historic emissions up to 2016, <https://www.climatewatchdata.org/ghg-emissions?regions=WORLD%2CGBR>
- 220 BEIS (2020), Digest of UK Energy Statistics, Chapter 3 <https://www.gov.uk/government/statistics/petroleum-chapter-3-digest-of-united-kingdom-energy-statistics-dukes>





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# Climate Change Act 2008

## 2008 CHAPTER 27

An Act to set a target for the year 2050 for the reduction of targeted greenhouse gas emissions; to provide for a system of carbon budgeting; to establish a Committee on Climate Change; to confer powers to establish trading schemes for the purpose of limiting greenhouse gas emissions or encouraging activities that reduce such emissions or remove greenhouse gas from the atmosphere; to make provision about adaptation to climate change; to confer powers to make schemes for providing financial incentives to produce less domestic waste and to recycle more of what is produced; to make provision about the collection of household waste; to confer powers to make provision about charging for single use carrier bags; to amend the provisions of the Energy Act 2004 about renewable transport fuel obligations; to make provision about carbon emissions reduction targets; to make other provision about climate change; and for connected purposes. 9 [26th November 2008]

BE IT ENACTED by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

### PART 1

#### CARBON TARGET AND BUDGETING

##### *The target for 2050*

#### 1 The target for 2050

- (1) It is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least [<sup>F1</sup>100%] lower than the 1990 baseline.
- (2) “The 1990 baseline” means the aggregate amount of—

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- (a) net UK emissions of carbon dioxide for that year, and
- (b) net UK emissions of each of the other targeted greenhouse gases for the year that is the base year for that gas.

#### Textual Amendments

**F1** Word in s. 1(1) substituted (27.6.2019) by [The Climate Change Act 2008 \(2050 Target Amendment\) Order 2019 \(S.I. 2019/1056\)](#), arts. 1, 2

## 2 Amendment of 2050 target or baseline year

- (1) The Secretary of State may by order—
  - (a) amend the percentage specified in section 1(1);
  - (b) amend section 1 to provide for a different year to be the baseline year.
- (2) The power in subsection (1)(a) may only be exercised—
  - (a) if it appears to the Secretary of State that there have been significant developments in—
    - (i) scientific knowledge about climate change, or
    - (ii) European or international law or policy,
 that make it appropriate to do so, or
  - (b) in connection with the making of—
    - (i) an order under section 24 (designation of further greenhouse gases as targeted greenhouse gases), or
    - (ii) regulations under section 30 (emissions from international aviation or international shipping).
- (3) The developments in scientific knowledge referred to in subsection (2) are—
  - (a) in relation to the first exercise of the power in subsection (1)(a), developments since the passing of this Act;
  - (b) in relation to a subsequent exercise of that power, developments since the evidential basis for the previous exercise was established.
- (4) The power in subsection (1)(b) may only be exercised if it appears to the Secretary of State that there have been significant developments in European or international law or policy that make it appropriate to do so.
- (5) An order under subsection (1)(b) may make consequential amendments of other references in this Act to the baseline year.
- (6) An order under this section is subject to affirmative resolution procedure.

## 3 Consultation on order amending 2050 target or baseline year

- (1) Before laying before Parliament a draft of a statutory instrument containing an order under section 2 (order amending the 2050 target or the baseline year), the Secretary of State must—
  - (a) obtain, and take into account, the advice of the Committee on Climate Change, and
  - (b) take into account any representations made by the other national authorities.

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- (2) The Committee must, at the time it gives its advice to the Secretary of State, send a copy to the other national authorities.
- (3) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.
- (4) The Secretary of State may proceed to lay such a draft statutory instrument before Parliament without having received a national authority's representations if the authority does not provide them before the end of the period of three months beginning with the date the Committee's advice was sent to the authority.
- (5) At the same time as laying such a draft statutory instrument before Parliament, the Secretary of State must publish a statement setting out whether and how the order takes account of any representations made by the other national authorities.
- (6) If the order makes provision different from that recommended by the Committee, the Secretary of State must also publish a statement setting out the reasons for that decision.
- (7) A statement under this section may be published in such manner as the Secretary of State thinks fit.

### *Carbon budgeting*

## **4 Carbon budgets**

- (1) It is the duty of the Secretary of State—
  - (a) to set for each succeeding period of five years beginning with the period 2008-2012 (“budgetary periods”) an amount for the net UK carbon account (the “carbon budget”), and
  - (b) to ensure that the net UK carbon account for a budgetary period does not exceed the carbon budget.
- (2) The carbon budget for a budgetary period may be set at any time after this Part comes into force, and must be set—
  - (a) for the periods 2008-2012, 2013-2017 and 2018-2022, before 1st June 2009;
  - (b) for any later period, not later than 30th June in the 12th year before the beginning of the period in question.

## **5 Level of carbon budgets**

- (1) The carbon budget—
  - (a) for the budgetary period including the year 2020, must be such that the annual equivalent of the carbon budget for the period is at least [<sup>F2</sup>34%] lower than the 1990 baseline;
  - (b) for the budgetary period including the year 2050, must be such that the annual equivalent of the carbon budget for the period is lower than the 1990 baseline by at least the percentage specified in section 1 (the target for 2050);
  - (c) for the budgetary period including any later year specified by order of the Secretary of State, must be such that the annual equivalent of the carbon budget for the period is—
    - (i) lower than the 1990 baseline by at least the percentage so specified, or

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- (ii) at least the minimum percentage so specified, and not more than the maximum percentage so specified, lower than the 1990 baseline.
- (2) The “annual equivalent”, in relation to the carbon budget for a period, means the amount of the carbon budget for the period divided by the number of years in the period.
- (3) An order under this section is subject to affirmative resolution procedure.
- <sup>F3</sup>(4) .....

#### Textual Amendments

- F2** Word in s. 5(1)(a) substituted (31.5.2009) by [Climate Change Act 2008 \(2020 Target, Credit Limit and Definitions\) Order 2009 \(S.I. 2009/1258\)](#), arts. 1, **2(2)**
- F3** S. 5(4) omitted (31.5.2009) by virtue of [Climate Change Act 2008 \(2020 Target, Credit Limit and Definitions\) Order 2009 \(S.I. 2009/1258\)](#), arts. 1, **2(3)**

## 6 Amendment of target percentages

- (1) The Secretary of State may by order amend—
  - (a) the percentage specified in section 5(1)(a);
  - (b) any percentage specified under section 5(1)(c).
- (2) That power may only be exercised—
  - (a) if it appears to the Secretary of State that there have been significant developments in—
    - (i) scientific knowledge about climate change, or
    - (ii) European or international law or policy,
 that make it appropriate to do so, or
  - (b) in connection with the making of—
    - (i) an order under section 24 (designation of further greenhouse gases as targeted greenhouse gases), or
    - (ii) regulations under section 30 (emissions from international aviation or international shipping).
- (3) The developments in scientific knowledge referred to in subsection (2)(a) are—
  - (a) in relation to the first exercise of the power conferred by this section in relation to the percentage specified in section 5(1)(a), developments since June 2000 (the date of the Royal Commission on Environmental Pollution's 22nd Report, “Energy – the Changing Climate”);
  - (b) in relation to the first exercise of the power conferred by this section in relation to any percentage specified under section 5(1)(c), developments since the evidential basis for the order setting that percentage was established;
  - (c) in relation to a subsequent exercise of any of those powers, developments since the evidential basis for the previous exercise was established.
- (4) The power conferred by this section to amend the percentage in section 5(1)(a) includes power to amend or repeal section 5(4) (which directs that targeted greenhouse gases other than carbon dioxide are to be left out of account for the purposes of that provision).

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(5) An order under this section is subject to affirmative resolution procedure.

## **7 Consultation on order setting or amending target percentages**

- (1) Before laying before Parliament a draft of a statutory instrument containing an order under section 5(1)(c) (order setting target percentage) or section 6 (order amending target percentage), the Secretary of State must—
  - (a) obtain, and take into account, the advice of the Committee on Climate Change, and
  - (b) take into account any representations made by the other national authorities.
- (2) The Committee must, at the time it gives its advice to the Secretary of State, send a copy to the other national authorities.
- (3) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.
- (4) The Secretary of State may proceed to lay such a draft statutory instrument before Parliament without having received a national authority's representations if the authority does not provide them before the end of the period of three months beginning with the date the Committee's advice was sent to the authority.
- (5) At the same time as laying such a draft statutory instrument before Parliament, the Secretary of State must publish a statement setting out whether and how the order takes account of any representations made by the other national authorities.
- (6) If the order makes provision different from that recommended by the Committee, the Secretary of State must also publish a statement setting out the reasons for that decision.
- (7) A statement under this section may be published in such manner as the Secretary of State thinks fit.

## **8 Setting of carbon budgets for budgetary periods**

- (1) The Secretary of State must set the carbon budget for a budgetary period by order.
- (2) The carbon budget for a period must be set with a view to meeting—
  - (a) the target in section 1 (the target for 2050), and
  - (b) the requirements of section 5 (requirements as to level of carbon budgets), and complying with the European and international obligations of the United Kingdom.
- (3) An order setting a carbon budget is subject to affirmative resolution procedure.

## **9 Consultation on carbon budgets**

- (1) Before laying before Parliament a draft of a statutory instrument containing an order under section 8 (order setting carbon budget), the Secretary of State must—
  - (a) take into account the advice of the Committee on Climate Change under section 34 (advice in connection with carbon budgets), and
  - (b) take into account any representations made by the other national authorities.

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- (2) The Secretary of State may proceed to lay such a draft statutory instrument before Parliament without having received a national authority's representations if the authority does not provide them before the end of the period of three months beginning with the date the Committee's advice was sent to the authority.
- (3) At the same time as laying such a draft statutory instrument before Parliament, the Secretary of State must publish a statement setting out whether and how the order takes account of any representations made by the other national authorities.
- (4) If the order sets the carbon budget at a different level from that recommended by the Committee, the Secretary of State must also publish a statement setting out the reasons for that decision.
- (5) A statement under this section may be published in such manner as the Secretary of State thinks fit.

## **10 Matters to be taken into account in connection with carbon budgets**

- (1) The following matters must be taken into account—
  - (a) by the Secretary of State in coming to any decision under this Part relating to carbon budgets, and
  - (b) by the Committee on Climate Change in considering its advice in relation to any such decision.
- (2) The matters to be taken into account are—
  - (a) scientific knowledge about climate change;
  - (b) technology relevant to climate change;
  - (c) economic circumstances, and in particular the likely impact of the decision on the economy and the competitiveness of particular sectors of the economy;
  - (d) fiscal circumstances, and in particular the likely impact of the decision on taxation, public spending and public borrowing;
  - (e) social circumstances, and in particular the likely impact of the decision on fuel poverty;
  - (f) energy policy, and in particular the likely impact of the decision on energy supplies and the carbon and energy intensity of the economy;
  - (g) differences in circumstances between England, Wales, Scotland and Northern Ireland;
  - (h) circumstances at European and international level;
  - (i) the estimated amount of reportable emissions from international aviation and international shipping for the budgetary period or periods in question.
- (3) In subsection (2)(i) “the estimated amount of reportable emissions from international aviation and international shipping”, in relation to a budgetary period, means the aggregate of the amounts relating to emissions of targeted greenhouse gases from international aviation and international shipping that the Secretary or State or (as the case may be) the Committee estimates the United Kingdom will be required to report for that period in accordance with international carbon reporting practice.
- (4) Such amounts may be estimated using such reasonable method or methods as the Secretary of State or (as the case may be) the Committee considers appropriate.

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- (5) The duty in subsection (2)(i) applies if and to the extent that regulations under section 30 do not provide for emissions of targeted greenhouse gases from international aviation and international shipping in the budgetary period or periods in question to be treated as emissions from sources in the United Kingdom for the purposes of this Part.
- (6) Section 30(1) (emissions from international aviation and international shipping not to count as emissions from UK sources for the purposes of this Part, except as provided by regulations) does not prevent the Secretary of State or the Committee from taking into account the matter referred to in subsection (2)(i) for the purposes of this section.
- (7) Nothing in this section is to be read as restricting the matters that the Secretary of State or the Committee may take into account.

#### *Limit on use of carbon units*

### **11 Limit on use of carbon units**

- (1) It is the duty of the Secretary of State to set a limit on the net amount of carbon units that may be credited to the net UK carbon account for each budgetary period.
- (2) The “net amount of carbon units” means—
  - (a) the amount of carbon units credited to the net UK carbon account for the period in accordance with regulations under section 27, less
  - (b) the amount of carbon units debited from the net UK carbon account for the period in accordance with such regulations.
- (3) The limit for a budgetary period must be set—
  - (a) for the period 2008-2012, not later than 1st June 2009, and
  - (b) for any later period, not later than 18 months before the beginning of the period in question.
- (4) The Secretary of State must set a limit under this section by order.
- (5) The order may provide that carbon units of a description specified in the order do not count towards the limit.
- (6) An order under this section is subject to affirmative resolution procedure.
- (7) Before laying before Parliament a draft of a statutory instrument containing an order under this section in relation to a budgetary period, the Secretary of State must—
  - (a) take into account the advice of the Committee on Climate Change under section 34(1)(b) (advice on use of carbon units) in relation to that period, and
  - (b) consult the other national authorities.

#### *Indicative annual ranges*

### **12 Duty to provide indicative annual ranges for net UK carbon account**

- (1) As soon as is reasonably practicable after making an order setting the carbon budget for a budgetary period, the Secretary of State must lay before Parliament a report

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setting out an indicative annual range for the net UK carbon account for each year within the period.

- (2) An “indicative annual range”, in relation to a year, is a range within which the Secretary of State expects the amount of the net UK carbon account for the year to fall.
- (3) Before laying a report under this section before Parliament, the Secretary of State must consult the other national authorities on the indicative annual ranges set out in the report.
- (4) The Secretary of State must send a copy of the report to those authorities.

*Proposals and policies for meeting carbon budgets*

**13 Duty to prepare proposals and policies for meeting carbon budgets**

- (1) The Secretary of State must prepare such proposals and policies as the Secretary of State considers will enable the carbon budgets that have been set under this Act to be met.
- (2) The proposals and policies must be prepared with a view to meeting—
  - (a) the target in section 1 (the target for 2050), and
  - (b) any target set under section 5(1)(c) (power to set targets for later years).
- (3) The proposals and policies, taken as a whole, must be such as to contribute to sustainable development.
- (4) In preparing the proposals and policies, the Secretary of State may take into account the proposals and policies the Secretary of State considers may be prepared by other national authorities.

**14 Duty to report on proposals and policies for meeting carbon budgets**

- (1) As soon as is reasonably practicable after making an order setting the carbon budget for a budgetary period, the Secretary of State must lay before Parliament a report setting out proposals and policies for meeting the carbon budgets for the current and future budgetary periods up to and including that period.
- (2) The report must, in particular, set out—
  - (a) the Secretary of State's current proposals and policies under section 13, and
  - (b) the time-scales over which those proposals and policies are expected to take effect.
- (3) The report must explain how the proposals and policies set out in the report affect different sectors of the economy.
- (4) The report must outline the implications of the proposals and policies as regards the crediting of carbon units to the net UK carbon account for each budgetary period covered by the report.
- (5) So far as the report relates to proposals and policies of the Scottish Ministers, the Welsh Ministers or a Northern Ireland department, it must be prepared in consultation with that authority.
- (6) The Secretary of State must send a copy of the report to those authorities.

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## **15 Duty to have regard to need for UK domestic action on climate change**

- (1) In exercising functions under this Part involving consideration of how to meet—
  - (a) the target in section 1(1) (the target for 2050), or
  - (b) the carbon budget for any period,the Secretary of State must have regard to the need for UK domestic action on climate change.
- (2) “UK domestic action on climate change” means reductions in UK emissions of targeted greenhouse gases or increases in UK removals of such gases (or both).

*Determination whether objectives met*

## **16 Annual statement of UK emissions**

- (1) It is the duty of the Secretary of State to lay before Parliament in respect of each year, beginning with the year 2008, a statement containing the following information.
- (2) In respect of each greenhouse gas (whether or not a targeted greenhouse gas), it must—
  - (a) state the amount for the year of UK emissions, UK removals and net UK emissions of that gas,
  - (b) identify the methods used to measure or calculate those amounts, and
  - (c) state whether any of those amounts represents an increase or decrease compared to the equivalent amount for the previous year.
- (3) It must state the aggregate amount for the year of UK emissions, UK removals and net UK emissions of all greenhouse gases.
- (4) If in accordance with international carbon reporting practice a change of method is such as to require adjustment of an amount for an earlier year in the same budgetary period, it must specify the adjustment required and state the adjusted amount.
- (5) If emissions of a greenhouse gas from international aviation or international shipping are not required to be included in the statement by virtue of subsection (2), it must state any amounts relating to such emissions that the United Kingdom is required to report for the year in accordance with international carbon reporting practice.
- (6) It must—
  - (a) state the total amount of carbon units that have been credited to or debited from the net UK carbon account for the year, and
  - (b) give details of the number and type of those carbon units.
- (7) It must state the amount of the net UK carbon account for the year.
- (8) It must state—
  - (a) the amount of net UK emissions of carbon dioxide for the year 1990,
  - (b) the amount of net UK emissions of each targeted greenhouse gas other than carbon dioxide for the year that is the base year for that gas, and
  - (c) a baseline amount for each greenhouse gas that is not a targeted greenhouse gas, determined on such basis as the Secretary of State considers appropriate.
- (9) The amount referred to in subsection (8)(c) may be—

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- (a) the amount of net UK emissions of the gas for the year 1990 or a different year, or
  - (b) the average amount of net UK emissions of the gas for a number of years.
- (10) The statement required by this section must be laid before Parliament not later than 31st March in the second year following that to which it relates.
- (11) The Secretary of State must send a copy of the statement to the other national authorities.

## **17 Powers to carry amounts from one budgetary period to another**

- (1) The Secretary of State may decide to carry back part of the carbon budget for a budgetary period to the preceding budgetary period.

The carbon budget for the later period is reduced, and that for the earlier period increased, by the amount carried back.

- (2) The amount carried back under subsection (1) must not exceed 1% of the carbon budget for the later period.
- (3) The Secretary of State may decide to carry forward the whole or part of any amount by which the carbon budget for a budgetary period exceeds the net UK carbon account for the period.

The amount of the carbon budget for the next budgetary period is increased by the amount carried forward.

- (4) Before deciding to carry an amount back or forward under this section, the Secretary of State must—
- (a) consult the other national authorities, and
  - (b) obtain, and take into account, the advice of the Committee on Climate Change.
- (5) Any such decision must be made no later than 31st May in the second year after the end of the earlier of the two budgetary periods affected.

## **18 Final statement for budgetary period**

- (1) It is the duty of the Secretary of State to lay before Parliament in respect of each budgetary period a statement containing the following information.
- (2) In respect of each targeted greenhouse gas, it must state the final amount for the period of UK emissions, UK removals and net UK emissions of that gas.

That is the total of the amounts (or adjusted amounts) stated under section 16 (annual statement of UK emissions) in respect of that gas for the years included in the period.

- (3) It must—
- (a) state the final amount of carbon units that have been credited to or debited from the net UK carbon account for the period, and
  - (b) give details of the number and type of those carbon units.
- (4) It must state the final amount of the net UK carbon account for the period.

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- (5) It must state whether the Secretary of State has decided to carry an amount back under section 17(1) (power to carry amount back from the budget for the next budgetary period), and if so what amount.
- (6) It must state the amount of the carbon budget for the period.  

That is the amount originally set, subject to any exercise of the powers conferred by section 17 (powers to carry amounts from one budgetary period to another) and any alteration of the budget under section 21.
- (7) Whether the carbon budget for a period has been met shall be determined by reference to the figures given in the statement laid before Parliament under this section in respect of that period.
- (8) If the carbon budget for the period has not been met, the statement must explain why it has not been met.
- (9) The statement required by this section must be laid before Parliament not later than 31st May in the second year following the end of the period to which it relates.
- (10) The Secretary of State must send a copy of the statement to the other national authorities.

## **19 Duty to report on proposals and policies for compensating for budget excess**

- (1) As soon as is reasonably practicable after laying a statement before Parliament under section 18 in respect of a period for which the net UK carbon account exceeds the carbon budget, the Secretary of State must lay before Parliament a report setting out proposals and policies to compensate in future periods for the excess emissions.
- (2) So far as the report relates to proposals and policies of the Scottish Ministers, the Welsh Ministers or a Northern Ireland department, it must be prepared in consultation with that authority.
- (3) The Secretary of State must send a copy of the report to those authorities.

## **20 Final statement for 2050**

- (1) It is the duty of the Secretary of State to lay before Parliament in respect of the year 2050 a statement containing the following information.
- (2) In respect of each targeted greenhouse gas, it must state the amount for that year of UK emissions, UK removals and net UK emissions of that gas.  

That is the amount stated for that year in respect of that gas under section 16 (annual statement of UK emissions).
- (3) It must—
  - (a) state the amount of carbon units that have been credited to or debited from the net UK carbon account for the year, and
  - (b) give details of the number and type of those carbon units.
- (4) It must state the amount of the net UK carbon account for that year.

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- (5) Whether the target in section 1 (the target for 2050) has been met shall be determined by reference to the figures given in the statement laid before Parliament under this section.
- (6) If the target has not been met, the statement must explain why it has not been met.
- (7) The statement required by this section must be laid before Parliament not later than 31st May 2052.
- (8) The Secretary of State must send a copy of the statement to the other national authorities.

### *Alteration of budgets or budgetary periods*

## **21 Alteration of carbon budgets**

- (1) An order setting the carbon budget for a period may not be revoked after the date by which a budget for the period was required to be set.
- (2) An order setting the carbon budget for a period may be amended after the date by which a budget for the period was required to be set only if it appears to the Secretary of State that, since the budget was originally set (or previously altered), there have been significant changes affecting the basis on which the previous decision was made.
- (3) An order setting the carbon budget for a period may be amended after the period has begun only if it appears to the Secretary of State that there have been such changes since the period began.
- (4) An order setting the carbon budget for a period may not be amended after the period has ended.
- (5) An order revoking or amending an order setting a carbon budget is subject to affirmative resolution procedure.

## **22 Consultation on alteration of carbon budgets**

- (1) Before laying before Parliament a draft of a statutory instrument containing an order under section 21 (alteration of carbon budgets), the Secretary of State must—
  - (a) obtain, and take into account, the advice of the Committee on Climate Change, and
  - (b) take into account any representations made by the other national authorities.
- (2) The Committee must, at the time it gives its advice to the Secretary of State, send a copy to the other national authorities.
- (3) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.
- (4) The Secretary of State may proceed to lay such a draft statutory instrument before Parliament without having received a national authority's representations if the authority does not provide them before the end of the relevant period.
- (5) The relevant period is—

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- (a) if the budgetary period to which the order relates has begun, one month beginning with the date the Committee's advice was sent to the authority, or
  - (b) otherwise, three months beginning with that date.
- (6) At the same time as laying such a draft statutory instrument before Parliament, the Secretary of State must publish a statement setting out whether and how the order takes account of any representations made by the other national authorities.
- (7) If the order makes provision different from that recommended by the Committee, the Secretary of State must also publish a statement setting out the reasons for that decision.
- (8) A statement under this section may be published in such manner as the Secretary of State thinks fit.

## 23 Alteration of budgetary periods

- (1) The Secretary of State may by order amend section 4(1)(a) so as to alter—
  - (a) the length of the budgetary periods, or
  - (b) the dates in the calendar year on which the budgetary periods begin and end.
- (2) This power may only be exercised if it appears to the Secretary of State necessary to do so in order to keep the budgetary periods under this Part in line with similar periods under any agreement at European or international level to which the United Kingdom is a party.
- (3) The power may not be exercised in such a way that any period falls outside a budgetary period.
- (4) An order may make such consequential amendments of the provisions of this Act as appear to the Secretary of State to be necessary or expedient.
- (5) Before making an order under this section the Secretary of State must consult the other national authorities.
- (6) An order under this section is subject to affirmative resolution procedure.

### Modifications etc. (not altering text)

C1 S. 23(4) power to amend conferred (18.12.2013) by [Energy Act 2013 \(c. 32\)](#), [ss. 1\(8\)\(a\)](#), 156(3)

## Targeted greenhouse gases

## 24 Targeted greenhouse gases

- (1) In this Part a “targeted greenhouse gas” means—
  - (a) carbon dioxide,
  - (b) methane,
  - (c) nitrous oxide,
  - (d) hydrofluorocarbons,
  - (e) perfluorocarbons,
  - (f) sulphur hexafluoride, and

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- (g) any other greenhouse gas designated as a targeted greenhouse gas by order made by the Secretary of State.
- (2) The order may make such consequential amendments of the provisions of this Act as appear to the Secretary of State to be necessary or expedient.
- (3) Before making an order under this section, the Secretary of State must—
  - (a) consult the other national authorities, and
  - (b) obtain, and take into account, the advice of the Committee on Climate Change.
- (4) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.
- (5) If the order makes provision different from that recommended by the Committee, the Secretary of State must publish a statement setting out the reasons for that decision.
- (6) The statement may be published in such manner as the Secretary of State thinks fit.
- (7) An order under this section is subject to affirmative resolution procedure.

## 25 Base years for targeted greenhouse gases other than CO<sub>2</sub>

- (1) The base years for the purposes of this Act for targeted greenhouse gases other than carbon dioxide are—

<i>Gas</i>	<i>Base year</i>
methane	1990
nitrous oxide	1990
hydrofluorocarbons	1995
perfluorocarbons	1995
sulphur hexafluoride	1995

- (2) The Secretary of State may make provision by order amending the table in subsection (1) so as to—
  - (a) specify the base year for a gas designated as a targeted greenhouse gas by order under section 24(1), or
  - (b) specify a different base year from that for the time being specified in relation to any targeted greenhouse gas other than carbon dioxide.
- (3) An order may—
  - (a) designate a particular base year, or
  - (b) designate a number of base years and provide that the average amount of net UK emissions of a gas for those years is to be treated for the purposes of this Act as the amount of net UK emissions for the base year.
- (4) The power in subsection (2)(b) may only be exercised if it appears to the Secretary of State that there have been significant developments in European or international law or policy that make it appropriate to do so.
- (5) Before making an order under this section, the Secretary of State must—
  - (a) consult the other national authorities, and

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- (b) obtain, and take into account, the advice of the Committee on Climate Change.
- (6) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.
- (7) If the order makes provision different from that recommended by the Committee, the Secretary of State must publish a statement setting out the reasons for that decision.
- (8) The statement may be published in such manner as the Secretary of State thinks fit.
- (9) An order under this section is subject to affirmative resolution procedure.

### *Carbon units, carbon accounting and the net UK carbon account*

## **26 Carbon units and carbon accounting**

- (1) In this Part a “carbon unit” means a unit of a kind specified in regulations made by the Secretary of State and representing—
  - (a) a reduction in an amount of greenhouse gas emissions,
  - (b) the removal of an amount of greenhouse gas from the atmosphere, or
  - (c) an amount of greenhouse gas emissions allowed under a scheme or arrangement imposing a limit on such emissions.
- (2) The Secretary of State may make provision by regulations for a scheme—
  - (a) for registering or otherwise keeping track of carbon units, or
  - (b) for establishing and maintaining accounts in which carbon units may be held, and between which they may be transferred, by the Secretary of State.

The regulations may, in particular, provide for an existing scheme to be adapted for these purposes.

- (3) The regulations may make provision—
  - (a) appointing a body to administer the scheme;
  - (b) establishing a body for that purpose and making such provision in relation to the appointment of members, staffing, expenditure, procedure and otherwise as the Secretary of State considers appropriate;
  - (c) conferring power on the Secretary of State to give guidance or directions to the body administering the scheme;
  - (d) conferring power on the Secretary of State to delegate the performance of any of the functions conferred or imposed on the Secretary of State by the regulations;
  - (e) requiring the payment by persons using the scheme of charges (of an amount determined by or under the regulations) towards the cost of operating it.
- (4) If an existing body is appointed to administer the scheme, the regulations may make such modifications of any enactment relating to that body as the Secretary of State considers appropriate.

## **27 Net UK carbon account**

- (1) In this Part the “net UK carbon account” for a period means the amount of net UK emissions of targeted greenhouse gases for the period—

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- (a) reduced by the amount of carbon units credited to the net UK carbon account for the period in accordance with regulations under this section, and
  - (b) increased by the amount of carbon units that in accordance with such regulations are to be debited from the net UK carbon account for the period.
- (2) The net amount of carbon units credited to the net UK carbon account for a budgetary period must not exceed the limit set under section 11 (limit on use of carbon units) for the period.
- (3) The Secretary of State must make provision by regulations about—
- (a) the circumstances in which carbon units may be credited to the net UK carbon account for a period,
  - (b) the circumstances in which such units must be debited from that account for a period, and
  - (c) the manner in which this is to be done.
- (4) The regulations must contain provision for ensuring that carbon units that are credited to the net UK carbon account for a period cease to be available to offset other greenhouse gas emissions.
- (5) The regulations must contain provision—
- (a) for determining whether the total amount of carbon units allocated to the United Kingdom for each budgetary period under schemes or arrangements imposing a limit on emissions from sources in the United Kingdom represent an amount of net UK emissions of targeted greenhouse gases for the period greater than the carbon budget for the period, and
  - (b) for ensuring that, if this is the case, carbon units representing the amount of such emissions in excess of the budget are not used to offset greenhouse gas emissions in the United Kingdom or elsewhere.

## **28 Procedure for regulations under section 26 or 27**

- (1) The following provisions apply in relation to regulations under section 26 (carbon units and carbon accounting) or section 27 (net UK carbon account).
- (2) The regulations are subject to affirmative resolution procedure if—
- (a) they are the first regulations to be made under those sections,
  - (b) they specify a carbon unit of a kind not previously specified in regulations made under those sections,
  - (c) they alter the amount by which—
    - (i) a carbon unit that is credited to the net UK carbon account for a period reduces the net UK carbon account for that period, or
    - (ii) a carbon unit that is debited from the net UK carbon account for a period increases the net UK carbon account for that period, or
  - (d) they make modifications of an enactment contained in primary legislation.
- (3) Otherwise the regulations are subject to negative resolution procedure.
- (4) The Secretary of State must consult the other national authorities—
- (a) in the case of regulations subject to affirmative resolution procedure, before laying before Parliament a draft of a statutory instrument containing the regulations;

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- (b) in the case of regulations subject to negative resolution procedure, before making the regulations.
- (5) The Secretary of State must obtain, and take into account, the advice of the Committee on Climate Change before laying before Parliament a draft of a statutory instrument containing—
- (a) the first regulations to be made under those sections, or
  - (b) regulations making provision of the kind described in paragraph (b) or (c) of subsection (2).

#### *Other supplementary provisions*

### **29 UK emissions and removals of greenhouse gases**

- (1) In this Part—
- (a) “UK emissions”, in relation to a greenhouse gas, means emissions of that gas from sources in the United Kingdom;
  - (b) “UK removals”, in relation to a greenhouse gas, means removals of that gas from the atmosphere due to land use, land-use change or forestry activities in the United Kingdom;
  - (c) the “net UK emissions” for a period, in relation to a greenhouse gas, means the amount of UK emissions of that gas for the period reduced by the amount for the period of UK removals of that gas.
- (2) The amount of UK emissions and UK removals of a greenhouse gas for a period must be determined consistently with international carbon reporting practice.

### **30 Emissions from international aviation or international shipping**

- (1) Emissions of greenhouse gases from international aviation or international shipping do not count as emissions from sources in the United Kingdom for the purposes of this Part, except as provided by regulations made by the Secretary of State.
- (2) The Secretary of State may by order define what is to be regarded for this purpose as international aviation or international shipping.
- Any such order is subject to affirmative resolution procedure.
- (3) The Secretary of State must, before expiry of the period ending with 31st December 2012—
- (a) make provision by regulations as to the circumstances in which, and the extent to which, emissions from international aviation or international shipping are to be regarded for the purposes of this Part as emissions from sources in the United Kingdom, or
  - (b) lay before Parliament a report explaining why regulations making such provision have not been made.
- (4) The expiry of the period mentioned in subsection (3) does not affect the power of the Secretary of State to make regulations under this section.
- (5) Regulations under this section—
- (a) may make provision only in relation to emissions of a targeted greenhouse gas;

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- (b) may, in particular, provide for such emissions to be regarded as emissions from sources in the United Kingdom if they relate to the transport of passengers or goods to or from the United Kingdom.
- (6) Regulations under this section may make provision—
  - (a) as to the period or periods (whether past or future) in which emissions of the targeted greenhouse gas are to be taken into account as UK emissions of that gas, and
  - (b) as to the manner in which such emissions are to be taken into account in determining UK emissions of that gas for the year that is the base year for that gas.
- (7) They may, in particular—
  - (a) designate a different base year, or
  - (b) designate a number of base years,
 and provide for the emissions in that year, or the average amount of emissions in those years, to be treated for the purposes of this Act as UK emissions of that gas for the year that is the base year for that gas.
- (8) For the purposes of this section the base year for carbon dioxide is the year that is the baseline year for the purposes of this Part.

### **31 Procedure for regulations under section 30**

- (1) Before making regulations under section 30, the Secretary of State must obtain, and take into account, the advice of the Committee on Climate Change.
- (2) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.
- (3) If the regulations make provision different from that recommended by the Committee, the Secretary of State must publish a statement setting out the reasons for that decision.
- (4) The statement may be published in such manner as the Secretary of State thinks fit.
- (5) Regulations under section 30 are subject to affirmative resolution procedure.

## **PART 2**

### **THE COMMITTEE ON CLIMATE CHANGE**

#### *The Committee*

### **32 The Committee on Climate Change**

- (1) There shall be a body corporate to be known as the Committee on Climate Change or, in Welsh, as y Pwyllgor ar Newid Hinsawdd (referred to in this Part as “the Committee”).
- (2) Schedule 1 contains further provisions about the Committee.

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### *Functions of the Committee*

#### **33 Advice on level of 2050 target**

- (1) It is the duty of the Committee to advise the Secretary of State on—
  - (a) whether the percentage specified in section 1(1) (the target for 2050) should be amended, and
  - (b) if so, what the amended percentage should be.
- (2) Advice given by the Committee under this section must also contain the reasons for that advice.
- (3) The Committee must give its advice under this section not later than 1st December 2008.
- (4) The Committee must, at the time it gives its advice under this section to the Secretary of State, send a copy to the other national authorities.
- (5) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

#### **34 Advice in connection with carbon budgets**

- (1) It is the duty of the Committee to advise the Secretary of State, in relation to each budgetary period, on—
  - (a) the level of the carbon budget for the period,
  - (b) the extent to which the carbon budget for the period should be met—
    - (i) by reducing the amount of net UK emissions of targeted greenhouse gases, or
    - (ii) by the use of carbon units that in accordance with regulations under sections 26 and 27 may be credited to the net UK carbon account for the period,
  - (c) the respective contributions towards meeting the carbon budget for the period that should be made—
    - (i) by the sectors of the economy covered by trading schemes (taken as a whole);
    - (ii) by the sectors of the economy not so covered (taken as a whole), and
  - (d) the sectors of the economy in which there are particular opportunities for contributions to be made towards meeting the carbon budget for the period through reductions in emissions of targeted greenhouse gases.
- (2) In relation to the budgetary period 2008-2012, the Committee must also advise the Secretary of State on—
  - (a) whether it would be consistent with its advice on the level of the carbon budget for the period to set a carbon budget such that the annual equivalent for the period was lower than the 1990 baseline by 20%, and
  - (b) the costs and benefits of setting such a budget.
- (3) Advice given by the Committee under this section must also contain the reasons for that advice.
- (4) The Committee must give its advice under this section—

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- (a) for the budgetary periods 2008-2012, 2013-2017 and 2018-2022, not later than 1st December 2008;
  - (b) for any later period, not later than six months before the last date for setting the carbon budget for the period (see section 4(2)(b)).
- (5) The Committee must, at the time it gives its advice under this section to the Secretary of State, send a copy to the other national authorities.
- (6) As soon as is reasonably practicable after giving its advice under this section the Committee must publish that advice in such manner as it considers appropriate.

### **35 Advice on emissions from international aviation and international shipping**

- (1) It is the duty of the Committee to advise the Secretary of State on the consequences of treating emissions of targeted greenhouse gases from—
- (a) international aviation, and
  - (b) international shipping,
- as emissions from sources in the United Kingdom for the purposes of Part 1.
- (2) The duty applies if and to the extent that regulations under section 30 do not provide for such emissions to be so treated.
- (3) Advice given by the Committee under this section must also contain the reasons for that advice.
- (4) The Committee must give its advice under this section—
- (a) when it gives its advice under section 34 for the budgetary period 2023-2027, and
  - (b) when it gives its advice under that section for each subsequent budgetary period.
- (5) The Committee must, at the time it gives its advice under this section to the Secretary of State, send a copy to the other national authorities.
- (6) As soon as is reasonably practicable after giving its advice to the Secretary of State, the Committee must publish that advice in such manner as it considers appropriate.

### **36 Reports on progress**

- (1) It is the duty of the Committee to lay before Parliament and each of the devolved legislatures each year, beginning with the year 2009, a report setting out the Committee's views on—
- (a) the progress that has been made towards meeting the carbon budgets that have been set under Part 1 and the target in section 1 (the target for 2050),
  - (b) the further progress that is needed to meet those budgets and that target, and
  - (c) whether those budgets and that target are likely to be met.
- (2) The Committee's report in the second year after the end of a budgetary period must also set out the Committee's general views on—
- (a) the way in which the budget for the period was or was not met, and
  - (b) action taken during the period to reduce net UK emissions of targeted greenhouse gases.

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- (3) The first report under this section must be laid before Parliament and the devolved legislatures not later than 30th September 2009.
- (4) Each subsequent report under this section, other than one in the second year after the end of a budgetary period, must be laid before Parliament and the devolved legislatures not later than 30th June in the year in which it is made.
- (5) A report in the second year after the end of a budgetary period must be laid before Parliament and the devolved legislatures not later than 15th July in the year in which it is made.
- (6) The Secretary of State may by order extend the period mentioned in subsection (4) or (5).
- (7) Before making such an order the Secretary of State must consult the other national authorities.
- (8) Any such order is subject to negative resolution procedure.

### **37 Response to Committee's reports on progress**

- (1) The Secretary of State must lay before Parliament a response to the points raised by each report of the Committee under section 36 (reports on progress).
- (2) Before doing so, the Secretary of State must consult the other national authorities on a draft of the response.
- (3) The response to the Committee's first report under section 36 must be laid before Parliament not later than 15th January 2010.
- (4) Each subsequent response must be laid before Parliament not later than 15th October in the year in which the Committee's report is made.
- (5) The Secretary of State may by order extend that period.
- (6) Any such order is subject to negative resolution procedure.

### **38 Duty to provide advice or other assistance on request**

- (1) The Committee must, at the request of a national authority, provide advice, analysis, information or other assistance to the authority in connection with—
  - (a) the authority's functions under this Act,
  - (b) the progress made towards meeting the objectives set by or under this Act,
  - (c) adaptation to climate change, or
  - (d) any other matter relating to climate change.
- (2) In particular, the Committee must, at the request of a national authority—
  - (a) advise the authority about any limit proposed to be set by a trading scheme on the total amount of the activities to which the scheme applies, or
  - (b) assist the authority in connection with the preparation of statistics relating to greenhouse gas emissions.
- (3) The Committee must, at the request of a national authority other than the Secretary of State, provide advice, analysis, information or other assistance to the authority in connection with any target, budget or similar requirement relating to emissions of

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greenhouse gas that has been adopted by the authority or to which the authority is otherwise subject.

### *Supplementary provisions*

#### **39 General ancillary powers**

- (1) The Committee may do anything that appears to it necessary or appropriate for the purpose of, or in connection with, the carrying out of its functions.
- (2) In particular the Committee may—
  - (a) enter into contracts,
  - (b) acquire, hold and dispose of property,
  - (c) borrow money,
  - (d) accept gifts, and
  - (e) invest money.
- (3) In exercising its functions, the Committee may—
  - (a) gather information and carry out research and analysis,
  - (b) commission others to carry out such activities, and
  - (c) publish the results of such activities carried out by the Committee or others.
- (4) The Committee must have regard to the desirability of involving the public in the exercise of its functions.

#### **40 Grants to the Committee**

A national authority may make grants to the Committee of such amount and subject to such conditions as the authority thinks fit.

#### **41 Powers to give guidance**

- (1) The national authorities may give the Committee guidance as to the matters it is to take into account in the exercise of—
  - (a) its functions generally, or
  - (b) any of its functions under Schedule 1.
- (2) The Secretary of State may give the Committee guidance as to the matters it is to take into account in the exercise of its functions under—
  - (a) Part 1 (carbon target and budgeting),
  - (b) section 33 (advice on level of 2050 target),
  - (c) section 34 (advice in connection with carbon budgets),
  - (d) section 35 (advice on emissions from international aviation and international shipping),
  - (e) section 36 (reports on progress),
  - (f) section 57 (advice on report on impact of climate change), or
  - (g) section 59 (reporting on progress in connection with adaptation).

Before giving guidance under any of paragraphs (a) to (f), the Secretary of State must consult the other national authorities.

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- (3) A national authority that requests the Committee to provide advice, analysis, information or other assistance under—
- (a) section 38 (duty to provide advice or assistance on request), or
  - (b) section 48 (advice on trading scheme regulations),
- may give the Committee guidance as to the matters it is to take into account in responding to that request.
- If the request is made by two or more national authorities, the guidance must be given by them jointly.
- (4) The power to give guidance under this section includes power to vary or revoke it.
- (5) In performing its functions the Committee must have regard to any guidance given under this section.

## **42 Powers to give directions**

- (1) The national authorities may give the Committee directions as to the exercise of—
- (a) its functions generally, or
  - (b) any of its functions under Schedule 1.
- (2) The Secretary of State may give the Committee directions as to the exercise of its functions under—
- (a) Part 1 (carbon target and budgeting),
  - (b) section 33 (advice on level of 2050 target),
  - (c) section 34 (advice in connection with carbon budgets),
  - (d) section 35 (advice on emissions from international aviation and international shipping),
  - (e) section 36 (reports on progress),
  - (f) section 57 (advice on report on impact of climate change), or
  - (g) section 59 (reporting on progress in connection with adaptation).

Before giving directions under any of paragraphs (a) to (f), the Secretary of State must consult the other national authorities.

- (3) A national authority that requests the Committee to provide advice, analysis, information or other assistance under—
- (a) section 38 (duty to provide advice or assistance on request), or
  - (b) section 48 (advice on trading scheme regulations),
- may give the Committee directions as to the exercise of its functions in responding to that request.
- If the request is made by two or more national authorities, the directions must be given by them jointly.
- (4) The power to give directions under this section does not include power to direct the Committee as to the content of any advice or report.
- (5) The power to give directions under this section includes power to vary or revoke the directions.
- (6) The Committee must comply with any directions given under this section.

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## *Interpretation*

### **43 Interpretation of Part 2**

Expressions used in this Part that are defined in Part 1 (carbon target and budgeting) have the same meaning as in that Part.

## **PART 3**

### TRADING SCHEMES

#### *Trading schemes*

### **44 Trading schemes**

- (1) The relevant national authority may make provision by regulations for trading schemes relating to greenhouse gas emissions.
- (2) A “trading scheme” is a scheme that operates by—
  - (a) limiting or encouraging the limitation of activities that consist of the emission of greenhouse gas or that cause or contribute, directly or indirectly, to such emissions, or
  - (b) encouraging activities that consist of, or that cause or contribute, directly or indirectly, to reductions in greenhouse gas emissions or the removal of greenhouse gas from the atmosphere.

### **45 Activities to which trading schemes may apply**

- (1) For the purposes of this Part activities are regarded as indirectly causing or contributing to greenhouse gas emissions if they involve, in particular—
  - (a) the consumption of energy,
  - (b) the use of materials in whose production energy was consumed,
  - (c) the disposal otherwise than for recycling of materials in whose production energy was consumed, or
  - (d) the production or supply of anything whose subsequent use directly causes or contributes to greenhouse gas emissions.
- (2) Correspondingly, for the purposes of this Part activities are regarded as indirectly causing or contributing to the reduction of greenhouse gas emissions if they involve a reduction under any of those heads.
- (3) This Part applies to activities carried on in the United Kingdom, regardless of where the related emissions, reductions or removals of greenhouse gas occur.

### **46 Matters that may or must be provided for in regulations**

- (1) Schedule 2 specifies matters that may or must be provided for in regulations under section 44.
- (2) In that Schedule—

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Part 1 deals with schemes that operate by limiting or encouraging the limitation of activities that consist of the emission of greenhouse gas or that cause or contribute, directly or indirectly, to such emissions;

Part 2 deals with schemes that operate by encouraging activities that consist of, or that cause or contribute, directly or indirectly, to reductions in greenhouse gas emissions or the removal of greenhouse gas from the atmosphere;

Part 3 deals with administration and enforcement.

- (3) Regulations under section 44 may also make provision about the application of the regulations to the Crown.

### *Authorities and regulations*

#### **47 Relevant national authorities**

- (1) This section identifies “the relevant national authority” for the purposes of this Part.
- (2) The Scottish Ministers are the relevant national authority in relation to matters within the legislative competence of the Scottish Parliament.
- (3) The Welsh Ministers are the relevant national authority in relation to matters that—
- (a) are within the legislative competence of the National Assembly for Wales, or
  - (b) relate to limiting or encouraging the limitation of activities in Wales that consist of the emission of greenhouse gas, other than activities in connection with offshore oil and gas exploration and exploitation.
- (4) In subsection (3)(b)—
- “Wales” has the same meaning as in the Government of Wales Act 2006 (c. 32); and
  - “offshore oil and gas exploration and exploitation” has the same meaning as in the National Assembly for Wales (Transfer of Functions) Order 2005 (S.I. 2005/1958).
- (5) The Secretary of State or the relevant Northern Ireland department is the relevant authority in relation to reserved matters within the meaning of the Northern Ireland Act 1998 (c. 47).
- (6) The relevant Northern Ireland department is the relevant authority in relation to all other matters within the legislative competence of the Northern Ireland Assembly.
- (7) The Secretary of State is the relevant national authority in relation to all other matters.

#### **48 Procedure for making regulations**

- (1) Before making regulations under this Part, a national authority must—
- (a) obtain, and take into account, the advice of the Committee on Climate Change, and
  - (b) consult such persons likely to be affected by the regulations as the authority considers appropriate.
- (2) In particular, before making regulations under this Part that set a limit on the total amount of the activities to which a trading scheme applies for a trading period or

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periods, a national authority must obtain, and take into account, the advice of the Committee on Climate Change on the amount of that limit.

- (3) Regulations under this Part are subject to affirmative resolution procedure if they contain provision—
- (a) setting up a trading scheme,
  - (b) extending the class of participants or activities to which a trading scheme applies,
  - (c) extending the duration of a trading scheme,
  - (d) making the overall requirements of a trading scheme significantly more onerous,
  - (e) conferring new powers to enforce the requirements of a trading scheme,
  - (f) imposing or providing for the imposition of new financial or other penalties or increasing the amount of existing financial penalties,
  - (g) creating an offence or increasing the penalties for an existing offence, or
  - (h) amending or repealing a provision of an enactment contained in primary legislation.
- (4) Regulations under this Part are subject to affirmative resolution procedure if they are the first such regulations to contain provision under paragraph 31 of Schedule 2 (appeals).
- (5) Other regulations under this Part are subject to negative resolution procedure.
- (6) The relevant Northern Ireland department may only make regulations under this Part dealing with a reserved matter within the meaning of the Northern Ireland Act 1998 (c. 47) with the consent of the Secretary of State.

#### **49 Further provisions about regulations**

- (1) Schedule 3 makes further provision about regulations under this Part.
- (2) In that Schedule—
- Part 1 relates to regulations made by a single national authority;
  - Part 2 relates to regulations made by two or more national authorities; and
  - Part 3 confers power to make provision by Order in Council.

#### *Other supplementary provisions*

#### **50 Information**

- (1) Schedule 4 confers powers to require information for the purposes of enabling a trading scheme to be established.
- (2) Paragraphs 1 to 5 of that Schedule shall cease to have effect on 1st January 2011.

#### **51 Powers to give guidance**

- (1) The relevant national authority may give guidance to the administrator of a trading scheme.
- (2) The power to give guidance under this section includes power to vary or revoke it.

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(3) The administrator must have regard to any guidance given under this section.

## **52 Powers to give directions**

- (1) The relevant national authority may give directions to the administrator of a trading scheme.
- (2) The power to give directions under this section includes power to vary or revoke the directions.
- (3) The administrator must comply with any directions given under this section.

## **53 Grants to administrators and participants**

- (1) A national authority may make, or arrange for the making of, grants to—
  - (a) the administrator of a trading scheme, or
  - (b) the participants in a trading scheme.
- (2) A grant under this section may be made subject to such conditions as may be determined by, or in accordance with arrangements made by, the national authority that makes the grant.

## **54 Power to make consequential provision**

A national authority may by regulations—

- (a) make such provision amending, repealing or revoking any enactment as the authority considers appropriate in consequence of provision made by that authority by regulations under section 44 (trading schemes);
- (b) make such transitional provision and savings as the authority considers appropriate in connection with the coming into effect of such provision.

### *Interpretation*

## **55 Interpretation of Part 3**

In this Part—

“administrator”, in relation to a trading scheme, means a person appointed as the administrator of the scheme by regulations under paragraph 21 of Schedule 2;

“participant”, in relation to a trading scheme, means a person to whom the scheme applies by virtue of regulations under paragraph 4 or 15 of Schedule 2;

“trading period”, in relation to a trading scheme, means a period by reference to which the scheme is to operate by virtue of regulations under paragraph 2 or 13 of Schedule 2.

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## PART 4

### IMPACT OF AND ADAPTATION TO CLIMATE CHANGE

#### *National reports and programmes*

#### **56 Report on impact of climate change**

- (1) It is the duty of the Secretary of State to lay reports before Parliament containing an assessment of the risks for the United Kingdom of the current and predicted impact of climate change.
- (2) The first report under this section must be laid before Parliament no later than three years after this section comes into force.
- (3) Subsequent reports must be laid before Parliament no later than five years after the previous report was so laid.
- (4) The Secretary of State may extend the period for laying any such report, but must publish a statement setting out the reasons for the delay and specifying when the report will be laid before Parliament.
- (5) Before laying a report under this section before Parliament, the Secretary of State must take into account the advice of the Committee on Climate Change under section 57.
- (6) The Secretary of State must send a copy of each report under this section to the other national authorities.

#### **57 Advice of Committee on Climate Change on impact report**

- (1) It is the duty of the Committee on Climate Change to advise the Secretary of State on the preparation of each of the Secretary of State's reports under section 56.
- (2) The Committee must give its advice under this section in relation to a report not later than six months before the last date for laying the report before Parliament (see subsections (2) to (4) of section 56).
- (3) The Committee must, at the time it gives its advice under this section to the Secretary of State, send a copy to the other national authorities.
- (4) As soon as is reasonably practicable after giving its advice under this section the Committee must publish that advice in such manner as it considers appropriate.

#### **58 Programme for adaptation to climate change**

- (1) It is the duty of the Secretary of State to lay programmes before Parliament setting out —
  - (a) the objectives of Her Majesty's Government in the United Kingdom in relation to adaptation to climate change,
  - (b) the Government's proposals and policies for meeting those objectives, and
  - (c) the time-scales for introducing those proposals and policies,addressing the risks identified in the most recent report under section 56.

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- (2) The objectives, proposals and policies must be such as to contribute to sustainable development.
- (3) Each programme under this section must be laid before Parliament as soon as is reasonably practicable after the laying of the report under section 56 to which it relates.
- (4) The Secretary of State must send a copy of each programme under this section to the other national authorities.

## **59 Reporting on progress in connection with adaptation**

- (1) Each report of the Committee on Climate Change under section 36 to which this section applies must contain an assessment of the progress made towards implementing the objectives, proposals and policies set out in the programmes laid before Parliament under section 58 (adaptation to climate change).
- (2) This section applies to the report in the second year after that in which the Secretary of State lays the first programme under section 58 before Parliament.
- (3) After that, this section applies to the report under section 36 in every second year after that in which the Committee last made a report to which this section applies, subject to any order under subsection (4).
- (4) The Secretary of State may by order provide that this section shall apply to the report under section 36 in the year specified in the order and in every subsequent year.
- (5) An order under subsection (4) is subject to negative resolution procedure.

## **60 Programme for adaptation to climate change: Northern Ireland**

- (1) It is the duty of the relevant Northern Ireland department to lay programmes before the Northern Ireland Assembly setting out—
  - (a) the objectives of the department in relation to adaptation to climate change,
  - (b) the department's proposals and policies for meeting those objectives, and
  - (c) the time-scales for introducing those proposals and policies,addressing the risks identified in the most recent report under section 56.
- (2) The objectives, proposals and policies must be such as to contribute to sustainable development.
- (3) The second and each subsequent programme under this section must contain an assessment of the progress made towards implementing the objectives, proposals and policies set out in earlier programmes.
- (4) Each programme under this section must be laid before the Northern Ireland Assembly as soon as is reasonably practicable after the laying before Parliament of the report under section 56 to which it relates.
- (5) The relevant Northern Ireland department must send a copy of each programme under this section to the other national authorities.

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### *Reporting authorities: non-devolved functions*

#### **61 Guidance by Secretary of State to reporting authorities**

- (1) The Secretary of State may issue guidance to reporting authorities about—
  - (a) assessing the current and predicted impact of climate change in relation to the authorities' functions,
  - (b) preparing proposals and policies for adapting to climate change in the exercise of their functions, and
  - (c) co-operating with other reporting authorities for that purpose.
- (2) This section does not apply to devolved functions.

#### **62 Directions by Secretary of State to prepare reports**

- (1) The Secretary of State may direct a reporting authority to prepare a report containing any of the following—
  - (a) an assessment of the current and predicted impact of climate change in relation to the authority's functions;
  - (b) a statement of the authority's proposals and policies for adapting to climate change in the exercise of its functions and the time-scales for introducing those proposals and policies;
  - (c) an assessment of the progress made by the authority towards implementing the proposals and policies set out in its previous reports.
- (2) The Secretary of State may direct two or more reporting authorities to prepare a joint report.
- (3) The Secretary of State may give directions about—
  - (a) the time within which a report must be prepared, and
  - (b) its content,
 and may, in particular, require it to cover a particular geographical area.
- (4) This section does not apply to devolved functions.

#### **63 Compliance with Secretary of State's directions**

- (1) A reporting authority must comply with any directions under section 62.
- (2) Where two or more reporting authorities are directed to prepare a joint report, they must take reasonable steps to co-operate with each other for that purpose.
- (3) In preparing a report, a reporting authority must have regard to the following, so far as relevant—
  - (a) the most recent report under section 56 (report on impact of climate change);
  - (b) the most recent programme under section 58 (programme for adaptation to climate change);
  - (c) any guidance issued by the Secretary of State under section 61.
- (4) If the authority—
  - (a) has functions that are exercisable in or as regards Wales, or
  - (b) has devolved Welsh functions,

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it must also have regard, so far as relevant, to any guidance issued by the Welsh Ministers under section 66 and the most recent report under section 80 (report on climate change: Wales).

- (5) The authority must send a copy of the report to the Secretary of State.
- (6) The Secretary of State must publish the report in such manner as the Secretary of State considers appropriate.
- (7) This does not require the Secretary of State to publish—
  - (a) information the Secretary of State could refuse to disclose in response to a request under—
    - (i) the Freedom of Information Act 2000 (c. 36), or
    - (ii) the Environmental Information Regulations 2004 (S.I. 2004/3391) or any regulations replacing those regulations;
  - (b) information whose disclosure is prohibited by any enactment.
- (8) The authority must have regard to the report in exercising its functions other than its devolved functions.

#### **64 Consent of, or consultation with, devolved authorities**

- (1) The Secretary of State must obtain the consent of a devolved authority before issuing guidance under section 61 or giving a direction under section 62 relating to functions in relation to which—
  - (a) functions are exercisable jointly by that devolved authority and a Minister of the Crown, or
  - (b) functions are exercisable by a Minister of the Crown only with the agreement of that devolved authority.
- (2) The Secretary of State must consult a devolved authority before issuing guidance under section 61 or giving a direction under section 62 relating to functions in relation to which—
  - (a) functions are exercisable by that devolved authority other than jointly with a Minister of the Crown, or
  - (b) functions are exercisable by a Minister of the Crown only after consultation with that devolved authority.

#### **65 Report on exercise of power to give directions**

- (1) It is the duty of the Secretary of State to lay reports before Parliament setting out how the Secretary of State intends to exercise the power under section 62 to give directions to reporting authorities.
- (2) The reports must, in particular, identify—
  - (a) the circumstances in which directions are likely to be given, and
  - (b) the authorities or kinds of authority to whom the Secretary of State considers directions should be given as a matter of priority.
- (3) Nothing in a report under this section affects the exercise of the Secretary of State's power under section 62.

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- (4) Before laying a report under this section before Parliament the Secretary of State must consult such persons likely to be affected by the report as the Secretary of State considers appropriate.
- (5) The first report under this section must be laid before Parliament no later than 12 months after this Act is passed.
- (6) Subsequent reports must be laid before Parliament no later than the time when the next programme under section 58 is so laid.
- (7) The Secretary of State must send a copy of each report under this section to the other national authorities.

*Reporting authorities: devolved Welsh functions*

## **66 Guidance by Welsh Ministers to reporting authorities**

The Welsh Ministers may issue guidance to reporting authorities about—

- (a) assessing the current and predicted impact of climate change in relation to the authorities' devolved Welsh functions,
- (b) preparing proposals and policies for adapting to climate change in the exercise of those functions, and
- (c) co-operating with other reporting authorities for that purpose.

## **67 Directions by Welsh Ministers to prepare reports**

- (1) The Welsh Ministers may direct a reporting authority to prepare a report containing any of the following—
  - (a) an assessment of the current and predicted impact of climate change in relation to the authority's devolved Welsh functions;
  - (b) a statement of the authority's proposals and policies for adapting to climate change in the exercise of those functions and the time-scales for introducing those proposals and policies;
  - (c) an assessment of the progress made by the authority towards implementing the proposals and policies set out in its previous reports.
- (2) The Welsh Ministers may direct two or more reporting authorities to prepare a joint report.
- (3) The Welsh Ministers may give directions about—
  - (a) the time within which a report must be prepared, and
  - (b) its content,
 and may, in particular, require it to cover a particular geographical area.

## **68 Compliance with Welsh Ministers' directions**

- (1) A reporting authority must comply with any directions under section 67.
- (2) Where two or more reporting authorities are directed to prepare a joint report, they must take reasonable steps to co-operate with each other for that purpose.

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- (3) In preparing a report, a reporting authority must have regard to the following, so far as relevant—
  - (a) the most recent report under section 56 (report on impact of climate change);
  - (b) the most recent programme under section 58 (programme for adaptation to climate change);
  - (c) any guidance issued by the Secretary of State under section 61;
  - (d) any guidance issued by the Welsh Ministers under section 66;
  - (e) the most recent report under section 80 (report on climate change: Wales).
- (4) The authority must send a copy of the report to the Welsh Ministers.
- (5) The Welsh Ministers must publish the report in such manner as they consider appropriate.
- (6) This does not require the Welsh Ministers to publish—
  - (a) information they could refuse to disclose in response to a request under—
    - (i) the Freedom of Information Act 2000 (c. 36), or
    - (ii) the Environmental Information Regulations 2004 (S.I. 2004/3391) or any regulations replacing those regulations;
  - (b) information whose disclosure is prohibited by any enactment.
- (7) The authority must have regard to the report in exercising its devolved Welsh functions.

## **69 Consent of, or consultation with, Secretary of State**

- (1) The Welsh Ministers must obtain the consent of the Secretary of State before issuing guidance under section 66 or giving a direction under section 67 relating to functions in relation to which—
  - (a) functions are exercisable by a Minister of the Crown jointly with the Welsh Ministers, the First Minister or the Counsel General, or
  - (b) functions are exercisable by the Welsh Ministers, the First Minister or the Counsel General only with the agreement of a Minister of the Crown.
- (2) The Welsh Ministers must consult the Secretary of State before issuing guidance under section 66 or giving a direction under section 67 relating to functions in relation to which—
  - (a) functions are exercisable by a Minister of the Crown other than jointly with the Welsh Ministers, the First Minister or the Counsel General, or
  - (b) functions are exercisable by the Welsh Ministers, the First Minister or the Counsel General only after consultation with a Minister of the Crown.

### *Interpretation*

## **70 Interpretation**

- (1) In sections 61 to 69 and this section “reporting authority” means—
  - (a) a person or body with functions of a public nature,
  - (b) a person who is or is deemed to be a statutory undertaker for the purposes of any provision of—

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- (i) Part 11 of the Town and Country Planning Act 1990 (c. 8) (see section 262 of that Act), or
  - (ii) Part 10 of the Town and Country Planning (Scotland) Act 1997 (c. 8) (see section 214 of that Act), or
  - (c) a person who is a statutory undertaker within the meaning of [<sup>F4</sup>the Planning Act (Northern Ireland) 2011 (see section 250 of that Act)].
- (2) None of the following are reporting authorities for the purposes of those sections and this section—
- (a) a Minister of the Crown;
  - (b) either House of Parliament;
  - (c) a devolved authority;
  - (d) a devolved legislature.
- (3) In those sections and this section “devolved authority” means—
- (a) the Welsh Ministers, the First Minister or the Counsel General,
  - (b) the Scottish Ministers, the First Minister, the Lord Advocate or the Solicitor General for Scotland, or
  - (c) a Minister within the meaning of the Northern Ireland Act 1998 (c. 47) or a Northern Ireland department.
- (4) References in those sections to a reporting authority's “devolved functions” are to functions—
- (a) conferred or imposed by or under a Measure or Act of the National Assembly for Wales,
  - (b) exercisable in or as regards Wales and [<sup>F5</sup>capable of being conferred by provision falling within] the legislative competence of the National Assembly for Wales,
  - (c) exercisable in or as regards Scotland and relating to matters within the legislative competence of the Scottish Parliament,
  - (d) exercisable in or as regards Northern Ireland and relating to transferred matters within the meaning of the Northern Ireland Act 1998, or
  - (e) in relation to which functions are exercisable by a devolved authority,
- and in relation to which no functions are exercisable by a Minister of the Crown.
- (5) For this purpose functions are not to be regarded as exercisable by a Minister of the Crown in relation to a reporting authority's functions merely because—
- (a) the Minister of the Crown may exercise functions—
    - (i) under section 2(2) of the European Communities Act 1972 (c. 68),
    - (ii) by virtue of section 57(1) or under section 58 of the Scotland Act 1998 (c. 46) (Community and international obligations),
    - (iii) under section 27 or 28 of the Northern Ireland Act 1998 (international etc obligations),
    - (iv) by virtue of paragraph 5 of Schedule 3 to the Government of Wales Act 2006 (c. 32) or under section 82 of that Act (Community and international obligations), or
    - (v) under section 152 of that Act (intervention in case of functions relating to water etc),
- in relation to the reporting authority's functions,

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- (b) the Minister of the Crown's agreement is required to the exercise of a function by a devolved authority in relation to the reporting authority's functions, or
  - (c) the Minister of the Crown must be consulted by a devolved authority about the exercise of a function in relation to the reporting authority's functions.
- (6) References in those sections to a reporting authority's "devolved Welsh functions" are to functions—
- (a) conferred or imposed by or under a Measure or Act of the National Assembly for Wales,
  - (b) exercisable in or as regards Wales and [<sup>F6</sup>capable of being conferred by provision falling within] the legislative competence of the National Assembly for Wales, or
  - (c) in relation to which functions are exercisable by the Welsh Ministers, the First Minister or the Counsel General.
- (7) For this purpose functions are not to be regarded as exercisable by the Welsh Ministers, the First Minister or the Counsel General in relation to a reporting authority's functions merely because—
- (a) the agreement of the Welsh Ministers, the First Minister or the Counsel General is required to the exercise of a function by a Minister of the Crown in relation to the reporting authority's functions, or
  - (b) the Welsh Ministers, the First Minister or the Counsel General must be consulted by a Minister of the Crown about the exercise of a function in relation to the reporting authority's functions.
- (8) In those sections and this section—
- (a) "Counsel General" and "Wales" have the same meanings as in the Government of Wales Act 2006 (c. 32);
  - (b) "Minister of the Crown" includes a government department.

#### Textual Amendments

- F4** Words in s. 70(1)(c) substituted (N.I.) (1.4.2015) by [Planning Act \(Northern-Ireland\) 2011 \(c. 25\)](#), s. 254(1)(2), [Sch. 6 para. 102](#) (with s. 211); S.R. 2015/49, art. 3, [Sch. 1](#) (with [Sch. 2](#))
- F5** Words in s. 70(4)(b) substituted (1.4.2018) by [Wales Act 2017 \(c. 4\)](#), s. 71(4), [Sch. 6 para. 73](#) (with [Sch. 7 paras. 1, 6](#)); S.I. 2017/1179, reg. 3(r)
- F6** Words in s. 70(6)(b) substituted (1.4.2018) by [Wales Act 2017 \(c. 4\)](#), s. 71(4), [Sch. 6 para. 73](#) (with [Sch. 7 paras. 1, 6](#)); S.I. 2017/1179, reg. 3(r)

## PART 5

### OTHER PROVISIONS

#### *Waste reduction schemes*

#### 71 Waste reduction schemes

<sup>F7</sup>(1) .....

<sup>F8</sup>(2) .....

*Status: This version of this Act contains provisions that are prospective.*  
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F8(3) .....

**Textual Amendments**  
F7 S. 71(1) repealed (15.1.2012) by Localism Act 2011 (c. 20), ss. 47(a), 240(1)(e), Sch. 25 Pt. 8  
F8 S. 71(2)(3) repealed (15.1.2012) by Localism Act 2011 (c. 20), ss. 47(b), 240(1)(e), (3)Sch. 25 Pt. 8

**F972 Waste reduction provisions: piloting**

**Textual Amendments**  
F9 Ss. 72-75 repealed (15.1.2012) by Localism Act 2011 (c. 20), ss. 47(b), 240(1)(e), Sch. 25 Pts. 8

**F973 Waste reduction provisions: report and review**

**Textual Amendments**  
F9 Ss. 72-75 repealed (15.1.2012) by Localism Act 2011 (c. 20), ss. 47(b), 240(1)(e), Sch. 25 Pts. 8

**F974 Waste reduction provisions: interim report**

**Textual Amendments**  
F9 Ss. 72-75 repealed (15.1.2012) by Localism Act 2011 (c. 20), ss. 47(b), 240(1)(e), Sch. 25 Pts. 8

**F975 Waste reduction provisions: roll-out or repeal**

**Textual Amendments**  
F9 Ss. 72-75 repealed (15.1.2012) by Localism Act 2011 (c. 20), ss. 47(b), 240(1)(e), Sch. 25 Pts. 8

*Collection of household waste*

**76 Collection of household waste**

In section 46 of the Environmental Protection Act 1990 (c. 43) (receptacles for household waste), after subsection (10) insert—

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“(11) A waste collection authority is not obliged to collect household waste that is placed for collection in contravention of a requirement under this section.”.

### *Charges for <sup>F10</sup>carrier bags*

#### **Textual Amendments**

**F10** Words in Sch. 6 para. 2 substituted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 1\(b\)](#)

#### **77 Charges for <sup>F10</sup>carrier bags**

- (1) Schedule 6 makes provision about charges for <sup>F10</sup>carrier bags].
- (2) In that Schedule—
  - Part 1 confers power on the relevant national authority to make regulations about charges for <sup>F10</sup>carrier bags];
  - Part 2 makes provision about civil sanctions;
  - Part 3 makes provision about the procedures applying to regulations under the Schedule.
- (3) In that Schedule “the relevant national authority” means—
  - (a) the Secretary of State in relation to England;
  - (b) the Welsh Ministers in relation to Wales;
  - (c) the Department of the Environment in Northern Ireland in relation to Northern Ireland.
- (4) Regulations under that Schedule are subject to affirmative resolution procedure if—
  - (a) they are the first regulations to be made by the relevant national authority in question under the Schedule,
    - <sup>F11</sup>(aa) they are the first regulations to be made by the Welsh Ministers under paragraph 4A of the Schedule,]
    - <sup>F12</sup>(aa) they are to be made by the Department of the Environment in Northern Ireland under paragraph 4A of the Schedule;]
    - <sup>F13</sup>(ab) they are to be made by the Department of the Environment in Northern Ireland and increase the minimum amount specified under paragraph 4 of the Schedule;]
  - (b) they contain provision imposing or providing for the imposition of new civil sanctions,
  - (c) they increase the amount or maximum amount of a monetary penalty or change the basis on which such an amount or maximum is to be determined, or
  - (d) they amend or repeal a provision of an enactment contained in primary legislation.
- (5) Otherwise regulations under that Schedule are subject to negative resolution procedure.
- <sup>F14</sup>(6) Section 17(5) of the Interpretation Act (Northern Ireland) 1954 applies to a power to make regulations under Schedule 6.]

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#### Textual Amendments

- F11** S. 77(4)(aa) inserted (E.W.) (15.2.2011) by [Waste \(Wales\) Measure 2010 \(nawm 8\)](#), **ss. 2, 21(2)**
- F12** S. 77(4)(aa) inserted (N.I.) (4.5.2011) by [Single Use Carrier Bags Act \(Northern Ireland\) 2011 \(c. 26\)](#), **s. 1(2)**
- F13** S. 77(6) inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), **s. 2(3)**
- F14** S. 77(4)(ab) inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), **s. 2(2)**

#### *Renewable transport fuel obligations*

### 78 Renewable transport fuel obligations

Schedule 7 contains amendments to the provisions of the Energy Act 2004 (c. 20) relating to renewable transport fuel obligations.

#### *Carbon emissions reduction targets*

### 79 Carbon emissions reduction targets

Schedule 8 contains amendments to the provisions of the Gas Act 1986 (c. 44), the Electricity Act 1989 (c. 29) and the Utilities Act 2000 (c. 27) relating to carbon emissions reduction targets.

#### *Miscellaneous*

### 80 Report on climate change: Wales

- (1) It is the duty of the Welsh Ministers to lay before the National Assembly for Wales from time to time a report on—
  - (a) the objectives of the Welsh Ministers in relation to greenhouse gas emissions and the impact of climate change in Wales,
  - (b) the action that has been taken by the Welsh Ministers and others to deal with such emissions and that impact, and
  - (c) the future priorities for the Welsh Ministers and others for dealing with such emissions and that impact.
- (2) The report must, in particular, set out how the Welsh Ministers intend to exercise the power to give directions under section 67 (directions to reporting authorities to prepare adaptation reports).
- (3) Nothing in a report under this section affects the exercise of the Welsh Ministers' power under that section.
- (4) The second and each subsequent report under this section must contain an assessment of the progress made towards implementing the objectives mentioned in the earlier reports.
- (5) In this section “Wales” has the same meaning as in the Government of Wales Act 2006 (c. 32).

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PROSPECTIVE

## 81 Climate change measures reports in Wales

- (1) The Climate Change and Sustainable Energy Act 2006 (c. 19) is amended as follows.
- (2) After section 3 insert—

### **“3A Local authorities in Wales to have regard to climate change measures reports**

- (1) The Welsh Ministers must from time to time publish a climate change measures report.
- (2) A local authority in Wales must, in exercising its functions, have regard to any current climate change measures report.
- (3) A “climate change measures report” means a report containing information about the local authority measures the Welsh Ministers consider would or might have any of the following effects—
  - (a) improving efficiency in the use of any description or source of energy;
  - (b) increasing the amount of energy generated, or heat produced, by microgeneration;
  - (c) increasing the amount of energy generated, or heat produced, by plant that relies wholly or mainly on a source of energy or a technology listed in section 26(2);
  - (d) reducing emissions of greenhouse gases;
  - (e) reducing the number of households in which one or more persons are living in fuel poverty;
  - (f) addressing the impact of climate change.
- (4) Before publishing a climate change measures report, the Welsh Ministers must consult such representatives of local government, and such other persons, as the Welsh Ministers consider appropriate.
- (5) The Secretary of State's consent is required to the publication in a climate change measures report of information about a local authority measure to which subsection (6) applies.
- (6) This subsection applies to a local authority measure if the Secretary of State has a function in relation to the measure of—
  - (a) making subordinate legislation,
  - (b) issuing guidance or directions, or
  - (c) making determinations or hearing appeals,and that function is exercisable in relation to Wales.
- (7) In this section—

“local authority” means any of the following—

  - (a) a county council;
  - (b) a county borough council;
  - (c) a community council;

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“local authority measure” means anything a local authority in Wales may do in the exercise of its functions (including deciding not to exercise a power).”.

<sup>F15</sup>(3) .....

#### Textual Amendments

**F15** S. 81(3) omitted (26.5.2015) by virtue of [Deregulation Act 2015 \(c. 20\)](#), ss. [57\(4\)\(b\)](#), [115\(3\)\(e\)](#)

## 82 Repeal of previous reporting obligation

Section 2 of the Climate Change and Sustainable Energy Act 2006 (c. 19) (annual report on greenhouse gas emissions) is repealed.

## 83 Guidance on reporting

- (1) The Secretary of State must publish guidance on the measurement or calculation of greenhouse gas emissions to assist the reporting by persons on such emissions from activities for which they are responsible.
- (2) The guidance must be published not later than 1st October 2009.
- (3) The Secretary of State may from time to time publish revisions to guidance under this section or revised guidance.
- (4) Before publishing guidance under this section or revisions to it, the Secretary of State must consult the other national authorities.
- (5) Guidance under this section and revisions to it may be published in such manner as the Secretary of State thinks fit.

## 84 Report on contribution of reporting to climate change objectives

- (1) The Secretary of State must—
  - (a) review the contribution that reporting on greenhouse gas emissions may make to the achievement of the objectives of Her Majesty's Government in the United Kingdom in relation to climate change, and
  - (b) lay a report before Parliament setting out the conclusions of that review.
- (2) The report must be laid before Parliament not later than 1st December 2010.
- (3) In complying with this section the Secretary of State must consult the other national authorities.

## 85 Regulations about reporting by companies

- (1) The Secretary of State must, not later than 6th April 2012—
  - (a) make regulations under section 416(4) of the Companies Act 2006 (c. 46) requiring the directors' report of a company to contain such information as may be specified in the regulations about emissions of greenhouse gases from activities for which the company is responsible, or

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- (b) lay before Parliament a report explaining why no such regulations have been made.
- (2) Subsection (1)(a) is complied with if regulations are made containing provision in relation to companies, and emissions, of a description specified in the regulations.

## 86 Report on the civil estate

- (1) It is the duty of the [<sup>F16</sup>Minister for the Cabinet Office] to lay before Parliament in respect of each year, beginning with the year 2008, a report containing an assessment of the progress made in the year towards improving the efficiency and contribution to sustainability of buildings that are part of the civil estate.
- (2) The report must, in particular, include an assessment of the progress made in the year to which it relates towards—
  - (a) reducing the size of the civil estate, and
  - (b) ensuring that buildings that become part of the civil estate fall within the top quartile of energy performance.
- (3) If a building that does not fall within the top quartile of energy performance becomes part of the civil estate in the year to which the report relates, the report must state the reasons why the building has nevertheless become part of the civil estate.
- (4) A report under this section must be laid before Parliament not later than 1st June in the year following the year to which it relates.
- (5) In this section “building” means a building that uses energy for heating or cooling the whole or any part of its interior.
- (6) For the purposes of this section, a building is part of the civil estate if it is—
  - (a) used for the purposes of central government administration, and
  - (b) of a description of buildings for which, at the passing of this Act, the Treasury has responsibilities in relation to efficiency and sustainability.
- (7) The [<sup>F17</sup>Minister for the Cabinet Office] may by order provide for buildings of a specified description to be treated as being, or as not being, part of the civil estate for the purposes of this section.
- (8) Any such order is subject to affirmative resolution procedure.

### Textual Amendments

- F16** Words in s. 86(1) substituted (13.4.2011) by [The Transfer of Functions \(Report on the Civil Estate\) Order 2011 \(S.I. 2011/740\)](#), arts. 1(2), 3
- F17** Words in s. 86(7) substituted (13.4.2011) by [The Transfer of Functions \(Report on the Civil Estate\) Order 2011 \(S.I. 2011/740\)](#), arts. 1(2), 3

### Modifications etc. (not altering text)

- C2** S. 86 transfer of functions (13.4.2011) by [The Transfer of Functions \(Report on the Civil Estate\) Order 2011 \(S.I. 2011/740\)](#), arts. 1(2), 2

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## 87 Power of Ministers and departments to offset greenhouse gas emissions

- (1) An authority to which this section applies may acquire and dispose of units or interests in units representing—
- (a) a reduction in an amount of greenhouse gas emissions,
  - (b) the removal of an amount of greenhouse gas from the atmosphere, or
  - (c) an amount of greenhouse gas emissions allowed under a scheme or arrangement imposing a limit on such emissions.
- (2) This section applies to—
- (a) any Minister of the Crown or government department;
  - (b) the Scottish Ministers;
  - (c) the Welsh Ministers;
  - (d) any Northern Ireland department.
- (3) If the Treasury acquire such units or interests in units, until they are disposed of they shall be treated as held by the persons for the time being constituting the Treasury.

## 88 Fines for offences relating to pollution

- (1) In section 105(2) of the Clean Neighbourhoods and Environment Act 2005 (c. 16) (which postpones the increase by subsection (1)(b) in maximum fines under regulations under the Pollution Prevention and Control Act 1999 (c. 24) pending the commencement of section 154(1) of the Criminal Justice Act 2003 (c. 44)), for “Subsection (1)” substitute “ Subsection (1)(a) ”.

<sup>F18</sup>(2) .....

### Textual Amendments

**F18** S. 88(2) repealed (6.4.2010) by [The Environmental Permitting \(England and Wales\) Regulations 2010 \(S.I. 2010/675\)](#), reg. 1(1)(b), [Sch. 28](#) (with reg. 1(2), [Sch. 4](#))

## PART 6

### GENERAL SUPPLEMENTARY PROVISIONS

#### *Territorial scope of provisions relating to greenhouse gas emissions*

## 89 Territorial scope of provisions relating to greenhouse gas emissions

- (1) The provisions of this Act relating to emissions of greenhouse gases apply to emissions from sources or other matters occurring in, above or below—
- (a) UK coastal waters, or
  - (b) the UK sector of the continental shelf,
- as they apply to emissions from sources or matters occurring in the United Kingdom.
- (2) In subsection (1)—
- “UK coastal waters” means areas landward of the seaward limit of the territorial sea adjacent to the United Kingdom;

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“the UK sector of the continental shelf” means the areas designated under section 1(7) of the Continental Shelf Act 1964 (c. 29).

- (3) This section is subject to section 30 (emissions from international aviation or international shipping not to count as emissions from UK sources for the purposes of Part 1, except as provided by regulations).

### *Orders and regulations*

## **90 Orders and regulations**

- (1) Orders and regulations under this Act must be made by statutory instrument, subject as follows.
- (2) The power of a Northern Ireland department to make regulations under Part 3 (trading schemes) or Schedule 6 (charges for <sup>F10</sup>carrier bags)—
  - (a) is exercisable by statutory instrument if the instrument also contains regulations under that Part or Schedule made or to be made by another national authority, and
  - (b) otherwise, is exercisable by statutory rule for the purposes of the Statutory Rules (Northern Ireland) Order 1979 (S.I. 1979/1573 (N.I. 12)).
- (3) An order or regulations under this Act may—
  - (a) make different provision for different cases or circumstances,
  - (b) include supplementary, incidental and consequential provision, and
  - (c) make transitional provision and savings.
- (4) Any provision that may be made by order under this Act may be made by regulations.
- (5) Any provision that may be made by regulations under this Act may be made by order.

### **Textual Amendments**

**F10** Words in Sch. 6 para. 2 substituted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 1\(b\)](#)

## **91 Affirmative and negative resolution procedure**

- (1) Where orders or regulations under this Act are subject to “affirmative resolution procedure” the order or regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of each House of Parliament.
- (2) Where orders or regulations under this Act are subject to “negative resolution procedure” the statutory instrument containing the order or regulations is subject to annulment in pursuance of a resolution of either House of Parliament.
- (3) Any provision that may be made by an order or regulations under this Act subject to negative resolution procedure may be made by an order or regulations subject to affirmative resolution procedure.
- (4) This section does not apply to—
  - (a) regulations under Part 3 (trading schemes) (but see Schedule 3), or

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- (b) regulations under Schedule 6 (but see Part 3 of that Schedule).

### *Interpretation*

#### **92 Meaning of “greenhouse gas”**

- (1) In this Act “greenhouse gas” means any of the following—
- (a) carbon dioxide (CO<sub>2</sub>),
  - (b) methane (CH<sub>4</sub>),
  - (c) nitrous oxide (N<sub>2</sub>O),
  - (d) hydrofluorocarbons (HFCs),
  - (e) perfluorocarbons (PFCs),
  - (f) sulphur hexafluoride (SF<sub>6</sub>).
- (2) The Secretary of State may by order amend the definition of “greenhouse gas” in subsection (1) to add to the gases listed in that definition.
- (3) That power may only be exercised if it appears to the Secretary of State that an agreement or arrangement at European or international level recognises that the gas to be added contributes to climate change.
- (4) An order under this section is subject to negative resolution procedure.

#### **93 Measurement of emissions etc by reference to carbon dioxide equivalent**

- (1) For the purposes of this Act greenhouse gas emissions, reductions of such emissions and removals of greenhouse gas from the atmosphere shall be measured or calculated in tonnes of carbon dioxide equivalent.
- (2) A “tonne of carbon dioxide equivalent” means one metric tonne of carbon dioxide or an amount of any other greenhouse gas with an equivalent global warming potential (calculated consistently with international carbon reporting practice).

#### **94 Meaning of “international carbon reporting practice”**

- (1) In this Act “international carbon reporting practice” means accepted practice in relation to reporting for the purposes of the protocols to the United Nations Framework Convention on Climate Change or such other agreements or arrangements at European or international level as the Secretary of State may specify by order.
- (2) An order under this section is subject to negative resolution procedure.

#### **95 Meaning of “national authority”**

- (1) In this Act “national authority” means any of the following—
- (a) the Secretary of State;
  - (b) the Scottish Ministers;
  - (c) the Welsh Ministers;
  - (d) the relevant Northern Ireland department.
- (2) Functions conferred or imposed by this Act on “the national authorities” are to be exercised by all of them jointly.

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## 96 Meaning of “relevant Northern Ireland department”

- (1) In this Act “the relevant Northern Ireland department”, in relation to a matter or provision, means the Northern Ireland department responsible for the matter or, as the case may be, for the matters to which the provision relates.
- (2) If more than one department is responsible, the reference is to all of them.
- (3) Any question as to the Northern Ireland department responsible for a matter is to be determined by the Department of Finance and Personnel in Northern Ireland.

## 97 Minor definitions

In this Act—

“devolved legislature” means—

- (a) the Scottish Parliament,
- (b) the National Assembly for Wales, or
- (c) the Northern Ireland Assembly;

“emissions”, in relation to a greenhouse gas, means emissions of that gas into the atmosphere that are attributable to human activity;

“enactment” includes—

- (a) an enactment contained in subordinate legislation within the meaning of the Interpretation Act 1978 (c. 30),
- (b) an enactment contained in, or in an instrument made under, an Act of the Scottish Parliament,
- (c) an enactment contained in, or in an instrument made under, Northern Ireland legislation, and
- (d) an enactment contained in, or in an instrument made under, a Measure or Act of the National Assembly for Wales;

“European law” means—

- (a) all the rights, powers, liabilities, obligations and restrictions from time to time created or arising by or under the [F19]EU Treaties, and
- (b) all the remedies and procedures from time to time provided for by or under the [F19]EU Treaties,

and “European policy” has a corresponding meaning;

“modifications”, in relation to an enactment, includes additions or amendments to, or omissions from, the enactment;

“primary legislation” means—

- (a) an Act of Parliament,
- (b) an Act of the Scottish Parliament,
- (c) a Measure or Act of the National Assembly for Wales, or
- (d) Northern Ireland legislation.

### Textual Amendments

**F19** Words in Act substituted (22.4.2011) by The Treaty of Lisbon (Changes in Terminology) Order 2011 (S.I. 2011/1043), arts. 2, 3, 6 (with art. 3(2)(3)4(2)6(4)6(5))

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## 98 Index of defined expressions

In this Act the following expressions are defined or otherwise explained by the provisions indicated—

“the 1990 baseline” (in Parts 1 and 2)	section 1(2)
“administrator” (in Part 3)	section 55
“administrator” (in Schedule 6)	paragraph 6(1) and (4) of Schedule 6
“affirmative resolution procedure” (except in Part 3 and Schedule 6)	section 91(1)
“annual equivalent”, in relation to the carbon budget for a period (in Parts 1 and 2)	section 5(2)
“budgetary periods” (in Parts 1 and 2)	section 4(1)
“carbon budget” (in Parts 1 and 2)	section 4(1)
“carbon unit” (in Parts 1 and 2)	section 26(1)
“the chair” (in Schedule 1)	paragraph 1(1) of Schedule 1
[ <sup>F20</sup> “children” (in Schedule 6)]	[ <sup>F20</sup> paragraph 4B(2) of Schedule 6]
“civil sanction” (in Schedule 6)	paragraph 9(3) of Schedule 6
“the Committee” (in Part 2)	section 32
“Counsel General” (in sections 61 to 70)	section 70(8)
“the deputy chair” (in Schedule 1)	paragraph 2 of Schedule 1
“devolved authority” (in sections 61 to 70)	section 70(3)
“devolved functions”, in relation to a reporting authority (in sections 61 to 69)	section 70(4) and (5)
“devolved legislature”	section 97
“devolved Welsh functions”, in relation to	section 70(6) and (7)

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a reporting authority (in sections 61 to 69)	
“discretionary requirement” (in Schedule 6)	paragraph 12(3) of Schedule 6
“electricity distributor” (in Schedule 4)	paragraph 2(3) of Schedule 4
“electricity supplier” (in Schedule 4)	paragraph 2(2) of Schedule 4
“emissions”	section 97
“enactment”	section 97
“environmental authority” (in Schedule 4)	paragraph 1(2) of Schedule 4
“European law”	section 97
“European policy”	section 97
“financial year” (in Schedule 1)	paragraph 23 of Schedule 1
“fixed monetary penalty” (in Schedule 6)	paragraph 10(3) of Schedule 6
“greenhouse gas”	section 92
“international carbon reporting practice”	section 94
“Minister of the Crown” (in sections 61 to 70)	section 70(8)
“modifications”, in relation to an enactment	section 97
“national authority”	section 95
“negative resolution procedure” (except in Part 3 and Schedule 6)	section 91(2)
“net UK carbon account” (in Parts 1 and 2)	section 27(1)
“net UK emissions” for a period, in relation to a greenhouse gas (in Parts 1 and 2)	section 29(1)
“non-monetary discretionary requirement” (in Schedule 6)	paragraph 12(4) of Schedule 6
[ <sup>F21</sup> “nuisance” (in Schedule 6)]	[ <sup>F21</sup> paragraph 4B(6) of Schedule 6]

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“participant” (in Part 3)	section 55
[ <sup>F22</sup> “pollution” (in Schedule 6)]	[ <sup>F22</sup> paragraph 4B(3) of Schedule 6]
“potential participant” (in Schedule 4)	paragraph 3(2) of Schedule 4
“primary legislation”	section 97
“the relevant national authority” (in Part 3)	section 47
“the relevant national authority” (in Schedule 6)	section 77(3)
“the relevant Northern Ireland department”	section 96
“reporting authority” (in sections 61 to 70)	section 70(1) and (2)
“seller” (in Schedule 6)	paragraph 3 of Schedule 6
“[ <sup>F23</sup> carrier bag]” (in Schedule 6)	paragraph 5 of Schedule 6
“specified” (in Schedule 6)	paragraph 3(4) of Schedule 6
“targeted greenhouse gas” (in Parts 1 and 2)	section 24(1)
“trading period” (in Part 3)	section 55
“trading scheme”	section 44(2)
“UK emissions”, in relation to a greenhouse gas (in Part 1)	section 29(1)
“UK removals”, in relation to a greenhouse gas (in Part 1)	section 29(1)
“variable monetary penalty” (in Schedule 6)	paragraph 12(4) of Schedule 6
“Wales” (in sections 61 to 70)	section 70(8)
<sup>F24</sup>	<sup>F24</sup>
...	...
[ <sup>F25</sup> “young people” (in Schedule 6)]	[ <sup>F25</sup> paragraph 4B(8) of Schedule 6]

#### Textual Amendments

**F20** Words in s. 98 Table inserted (E.W.) (15.2.2011) by [Waste \(Wales\) Measure 2010 \(nawm 8\)](#), s. 21(2), [Sch. para. 2\(2\)](#)

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- F21** Words in s. 98 Table inserted (E.W.) (15.2.2011) by [Waste \(Wales\) Measure 2010 \(nawm 8\)](#), s. 21(2), [Sch. para. 2\(3\)](#)
- F22** Words in s. 98 Table inserted (E.W.) (15.2.2011) by [Waste \(Wales\) Measure 2010 \(nawm 8\)](#), s. 21(2), [Sch. para. 2\(4\)](#)
- F23** Words in Act substituted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), s. 1(a)
- F24** S. 98 entry repealed (15.1.2012) by [Localism Act 2011 \(c. 20\)](#), s. 240(1)(m), [Sch. 25 Pt. 8](#)
- F25** Words in s. 98 Table inserted (E.W.) (15.2.2011) by [Waste \(Wales\) Measure 2010 \(nawm 8\)](#), s. 21(2), [Sch. para. 2\(5\)](#)

### *Final provisions*

## **99 Extent**

- (1) This Act, apart from the provisions listed below, extends to the whole of the United Kingdom.
- (2) The following provisions of this Act extend to England and Wales only—
  - (a) sections 71 to 75 and Schedule 5 (waste reduction schemes);
  - (b) section 76 (collection of household waste);
  - (c) section 81 (climate change measures reports in Wales);
  - (d) section 88 (fines for offences relating to pollution).
- (3) Section 77 and Schedule 6 (charges for [<sup>F10</sup>carrier bags]) extend to England and Wales and Northern Ireland only.
- (4) Section 79 and Schedule 8 (carbon emissions reduction targets) extend to England and Wales and Scotland only.

### **Textual Amendments**

- F10** Words in Sch. 6 para. 2 substituted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), s. 1(b)

## **100 Commencement**

- (1) Part 1 (carbon target and budgeting), Part 2 (the Committee on Climate Change) and this Part come into force on the day this Act is passed.
- (2) Section 71(1) and Schedule 5 (waste reduction schemes) come into force in accordance with sections 72 to 75.
- (3) Section 81 (climate change measures reports in Wales) comes into force on such day as may be appointed by order made by the Welsh Ministers.
- (4) Section 82 (repeal of previous reporting obligation) comes into force on 1st January 2009.
- (5) The other provisions of this Act come into force at the end of two months beginning with the day it is passed.

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## **101 Short title**

The short title of this Act is the Climate Change Act 2008.

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## SCHEDULES

### SCHEDULE 1

Section 32

#### THE COMMITTEE ON CLIMATE CHANGE

##### *Membership*

- 1 (1) The Committee shall consist of—
  - (a) a person appointed by the national authorities to chair the Committee (“the chair”), and
  - (b) not less than five and not more than eight other members appointed by the national authorities.
- (2) The national authorities must consult the chair before appointing the other members.
- (3) In appointing a member, the national authorities must have regard to the desirability of securing that the Committee (taken as a whole) has experience in or knowledge of the following—
  - (a) business competitiveness;
  - (b) climate change policy at national and international level, and in particular the social impacts of such policy;
  - (c) climate science, and other branches of environmental science;
  - (d) differences in circumstances between England, Wales, Scotland and Northern Ireland and the capacity of national authorities to take action in relation to climate change;
  - (e) economic analysis and forecasting;
  - (f) emissions trading;
  - (g) energy production and supply;
  - (h) financial investment;
  - (i) technology development and diffusion.
- (4) The Secretary of State may by order amend sub-paragraph (1)(b) so as to alter the minimum or maximum number of members of the Committee.
- (5) Such an order may only be made with the consent of the other national authorities.
- (6) Any such order is subject to negative resolution procedure.
- 2 The national authorities may, after consulting the chair, appoint one of the members as deputy to the chair (“the deputy chair”).

##### *Term of office*

- 3 A member holds and vacates office in accordance with the terms of the member's appointment.
- 4 A member may resign by giving written notice to the Secretary of State.

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- 5 The national authorities may remove a member—
- (a) who has been absent from meetings of the Committee without its permission for a period of 6 months or more,
  - (b) who has become bankrupt or has made an arrangement with creditors,
  - (c) whose estate has been sequestrated in Scotland or who, under Scots law, has made a composition or arrangement with, or granted a trust deed for, creditors, or
  - (d) who in the opinion of the national authorities is otherwise unable or unfit to carry out the duties of that member.
- 6 A person ceases to be the chair or the deputy chair if the person—
- (a) resigns that office by giving written notice to the Secretary of State, or
  - (b) ceases to be a member.
- 7 A person who—
- (a) ceases to be a member, or
  - (b) ceases to be the chair or the deputy chair,
- may be reappointed to that office.

#### *Remuneration and pensions etc*

- 8 The Committee may pay to the members such remuneration and allowances as the national authorities may determine.
- 9 The Committee must, if required to do so by the national authorities—
- (a) pay such pensions, gratuities or allowances as the national authorities may determine to or in respect of any person who is or has been a member, or
  - (b) pay such sums as the national authorities may determine towards provision for the payment of pensions, gratuities or allowances to or in respect of such a person.
- 10 If the national authorities consider there are special circumstances which make it right for a person who has ceased to be a member to receive compensation, the Committee must pay the person such compensation as the national authorities may determine.

#### *Staff*

- 11 (1) The Committee must appoint a person to be chief executive, but may only appoint a person who has been approved by the national authorities.
- (2) The chief executive is an employee of the Committee.
- 12 The Committee may appoint other employees.
- 13 The Committee must, if required to do so by the national authorities—
- (a) pay such pensions, gratuities or allowances as the national authorities may determine to or in respect of any employee or former employee, or
  - (b) pay such sums as the national authorities may determine towards provision for the payment of pensions, gratuities or allowances to or in respect of any employee or former employee.

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- 14 (1) In Schedule 1 to the Superannuation Act 1972 (c. 11) (kinds of employment to which section 1 of that Act applies), in the list of other bodies, at the appropriate place insert — “ The Committee on Climate Change. ”
- (2) The Committee must pay to the Minister for the Civil Service, at such times as the Minister may direct, such sums as the Minister may determine in respect of any increase attributable to sub-paragraph (1) in the sums payable out of money provided by Parliament under the Superannuation Act 1972.

#### *Sub-committees*

- 15 (1) The Committee may establish sub-committees.
- (2) A sub-committee may include persons who are not members of the Committee.
- (3) The Committee may pay such remuneration and allowances as the national authorities may determine to any person who—
- (a) is a member of a sub-committee, but
  - (b) is not a member of the Committee.
- (4) This paragraph does not apply in relation to the Adaptation Sub-Committee.

#### *The Adaptation Sub-Committee*

- 16 (1) There shall be a sub-committee of the Committee, to be known as the Adaptation Sub-Committee or, in Welsh, as yr Is-bwyllgor Addasu (referred to in this paragraph as “the ASC”).
- (2) The ASC shall consist of—
- (a) a person appointed by the national authorities to chair the ASC (“the ASC chair”), and
  - (b) not less than five other members appointed by the national authorities.
- (3) The national authorities must—
- (a) consult the chair before appointing the ASC chair, and
  - (b) consult the ASC chair before appointing the other members of the ASC.
- (4) A person ceases to be the ASC chair if the person—
- (a) resigns that office by giving written notice to the Secretary of State, or
  - (b) ceases to be a member of the ASC.
- (5) The ASC may include persons who are not members of the Committee.
- (6) Paragraphs 3 to 5 (term of office) apply to a person who is—
- (a) a member of the Committee, and
  - (b) a member of the ASC,
- in that person's capacity as a member of the ASC.
- (7) Those paragraphs and paragraphs 8 to 10 (remuneration and pensions etc) apply to a member of the ASC who is not a member of the Committee as they apply to a member of the Committee.
- (8) In the application of paragraph 5(a) by virtue of this paragraph, the reference to the Committee is a reference to the ASC.

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- (9) A person who—
- (a) ceases to be a member of the ASC, or
  - (b) ceases to be the ASC chair,
- may be reappointed to that office.
- (10) The ASC must provide the Committee with such advice, analysis, information or other assistance as the Committee may require in connection with the exercise of its functions under—
- (a) section 38(1)(c) (advice etc to national authorities on adaptation to climate change),
  - (b) section 57 (advice on report on impact of climate change), or
  - (c) section 59 (reporting on progress in connection with adaptation).

#### *Proceedings*

- 17 The Committee may regulate—
- (a) its own procedure (including quorum), and
  - (b) the procedure of any sub-committee (including quorum).
- 18 The validity of anything done by the Committee or any sub-committee is not affected by—
- (a) any vacancy in the membership of the Committee or sub-committee, or
  - (b) any defect in the appointment of any member of the Committee or sub-committee.
- 19 The Committee must publish the minutes of its meetings in such manner as it considers appropriate.

#### *Discharge of functions*

- 20 The Committee may authorise a sub-committee, member or employee to exercise any of the Committee's functions.

#### *Application of seal and proof of documents*

- 21 (1) The application of the Committee's seal must be authenticated by the signature of—
- (a) a member of the Committee who is authorised (generally or specially) for that purpose, or
  - (b) an employee who is so authorised.
- (2) A document purporting to be duly executed under the seal of the Committee or to be signed on behalf of the Committee shall be received in evidence and treated as so executed or signed unless the contrary is shown.
- (3) This paragraph does not apply in relation to Scotland.

#### *Reports and accounts*

- 22 (1) For each financial year the Committee must—
- (a) prepare an annual report on the discharge of its functions during the year, and
  - (b) send a copy to the national authorities within such period as the national authorities may direct.

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- (2) A copy of each report received under this paragraph must be laid—
- (a) by the Secretary of State before Parliament,
  - (b) by the Scottish Ministers before the Scottish Parliament,
  - (c) by the Welsh Ministers before the National Assembly for Wales, and
  - (d) by the relevant Northern Ireland department before the Northern Ireland Assembly.
- 23 In this Schedule “financial year” means—
- (a) the period beginning with the day the Committee is established and ending with the next 31st March, and
  - (b) each subsequent period of 12 months ending with 31st March.
- 24 (1) The Committee must keep proper accounts and proper records in relation to the accounts.
- (2) For each financial year the Committee must—
- (a) prepare a statement of accounts in respect of that financial year, and
  - (b) send a copy of the statement to the national authorities and the Comptroller and Auditor General within such period as the national authorities direct.
- (3) The statement must be in such form as the national authorities may direct.
- (4) The Comptroller and Auditor General must—
- (a) examine, certify and report on the statement, and
  - (b) send a copy of the certified statement and the report to the national authorities as soon as possible.
- (5) A copy of each statement received under sub-paragraph (4) must be laid—
- (a) by the Secretary of State before Parliament,
  - (b) by the Scottish Ministers before the Scottish Parliament,
  - (c) by the Welsh Ministers before the National Assembly for Wales, and
  - (d) by the relevant Northern Ireland department before the Northern Ireland Assembly.

#### *Information*

- 25 (1) The Committee must provide the national authorities with such information as they may request about its property.
- (2) The Committee must provide the Secretary of State with such information as the Secretary of State may request about the exercise or proposed exercise of its functions under—
- (a) Part 1 (carbon target and budgeting),
  - (b) section 33 (advice on level of 2050 target),
  - (c) section 34 (advice in connection with carbon budgets),
  - (d) section 35 (advice on emissions from international aviation and international shipping),
  - (e) section 36 (reports on progress),
  - (f) section 57 (advice on report on impact of climate change), or
  - (g) section 59 (reporting on progress in connection with adaptation).

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- (3) The Committee must provide a national authority with such information as the national authority may request about the exercise or proposed exercise of the Committee's functions under—
- (a) section 38 (duty to provide advice or assistance on request), or
  - (b) section 48 (advice on trading scheme regulations),
- in relation to that national authority.

If the information relates to the exercise or proposed exercise of those functions in relation to two or more national authorities, the request must be made by all of them jointly.

- (4) The Committee must provide the national authorities with such information as they may request about the exercise or proposed exercise of any of its other functions.
- (5) The Committee must also—
- (a) permit any person authorised by a national authority to inspect and make copies of any accounts or other documents of the Committee, and
  - (b) provide such explanation of them as that person or the national authority may require.
- (6) Before exercising a function under sub-paragraph (5), the national authority must consult the other national authorities.

#### *Publication of advice etc*

- 26 A requirement under this Act for the Committee to publish anything does not oblige it to publish—
- (a) information it could refuse to disclose in response to a request under—
    - (i) the Freedom of Information Act 2000 (c. 36), or
    - (ii) the Environmental Information Regulations 2004 (S.I. 2004/3391) or any regulations replacing those regulations;
  - (b) information whose disclosure is prohibited by any enactment.

#### *Status*

- 27 (1) The Committee is not to be regarded as the servant or agent of the Crown or as enjoying any status, privilege or immunity of the Crown.
- (2) The Committee is to be treated as a cross-border public authority within the meaning of the Scotland Act 1998 (c. 46) for the purposes of the following provisions of that Act—
- (a) section 23(2)(b) (power of Scottish Parliament to require persons outside Scotland to attend to give evidence or produce documents);
  - (b) section 70(6) (legislation of Scottish Parliament not to require certain cross-border public authorities to prepare accounts).

#### *Public Records Act 1958 (c. 51)*

- 28 In Schedule 1 to the Public Records Act 1958 (definition of public records), in Part 2 of the Table at the end of paragraph 3, at the appropriate place insert— “ The Committee on Climate Change. ”

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*Parliamentary Commissioner Act 1967 (c. 13)*

29 In Schedule 2 to the Parliamentary Commissioner Act 1967 (departments etc subject to investigation)—

- (a) at the appropriate place insert— “ The Committee on Climate Change. ”, and
- (b) in the notes at the appropriate place insert—  
**Committee on Climate Change**

In the case of the Committee on Climate Change, no investigation is to be conducted in respect of any action taken by or on behalf of the Committee—

- (a) in the exercise in or as regards Scotland of any function to the extent that the function is exercisable within devolved competence (within the meaning of section 54 of the Scotland Act 1998), or
- (b) in connection with functions of the Committee in relation to Wales (within the meaning of the Government of Wales Act 2006).”

*House of Commons Disqualification Act 1975 (c. 24)*

30 In Part 2 of Schedule 1 to the House of Commons Disqualification Act 1975 (bodies of which all members are disqualified), at the appropriate place insert— “ The Committee on Climate Change. ”

*Northern Ireland Assembly Disqualification Act 1975 (c. 25)*

31 In Part 2 of Schedule 1 to the Northern Ireland Assembly Disqualification Act 1975 (bodies of which all members are disqualified), at the appropriate place insert— “ The Committee on Climate Change. ”

*Race Relations Act 1976 (c. 74)*

32 [F26 In Part 2 of Schedule 1A to the Race Relations Act 1976 (bodies and other persons subject to general statutory duty), at the appropriate place insert— “ The Committee on Climate Change. ”]

**Textual Amendments**

**F26** Sch. 1 para. 32 repealed (E.W.S.) (4.4.2011) by 2010 c. 15, Sch. 27 Pt. 1A (as inserted by [The Equality Act 2010 \(Public Authorities and Consequential and Supplementary Amendments\) Order 2011 \(S.I. 2011/1060\)](#), arts. 1(2), 3(3)(a), [Schs. 3](#))

*Freedom of Information Act 2000 (c. 36)*

33 In Part 6 of Schedule 1 to the Freedom of Information Act 2000 (other public bodies and offices which are public authorities), at the appropriate place insert— “ The Committee on Climate Change. ”

*Scottish Public Services Ombudsman Act 2002 (asp 11)*

34 (1) The Scottish Public Services Ombudsman Act 2002 is amended as follows.

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- (2) In section 7 (matters which may be investigated: restrictions), after subsection (6B) insert—

“(6C) The Ombudsman must not investigate action taken by or on behalf of the Committee on Climate Change in the exercise in or as regards Scotland of any function to the extent that the function is not exercisable within devolved competence (within the meaning of section 54 of the Scotland Act 1998).”

- (3) In Schedule 2 (persons liable to investigation), after paragraph 91A insert—

“91B The Committee on Climate Change.”

*Public Services Ombudsman (Wales) Act 2005 (c. 10)*

- 35 In Schedule 3 to the Public Services Ombudsman (Wales) Act 2005 (listed authorities), after the heading “Environment” insert— “The Committee on Climate Change.”

SCHEDULE 2

Section 46

TRADING SCHEMES

**PART 1**

SCHEMES LIMITING ACTIVITIES

*Introductory*

- 1 This Part of this Schedule deals with trading schemes that operate by limiting or encouraging the limitation of activities that consist of the emission of greenhouse gas or that cause or contribute, directly or indirectly, to such emissions.

*Trading periods*

- 2 The regulations must specify the period or periods by reference to which the scheme is to operate (a “trading period”).

*Activities*

- 3 (1) The regulations must identify the activities to which the trading scheme applies.
- (2) The regulations may identify the activities by reference to any, or any combination of, criteria and in particular—
- (a) may identify the activities by reference to the locations or locations at which they are carried on, or
  - (b) may be expressed to apply to all activities of a particular kind carried on in the United Kingdom or a part of the United Kingdom.
- (3) The regulations must specify the units of measurement of the activities for the purposes of the scheme.

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- (4) The regulations may specify units of measurement by reference to—
  - (a) the activities themselves,
  - (b) anything consumed or used for the purposes of the activities,
  - (c) anything produced by the activities, or
  - (d) any other consequence of the activities.
- (5) The regulations may, in particular, make provision—
  - (a) for activities to be measured by reference to the amount (in tonnes of carbon dioxide equivalent) of the greenhouse gas emissions for which those activities are to be regarded as responsible; and
  - (b) as to the method by which that amount is to be measured or calculated.
- (6) The regulations may make different provision in relation to different descriptions of activity to which the scheme applies.

#### *Participants*

- 4 (1) The regulations must identify the persons to whom the trading scheme applies (the “participants”).
- (2) The regulations—
  - (a) may identify the participants by reference to any, or any combination of, criteria, or
  - (b) provide for their identification by a specified person or body.
- (3) The regulations may, in particular, identify or provide for the identification of the participants by reference to their responsibility for activities to which the trading scheme applies.
- (4) The regulations may provide for more than one person to be treated as a single participant.
- (5) The regulations may provide for persons to cease to be participants in circumstances specified in the regulations.

#### *Allocation of allowances*

- 5 (1) The regulations may provide for the allocation among the participants of allowances representing the right to carry on a specified amount of the activities in a trading period.
- (2) The regulations may set a limit on—
  - (a) the total amount of the activities for a trading period, and
  - (b) the total amount of the allowances to be allocated for the period.
- (3) The regulations may specify the method of allocation or provide for it to be determined in accordance with the regulations.
- (4) The regulations may not provide for allowances to be allocated in return for consideration.

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### *Use of allowances*

- 6
- (1) The regulations may require each participant to have or acquire enough allowances to match the participant's activities in a trading period, subject to any offsetting in accordance with provision made under paragraph 7.
  - (2) The regulations—
    - (a) may permit allowances held by a participant at the end of a trading period in excess of the participant's activities in the period to be used to cover the participant's activities in a later trading period,
    - (b) may permit allowances allocated to a participant for a trading period to be used to cover the participant's activities in an earlier trading period, and
    - (c) may in either case provide for such use of allowances to be subject to such conditions and limitations as may be specified in or determined in accordance with the regulations.
  - (3) The regulations must contain provision for ensuring that allowances used by a participant for the purposes of a trading scheme cannot be used by the participant for any other purpose.
  - (4) The regulations—
    - (a) may provide for the expiry of allowances after such period as may be specified in or determined in accordance with the regulations;
    - (b) may enable allowances to be cancelled by a person by whom they are held instead of being used for the purposes of a trading scheme.

### *Credits*

- 7
- (1) The regulations may enable participants to offset the carrying on of the activities in a trading period by acquiring credits representing—
    - (a) a reduction in an amount of greenhouse gas emissions, or
    - (b) the removal of an amount of greenhouse gas from the atmosphere.
  - (2) Regulations that make provision under this paragraph for a trading period must set a limit on the total amount of the activities for the period.
  - (3) If the regulations also provide for the allocation of allowances for the period, they must—
    - (a) set a limit on the total amount of the allowances to be allocated for the period, and
    - (b) require each participant to acquire enough credits to offset any activities carried on by the participant in the period in excess of those for which the participant has or has acquired allowances.
  - (4) Otherwise, such regulations must—
    - (a) set a limit on the amount of the activities that each participant may carry on in the period, and
    - (b) require each participant to acquire enough credits to offset any activities carried on by the participant in the period in excess of that limit.
  - (5) The regulations must specify—
    - (a) the descriptions of credits that may be used for offsetting a participant's activities,

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- (b) the value of different descriptions of credit as regards the amount of the activities they are treated as offsetting, and
  - (c) the circumstances in which credits of any description may be used for the purposes of the trading scheme.
- (6) The regulations—
- (a) must contain provision for ensuring that credits used to offset activities under a trading scheme cannot be used by the participant for any other purpose;
  - (b) may enable credits to be cancelled by a person by whom they are held instead of being used for that purpose.

### *Payments*

- 8
- (1) The regulations may provide that a participant who does not have or acquire enough allowances or credits to match or offset the participant's activities in a trading period must pay an amount specified in or determined in accordance with the regulations within the period so specified.
  - (2) The regulations may require the payment to be made to—
    - (a) the administrator, or
    - (b) such other person as the regulations may specify.
  - (3) The provision that may be made about the amount of the payment includes, in particular, provision—
    - (a) for the amount to be determined by the administrator or a national authority;
    - (b) in a case where the payment is not made within the period specified in the regulations, for the amount to increase at the rate so specified until payment;
    - (c) for the amount of the payment, or of any amount by reference to which it is to be calculated, to be adjusted from time to time by reference to inflation or some other factor.
  - (4) Provision within sub-paragraph (3)(c) may refer, in particular, to an index or data specified in the regulations (including as modified from time to time after the regulations come into force).
  - (5) If the regulations provide for payments to be made to a person other than a national authority, they must provide for that person to pay the sums received to the national authority or authorities specified in or determined in accordance with the regulations.

### *Trading*

- 9
- (1) The regulations must provide for the participants in a trading scheme to trade in any allowances or credits under the scheme.
  - (2) The regulations may also provide for trading in the allowances or credits by third parties authorised in accordance with the regulations.
  - (3) The regulations must specify the circumstances in which trading is permitted.
  - (4) The regulations may require trading to be notified to the administrator of the trading scheme.

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### *Permits*

- 10 (1) The regulations may provide that participants may only carry on activities to which the trading scheme applies, or specified activities to which the scheme applies, if they hold a permit.
- (2) The regulations may make provision about the issue, variation, transfer, surrender and revocation of permits.
- (3) The regulations may provide for conditions to be attached to permits.
- (4) References in this Schedule to the requirements of the scheme include requirements imposed by conditions attached to a permit.

### *Units under other schemes*

- 11 (1) The regulations may make provision for recognising any of the following as equivalent to allowances or credits under the trading scheme—
- (a) allowances, credits or certificates under another trading scheme for which provision is made by regulations under this Part of this Act;
  - (b) units under any other trading scheme (at United Kingdom, European or international level) relating to greenhouse gas emissions.
- (2) The regulations may provide—
- (a) for determining the value for the purposes of the scheme of any such allowances, credits, certificates or units, and
  - (b) for the use for the purposes of the scheme of any such allowances, credits, certificates or units to be subject to such conditions and limitations as may be specified in or determined in accordance with the regulations.

## **PART 2**

### **SCHEMES ENCOURAGING ACTIVITIES**

#### *Introductory*

- 12 This Part of this Schedule deals with trading schemes that operate by encouraging activities that consist of, or that cause or contribute, directly or indirectly to—
- (a) reductions in greenhouse gas emissions, or
  - (b) the removal of greenhouse gas from the atmosphere.

#### *Trading periods*

- 13 The regulations must specify the period or periods by reference to which the scheme is to operate (a “trading period”).

#### *Activities*

- 14 (1) The regulations must identify the activities to which the trading scheme applies.
- (2) The regulations may identify the activities by reference to any, or any combination of, criteria and in particular—

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- (a) may identify the activities by reference to the locations or locations at which they are carried on, or
  - (b) may be expressed to apply to all activities of a particular kind carried on in the United Kingdom or a part of the United Kingdom.
- (3) The regulations must specify the units of measurement of the activities for the purposes of the scheme.
- (4) The regulations may specify units of measurement by reference to—
  - (a) the activities themselves,
  - (b) anything consumed or used for the purposes of the activities,
  - (c) anything produced by the activities, or
  - (d) any other consequence of the activities.
- (5) The regulations may, in particular, make provision—
  - (a) for activities to be measured by reference to the amount (in tonnes of carbon dioxide equivalent) of the reduction of greenhouse gas emissions, or removals of greenhouse gas from the atmosphere, for which those activities are to be regarded as responsible; and
  - (b) as to the method by which that amount is to be measured or calculated.
- (6) The regulations may make different provision in relation to different descriptions of activity to which the scheme applies.

#### *Participants*

- 15 (1) The regulations must identify the persons to whom the trading scheme applies (the “participants”).
- (2) The regulations—
  - (a) may identify the participants by reference to any, or any combination of, criteria, or
  - (b) provide for their identification by a specified person or body.
- (3) The regulations may provide for more than one person to be treated as a single participant.
- (4) The regulations may provide for persons to cease to be participants in circumstances specified in the regulations.

#### *Targets and obligations*

- 16 The regulations must, for each trading period—
  - (a) set a target for the total amount of the activities, and
  - (b) impose, or provide for the imposition of, an obligation on each participant in relation to the carrying on of a specified amount of the activities in the period.

#### *Certificates*

- 17 (1) The regulations must provide for the issue of certificates evidencing the carrying on of the activities in a trading period.

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- (2) The regulations may provide for certificates to evidence the carrying on of the activities—
  - (a) by the participant in question,
  - (b) by another participant in the trading scheme, or
  - (c) by a third party authorised in accordance with the regulations to obtain certificates for the purposes of the scheme.
- (3) The regulations must require each participant to have enough certificates at the end of each trading period to comply with the participant's obligations under the trading scheme.
- (4) The regulations must contain provision for ensuring that certificates used by a participant for that purpose cannot be used by the participant for any other purpose.
- (5) The regulations—
  - (a) may provide for the expiry of certificates after such period as may be specified in or determined in accordance with the regulations;
  - (b) may enable certificates to be cancelled by a person by whom they are held instead of being used for the purposes of a trading scheme.

#### *Payments*

- 18 (1) The regulations may provide that a participant who does not have enough certificates at the end of a trading period to comply with the participant's obligations under the trading scheme must pay an amount specified in or determined in accordance with the regulations within the period so specified.
- (2) The regulations may require the payment to be made to—
  - (a) the administrator, or
  - (b) such other person as the regulations may specify.
- (3) The provision that may be made about the amount of the payment includes, in particular, provision—
  - (a) for the amount to be determined by the administrator or a national authority;
  - (b) in a case where the payment is not made within the period specified in the regulations, for the amount to increase at the rate so specified until payment;
  - (c) for the amount of the payment, or of any amount by reference to which it is to be calculated, to be adjusted from time to time by reference to inflation or some other factor.
- (4) Provision within sub-paragraph (3)(c) may refer, in particular, to an index or data specified in the regulations (including as modified from time to time after the regulations come into force).
- (5) If the regulations provide for payments to be made to a person other than a national authority, they must provide for that person to pay the sums received to the national authority or authorities specified in or determined in accordance with the regulations.

#### *Trading*

- 19 (1) The regulations must provide for the participants in a trading scheme to trade in certificates.

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- (2) The regulations may also provide for trading in certificates by third parties authorised in accordance with the regulations.
- (3) The regulations must specify the circumstances in which trading is permitted.
- (4) The regulations may require trading to be notified to the administrator of the trading scheme.

#### *Units under other schemes*

- 20 (1) The regulations may make provision for recognising any of the following as equivalent to certificates under the trading scheme—
  - (a) allowances, credits or certificates under another trading scheme for which provision is made by regulations under this Part of this Act;
  - (b) units under any other trading scheme (at United Kingdom, European or international level) relating to greenhouse gas emissions.
- (2) The regulations may provide—
  - (a) for determining the value for the purposes of the scheme of any such allowances, credits, certificates or units, and
  - (b) for the use for the purposes of the scheme of any such allowances, credits, certificates or units to be subject to such conditions and limitations as may be specified in or determined in accordance with the regulations.

### **PART 3**

#### ADMINISTRATION AND ENFORCEMENT

##### *The administrator*

- 21 (1) The regulations may appoint a person as the administrator of a trading scheme.
- (2) The regulations may confer or impose functions on the administrator for the purposes of the scheme.
- (3) Only the following may be appointed as the administrator of a trading scheme—
  - (a) the Secretary of State,
  - (b) the Scottish Ministers,
  - (c) the Welsh Ministers,
  - (d) the relevant Northern Ireland department,
  - (e) a body established by an enactment, or
  - (f) any combination of the above.
- (4) The same person may be appointed as the administrator of more than one trading scheme.
- (5) More than one person may be appointed as the administrator of the same trading scheme.

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### *Information*

- 22 (1) The regulations may require such information as may be specified in or determined in accordance with the regulations to be provided to—
- (a) the administrator of a trading scheme,
  - (b) a national authority, or
  - (c) participants or potential participants in the scheme,
- for purposes connected with the scheme.
- (2) The regulations may confer power on the administrator of a trading scheme to require information to be provided to any of those persons for those purposes.
- (3) The regulations must provide for a requirement by the administrator to provide information to be notified in writing to the person to whom it is made.
- (4) If the regulations confer functions on the administrator for the purposes of this paragraph, they may provide for the administrator to delegate the performance of any of those functions.
- (5) The regulations may provide for information held by or on behalf of the administrator of a trading scheme in connection with the administrator's functions to be disclosed to—
- (a) any other administrator of the scheme,
  - (b) the administrator of another trading scheme, or
  - (c) a national authority.

### *Registers*

- 23 (1) The regulations may provide for the creation and maintenance of a register or registers of information relating to a trading scheme and, in particular, for the register or registers to keep track of any of the following—
- (a) the participants in a trading scheme;
  - (b) any limits on or obligations applying to the participants' activities under the scheme;
  - (c) any allocation of allowances among the participants;
  - (d) the allowances, credits, certificates or other units held by the participants or others;
  - (e) trading in allowances, credits, certificates or other units;
  - (f) the use by the participants or others of allowances, credits, certificates or other units for the purposes of the scheme;
  - (g) the cancellation of allowances, credits, certificates or other units;
  - (h) permits held by the participants, and any conditions attached to those permits.
- (2) The regulations may, in particular, provide for the establishment and maintenance of accounts in which allowances, credits, certificates or other units may be held by the participants, the administrator or others and between which they may be transferred.
- (3) The regulations may provide for the same register to operate in relation to more than one trading scheme.
- (4) The regulations may make provision for the disclosure of information held in or derived from a register relating to a trading scheme—

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- (a) for the purposes of the administration of another trading scheme for which provision is made by regulations under this Part of this Act, or
- (b) for the purposes of the administration of any other trading scheme (at United Kingdom, European or international level) relating to greenhouse gas emissions.

#### *Publication of information*

- 24 The regulations may confer or impose functions on the administrator of a trading scheme in relation to the publication of information relating to the scheme or its participants (including, in particular, information supplied to the administrator by the participants and others).

#### *Acquisition of units by the administrator*

- 25 The regulations may confer powers on the administrator of a trading scheme to acquire—
- (a) allowances, credits or certificates under another trading scheme for which provision is made by regulations under this Part of this Act, or
  - (b) units under any other trading scheme (at United Kingdom, European or international level) relating to greenhouse gas emissions.

#### *Charges*

- 26 (1) The regulations may—
- (a) require the payment by participants or other persons authorised to trade in allowances, credits or certificates of charges of an amount determined by or under the regulations by reference to the costs of operating the scheme, and
  - (b) provide for such charges to be imposed by—
    - (i) a national authority,
    - (ii) the administrator of the scheme, or
    - (iii) such other person as may be specified in or determined in accordance with the regulations.
- (2) If the regulations provide for charges to be payable to a person other than a national authority, they must provide for that person to pay the sums received to the national authority or authorities specified in or determined in accordance with the regulations.

#### *Monitoring compliance*

- 27 (1) The regulations may make provision for monitoring compliance with the requirements of a trading scheme.
- (2) The regulations may, in particular, make provision about—
- (a) the keeping of records by the participants,
  - (b) the provision of information by the participants and others,
  - (c) the audit and verification of that information, and
  - (d) the inspection of premises.
- (3) If the regulations confer functions on the administrator of the scheme for the purposes of this paragraph, they may provide for the administrator to delegate the performance of any of those functions.

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### *Enforcement*

- 28 (1) The regulations may confer powers on a person to whom this paragraph applies to—
- (a) require the production of documents or the provision of information,
  - (b) question the officers of a company,
  - (c) enter premises with a warrant, or
  - (d) seize documents or records.
- (2) The regulations must provide that the power in question may only be exercised where the person on whom it is conferred reasonably believes there has been a failure to comply with the requirements of a trading scheme.
- (3) This paragraph applies to—
- (a) a national authority,
  - (b) the administrator of the scheme, and
  - (c) such other person as may be specified in or determined in accordance with the regulations.

### *Penalties*

- 29 (1) The regulations may provide that a person is liable to a financial or other penalty if the person fails to comply with the requirements of a trading scheme.
- (2) The regulations may—
- (a) specify the amount of any financial penalty, or
  - (b) provide for the amount of any financial penalty to be determined in accordance with the regulations.
- (3) If the regulations provide for financial penalties to be payable to a person other than a national authority, they must provide for that person to pay the sums received to the national authority or authorities specified in or determined in accordance with the regulations.

### *Offences*

- 30 (1) The regulations may create offences relating to trading schemes.
- (2) The regulations may provide for such an offence to be triable—
- (a) only summarily, or
  - (b) either summarily or on indictment.
- (3) The regulations may provide for such an offence to be punishable on summary conviction—
- (a) with imprisonment for a term not exceeding such period as is specified in the regulations (which may not exceed the normal maximum term),
  - (b) with a fine not exceeding such amount as is so specified (which may not exceed £50,000), or
  - (c) with both.
- (4) The “normal maximum term” means—
- (a) in relation to England and Wales—
    - (i) in the case of an offence triable only summarily, 51 weeks, and

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- (ii) in the case of an offence triable either summarily or on indictment, twelve months;
  - (b) in relation to Scotland—
    - (i) in the case of an offence triable only summarily, 6 months, and
    - (ii) in the case of an offence triable either summarily or on indictment, twelve months;
  - (c) in relation to Northern Ireland, six months.
- (5) Regulations that—
- (a) are made before the date on which section 281(5) of the Criminal Justice Act 2003 (c. 44) comes into force, and
  - (b) in relation to England and Wales, make provision for a summary offence to be punishable with a term of imprisonment exceeding six months,
- must provide that, where the offence is committed before that date, it is punishable with imprisonment for a term not exceeding six months.
- (6) Regulations that—
- (a) are made before the date on which [<sup>F27</sup>paragraph 24(2) of Schedule 22 to the Sentencing Act 2020] comes into force, and
  - (b) in relation to England and Wales, make provision for an offence triable either summarily or on indictment to be punishable on summary conviction with a term of imprisonment exceeding six months,
- must provide that, where the offence is committed before that date, it is punishable on summary conviction with imprisonment for a term not exceeding six months.
- (7) The regulations may provide for an offence to be punishable on indictment—
- (a) with imprisonment for a term not exceeding such period as is specified in the regulations (which may not exceed five years),
  - (b) with a fine, or
  - (c) with both.
- (8) The regulations may—
- (a) provide for defences against offences, and
  - (b) make provision about matters of procedure and evidence in proceedings relating to offences.

#### Textual Amendments

**F27** Words in [Sch. 2 para. 30\(6\)\(a\)](#) substituted (1.12.2020) by [Sentencing Act 2020 \(c. 17\), s. 416\(1\), Sch. 24 para. 443\(1\)](#) (with [Sch. 24 para. 447, Sch. 27](#)); [S.I. 2020/1236, reg. 2](#)

#### Appeals

- 31 (1) The regulations may confer rights of appeal against—
- (a) decisions made in relation to a trading scheme, and
  - (b) civil penalties imposed or enforcement action taken for failure to comply with the requirements of a trading scheme.
- (2) The regulations must specify the court, tribunal or person who is to hear and determine appeals in relation to a trading scheme.

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- (3) The regulations may, in particular, provide for appeals in relation to a trading scheme to be heard by—
- (a) a national authority, if not the administrator of the trading scheme, or
  - (b) a person appointed by a national authority for that purpose.
- (4) They may provide for an appeal to be determined by a person other than the person by whom the appeal was heard.

### SCHEDULE 3

Section 49

#### TRADING SCHEMES REGULATIONS: FURTHER PROVISIONS

#### PART 1

##### REGULATIONS MADE BY A SINGLE NATIONAL AUTHORITY

- 1 This Part of this Schedule applies in relation to an instrument containing regulations under this Part of this Act made by a single national authority.
- 2 (1) Where the instrument contains regulations that—
- (a) are to be made by the Secretary of State, and
  - (b) are subject to affirmative resolution procedure,
- the regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of each House of Parliament.
- (2) Where the instrument contains regulations that—
- (a) are to be made by a national authority other than the Secretary of State, and
  - (b) are subject to affirmative resolution procedure,
- the regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of the relevant devolved legislature.
- 3 (1) An instrument containing regulations made by the Secretary of State that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of either House of Parliament.
- (2) An instrument containing regulations made by the Scottish Ministers that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of the Scottish Parliament.
- (3) An instrument containing regulations made by the Welsh Ministers that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of the National Assembly for Wales.
- (4) An instrument containing regulations made by a Northern Ireland department that are subject to negative resolution procedure is subject to negative resolution within the meaning of section 41(6) of the Interpretation Act (Northern Ireland) 1954 (c. 33 (N.I.)) as if it were a statutory instrument within the meaning of that Act.
- 4 Any provision that may be made by regulations subject to negative resolution procedure may be made by regulations subject to affirmative resolution procedure.

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## PART 2

### REGULATIONS MADE BY TWO OR MORE NATIONAL AUTHORITIES

- 5 This Part of this Schedule applies in relation to an instrument containing regulations under this Part of this Act made or to be made by any two or more of—
- (a) the Secretary of State,
  - (b) the Welsh Ministers, and
  - (c) a Northern Ireland department.
- 6 If any of the regulations are subject to affirmative resolution procedure, all of them are subject to that procedure.
- 7 Paragraphs 2 and 3 (affirmative and negative resolution procedure) apply to the instrument as they apply to an instrument containing regulations made by a single national authority.
- 8 (1) If in accordance with paragraph 3 (negative resolution procedure)—
- (a) either House of Parliament resolves that an address be presented to Her Majesty praying that an instrument containing regulations made by the Secretary of State be annulled, or
  - (b) a devolved legislature resolves that an instrument containing regulations made by a national authority be annulled,
- nothing further is to be done under the instrument after the date of the resolution and Her Majesty may by Order in Council revoke the instrument.
- (2) This is without prejudice to the validity of anything previously done under the instrument or to the making of a new instrument.
- (3) This paragraph applies in place of provision made by any other enactment about the effect of such a resolution.

## PART 3

### POWER TO MAKE PROVISION BY ORDER IN COUNCIL

- 9 (1) Her Majesty may by Order in Council make provision for trading schemes.
- (2) That power may only be exercised to make an Order in Council—
- (a) that extends or applies both to Scotland and to one or more of England, Wales and Northern Ireland, or
  - (b) that extends to Scotland only and contains both provision within the legislative competence of the Scottish Parliament and provision outside that competence.
- (3) The provision that may be made by an Order in Council under this paragraph includes any provision that may be made by a national authority by regulations under this Part of this Act.
- 10 No recommendation is to be made to Her Majesty in Council to make an Order in Council under paragraph 9 unless the requirements of section 48(1) and (2) as to advice and consultation have been complied with.

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- 11 (1) This paragraph applies to an Order in Council under paragraph 9 containing any provision that, were it to be made by regulations under this Part of this Act, would be subject to affirmative resolution procedure.
- (2) No recommendation is to be made to Her Majesty in Council to make an Order in Council to which this paragraph applies unless—
- (a) in the case of an Order in Council containing provision that may be made by the Secretary of State by regulations under this Part of this Act, a draft of the statutory instrument containing the Order in Council has been laid before, and approved by a resolution of, each House of Parliament, and
  - (b) in the case of an Order in Council containing provision that may be made by a national authority other than the Secretary of State by regulations under this Part of this Act, a draft of the statutory instrument containing the Order in Council has been laid before, and approved by a resolution of, the relevant devolved legislature.
- 12 (1) This paragraph applies to an Order in Council under paragraph 9 other than one to which paragraph 11 applies.
- (2) An Order in Council to which this paragraph applies containing provision that may be made by the Secretary of State by regulations under this Part of this Act is subject to annulment in pursuance of a resolution of either House of Parliament.
- (3) An Order in Council to which this paragraph applies containing provision that may be made by the Scottish Ministers by regulations under this Part of this Act is subject to annulment in pursuance of a resolution of the Scottish Parliament.
- (4) An Order in Council to which this paragraph applies containing provision that may be made by the Welsh Ministers by regulations under this Part of this Act is subject to annulment in pursuance of a resolution of the National Assembly for Wales.
- (5) An Order in Council to which this paragraph applies containing provision that may be made by a Northern Ireland department by regulations under this Part of this Act is subject to negative resolution within the meaning of section 41(6) of the Interpretation Act (Northern Ireland) 1954 (c. 33 (N.I.)) as if it were a statutory instrument within the meaning of that Act.
- 13 (1) If in accordance with paragraph 12—
- (a) either House of Parliament resolves that an address be presented to Her Majesty praying that an Order in Council be annulled, or
  - (b) a devolved legislature resolves that an Order in Council be annulled,
- nothing further is to be done under the Order in Council after the date of the resolution and Her Majesty may by Order in Council revoke it.
- (2) This is without prejudice to the validity of anything previously done under the Order in Council or to the making of a new Order in Council.
- (3) This paragraph applies in place of provision made by any other enactment about the effect of such a resolution.

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## SCHEDULE 4

Section 50

### TRADING SCHEMES: POWERS TO REQUIRE INFORMATION

#### *Introductory*

- 1 [F28(1) The powers conferred by this Schedule are exercisable by the following authorities—
- (a) the Secretary of State;
  - (b) the Scottish Ministers;
  - (c) the relevant Northern Ireland department;
  - (d) the Welsh Ministers;
  - (e) the Environment Agency;
  - (f) the Scottish Environment Protection Agency.
- (2) References in this Schedule to an “environmental authority” are to any of those authorities.]

#### **Textual Amendments**

**F28** Sch. 4 paras. 1-5 ceased to have effect (26.1.2009) by virtue of [Climate Change Act 2008 \(c. 27\)](#), [ss. 50\(2\), 100\(5\)](#)

#### *Information from electricity suppliers and distributors*

- 2 [F28(1) An environmental authority may, for the purposes of enabling a trading scheme to be established, by notice require an electricity supplier or electricity distributor to provide any of the following information—
- (a) information about the electricity meters and metering systems for which the supplier or distributor is responsible, including (in particular) their locations and any identifying features;
  - (b) information about the persons to whom electricity measured by those meters or systems is supplied or who purchase such electricity;
  - (c) information about the consumption by those persons of that electricity;
  - (d) any other information that the environmental authority considers necessary for identifying the potential participants in the scheme.
- (2) An “electricity supplier”—
- (a) in relation to England and Wales and Scotland means an authorised supplier within the meaning of the Electricity Act 1989 (c. 29) (see section 64(1) of that Act);
  - (b) in relation to Northern Ireland means—
    - (i) an electricity supplier within the meaning of the Electricity (Northern Ireland) Order 1992 (S.I. 1992/231) (N.I. 1) (see Article 3 of that Order), or
    - (ii) a person who may supply electricity to premises without a licence by virtue of an exemption under Article 9 of that Order.
- (3) An “electricity distributor”—

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- (a) in relation to England and Wales and Scotland means an authorised distributor within the meaning of the Electricity Act 1989 (see section 64(1) of that Act);
  - (b) in relation to Northern Ireland means an electricity distributor within the meaning of the Electricity (Northern Ireland) Order 1992 (see Article 3 of that Order).
- (4) References in this Schedule to an electricity supplier or electricity distributor include an agent of such a supplier or distributor.]

#### Textual Amendments

**F28** Sch. 4 paras. 1-5 ceased to have effect (26.1.2009) by virtue of [Climate Change Act 2008 \(c. 27\)](#), [ss. 50\(2\), 100\(5\)](#)

#### *Information from potential participants in a trading scheme*

- 3 [F28(1) An environmental authority may, for the purposes of enabling a trading scheme to be established, by notice require a potential participant in the scheme to provide any of the following information—
- (a) information about whether the criteria specified in the notice are met by the potential participant, either alone or together with any other person or persons;
  - (b) information identifying any potential co-participant;
  - (c) contact details for the potential participant and any potential co-participant;
  - (d) information about the meters that measure electricity supplied to or purchased by the potential participant or any potential co-participant;
  - (e) information about the consumption of electricity by the potential participant and any potential co-participant;
  - (f) information about any climate change agreement (within the meaning of Schedule 6 to the Finance Act 2000 (c. 17)) entered into by or on behalf of the potential participant or any potential co-participant.
- (2) A “potential participant”, in relation to a trading scheme, means a person who the environmental authority considers—
- (a) will or may be a participant in the scheme, or
  - (b) will or may fall to be treated together with any other person or persons (a “potential co-participant”) as such a participant.]

#### Textual Amendments

**F28** Sch. 4 paras. 1-5 ceased to have effect (26.1.2009) by virtue of [Climate Change Act 2008 \(c. 27\)](#), [ss. 50\(2\), 100\(5\)](#)

#### *Requirements for a valid notice*

- 4 [F28(1) A notice under this Schedule must comply with the following requirements.
- (2) The notice must—
- (a) be in writing,

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- (b) specify the information to be provided,
  - (c) specify the name and address of the person to whom the information is to be provided,
  - (d) specify the date by which the information is to be provided, and
  - (e) explain the consequences of failure to comply with the notice.
- (3) An environmental authority must not give a notice requiring information from a person unless—
- (a) the authority has previously sent the person a request in writing for the information, and
  - (b) the person has failed to provide the information within the period of 28 days beginning with the day on which the request was sent.]

#### Textual Amendments

**F28** Sch. 4 paras. 1-5 ceased to have effect (26.1.2009) by virtue of [Climate Change Act 2008 \(c. 27\)](#), ss. [50\(2\)](#), [100\(5\)](#)

#### *Failure to comply with notice etc an offence*

- 5 [F28(1) A person who—
- (a) fails without reasonable excuse to comply with a notice under this Schedule, or
  - (b) provides information in response to such a notice that the person knows or suspects to be false or misleading, commits an offence.
- (2) A person guilty of such an offence is liable on summary conviction to a fine not exceeding level 5 on the standard scale.]

#### Textual Amendments

**F28** Sch. 4 paras. 1-5 ceased to have effect (26.1.2009) by virtue of [Climate Change Act 2008 \(c. 27\)](#), ss. [50\(2\)](#), [100\(5\)](#)

#### *Disclosure of information*

- 6 (1) This paragraph applies to information obtained by an environmental authority (whether or not pursuant to a notice under this Schedule) from—
- (a) an electricity supplier or electricity distributor, or
  - (b) a potential participant,
- for the purposes of enabling a trading scheme to be established.
- (2) The information may be disclosed for the purposes of or in connection with the establishment, operation or enforcement of a trading scheme—
- (a) by an environmental authority to another environmental authority or the administrator of the scheme, or
  - (b) by the administrator of the scheme to any other administrator of the scheme or an environmental authority.

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- (3) This does not affect any other right to disclose information within sub-paragraph (1) apart from this paragraph.

## F29 SCHEDULE 5

Section 71

### Textual Amendments

**F29** Sch. 5 repealed (15.1.2012) by [Localism Act 2011 \(c. 20\)](#), ss. 47(a), 240(1)(e), [Sch. 25 Pts. 8](#)

## SCHEDULE 6

Section 77

### CHARGES FOR [F10 CARRIER BAGS]

#### PART 1

#### POWERS TO MAKE REGULATIONS ABOUT CHARGES

##### *General power*

- 1 The relevant national authority may make provision by regulations about charging by sellers of goods for the supply of [F10 carrier bags].

##### *Requirement to charge*

- 2 The regulations may make provision requiring sellers of goods to charge for [F10 carrier bags] supplied—
- [F30(a) at a place where goods are sold, for the purpose of enabling goods to be taken away, or]
  - [F30(b) for the purpose of enabling goods to be delivered.]

### Textual Amendments

**F30** Sch. 6 para. 2(a)(b) substituted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), [s. 3\(1\)](#)

- [F31]2A The regulations may make provision for treating carrier bags as having been supplied for the purpose of enabling goods to be taken away if the carrier bags have been designed for that purpose.]

### Textual Amendments

**F31** Sch. 6 para. 2A inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), [s. 3\(2\)](#)

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### *Sellers of goods*

- 3 (1) “Seller”, in relation to goods, has the meaning given by the regulations which may define that term by reference (in particular) to—
- (a) a person's involvement in selling the goods,
  - (b) a person's interest in the goods, or
  - (c) a person's interest in the place at or from which the goods are sold,
- or any combination of those factors.
- (2) The regulations may make provision for regulations under this Schedule to apply—
- (a) to all sellers of goods,
  - (b) to sellers of goods named in the regulations,
  - (c) to sellers of goods identified by reference to specified factors, or
  - (d) to sellers of goods within paragraph (b) and sellers of goods within paragraph (c).
- (3) The specified factors may include—
- (a) the place or places at or from which a seller supplies goods;
  - (b) the type of goods that a seller supplies;
  - (c) the value of goods that a seller supplies;
  - (d) a seller's turnover or any part of that turnover.
  - <sup>F32</sup>(e) the number of a seller's full-time equivalent employees.]
- (4) In this Schedule “specified” means specified in regulations under this Schedule.
- <sup>F33</sup>(5) For the purposes of sub-paragraph (3)(e), the number of a seller's full-time equivalent employees is calculated as follows—
- Step 1* Find the number for full-time employees of the seller.
  - Step 2* Add, for each employee of the seller who is not a full-time employee, such fraction as is just and reasonable. The result is the number of full-time equivalent employees.]

#### **Textual Amendments**

- F32** Sch. 6 para. 3(5) inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 4\(3\)](#)  
**F33** Sch. 6 para. 3(3)(e) inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 4\(2\)](#)

### *Amount of charge*

- 4 The regulations may specify the minimum amount that a seller must charge for each <sup>F23</sup>carrier bag], or provide for that amount to be determined in accordance with the regulations.

#### **Textual Amendments**

- F23** Words in Act substituted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 1\(a\)](#)

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### *Destination of proceeds – Wales*

[<sup>F34</sup>4A (1) This paragraph applies to regulations made by the Welsh Ministers in relation to Wales.

(2) The regulations may provide for the application of the net proceeds of the charge to specified purposes.

[ The regulations may—

<sup>F35</sup>(2A) (a) provide for the time when and manner in which the gross or net proceeds of the charge are to be paid to the Department;  
(b) provide for the payment of interest for late payment of the gross or net proceeds of the charge to the Department.]

(3) Regulations under sub-paragraph (2) may (among other things)–

- (a) require sellers to apply the net proceeds of the charge to any one or more specified purposes;
- (b) provide for any duty imposed under paragraph (a) to be discharged (subject to any provision made under paragraph (c)) by the net proceeds of the charge being accepted by any one or more of the following persons–
  - (i) specified persons;
  - (ii) persons who fall within a specified category of person;
- (c) make provision about the arrangements under which the net proceeds of the charge are to be given by sellers to the persons mentioned in paragraph (b) or any other person;
- (d) require persons who accept any net proceeds of the charge under paragraph (b) to apply the proceeds to any one or more specified purposes;
- (e) provide for recovery by the Welsh Ministers of sums equal to the proceeds of the charge that have been accepted or applied otherwise than in accordance with provision made under sub-paragraph (2);
- (f) provide for the application of sums recovered under paragraph (e) to specified purposes (this includes making provision to the effect that such sums are not to be paid into the Welsh Consolidated Fund);
- (g) require the Welsh Ministers to give guidance about compliance with the regulations.

(4) The purposes that may be specified under sub-paragraph (2) are limited to purposes relating to any of the following–

- (a) preventing or reducing waste;
- (b) the collection, management, treatment or disposal of waste;
- (c) protecting or improving the environment in relation to pollution or nuisances;
- (d) educational or recreational activities for children or young people which relate to any of the matters specified in paragraphs (a) to (c).

(5) But purposes concerning the production of renewable energy for consumption in transport or the use of that energy in transport may not be specified under sub-paragraph (2).

(6) The regulations may make provision for regulations under this Schedule to apply to persons other than sellers, if the Welsh Ministers consider that such provision is appropriate for the enforcement of provision made under sub-paragraph (2) or for otherwise making such provision effective.

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- (7) The specified factors under paragraph 3(2)(c) may also include—
- (a) a seller's arrangements for applying the net proceeds of the charge, or
  - (b) any other factor that the Welsh Ministers consider appropriate, whether or not that factor is of the same kind as the factors listed in that paragraph.
- (8) The regulations may provide for exceptions and exemptions.]

#### Textual Amendments

- F34** Sch. 6 paras. 4A, 4B inserted (E.W.) (15.2.2011) by [Waste \(Wales\) Measure 2010 \(nawm 8\), ss. 1\(2\), 21\(2\)](#)
- F35** Sch. 6 para. 4A(2A) inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 5](#)

[<sup>F36</sup>4A (1) This paragraph applies to regulations made by the Department in relation to Northern Ireland.

- (2) The regulations may require the seller to pay to the Department—
- (a) the gross proceeds of the charge, or
  - (b) the net proceeds of the charge.
- (3) Paragraph 7(3)(c) does not apply to any amount required by regulations made under this paragraph to be paid to the Department.
- (4) In this paragraph—
- “ the Department ” means the Department of the Environment in Northern Ireland;
  - “ gross proceeds of the charge ” means the amount received by the seller by way of charges for [<sup>F10</sup> carrier bags ] ;
  - “ net proceeds of the charge ” means the seller's gross proceeds of the charge reduced by such amounts as may be specified. ]

#### Textual Amendments

- F36** Sch. 6 para. 4A inserted (N.I.) (4.5.2011) by [Single Use Carrier Bags Act \(Northern Ireland\) 2011 \(c. 26\), s. 1\(1\)](#)

#### *Interpretation of paragraph 4A*

- [<sup>F34</sup>4B (1) This paragraph applies for the purposes of paragraph 4A.
- (2) “ Children ” means persons who have not attained the age of 18.
- (3) “ Pollution ” means pollution of the air, water or land which may give rise to any environmental harm, including (but not limited to) pollution caused by light, noise, heat or vibrations or any other kind of release of energy.
- (4) For the purposes of the definition in sub-paragraph (3), “ environmental harm ” means any of the following—
- (a) harm to the health of humans and other living organisms;
  - (b) harm to the quality of the environment, including—
    - (i) harm to the quality of the environment taken as a whole,

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- (ii) harm to the quality of the air, water or land, and
  - (iii) other impairment of, or interference with, the ecological systems of which any living organisms form part;
  - (c) offence to the senses of human beings;
  - (d) damage to property;
  - (e) impairment of, or interference with, the amenity of the environment or any legitimate use of the environment.
- (5) For the purposes of sub-paragraphs (3) and (4), “ air ” includes (but is not limited to) air within buildings and air within other natural or man-made structures above or below ground.
- (6) “ Nuisance ” means an act or omission affecting any place, or a state of affairs in any place, which may impair, or interfere with, the amenity of the environment or any legitimate use of the environment.
- (7) “ Net proceeds of the charge ” has the same meaning as in paragraph 7(4).
- (8) “ Young people ” means persons who have attained the age of 18, but not the age of 25. ]

#### Textual Amendments

**F34** Sch. 6 paras. 4A, 4B inserted (E.W.) (15.2.2011) by [Waste \(Wales\) Measure 2010 \(nawm 8\)](#), **ss. 1(2), 21(2)**

#### *[<sup>F10</sup>Carrier bags]*

- 5 [<sup>F37</sup>(1)] “[<sup>F23</sup>Carrier bag]” has the meaning given by the regulations, which may define that term by reference (in particular) to—
- (a) a bag's size, thickness, construction, composition or other characteristics, [<sup>F38</sup>or]
  - (b) its intended use, [<sup>F39</sup>or]
  - (c) its price,]
- or any combination of those factors.
- [<sup>F40</sup>(2) In this paragraph “ price ” means the price paid by a specified person, excluding any minimum charge that may be applicable by virtue of paragraph 4. ]

#### Textual Amendments

**F23** Words in Act substituted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), **s. 1(a)**

**F37** Sch. 6 para. 5 renumbered as Sch. 6 para. 5(1) (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), **s. 6(2)**

**F38** Word in Sch. 6 para. 5(1)(a) omitted (N.I.) (28.4.2014) by virtue of [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), **s. 6(3)(a)**

**F39** Sch. 6 para. 5(1)(c) and preceding word inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), **s. 6(3)(b)**

**F40** Sch. 6 para. 5(2) inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), **s. 6(4)**

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### *Administration*

- 6 (1) The regulations may appoint a person (an “administrator”) to administer provision made by regulations under this Schedule.
- (2) More than one person may be appointed as administrator.
- (3) The regulations may confer or impose powers or duties on an administrator and may (in particular) do so—
- (a) by making modifications to any enactment applying to the administrator, or
  - (b) by providing for any such enactment to apply, with or without modifications, for the purposes of regulations under this Schedule.
- (4) References in this Schedule to an administrator include a person appointed by an administrator.

### *Record-keeping and publication of records*

- 7 (1) The regulations may require records to be kept relating to charges made for [<sup>F10</sup>carrier bags].
- (2) The regulations may require—
- (a) the records, or such other information as may be specified, to be published at such times and in such manner as may be specified;
  - (b) the records, or such other information as may be specified, to be supplied on request and in such manner as may be specified to—
    - (i) the relevant national authority,
    - (ii) an administrator, or
    - (iii) members of the public.
- (3) The regulations may (in particular) require the publication or supply of records or information relating to any of the following—
- (a) the amount received by a seller by way of charges for [<sup>F10</sup>carrier bags];
  - (b) the seller's gross or net proceeds of the charge;
  - (c) the uses to which the net proceeds of the charge have been put.
  - [<sup>F41</sup>(d) payments of the gross or net proceeds of the charge made to the Department of the Environment in Northern Ireland.]
- [<sup>F42</sup>(3A) Regulations made by the Welsh Ministers may also require the publication or supply of records or information relating to the amount received by a person from a seller by way of net proceeds of the charge to be applied to purposes specified under paragraph 4A(2).]
- (4) In this paragraph—
- “gross proceeds of the charge” means the amount received by the seller by way of charges for [<sup>F10</sup>carrier bags];
  - “net proceeds of the charge” means the seller's gross proceeds of the charge reduced by such amounts as may be specified.

#### **Textual Amendments**

**F41** Sch. 6 para. 7(3)(d) inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\)](#), s. 7(2)

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**F42** Sch. 6 para. 7(3A) inserted (E.W.) (15.2.2011) by [Waste \(Wales\) Measure 2010 \(nawm 8\), ss. 1\(3\), 21\(2\)](#)

### *Enforcement*

- 8 (1) The regulations may confer or impose powers or duties on an administrator to enforce provision made by regulations under this Schedule.
- (2) The regulations may (in particular) confer powers on an administrator to—
- (a) require the production of documents or the provision of information,<sup>[F43]</sup> or<sup>[F44]</sup>
  - (aa) inspect, retain or copy such documents, or<sup>[F44]</sup>
  - (b) question a seller or officers or employees of a seller.
- <sup>[F45]</sup>(2A) Regulations made by the Welsh Ministers may also confer powers on an administrator to question a person the administrator reasonably believes has received any net proceeds of the charge or officers or employees of such a person.]
- <sup>[F46]</sup>(3) Regulations under sub-paragraph (2) must contain provision for ensuring that the power in question is exercised by a person only where the person reasonably believes there has been a failure to comply with a requirement of regulations under this Schedule.]

#### **Textual Amendments**

- F43** Word in Sch. 6 para. 8(2)(a) omitted (N.I.) (28.4.2014) by virtue of [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 7\(3\)\(a\)](#)
- F44** Sch. 6 para. 8(2)(aa) inserted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 7\(3\)\(b\)](#)
- F45** Sch. 6 para. 8(2A) inserted (E.W.) (15.2.2011) by [Waste \(Wales\) Measure 2010 \(nawm 8\), ss. 1\(4\), 21\(2\)](#)
- F46** Sch. 6 para. 8(3) omitted (N.I.) (28.4.2014) by virtue of [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 7\(3\)\(c\)](#)

## **PART 2**

### CIVIL SANCTIONS

#### *Civil sanctions*

- 9 (1) The relevant national authority may make provision by regulations about civil sanctions for breaches of regulations under this Schedule.
- (2) For the purposes of this Schedule a person breaches regulations under this Schedule if, in such circumstances as may be specified, the person—
- (a) fails to comply with a requirement made by or under the regulations, or
  - (b) obstructs or fails to assist an administrator.
- (3) In this Schedule “civil sanction” means—
- (a) a fixed monetary penalty (see paragraph 10), or
  - (b) a discretionary requirement (see paragraph 12).

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### *Fixed monetary penalties*

- 10 (1) The regulations may make provision conferring on an administrator the power by notice to impose a fixed monetary penalty on a person who breaches regulations under this Schedule.
- (2) The regulations may only confer such a power in relation to a case where the administrator is satisfied on the balance of probabilities that the breach has occurred.
- (3) For the purposes of this Schedule a “fixed monetary penalty” is a requirement to pay to an administrator a penalty of an amount specified in or determined in accordance with the regulations.
- (4) The regulations may not provide for the imposition of a fixed monetary penalty in excess of £5,000.

### *Fixed monetary penalties: procedure*

- 11 (1) Provision under paragraph 10 must secure that—
- (a) where an administrator proposes to impose a fixed monetary penalty on a person, the administrator must serve on that person a notice of what is proposed (a “notice of intent”) that complies with sub-paragraph (2),
  - (b) the notice of intent also offers the person the opportunity to discharge the person's liability for the fixed monetary penalty by payment of a specified sum (which must be less than or equal to the amount of the penalty),
  - (c) if the person does not so discharge liability—
    - (i) the person may make written representations and objections to the administrator in relation to the proposed imposition of the fixed monetary penalty, and
    - (ii) the administrator must at the end of the period for making representations and objections decide whether to impose the fixed monetary penalty,
  - (d) where the administrator decides to impose the fixed monetary penalty, the notice imposing it (“the final notice”) complies with sub-paragraph (4), and
  - (e) the person on whom a fixed monetary penalty is imposed may appeal against the decision to impose it.
- (2) To comply with this sub-paragraph the notice of intent must include information as to—
- (a) the grounds for the proposal to impose the fixed monetary penalty,
  - (b) the effect of payment of the sum referred to in sub-paragraph (1)(b),
  - (c) the right to make representations and objections,
  - (d) the circumstances in which the administrator may not impose the fixed monetary penalty,
  - (e) the period within which liability to the fixed monetary penalty may be discharged, which may not exceed the period of 28 days beginning with the day on which the notice of intent was received, and
  - (f) the period within which representations and objections may be made, which may not exceed the period of 28 days beginning with the day on which the notice of intent was received.

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- (3) Provision pursuant to sub-paragraph (1)(c)(ii) must include provision for circumstances in which the administrator may not decide to impose a fixed monetary penalty.
- (4) To comply with this sub-paragraph the final notice referred to in sub-paragraph (1)(d) must include information as to—
  - (a) the grounds for imposing the penalty,
  - (b) how payment may be made,
  - (c) the period within which payment must be made,
  - (d) any early payment discounts or late payment penalties,
  - (e) rights of appeal, and
  - (f) the consequences of non-payment.
- (5) Provision pursuant to sub-paragraph (1)(e) must secure that the grounds on which a person may appeal against a decision of the administrator include the following—
  - (a) that the decision was based on an error of fact;
  - (b) that the decision was wrong in law;
  - (c) that the decision was unreasonable.

#### *Discretionary requirements*

- 12 (1) The regulations may make provision conferring on an administrator the power by notice to impose one or more discretionary requirements on a person who breaches regulations under this Schedule.
- (2) The regulations may only confer such a power in relation to a case where the administrator is satisfied on the balance of probabilities that the breach has occurred.
- (3) For the purposes of this Schedule a “discretionary requirement” means—
  - (a) a requirement to pay a monetary penalty to an administrator of such amount as the administrator may determine, or
  - (b) a requirement to take such steps as an administrator may specify, within such period as the administrator may specify, to secure that the breach does not continue or recur.
- (4) In this Schedule—
 

“variable monetary penalty” means a requirement referred to in sub-paragraph (3)(a);

“non-monetary discretionary requirement” means a requirement referred to in sub-paragraph (3)(b).
- (5) The regulations must, in relation to each kind of breach of regulations under this Schedule for which a variable monetary penalty may be imposed—
  - (a) specify the maximum penalty that may be imposed for a breach of that kind, or
  - (b) provide for that maximum to be determined in accordance with the regulations.
- (6) The regulations may not permit discretionary requirements to be imposed on a person on more than one occasion in relation to the same act or omission.

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*Discretionary requirements: procedure*

- 13 (1) Provision under paragraph 12 must secure that—
- (a) where an administrator proposes to impose a discretionary requirement on a person, the administrator must serve on that person a notice of what is proposed (a “notice of intent”) that complies with sub-paragraph (2),
  - (b) that person may make written representations and objections to the administrator in relation to the proposed imposition of the discretionary requirement,
  - (c) after the end of the period for making such representations and objections, the administrator must decide whether to—
    - (i) impose the discretionary requirement, with or without modifications, or
    - (ii) impose any other discretionary requirement that the administrator has power to impose under paragraph 12,
  - (d) where the administrator decides to impose a discretionary requirement, the notice imposing it (the “final notice”) complies with sub-paragraph (4), and
  - (e) the person on whom a discretionary requirement is imposed may appeal against the decision to impose it.
- (2) To comply with this sub-paragraph the notice of intent must include information as to—
- (a) the grounds for the proposal to impose the discretionary requirement,
  - (b) the right to make representations and objections,
  - (c) the circumstances in which the administrator may not impose the discretionary requirement,
  - (d) the period within which representations and objections may be made, which may not be less than the period of 28 days beginning with the day on which the notice of intent is received.
- (3) Provision pursuant to sub-paragraph (1)(c) must include provision for circumstances in which the administrator may not decide to impose a fixed monetary penalty.
- (4) To comply with this sub-paragraph the final notice referred to in sub-paragraph (1)(d) must include information as to—
- (a) the grounds for imposing the discretionary requirement,
  - (b) where the discretionary requirement is a variable monetary penalty—
    - (i) how payment may be made,
    - (ii) the period within which payment must be made, and
    - (iii) any early payment discounts or late payment penalties,
  - (c) rights of appeal, and
  - (d) the consequences of non-compliance.
- (5) Provision pursuant to sub-paragraph (1)(e) must secure that the grounds on which a person may appeal against a decision of the administrator include the following—
- (a) that the decision was based on an error of fact;
  - (b) that the decision was wrong in law;
  - (c) in the case of a variable monetary penalty, that the amount of the penalty is unreasonable;
  - (d) in the case of a non-monetary discretionary requirement, that the nature of the requirement is unreasonable;

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- (e) that the decision was unreasonable for any other reason.

*Discretionary requirements: enforcement*

- 14 (1) Provision under paragraph 12 may include provision for a person to pay a monetary penalty (a “non-compliance penalty”) to an administrator if the person fails to comply with a non-monetary discretionary requirement imposed on the person.
- (2) Provision under sub-paragraph (1) may—
- (a) specify the amount of the non-compliance penalty or provide for that amount to be determined in accordance with the regulations, or
  - (b) provide for the amount to be determined by the administrator or in some other way.
- (3) If the regulations make provision within sub-paragraph (2)(b), they must, in relation to each kind of failure for which a non-compliance penalty may be imposed—
- (a) specify the maximum penalty that may be imposed for a failure of that kind, or
  - (b) provide for that maximum to be determined in accordance with the regulations.
- (4) Provision under sub-paragraph (1) must secure that—
- (a) the non-compliance penalty is imposed by notice served by the administrator, and
  - (b) the person on whom it is imposed may appeal against that notice.
- (5) Provision pursuant to paragraph (b) of sub-paragraph (4) must secure that the grounds on which a person may appeal against a notice referred to in that sub-paragraph include the following—
- (a) that the decision to serve the notice was based on an error of fact;
  - (b) that the decision was wrong in law;
  - (c) that the decision was unfair or unreasonable for any reason (including, in a case where the amount of the non-compliance penalty was determined by the administrator, that the amount is unreasonable).

*Combination of sanctions*

- 15 (1) Provision may not be made under paragraphs 10 and 12 conferring powers on an administrator in relation to the same kind of breach of regulations under this Schedule unless it complies with the following requirements.
- (2) The provision must secure that the administrator may not serve a notice of intent referred to in paragraph 11(1)(a) on a person in relation to a breach where a discretionary requirement has been imposed on that person in relation to the same breach.
- (3) Such provision must secure that the administrator may not serve a notice of intent referred to in paragraph 13(1)(a) on a person in relation to a breach where—
- (a) a fixed monetary penalty has been imposed on that person in relation to the same breach, or
  - (b) the person has discharged liability to a fixed monetary penalty in relation to that breach pursuant to paragraph 11(1)(b).

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### *Monetary penalties*

- 16 (1) If the regulations confer power on an administrator to require a person to pay a fixed monetary penalty, a variable monetary penalty or a non-compliance penalty under paragraph 14(1), they may include provision—
- (a) for early payment discounts;
  - (b) for the payment of interest or other financial penalties for late payment of the penalty, such interest or other financial penalties not in total to exceed the amount of that penalty;
  - (c) for enforcement of the penalty.
- (2) Provision under sub-paragraph (1)(c) may include—
- (a) provision for the administrator to recover the penalty, and any interest or other financial penalty for late payment, as a civil debt;
  - (b) provision for the penalty, and any interest or other financial penalty for late payment to be recoverable, on the order of a court, as if payable under a court order.

### *Costs recovery*

- 17 (1) Provision under paragraph 12 may include provision for an administrator, by notice, to require a person on whom a discretionary requirement is imposed to pay the costs incurred by the administrator in relation to the imposition of the discretionary requirement up to the time of its imposition.
- (2) In sub-paragraph (1), the reference to costs includes in particular—
- (a) investigation costs;
  - (b) administration costs;
  - (c) costs of obtaining expert advice (including legal advice).
- (3) Provision under this paragraph must secure that, in any case where a notice requiring payment of costs is served—
- (a) the notice specifies the amount required to be paid;
  - (b) the administrator may be required to provide a detailed breakdown of that amount;
  - (c) the person required to pay costs is not liable to pay any costs shown by the person to have been unnecessarily incurred;
  - (d) the person required to pay costs may appeal against—
    - (i) the decision of the administrator to impose the requirement to pay costs;
    - (ii) the decision of the administrator as to the amount of those costs.
- (4) Provision under this paragraph may include the provision referred to in paragraph 16(1)(b) and (c) and (2).
- (5) Provision under this paragraph must secure that the administrator is required to publish guidance about how the administrator will exercise the power conferred by the provision.

### *Appeals*

- 18 (1) The regulations may not provide for the making of an appeal other than to—

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- (a) the First-tier Tribunal, or
  - (b) another tribunal created under an enactment.
- (2) In sub-paragraph (1)(b) “tribunal” does not include an ordinary court of law.
- (3) If the regulations make provision for an appeal in relation to the imposition of any requirement or service of any notice, they may include—
- (a) provision suspending the requirement or notice pending determination of the appeal;
  - (b) provision as to the powers of the tribunal to which the appeal is made;
  - (c) provision as to how any sum payable in pursuance of a decision of that tribunal is to be recoverable.
- (4) The provision referred to in sub-paragraph (3)(b) includes provision conferring on the tribunal to which the appeal is made power—
- (a) to withdraw the requirement or notice;
  - (b) to confirm the requirement or notice;
  - (c) to take such steps as the administrator could take in relation to the act or omission giving rise to the requirement or notice;
  - (d) to remit the decision whether to confirm the requirement or notice, or any matter relating to that decision, to the administrator;
  - (e) to award costs.

*Publicity for imposition of civil sanctions*

- 19 (1) The regulations may make provision enabling an administrator to give a publicity notice to a person on whom a civil sanction has been imposed in accordance with regulations under this Schedule.
- (2) A “publicity notice” is a notice requiring the person to publicise—
- (a) the fact that the civil sanction has been imposed, and
  - (b) such other information as may be specified in the regulations,
- in such manner as may be specified in the notice.
- (3) The regulations may provide for a publicity notice to—
- (a) specify the time for compliance with the notice, and
  - (b) require the person to whom it is given to supply an administrator with evidence of compliance within such time as may be specified in the notice.
- (4) The regulations may provide that, if a person fails to comply with a publicity notice, an administrator may—
- (a) publicise the information required to be publicised by the notice, and
  - (b) recover the costs of doing so from that person.

*Persons liable to civil sanctions*

- 20 The regulations may make provision about the persons liable to civil sanctions under regulations under this Schedule and may (in particular) provide for—
- (a) the officers of a body corporate to be so liable as well the body corporate itself, and
  - (b) for the partners of a partnership to be liable as well as the partnership itself,

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in such circumstances as may be specified.

*Guidance as to use of civil sanctions*

- 21 (1) Where power is conferred on an administrator by the regulations to impose a civil sanction in relation to a breach of regulations under this Schedule, the provision conferring the power must secure that—
- (a) the administrator must publish guidance about the administrator's use of the civil sanction,
  - (b) the guidance must contain the relevant information,
  - (c) the administrator must revise the guidance where appropriate,
  - (d) the administrator must consult such persons as the provision may specify before publishing any guidance or revised guidance, and
  - (e) the administrator must have regard to the guidance or revised guidance in exercising the administrator's functions.
- (2) In the case of guidance relating to a fixed monetary penalty, the relevant information referred to in sub-paragraph (1)(b) is information as to—
- (a) the circumstances in which the penalty is likely to be imposed,
  - (b) the circumstances in which it may not be imposed,
  - (c) the amount of the penalty,
  - (d) how liability for the penalty may be discharged and the effect of discharge, and
  - (e) rights to make representations and objections and rights of appeal.
- (3) In the case of guidance relating to a discretionary requirement, the relevant information referred to in sub-paragraph (1)(b) is information as to—
- (a) the circumstances in which the requirement is likely to be imposed,
  - (b) the circumstances in which it may not be imposed,
  - (c) in the case of a variable monetary penalty, the matters likely to be taken into account by the administrator in determining the amount of the penalty (including, where relevant, any discounts for voluntary reporting of non-compliance), and
  - (d) rights to make representations and objections and rights of appeal.

*Publication of enforcement action*

- 22 (1) Where power is conferred on an administrator by the regulations to impose a civil sanction in relation to a breach of regulations under this Schedule, the provision conferring the power must, subject to this paragraph, secure that the administrator must from time to time publish reports specifying—
- (a) the cases in which the civil sanction has been imposed, and
  - (b) where the civil sanction is a fixed monetary penalty, the cases in which liability to the penalty has been discharged pursuant to paragraph 11(1)(b).
- (2) In sub-paragraph (1)(a), the reference to cases in which the civil sanction has been imposed do not include cases where the sanction has been imposed but overturned on appeal.
- (3) The provision conferring the power need not secure the result in sub-paragraph (1) in cases where the relevant authority considers that it would be inappropriate to do so.

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### *Compliance with regulatory principles*

- 23 A relevant national authority may not make any provision conferring power on an administrator to impose a civil sanction in relation to a breach of regulations under this Schedule unless the authority is satisfied that the administrator will act in accordance with the principles that—
- (a) regulatory activities should be carried out in a way that is transparent, accountable, proportionate and consistent;
  - (b) regulatory activities should be targeted only at cases in which action is needed.

### *Review*

- 24 (1) A relevant national authority must in accordance with this paragraph review the operation of any provision made by the authority conferring power on an administrator to impose a civil sanction in relation to a breach of regulations under this Schedule.
- (2) The review must take place as soon as practicable after the end of the period of three years beginning with the day on which the provision comes into force.
  - (3) The review must in particular consider whether the provision has implemented its objectives efficiently and effectively.
  - (4) In conducting a review under this paragraph the relevant national authority must consult such persons as the authority considers appropriate.
  - (5) The relevant national authority must publish the results of a review under this <sup>F47</sup>paragraph].
  - <sup>F48</sup>(6) The relevant national authority must lay a copy of a review under this paragraph before—
    - (a) Parliament (where the relevant national authority is the Secretary of State);
    - (b) the National Assembly for Wales (where the relevant national authority is the Welsh Ministers);
    - (c) the Northern Ireland Assembly (where the relevant national authority is the Department of the Environment in Northern Ireland)].

#### **Textual Amendments**

**F47** Word in Sch. 6 para. 24(5) substituted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 8\(2\)\(a\)](#)

**F48** Sch. 6 para. 24(6) omitted (N.I.) (28.4.2014) by virtue of [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 8\(2\)\(b\)](#)

### *Suspension*

- 25 (1) Where provision has been made by a relevant national authority conferring power on an administrator to impose a civil sanction in relation to a breach of regulations under this Schedule, the authority may direct the administrator—
- (a) where the power is power to impose a fixed monetary penalty, not to serve any further notice of intent referred to in paragraph 11(1)(a) in relation to a breach of that kind, and

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- (b) where the power is power to impose a discretionary requirement, not to serve any further notice of intent referred to in paragraph 13(1)(a) in relation to a breach of that kind.
- (2) The relevant national authority may only give a direction under sub-paragraph (1) in relation to a breach of regulations under this Schedule if it is satisfied that the administrator has failed on more than one occasion—
- (a) to comply with any duty imposed on it under or by virtue of this Schedule in relation to a breach of that kind,
  - (b) to act in accordance with the guidance it has published in relation to a breach of that kind (in particular, the guidance published under paragraph 21), or
  - (c) to act in accordance with the principles referred to in paragraph 23 or with other principles of best practice in relation to the enforcement of a breach of that kind.
- (3) The relevant national authority may by direction revoke a direction given by it under sub-paragraph (1) if satisfied that the administrator has taken the appropriate steps to remedy the failure to which that direction related.
- (4) Before giving a direction under sub-paragraph (1) or (3) the relevant national authority must consult—
- (a) the administrator, and
  - (b) such other persons as the authority considers appropriate.
- (5) Where the relevant national authority gives a direction under this section, the authority must lay a copy before—
- (a) Parliament (where the relevant national authority is the Secretary of State);
  - (b) the National Assembly for Wales (where the relevant national authority is the Welsh Ministers);
  - (c) the Northern Ireland Assembly (where the relevant national authority is the Department of the Environment in Northern Ireland).
- (6) Where the relevant national authority gives a direction under this<sup>F49</sup> paragraph], the administrator must—
- (a) publish the direction in such manner as the authority thinks fit, and
  - (b) take such other steps as the administrator thinks fit or the authority may require to bring the direction to the attention of other persons likely to be affected by it.

#### Textual Amendments

**F49** Word in Sch. 6 para. 25(6) substituted (N.I.) (28.4.2014) by [Carrier Bags Act \(Northern Ireland\) 2014 \(c. 7\), s. 8\(3\)](#)

#### *Payment of penalties into Consolidated Fund*

- 26 (1) Where pursuant to any provision made under this Schedule an administrator receives—
- (a) a fixed monetary penalty, a variable monetary penalty or a non-compliance penalty under paragraph 14,
  - (b) any interest or other financial penalty for late payment of such a penalty, or

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- (c) a sum paid in discharge of liability to a fixed monetary penalty pursuant to paragraph 11(1)(b),  
the administrator must pay it into the relevant Fund.
- (2) In sub-paragraph (1) “relevant Fund” means—
- (a) in a case where the administrator has functions only in relation to Wales, the Welsh Consolidated Fund,
  - (b) in a case where the administrator has functions only in relation to Northern Ireland, the Northern Ireland Consolidated Fund, and
  - (c) in any other case, the Consolidated Fund.

### PART 3

#### PROCEDURES APPLYING TO REGULATIONS

##### *Regulations made by a single authority*

- 27 (1) This paragraph applies in relation to an instrument containing regulations under this Schedule made by a single national authority.
- (2) Where the instrument contains regulations that—
- (a) are to be made by the Secretary of State, and
  - (b) are subject to affirmative resolution procedure,
- the regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of each House of Parliament.
- (3) Where the instrument contains regulations that—
- (a) are to be made by a national authority other than the Secretary of State, and
  - (b) are subject to affirmative resolution procedure,
- the regulations must not be made unless a draft of the statutory instrument containing them has been laid before and approved by a resolution of the relevant devolved legislature.
- (4) An instrument containing regulations made by the Secretary of State that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of either House of Parliament.
- (5) An instrument containing regulations made by the Welsh Ministers that are subject to negative resolution procedure is subject to annulment in pursuance of a resolution of the National Assembly for Wales.
- (6) An instrument containing regulations made by the Department of the Environment in Northern Ireland that are subject to negative resolution procedure is subject to negative resolution within the meaning of section 41(6) of the Interpretation Act (Northern Ireland) 1954 (c. 33 (N.I.)) as if it were a statutory instrument within the meaning of that Act.
- (7) Any provision that may be made by regulations subject to negative resolution procedure may be made by regulations subject to affirmative resolution procedure.

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*Regulations made by two or more national authorities*

- 28 (1) This paragraph applies in relation to an instrument containing regulations under this Schedule made or to be made by any two or more of—
- (a) the Secretary of State,
  - (b) the Welsh Ministers, and
  - (c) the Department of the Environment in Northern Ireland.
- (2) If any of the regulations are subject to affirmative resolution procedure, all of them are subject to that procedure.
- (3) Sub-paragraphs (2) to (6) of paragraph 27 apply to the instrument as they apply to an instrument containing regulations made by a single national authority.
- (4) If in accordance with that paragraph—
- (a) either House of Parliament resolves that an address be presented to Her Majesty praying that an instrument containing regulations made by the Secretary of State be annulled, or
  - (b) a devolved legislature resolves that an instrument containing regulations made by a national authority be annulled,
- nothing further is to be done under the instrument after the date of the resolution and Her Majesty may by Order in Council revoke the instrument.
- (5) This is without prejudice to the validity of anything previously done under the instrument or to the making of a new instrument.
- (6) This paragraph applies in place of provision made by any other enactment about the effect of such a resolution.

*Hybrid instruments*

- 29 If a draft of an instrument containing regulations under this Schedule would, apart from this paragraph, be treated for the purposes of the standing orders of either House of Parliament as a hybrid instrument, it is to proceed in that House as if it were not such an instrument.

SCHEDULE 7

Section 78

RENEWABLE TRANSPORT FUEL OBLIGATIONS

*Introductory*

- 1 Chapter 5 of Part 2 of the Energy Act 2004 (c. 20) (renewable transport fuel obligations) is amended as follows.

*The Administrator*

- 2 For section 125 (the Administrator) substitute—

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## **“125 Appointment of the Administrator**

### **“125 “125 Appointment of the Administrator**

- (1) For the purposes of provision made by or under this Chapter, an RTF order may—
  - (a) establish a body corporate, and
  - (b) appoint that body as the Administrator.
- (2) An RTF order may—
  - (a) make provision for the appointment of members of the body;
  - (b) make provision in relation to the staffing of the body;
  - (c) make provision in relation to the expenditure of the body;
  - (d) make provision regulating the procedure of the body;
  - (e) make any other provision that the Secretary of State considers appropriate for purposes connected with the establishment and maintenance of the body.
- (3) The provision that may be made by an RTF order by virtue of this section includes, in particular, provision conferring discretions on—
  - (a) the Secretary of State;
  - (b) the body itself; or
  - (c) members or staff of the body.

## **125A General functions of the Administrator**

### **125A 125A General functions of the Administrator**

- (1) An RTF order may—
  - (a) confer or impose powers and duties on the Administrator for purposes connected with the implementation of provision made by or under this Chapter;
  - (b) confer discretions on the Administrator in relation to the making of determinations under such an order and otherwise in relation to the Administrator's powers and duties; and
  - (c) impose duties on transport fuel suppliers for purposes connected with the Administrator's powers and duties (including, in particular, duties framed by reference to determinations made by the Administrator).
- (2) It is the duty of the Administrator to promote the supply of renewable transport fuel whose production, supply or use—
  - (a) causes or contributes to the reduction of carbon emissions, and
  - (b) contributes to sustainable development or the protection or enhancement of the environment generally.

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## **125B Functions of the Administrator: supplementary**

### **125B 125B Functions of the Administrator: supplementary**

- (1) The powers that may be conferred on the Administrator by virtue of section 125A(1) include, in particular—
  - (a) power to require a transport fuel supplier to provide the Administrator with such information as the Administrator may require for purposes connected with the carrying out of the Administrator's functions;
  - (b) power to impose requirements as to the form in which such information must be provided and as to the period within which it must be provided;
  - (c) power to impose charges of specified amounts on transport fuel suppliers.
- (2) The Secretary of State may give written directions to the Administrator about the exercise of any power conferred on the Administrator by virtue of subsection (1)(a) or (b).
- (3) The power to give directions under subsection (2) includes power to vary or revoke the directions.
- (4) The Administrator must comply with any directions given under that subsection.
- (5) Sums received by the Administrator by virtue of provision within subsection (1)(c)—
  - (a) where the Administrator is the Secretary of State, must be paid into the Consolidated Fund, and
  - (b) otherwise, must be used for the purpose of meeting costs incurred in carrying out the Administrator's functions.
- (6) The Secretary of State may make grants to the Administrator on such terms as the Secretary of State may determine.

## **125C Transfer of functions to new Administrator**

### **125C 125C Transfer of functions to new Administrator**

- (1) The Secretary of State may by order—
  - (a) appoint a person as the Administrator (“the new Administrator”) in place of a person previously so appointed by order under this Chapter (“the old Administrator”), and
  - (b) provide for the transfer of the functions of the old Administrator to the new Administrator.
- (2) Only the following persons may be appointed as the Administrator by order under this section—
  - (a) the Secretary of State;
  - (b) a body or other person established or appointed by or under any enactment to carry out other functions;

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*Status: This version of this Act contains provisions that are prospective.*

*Changes to legislation: Climate Change Act 2008 is up to date with all changes known to be in force on or before 05 August 2021. There are changes that may be brought into force at a future date. Changes that have been made appear in the content and are referenced with annotations. (See end of Document for details) View outstanding changes*

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- (c) a body corporate established by the order for appointment as the Administrator.
- (3) An order under this section that establishes a body for appointment as the Administrator may make any provision that may be made by an RTF order by virtue of section 125.
- (4) An order under this section may provide for the transfer of staff of the old Administrator, and of any property, rights or liabilities to which the old Administrator is entitled or subject, to the new Administrator and may, in particular—
- (a) provide for the transfer of any property, rights or liabilities to have effect subject to exceptions or reservations specified in or determined under the order;
  - (b) provide for the creation of interests in, or rights over, property transferred or retained or for the creation of new rights and liabilities;
  - (c) provide for the order to have effect in spite of anything that would prevent or restrict the transfer of the property, rights or liabilities otherwise than by the order.
- (5) The order may, in particular—
- (a) provide for anything done by or in relation to the old Administrator to have effect as if done by or in relation to the new Administrator;
  - (b) permit anything (which may include legal proceedings) which is in the process of being done by or in relation to the old Administrator when the transfer takes effect to be continued by or in relation to the new Administrator;
  - (c) provide for a reference to the old Administrator in an instrument or other document to be treated as a reference to the new Administrator;
  - (d) where the old Administrator was established by order under this Chapter, make provision for the dissolution of the old Administrator;
  - (e) make such modifications of any enactment relating to the old Administrator or the new Administrator as the Secretary of State considers appropriate for the purpose of facilitating the transfer.
- (6) An order under this section that provides for the transfer of staff of the old Administrator to the new Administrator must make provision for the Transfer of Undertakings (Protection of Employment) Regulations 2006 to apply to the transfer.
- (7) Subject to subsection (8), an order under this section is subject to the negative resolution procedure.
- (8) The power to make an order under this section is subject to the affirmative resolution procedure if the order—
- (a) contains provision by virtue of subsection (2)(c), or
  - (b) makes any modification of an enactment contained in—
    - (i) an Act of Parliament,
    - (ii) an Act of the Scottish Parliament,
    - (iii) a Measure or Act of the National Assembly for Wales, or
    - (iv) Northern Ireland legislation.”.

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#### *Determination of amounts of transport fuel*

- 3 In section 126 (determination of amounts of transport fuel), after subsection (4) insert—
- “(5) If an RTF order makes provision for the counting or determination of amounts of transport fuel for the purposes of provision made by or under this Chapter by reference to any document, it may provide for references to the document to have effect as references to it as revised or re-issued from time to time.
- (6) The Secretary of State may give written directions to the Administrator about the exercise of any of the Administrator's functions in connection with the counting or determination of amounts of transport fuel for the purposes of provision made by or under this Chapter.
- (7) The power to give directions under subsection (6) includes power to vary or revoke the directions.
- (8) The Administrator must comply with any directions given under that subsection.”.

#### *Discharge of obligation by payment*

- 4 In section 128 (discharge of obligation by payment), for subsections (6) and (7) substitute—
- “(6) Where the Administrator is the Secretary of State—
- (a) sums received by the Administrator by virtue of this section must be paid into the Consolidated Fund, and
- (b) an RTF order may make provision for sums to be paid by the Administrator to transport fuel suppliers, or to transport fuel suppliers of a specified description, in accordance with the specified system of allocation.
- (7) Such an order must contain provision ensuring that the total of the sums so paid by the Administrator does not at any time exceed the total of the sums so received by the Administrator up to that time.
- (8) Where the Administrator is a person other than the Secretary of State, an RTF order may—
- (a) require the Administrator to use, to the specified extent, sums received by the Administrator by virtue of this section for the purpose of meeting costs incurred in carrying out the Administrator's functions, or
- (b) require the Administrator to pay, to the specified extent, sums so received to the Secretary of State.
- (9) Sums so received which are not dealt with in accordance with provision made under subsection (8) must be paid by the Administrator to transport fuel suppliers, or to transport fuel suppliers of a specified description, in accordance with the specified system of allocation.
- (10) The Secretary of State must pay sums received by the Secretary of State by virtue of provision made under subsection (8)(b) into the Consolidated Fund.”.

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### *Civil penalties*

- 5 In section 129 (imposition of civil penalties), for subsection (7) substitute—
- “(7) Sums received by the Administrator by virtue of this section—
- (a) where the Administrator is the Secretary of State, must be paid into the Consolidated Fund, and
  - (b) otherwise, must be paid to the Secretary of State, who must pay them into the Consolidated Fund.”.

### *Disclosure of information*

- 6 After section 131 insert—
- “131A Disclosure of information held by Revenue and Customs**
- “131A “131A Disclosure of information held by Revenue and Customs**
- (1) This section applies to information held by or on behalf of the Commissioners for Her Majesty's Revenue and Customs in connection with their functions under or by virtue of the Hydrocarbon Oil Duties Act 1979.
  - (2) Such information may be disclosed to—
    - (a) the Administrator, or
    - (b) an authorised person,
 for the purposes of or in connection with the Administrator's functions.
  - (3) In this Chapter “authorised person” means a person who—
    - (a) provides services to, or exercises functions on behalf of, the Administrator, and
    - (b) is authorised by the Administrator to receive information to which this section applies.
  - (4) The Administrator may authorise such a person to receive information to which this section applies either generally or for a specific purpose.

### **131B Further disclosure of information**

#### **131B 131B Further disclosure of information**

- (1) This section applies to information disclosed under section 131A, other than information which is also provided to the Administrator or an authorised person otherwise than under that section.
- (2) Information to which this section applies may not be disclosed—
  - (a) by the Administrator,
  - (b) by an authorised person, or
  - (c) by any other person who obtains it in the course of providing services to, or exercising functions on behalf of, the Administrator,
 except as permitted by the following provisions of this section.
- (3) Subsection (2) does not apply to a disclosure made—
  - (a) by the Administrator to an authorised person,
  - (b) by an authorised person to the Administrator, or

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(c) by an authorised person to another authorised person,  
for the purposes of, or in connection with, the discharge of the  
Administrator's functions.

(4) Subsection (2) does not apply to a disclosure if it is—

- (a) authorised by an enactment,
- (b) made in pursuance of an order of a court,
- (c) made for the purposes of a criminal investigation or criminal proceedings (whether or not within the United Kingdom) relating to a matter in respect of which the Administrator has functions,
- (d) made for the purposes of civil proceedings (whether or not within the United Kingdom) relating to a matter in respect of which the Administrator has functions,
- (e) made with the consent of the Commissioners for Her Majesty's Revenue and Customs, or
- (f) made with the consent of each person to whom the information relates.

### **131C Wrongful disclosure**

#### **131C 131C Wrongful disclosure**

(1) A person commits an offence if—

- (a) he discloses information about a person in contravention of section 131B(2), and
- (b) the person's identity is specified in the disclosure or can be deduced from it.

(2) In subsection (1) “information about a person” means revenue and customs information relating to a person within the meaning of section 19(2) of the Commissioners for Revenue and Customs Act 2005 (wrongful disclosure).

(3) It is a defence for a person charged with an offence under this section to prove that he reasonably believed—

- (a) that the disclosure was lawful, or
- (b) that the information had already and lawfully been made available to the public.

(4) A person guilty of an offence under this section is liable—

- (a) on conviction on indictment, to imprisonment for a term not exceeding two years or a fine or both, or
- (b) on summary conviction, to imprisonment for a term not exceeding twelve months or a fine not exceeding the statutory maximum or both.

(5) A prosecution for an offence under this section—

- (a) may be brought in England and Wales only with the consent of the Director of Public Prosecutions;
- (b) may be brought in Northern Ireland only with the consent of the Director of Public Prosecutions for Northern Ireland.

(6) In the application of this section—

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- (a) in England and Wales, in relation to an offence committed before the commencement of section 154(1) of the Criminal Justice Act 2003, or
  - (b) in Northern Ireland,
- the reference in subsection (4)(b) to twelve months is to be read as a reference to six months.”.

#### *Interpretation*

- 7 (1) Section 132(1) (interpretation of Chapter 5 of Part 2) is amended as follows.
- (2) For the definition of “Administrator” substitute—
- ““Administrator” means the person for the time being appointed as the Administrator by order under this Chapter;”.
- (3) In the appropriate place insert—
- ““authorised person” has the meaning given by section 131A(3);”;
- ““enactment” includes—
- (a) an enactment contained in subordinate legislation,
  - (b) an enactment contained in, or in an instrument made under, an Act of the Scottish Parliament,
  - (c) an enactment contained in, or in an instrument made under, Northern Ireland legislation, and
  - (d) an enactment contained in, or in an instrument made under, a Measure or Act of the National Assembly for Wales;”.
- (4) In section 196(1) of the Energy Act 2004 (c. 20) (general interpretation), in the definition of “enactment”, after “ “enactment”” insert “ (except in Chapter 5 of Part 2) ”.

## SCHEDULE 8

Section 79

### CARBON EMISSIONS REDUCTION TARGETS

#### *Gas Act 1986 (c. 44)*

- 1 (1) Section 33BC of the Gas Act 1986 (promotion of reductions in carbon emissions: gas transporters and gas suppliers) is amended as follows.
- (2) After subsection (1) insert—
- “(1A) The power to make orders under this section may be exercised so as to impose more than one carbon emissions reduction obligation on a person in relation to the same period or to periods that overlap to any extent.”.
- (3) In subsection (5) (provision that may be made by an order under section 33BC in relation to the obligations it imposes), after paragraph (b) insert—
- “(ba) requiring the whole or any part of a carbon emissions reductions target to be met by action relating to—

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- (i) persons of a specified description,
- (ii) specified areas or areas of a specified description, or
- (iii) persons of a specified description in specified areas or areas of a specified description;”.

(4) In subsection (13) (interpretation), at the appropriate place insert—

““specified” means specified in the order.”.

*Electricity Act 1989 (c. 29)*

2 In section 6(9) of the Electricity Act 1989 (definition of “electricity distributor” and “electricity supplier”), at the appropriate place insert—

““electricity generator” means any person who is authorised by a generation licence to generate electricity except where that person is acting otherwise than for purposes connected with the carrying on of activities authorised by the licence;”.

3 (1) Section 41A of that Act (promotion of reductions in carbon emissions: electricity distributors and electricity suppliers) is amended as follows.

(2) In subsection (1) (power by order to impose obligations on distributors and suppliers to achieve carbon emissions reductions targets)—

(a) before paragraph (a) insert—

“(za) on each electricity generator (or each electricity generator of a specified description);” and

(b) in the closing words, before “distributor” insert “ generator, ”.

(3) After that subsection insert—

“(1A) The power to make orders under this section may be exercised so as to impose more than one carbon emissions reduction obligation on a person in relation to the same period or to periods that overlap to any extent.”.

(4) In subsection (3) (power for order to specify criteria by reference to which the Gas and Electricity Markets Authority is to determine targets), before “electricity distributors” insert “ electricity generators, ”.

(5) In subsection (4) (duty of the Secretary of State and the Authority to carry out functions under the section in a way that does not inhibit competition), for the words from “no electricity distributor” to the end of the subsection substitute “—

(a) no electricity generator is unduly disadvantaged in competing with other electricity generators,

(b) no electricity distributor is unduly disadvantaged in competing with other electricity distributors, and

(c) no electricity supplier is unduly disadvantaged in competing with other electricity suppliers.”.

(6) In subsection (5) (provision that may be made by an order in relation to the obligations it imposes)—

(a) in paragraph (a), before “electricity distributors” insert “ electricity generators, ”,

(b) after paragraph (b) insert—

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- “(ba) requiring the whole or any part of a carbon emissions reductions target to be met by action relating to—
- (i) persons of a specified description,
  - (ii) specified areas or areas of a specified description, or
  - (iii) persons of a specified description in specified areas or areas of a specified description;”,
- (c) in paragraph (d), before “distributors” insert “ generators, ”, and
- (d) in paragraph (f), before “distributors” insert “ generators, ”.
- (7) In subsection (6) (power for order to authorise the Authority to require the provision of information), before “distributor” insert “ generator, ”.
- (8) In subsection (7)(d) (power for order to make provision for transfer of person's target to another distributor or supplier or to a gas transporter or supplier), before “electricity distributor” insert “ electricity generator, ”.
- (9) In subsection (8)(d) (power for order to make different provision in relation to different distributors or suppliers), before “distributors” insert “ generators, ”.
- (10) In subsection (11) (duty to consult before making order), before “electricity distributors” insert “ electricity generators, ”.
- (11) In subsection (13) (interpretation), at the appropriate place insert—
- ““specified” means specified in the order.”.
- (12) In the heading, before “electricity distributors” insert “ electricity generators, ”.
- 4 (1) Section 42AA of that Act (publication of statistical information about performance of suppliers and distributors) is amended as follows.
- (2) In subsection (1) (duty of Gas and Electricity Consumer Council to publish information about performance and consumer complaints)—
- (a) in paragraph (a), before “electricity suppliers” insert “ electricity generators, ”, and
  - (b) in paragraph (b), before “suppliers” insert “ generators, ”.
- (3) In subsection (2) (definition of “complaints”), before “electricity suppliers” insert “ electricity generators, ”.
- 5 In section 64(1) of that Act (interpretation etc of Part 1), in the definition of “electricity distributor” and “electricity supplier”, after “ “electricity distributor”” insert “ , “electricity generator” ”.
- Utilities Act 2000 (c. 27)*
- 6 (1) Section 103 of the Utilities Act 2000 (overall carbon emissions reduction targets) is amended as follows.
- (2) In subsection (1)(b) (power by order to specify overall target for the promotion of measures mentioned in section 41A(2) of the 1989 Act), before “distributors” insert “ generators, ”.
- (3) After subsection (1) insert—

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“(1A) The power conferred by this section may be exercised so as to specify more than one overall target in relation to the same period or to periods that overlap to any extent.”.

- (4) In subsection (2)(b) (power for order to specify criteria for apportionment of overall target between electricity and gas sectors), before “electricity distributors” insert “electricity generators, ”.
- (5) In subsection (4) (duty to consult before making order), before “electricity distributors” insert “electricity generators, ”.

**Status:**

This version of this Act contains provisions that are prospective.

**Changes to legislation:**

Climate Change Act 2008 is up to date with all changes known to be in force on or before 05 August 2021. There are changes that may be brought into force at a future date. Changes that have been made appear in the content and are referenced with annotations.

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**Changes and effects yet to be applied to :**

- s. 86 heading words inserted by [2016 c. 22 s. 211\(7\)](#)
- s. 77(3)(b) omitted by [2016 anaw 3 Sch. 2 para. 12\(2\)\(a\)](#)
- s. 77(4)(aa) omitted by [2016 anaw 3 Sch. 2 para. 12\(2\)\(b\)](#)
- s. 86(2)(a) words inserted by [2016 c. 22 s. 211\(3\)\(a\)](#)
- s. 86(2)(b) words inserted by [2016 c. 22 s. 211\(3\)\(b\)](#)
- s. 86(3) words inserted by [2016 c. 22 s. 211\(4\)\(a\)](#)
- s. 86(3) words inserted by [2016 c. 22 s. 211\(4\)\(b\)](#)
- s. 86(8) words substituted by [2016 c. 22 s. 211\(6\)](#)
- s. 98 words omitted by [2016 anaw 3 Sch. 2 para. 12\(3\)](#)
- Sch. 6 para. 4A4B omitted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(a\)](#)
- Sch. 6 para. 7(3A) omitted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(b\)](#)
- Sch. 6 para. 8(2A) omitted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(c\)](#)
- Sch. 6 para. 24(6)(b) omitted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(d\)](#)
- Sch. 6 para. 25(5)(b) omitted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(e\)](#)
- Sch. 6 para. 26(2)(a) omitted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(f\)](#)
- Sch. 6 para. 27(5) omitted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(g\)](#)
- Sch. 6 para. 28(1)(b) omitted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(i\)\(ii\)](#)
- Sch. 6 para. 28(1) words omitted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(i\)\(i\)](#)
- Sch. 6 para. 28 cross-heading words substituted by [2016 anaw 3 Sch. 2 para. 12\(4\)\(h\)](#)

**Changes and effects yet to be applied to the whole Act associated Parts and Chapters:**

Whole provisions yet to be inserted into this Act (including any effects on those provisions):

- s. 86(1)(a) words renumbered as s. 86(1)(a) by [2016 c. 22 s. 211\(2\)\(a\)](#)
- s. 86(1)(b) and word inserted by [2016 c. 22 s. 211\(2\)\(b\)](#)
- s. 86(7A)(7B) inserted by [2016 c. 22 s. 211\(5\)](#)

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STATUTORY INSTRUMENTS

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**2019 No. 1056**

**CLIMATE CHANGE**

**The Climate Change Act 2008 (2050  
Target Amendment) Order 2019**

*Made - - - - 26th June 2019*

*Coming into force in accordance with article 1*

A draft of this instrument was laid before and approved by a resolution of each House of Parliament, in accordance with sections 2(6) and 91(1) of the Climate Change Act 2008 (“the Act”)(**1**).

Before the draft was laid, the Secretary of State—

- (a) obtained and took into account the advice of the Committee on Climate Change, in accordance with section 3(1)(a) of the Act; and
- (b) took into account representations made by the Scottish Ministers, the Welsh Ministers and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland in accordance with section 3(1)(b) of the Act(**2**),

The Secretary of State considers that since the Act was passed, there have been significant developments in scientific knowledge about climate change that make it appropriate to amend the percentage specified in section 1(1) of the Act.

Accordingly, the Secretary of State, in exercise of the power conferred by section 2(1)(a) of the Act, makes the following Order:

**Citation and commencement**

**1.** This Order may be cited as the Climate Change Act 2008 (2050 Target Amendment) Order 2019 and comes into force on the day after the day on which it is made.

**Amendment of the target for 2050**

**2.—**(1) Section 1 of the Climate Change Act 2008 is amended as follows.

(2) In subsection (1), for “80%” substitute “100%”.

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(1) [2008 c.27](#)

(2) see sections 95 and 96 of the Act for definitions of “national authority” and “relevant Northern Ireland Department”.

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**Status:** This is the original version (as it was originally made). This item of legislation is currently only available in its original format.

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26th June 2019

*Chris Skidmore*  
Minister of State  
Department for Business, Energy and Industrial  
Strategy

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## EXPLANATORY NOTE

*(This note is not part of the Order)*

Article 2 of this Order amends section 1 of the Climate Change Act 2008 (c. 27) by altering the percentage amount in subsection (1). Section 1(1) imposes a duty on the Secretary of State as to the level of the “net UK carbon account” (the amount of net UK emissions of targeted greenhouse gases for a period adjusted by the amount of carbon units credited or debited to the account) for the year 2050. The duty is to ensure that the net UK carbon account is lower than the “1990 baseline” (the baseline of net UK emissions of targeted greenhouse gases against which the percentage amount in subsection 1(1) is applied) by a minimum percentage amount.

The amendment in this Order has the effect that the minimum percentage by which the net UK carbon account for the year 2050 must be lower than the 1990 baseline is increased from 80% to 100%.

A full impact assessment has not been produced for this instrument.



Department for  
Business, Energy  
& Industrial Strategy

# Updated energy and emissions projections 2019

October 2020



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# Executive summary

BEIS publishes annual projections of UK energy demand and greenhouse gas emissions<sup>1</sup>. This year, we have extended the projections to 2040 (from 2035 in EEP 2018). We base the estimates in this report and associated annexes on policy analysis from August 2019 and modelling from March 2020. We completed the latter before the coronavirus (Covid-19) pandemic. Therefore, our projections take no account of the impacts of this on future energy demand or emissions.

The Climate Change Act<sup>2</sup>, passed in 2008, committed the UK to reducing greenhouse gas emissions by at least 80% by 2050 in comparison with baseline levels<sup>3</sup>. It also established a system of legally-binding carbon budgets which limit the country's net greenhouse gas emissions in successive five-year periods. In June 2019, the UK became the first major economy to commit to reducing emissions to Net Zero by 2050<sup>4</sup>.

The Energy and Emissions Projections (EEP) are one way we monitor progress towards the UK's legislated targets. Between the baseline and 2018, the UK cut emissions by 346 MtCO<sub>2</sub>e or 43%. We project that they will fall a further 24% to 344 MtCO<sub>2</sub>e in 2040.

Each year, BEIS updates the projections to incorporate new evidence, policy development and methodology improvements. The new projections for UK territorial emissions are higher than in the previous edition (EEP 2018) for the third and fourth carbon budget period but lower for the fifth carbon budget period. UK territorial emissions include both emissions which fall under the EU Emissions Trading System (EU ETS), or "traded" emissions, and emissions outside this system ("non-traded" emissions). Traded emissions include almost all power sector emissions, domestic aviation (from 2012/13 onward) and energy-intensive industrial sectors. These do not directly affect performance against carbon budgets<sup>5</sup>.

---

<sup>1</sup> We use the Global Warming Potentials (GWPs) from Table 2.14 of Working Group 1 of the IPCC Fourth Assessment Report: Climate Change 2007: AR4 GWPs. See:

<https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-chapter2-1.pdf>

This is consistent with the Greenhouse Gas Inventory and BEIS emission statistics.

<sup>2</sup> See this link:

<http://www.legislation.gov.uk/ukpga/2008/27/contents/enacted>

<sup>3</sup> The base year for comparison is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for fluorinated gases:

<https://www.legislation.gov.uk/ukpga/2008/27/contents>

<sup>4</sup> The amendment is here:

<http://www.legislation.gov.uk/ukxi/2019/1056/article/1/made>

<sup>5</sup> Carbon budget performance is measured by the Net Carbon Account. In this calculation, emissions from the traded sector are set equal to the UK's share of the EU ETS cap (the total emissions permitted in the Emissions Trading System) rather than actual traded emissions. Further information on Net Carbon Account calculation can be found in Box 1.

Compared with EEP 2018, non-traded emissions projections are higher and traded emissions projections are lower. We explain the main reasons for specific changes in Chapter 6.

Because performance against carbon budget targets depends only on non-traded emissions, the projected shortfall between performance and carbon budget targets has risen since EEP 2018. We give more details about this in Chapter 2: this summarises the emissions projections and explains what this means for performance against carbon budgets.

# 1 Introduction

- This report contains projections of performance against UK greenhouse gas (GHG) carbon budget targets under existing policies.
- The Government sets legally binding carbon budgets for five-year periods. They aim to make sure the UK reaches its target of net zero emissions by 2050.
- The Net Carbon Account measures performance against carbon budgets. This primarily depends on the level of non-traded emissions. These are emissions not covered by the European Union Emissions Trading System (EU ETS).
- The legislated carbon budgets so far are: CB1 (2008 to 2012); CB2 (2013 to 2017); CB3 (2018 to 2022); CB4 (2023 to 2027); and CB5 (2028 to 2032). The Committee on Climate Change will advise the Government about the level for CB6 (2033 to 2037) in December 2020. The Government must set this budget by June 2021.

## 1.1 About this document

This report sets out the 2019 Energy and Emissions Projections<sup>6</sup>: EEP 2019. It includes a comparison with the previous edition (EEP 2018, published in April 2019). For this edition, we have extended the projections to 2040: in EEP 2018 the last projection year was 2035. We completed the modelling before the coronavirus (Covid-19) pandemic. Therefore, our assumptions and modelling take no account of any impacts this may have on future energy demand or emissions.

These projections bring together statistical and modelled information from many different sources<sup>7</sup>:

- The main source of energy consumption data is the annual Digest of UK Energy Statistics (DUKES). Its most recent figures are for 2018 (published July 2019). We therefore report energy consumption trends against a comparison year of 2018<sup>8</sup>.

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<sup>6</sup> The report and annexes contain outputs from projections under various different macroeconomic assumptions. The “baseline” projection projects energy and emissions without policies brought in since the 2009 Low Carbon Transition Plan. This is the closest scenario to the UNFCCC “without measures” (WoM) projection. A WoM scenario has all mitigation removed. The UK does not produce a WoM projection because we cannot remove the impacts of pre-LCTP climate change measures. Our “existing policies” scenario matches the UNFCCC “with [existing] measures” (WEM) projection. It includes implemented and adopted measures but not planned policies. Our main projection, the reference scenario, includes planned policies too. This matches the UNFCCC “with additional measures” (WAM) scenario.

<sup>7</sup> Energy and emissions projections:

<https://www.gov.uk/government/collections/energy-and-emissions-projections>

<sup>8</sup> There is more detail here:

<https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes/#2019>

- The main source of emissions statistics is the Greenhouse Gas (GHG) Inventory which is updated each February. The most recent figures are for 2018 (published February 2020). We therefore report emission trends against this year unless we state otherwise.
- We combine these with other economic and demographic data to update equations that project future energy demand and emissions in the absence of government policy.

This report includes projections of the UK's progress towards its carbon budget targets for GHG emissions. The 2008 Climate Change Act established a long-term target for the UK to reduce its emissions in 2050 by at least 80% compared with a largely 1990-based baseline<sup>9</sup>. This target tightened in June 2019 when the UK became the first major economy to commit to reducing its emissions to net zero by 2050.

The Climate Change Act also established a system of legally binding interim limits on net greenhouse gas (GHG) emissions. These are called carbon budgets<sup>10</sup>. Each one spans five years and is set with the aim of keeping the UK on track for its 2050 target. Performance against these carbon budget targets is measured using the Net Carbon Account (see Box 1 for details).

All UK emissions count towards 2050 targets<sup>11</sup>. This includes those which the European Union Emissions Trading System (EU ETS) covers. However, these "traded" emissions do not affect the Net Carbon Account and therefore have no impact on performance against carbon budget targets. We therefore include separate, more detailed statistics and commentary for emissions that are outside the EU ETS ("non-traded" emissions).

The United Kingdom left the European Union on 31st January 2020 but remains a full participant in the EU ETS during the transition period until 1st January 2021. In line with the withdrawal agreement, the UK will remain in the European Union Emissions Trading System (EU ETS) until 31st December 2020. The Government set out its approach to negotiations in the UK's Approach to Negotiations<sup>12</sup>, published on 27th February 2020. In this edition, we base traded emissions and projections on the EU ETS definition of traded emissions and use EU ETS traded carbon value projections.

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<sup>9</sup> The base year for comparison is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for fluorinated gases: <https://www.legislation.gov.uk/ukpga/2008/27/contents>

<sup>10</sup> See page 143 of the Clean Growth Strategy for more background on carbon budgets: <https://www.gov.uk/government/publications/clean-growth-strategy>

<sup>11</sup> We use the Global Warming Potentials (GWPs) from Table 2.14 of Working Group 1 of the IPCC Fourth Assessment Report: Climate Change 2007: AR4 GWPs. See: <https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-chapter2-1.pdf>

This is consistent with the Greenhouse Gas Inventory and BEIS emission statistics.

<sup>12</sup> For more information see:

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/868874/The\\_Future\\_Relationship\\_with\\_the\\_EU.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/868874/The_Future_Relationship_with_the_EU.pdf)

For discussion of potential alternatives see: <https://www.gov.uk/government/consultations/carbon-emissions-tax>

### **Box 1: The UK Net Carbon Account**

The Government assesses compliance with a carbon budget by comparing the UK “Net Carbon Account” (NCA) against the carbon budget level. The NCA is currently the sum of three components:

**1. Emissions allowances the UK receives under the EU Emissions Trading System (EU ETS)**

This is the UK’s share of tradable allowances for emissions in scope of the EU ETS. Emissions that are traded include most power sector emissions, domestic aviation (from 2012/13 onward) and those from energy-intensive industries. When we project performance against carbon budgets, we use the estimates for EU ETS allowances that the Government assumed at the time of setting each carbon budget. The UK’s actual future shares were not known at that time. We report these assumptions in the web tables.

**2. All UK GHG emissions not covered by EU ETS**

These are the actual level of “non-traded emissions” emitted by the UK i.e. those that are not traded under the EU ETS. This includes most emissions from: road transport, heating in buildings, agriculture, waste and light industry. Since EEP 2017, we have included emissions from “Energy from Waste” power plants under non-traded emissions. This mirrors the ETS directive.

**3. Credits/debits from other international credit systems**

## 1.2 The reference and other scenarios

Our main projection is the “reference scenario”. This is our core analysis of how the UK energy and emissions system could evolve under our central assumptions about how the system drivers will change. It includes government policies which have been implemented, adopted, or planned<sup>13</sup> as at August 2019. It excludes new policies and changes to existing policies which fall outside these categories<sup>14</sup>.

The results we report come from the reference scenario unless stated. Many other views of the future are possible: our annexes include some of these.

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<sup>13</sup> This equates to expired, implemented, adopted, and planned policies as defined by the United Nations Framework Convention on Climate Change (UNFCCC). See Part II, Section V(A) paragraph 13, page 83 of:

<http://unfccc.int/resource/docs/cop5/07.pdf>

This is a UNFCCC “with additional measures” (WAM) scenario. Annex D gives details of the policies we include.

<sup>14</sup> Examples of policies announced or in consultation since August 2019 (and hence not included) are the introduction of the Green Home Grant, a consultation on changes to the taxation of red diesel and a green gas levy, and also a consultation on bringing forward the phase-out date for internal-combustion engine sales from 2040. If these were included, the projected level of emissions reported here would be lower.

There are significant uncertainties in these projections. We include illustrative confidence intervals based on the figures in EEP 2018 in some of our charts. This is to give a visual indication of how our confidence in our estimates reduces into the future. These bounds are approximate and it is possible that next year's reference scenario may lie outside the ranges we show. The potential impacts of the Covid-19 pandemic on future energy consumption and emissions are also highly uncertain, and this document does not seek to quantify them. We will keep this matter under review in light of the developments with the Covid-19 pandemic.

We produce projections of energy demand and emissions outside the power sector by applying standard statistical techniques. These project forward energy demand and emissions based on trends and relationships in past data. We adjust these projections to take account of the estimated impact of government policies (as of August 2019).

We base our projection of electricity supply on a model of supplier behaviour rather than statistical analysis of past trends. For this edition, we have changed our approach slightly so the power sector is more in line with the rest of the EEP models. Our assumptions now reflect implemented, adopted and planned policy<sup>15</sup> in the power sector. (In EEP 2018 and previous editions, the generation scenario included assumptions that went beyond current government policy).

We publish our projections for the reference scenario and other scenarios in annexes alongside this report. Each section notes the relevant annexes. The data underlying the report's tables and figures are in the web tables and web figures supplementary files. Section 8 lists these resources in full.

## 1.3 Comparison with the 2018 projections

Figure 1.1 compares the main emissions trends from EEP 2019 with those from EEP 2018. We give more detail about the changes to the projections in Chapter 6. When we compare emissions for carbon budget periods three to five in EEP 2019:

- We project higher UK total territorial emissions than EEP 2018 in carbon budget periods three and four. For the third carbon budget period they are 48 MtCO<sub>2e</sub> (2%) higher and for the fourth 7 MtCO<sub>2e</sub> or <0.5% higher. In the fifth carbon budget period emissions are lower than in EEP 2018—by 23 MtCO<sub>2e</sub> or 1%. We discuss these changes in Section 6.1.
- Non-traded emissions projections are higher than EEP 2018 for all carbon budget periods. In the third carbon budget the difference is 62 MtCO<sub>2e</sub> (4%), in the fourth 49 MtCO<sub>2e</sub> (4%) and in the fifth 8 MtCO<sub>2e</sub> or 1%. We examine changes in non-traded emissions in Section 6.2.

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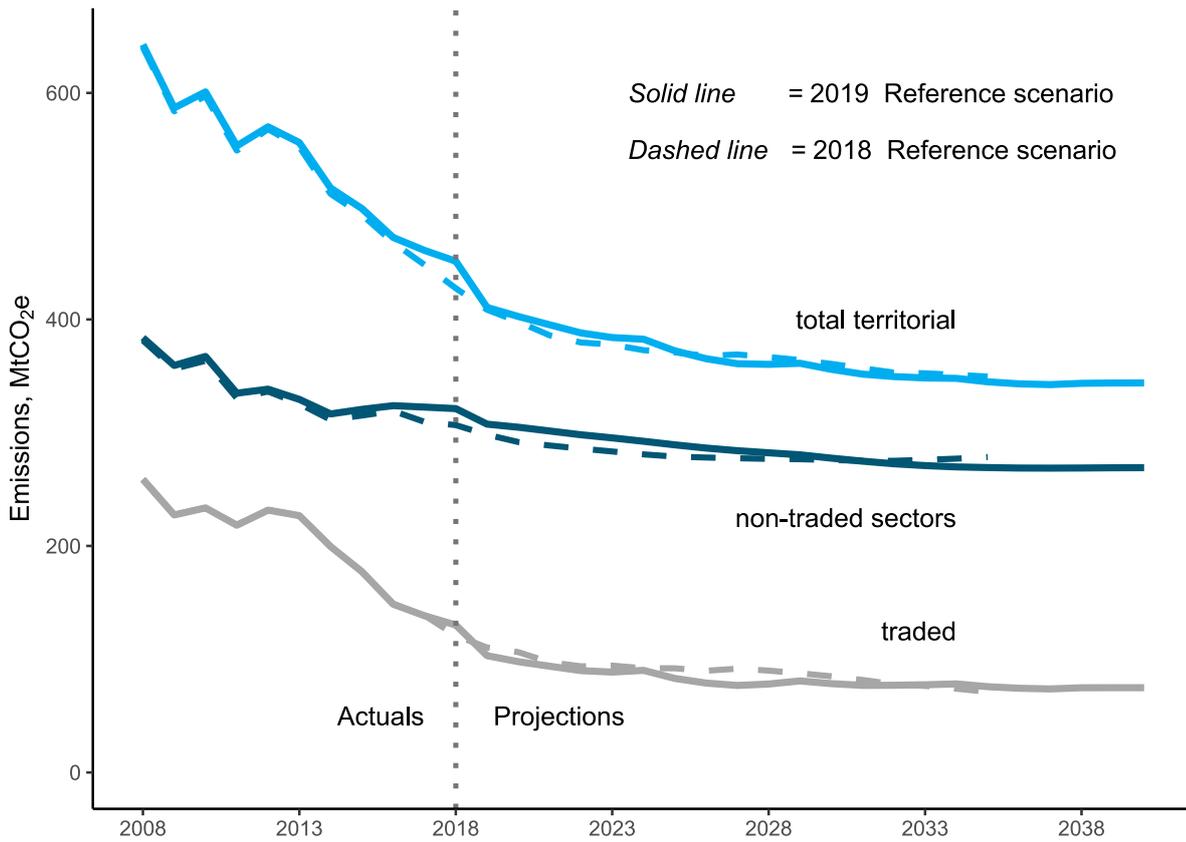
<sup>15</sup> This equates to expired, implemented, adopted, and planned policies as defined by the United Nations Framework Convention on Climate Change (UNFCCC). See Part II, Section V(A) paragraph 13, page 83 of:

<http://unfccc.int/resource/docs/cop5/07.pdf>

This is a UNFCCC “with additional measures” (WAM) scenario. Annex D gives details of the policies we include.

- Traded emissions projections are lower than in last year's edition for all carbon budget periods. They are lower by 14 MtCO<sub>2e</sub> (3%) in carbon budget three, by 42 MtCO<sub>2e</sub> (9%) in carbon budget four and by 31 MtCO<sub>2e</sub> (7%) in carbon budget five. We give a brief overview of the changes in traded emissions in Section 6.3.

**Figure 1.1:** Emission trends, MtCO<sub>2e</sub>



## 2 UK emissions projections

- The UK GHG Inventory reports emissions from 1990 onwards<sup>16</sup>. Between that year and 2018, territorial emissions from all sources reduced by 43% or 342 MtCO<sub>2e</sub>. We project that they will reduce by a further 24% (107 MtCO<sub>2e</sub>) to 344 MtCO<sub>2e</sub> in 2040.
- The UK met the first and second carbon budgets with headrooms of 36<sup>17</sup> and 384 MtCO<sub>2e</sub> respectively<sup>18</sup>. Under the reference scenario, we project that the UK will meet the third carbon budget with a headroom of around 26 MtCO<sub>2e</sub>.
- The projections show shortfalls against the fourth and fifth carbon budgets of 188 and 253 MtCO<sub>2e</sub>. The projections take account of policies that have been implemented, adopted or planned and where the policy design is sufficiently advanced to allow us to quantify impacts<sup>19</sup>.

This chapter looks at our projections for UK overall territorial, traded and non-traded emissions. It provides a summary of progress against the carbon budgets.

The UK GHG Inventory reports emissions from 1990 onwards<sup>20</sup>. Between that year and 2018, territorial emissions from all sources reduced by 43% or 342 MtCO<sub>2e</sub>. We project that they will reduce by a further 24% (107 MtCO<sub>2e</sub>) to 344 MtCO<sub>2e</sub> in 2040. Traded and non-traded emissions follow broadly similar trajectories (Figure 1.1)<sup>21</sup>. We project that traded emissions will fall by 55 MtCO<sub>2e</sub> (43%) to 75 MtCO<sub>2e</sub> in 2040. Non-traded emissions fall by 52 MtCO<sub>2e</sub> (16%) to 269 MtCO<sub>2e</sub> in 2040.

Figure 2.1 shows part of this series of actual and projected UK territorial emissions<sup>22</sup>. However, as with all such projections, there is substantial uncertainty around this analysis. We capture some of this uncertainty in our modelling<sup>23</sup>. The figure includes a “fan” to show what a range of possible outcomes might be. For this edition, we derived all the uncertainty analysis from the

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<sup>16</sup> Note this is slightly different from the carbon budgets baseline.

<sup>17</sup> Note that performance against carbon budgets depends on the level of non-traded emissions. The actual level of traded emissions does not affect it under current carbon accounting rules.

<sup>18</sup> The Government fixes its carbon budget performance against emissions from the greenhouse gas inventory for the end of each budget period. Note that later inventories may adjust these emission estimates. Summary figures for the first two carbon budgets are in Table 9 of the Statistical Summary here:

<https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018>

<sup>19</sup> Some policies in the Clean Growth Strategy (October 2017) have not yet reached this stage. We will include the impacts of these in future EEP editions when they are more fully developed. We will also include any policies that may have reached this stage after August 2019. The Clean Growth Strategy:

<https://www.gov.uk/government/publications/clean-growth-strategy>

<sup>20</sup> Note this is slightly different from the carbon budgets baseline.

<sup>21</sup> Note that performance against carbon budgets depends on the level of non-traded emissions. The actual level of traded emissions does not affect it under current carbon accounting rules.

<sup>22</sup> The full series is in Annex A.

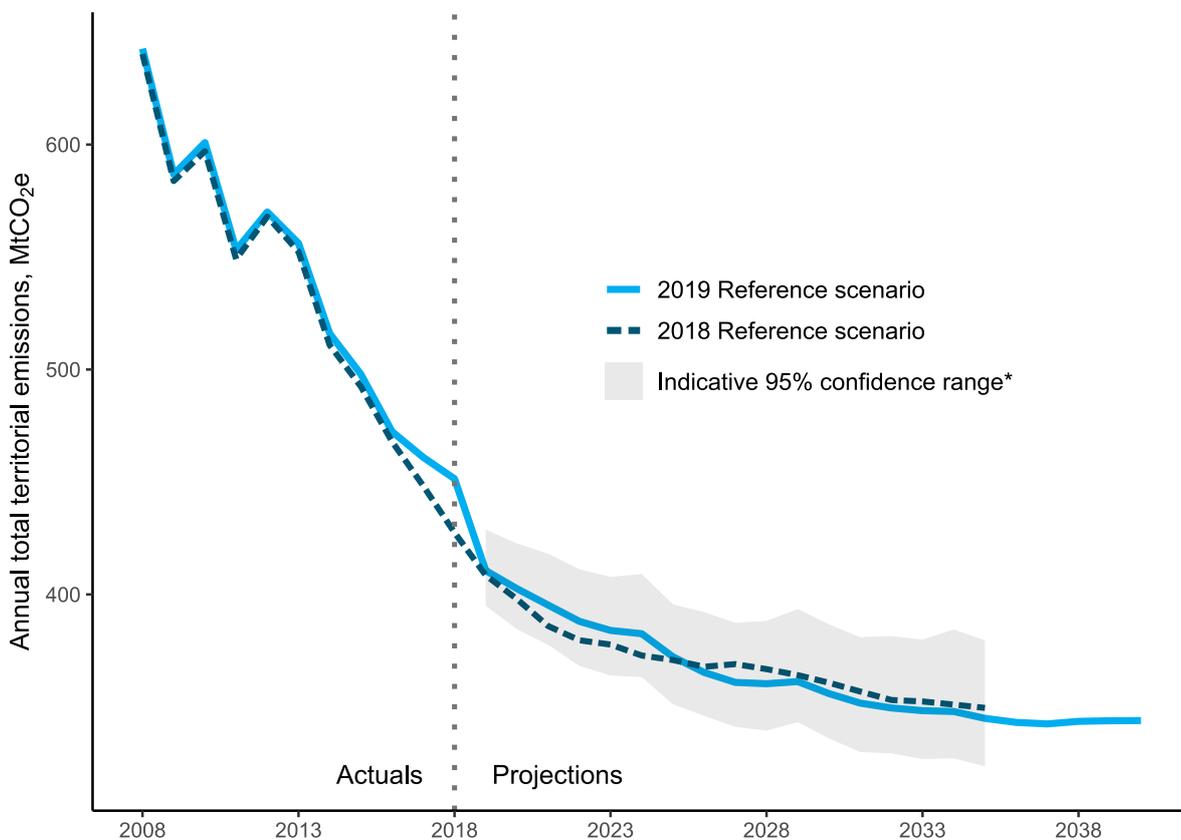
<sup>23</sup> In EEP 2018 we used Monte Carlo analysis to derive the uncertainty “fan”. This captured some aspects of uncertainty but with important exceptions. See Chapter 6 of:

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/794590/updated-energy-and-emissions-projections-2018.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794590/updated-energy-and-emissions-projections-2018.pdf)

estimates we published in EEP 2018. This is due to time constraints at the time of analysis. Until further data on Covid-19 impacts are available, we have assumed the drivers of uncertainty are similar to previous years. We will keep this matter under review. We include the fan as a visual suggestion of how we are less sure of our estimates as we look to the next decade and beyond.

We give emissions by National Communication sector and greenhouse gas in Annex A. Annex B shows CO<sub>2</sub> emissions by DUKES sectors and Annex C gives CO<sub>2</sub> emissions for International Panel on Climate Change (IPCC) categories.

**Figure 2.1:** Uncertainty in UK projected emissions, MtCO<sub>2</sub>e



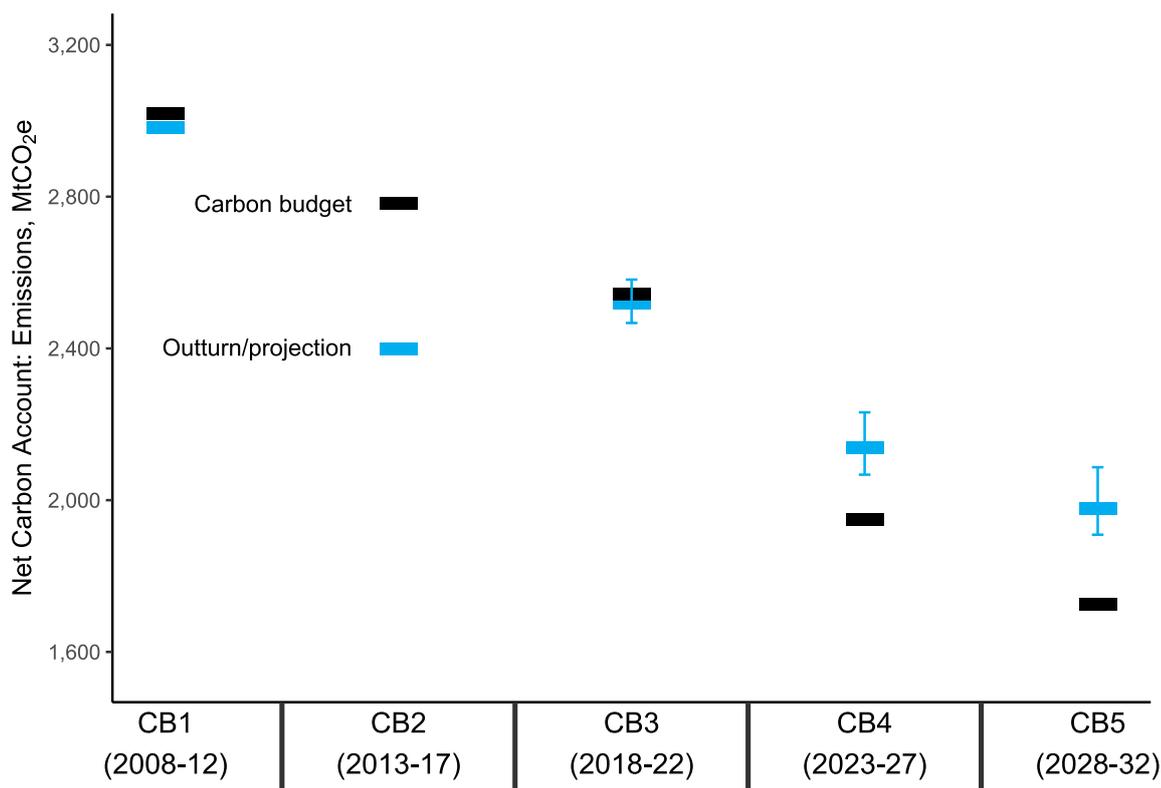
Notes:

\* The uncertainty ranges are indicative and are based on EEP 2018. The chart includes LULUCF.

## 2.1 Progress towards the carbon budgets

Between the carbon budgets baseline<sup>24</sup> and 2018, the UK cut emissions by 346 MtCO<sub>2e</sub> or 43%. Figure 2.2 shows actual and projected performance against the carbon budgets. The range it shows for each projection is indicative. We base the estimates on the 95% confidence intervals from EEP 2018. They give an approximate visual representation of the uncertainty in our figures. Table 2.1 shows how our projections compare with those in the previous edition.

**Figure 2.2:** Actual and projected performance against carbon budgets, MtCO<sub>2e</sub>



**Notes:**

Vertical bars show likely uncertainty in the projections. We based them on the 95% confidence intervals for the reference scenario of EEP 2018. They are approximate. Please note that the first and second carbon budgets use the actual net carbon accounts. The projections for the other carbon budgets use the traded cap assumed when the budgets were set<sup>25</sup>.

<sup>24</sup> The base year for comparison is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for fluorinated gases:

<https://www.legislation.gov.uk/ukpga/2008/27/contents>

<sup>25</sup> EEP uses the UK allocation of EU ETS allowances assumed by the respective carbon budgets at the time they were set. This is because the allocations only become final after the budget period they relate to ends. See Box 1.

**Table 2.1:** Net carbon account performance against carbon budgets, MtCO<sub>2</sub>e and per cent

		Carbon budget				
		CB1 (2008-12) actual	CB2 (2013-17) actual	CB3 (2018-22) projected	CB4 (2023-27) projected	CB5 (2028-32) projected
Carbon Budget level [1]	emissions, MtCO <sub>2</sub> e	3,018	2,782	2,544	1,950	1,725
Average annual required reduction vs. base emissions	%	-24%	-30%	-36%	-51%	-57%

**EEP 2018**

Reference scenario	projected emissions, MtCO <sub>2</sub> e	2,982	2,398	2,456	2,089	1,970
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**EEP 2019**

Reference scenario	projected emissions, MtCO <sub>2</sub> e	2,982	2,398	2,518	2,138	1,978
Result vs. Budget with reference case	emissions, MtCO <sub>2</sub> e	-36	-384	-26	188	253
Result vs. Budget with inclusion of CGS policy proposals [2]	emissions, MtCO <sub>2</sub> e	-36	-384	-26	158	173
Projected average annual reduction vs. base emissions [3]	%	-25%	-40%	-37%	-46%	-50%
Cumulative Result vs Budget	emissions, MtCO <sub>2</sub> e			-26	162	415

**Notes:**

1. This is the level of the third carbon budget in the 2009 legislation. The Government raised the budget level to 2,632 MtCO<sub>2</sub>e by carrying forward 88 MtCO<sub>2</sub>e of over-achievement from the second carbon budget period. See page 2 of:

<https://www.gov.uk/government/publications/annual-statement-of-emissions-for-2018>

2. This subset of early stage policies and proposals from the Clean Growth Strategy (CGS) gives an additional potential reduction of up to 30 and 80 MtCO<sub>2</sub>e over the fourth and fifth carbon budget periods respectively. Please see Box 1 for details of how we project future performance against the budgets.

3. Base emissions were around 797 MtCO<sub>2</sub>e<sup>26</sup>. Base year emissions estimates on which CB percentage reductions are based are revised annually and are therefore subject to change.

4. The UK Net Carbon Account (NCA) is fixed at the end of each CB period. The traded sector component of the NCA for CB1 and 2 is based on the actual UK share of EU ETS allowance, whereas for CB3, 4 and 5 it is based on the UK share of EU ETS allowances assumed at the time of setting the respective budgets. See 'Box 1' for further information on how the NCA is calculated.

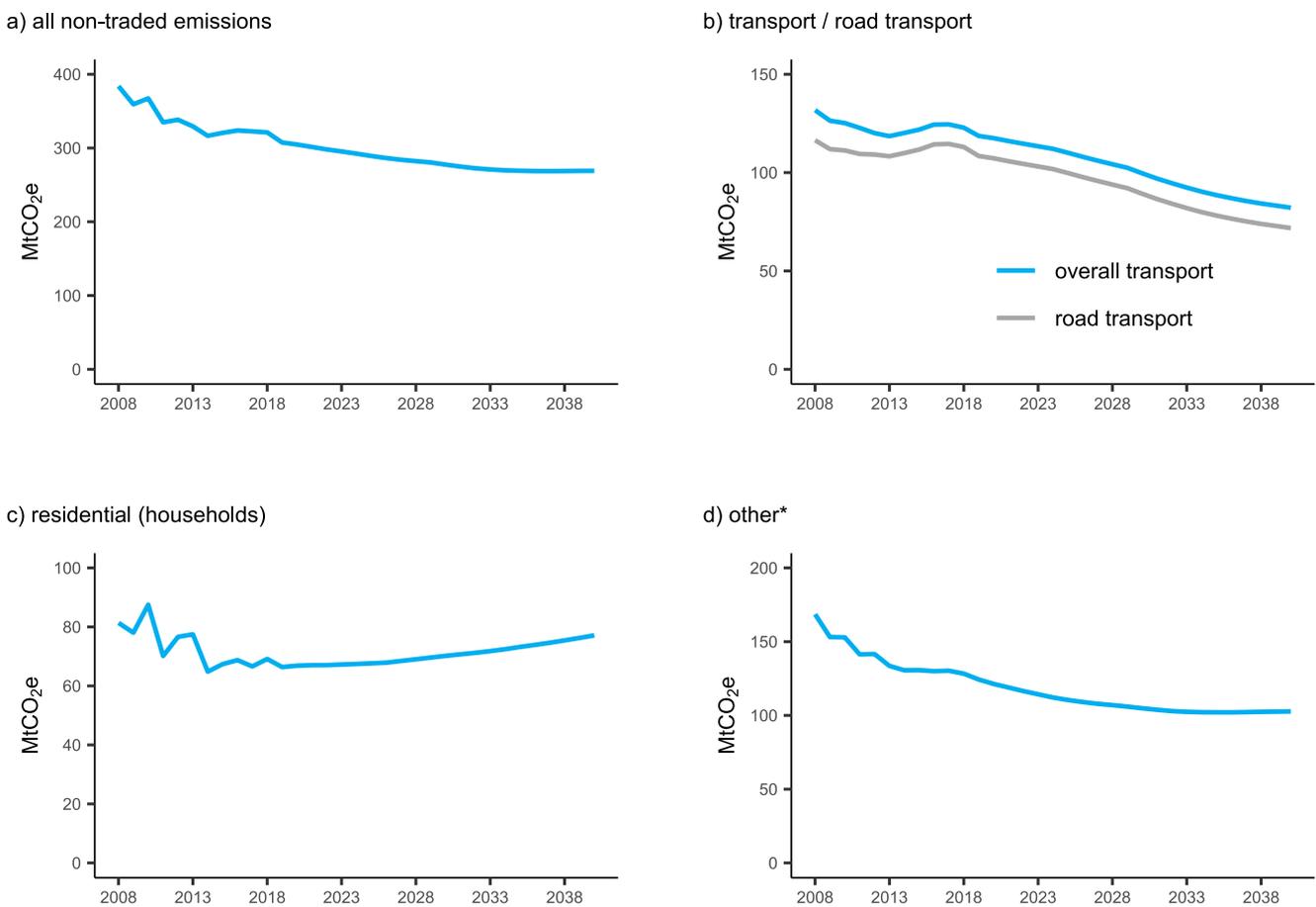
<sup>26</sup> The base year for comparison is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for fluorinated gases:  
<https://www.legislation.gov.uk/ukpga/2008/27/contents>

## 2.2 Non-traded emissions projections by sector

Between 2018 and 2040, we project an overall fall in non-traded emissions of 52 MtCO<sub>2e</sub> (16%). However, by the end of the period, non-traded emissions will form a slightly larger proportion of all territorial emissions. Their proportion rises from 71% to 78%: this is 7 percentage points higher.

Figure 2.3 shows the trends we project for non-traded emissions by sector. The overall pattern for each is very similar to EEP 2018. The biggest changes are for transport and residential non-traded emissions in this EEP edition.

**Figure 2.3:** Non-traded emissions in the economy, MtCO<sub>2e</sub>



**Notes:**

\* Other emissions covers emissions which are not from the residential or transport sectors. This includes emissions from industry, commerce and agriculture.

By far the majority of transport emissions come from road transport. We project these will be slightly higher than in EEP 2018 in the early years of projections. However, they decline at a faster rate than in last year's edition by the late 2020s. EEP 2019 suggests road transport emissions for the year 2035 will be 78 MtCO<sub>2e</sub> whilst in EEP 2018 the figure was 90 MtCO<sub>2e</sub>; this is 13% lower. Much of this reduction reflects new CO<sub>2</sub> regulations for cars, vans and HGVs and the updated policy assumption that electric vehicle uptake will be higher. Over the fourth

and fifth carbon budgets these trends translate into emissions of 498 MtCO<sub>2e</sub> (3% higher than the previous edition) and 446 MtCO<sub>2e</sub> (3% lower than the previous edition) respectively.

In these projections the lower residential emissions reflect reduced forecasts for the number of UK households from those in EEP 2018: by 2035 the emissions are 4 MtCO<sub>2e</sub> lower in this edition. For carbon budgets four and five, this means residential non-traded emissions are 12 and 14 MtCO<sub>2e</sub> lower respectively. On average for the fourth and fifth carbon budget periods, this is around 4% lower than in EEP 2018.

Section 4 discusses the energy demand projections which lead to these emissions.

## 3 Effect of policies on emissions

- We project government policies will reduce non-traded emissions by around 189 MtCO<sub>2e</sub> in the third, 264 MtCO<sub>2e</sub> in the fourth and 333 MtCO<sub>2e</sub> in the fifth carbon budget period.
- Most of the savings are from policies the Government adopted after the Low Carbon Transition Plan (LCTP) of 2009<sup>27</sup>.
- Non-traded emissions savings from policies in EEP 2019 are 16 MtCO<sub>2e</sub> lower than in EEP 2018 in the third and 11 MtCO<sub>2e</sub> lower in the fourth carbon budget periods. This is due to revised savings estimates for some existing policies. They are 18 MtCO<sub>2e</sub> higher in the fifth carbon budget due to new transport policies.
- Policies under the Resources and Waste Strategy are new to EEP 2019. These are: the Deposit Return Scheme, the Reform of the UK Packaging Producer Responsibility System, and Consistency in Household and Business Recycling Collections.
- We estimate government policies reduced emissions in the Electricity Supply Industry (ESI) by 41 MtCO<sub>2e</sub> in 2018 alone.

In this chapter we focus on policies that produce savings in the non-traded sector since they directly contribute to meeting the carbon budgets<sup>28</sup>. We briefly discuss the impact of government policies in the Electricity Supply Industry (ESI) in Section 3.3. These are mostly traded emissions.

The Government estimates individual policy impacts by comparing modelled emissions from scenarios which contain a policy with scenarios which do not.

We group policies by whether they were adopted before or after the Low Carbon Transition Plan (LCTP) of 2009. This was the UK's first comprehensive plan for moving to a low carbon economy. In this chapter, we only quote savings for policies adopted after the LCTP ("post-LCTP") unless we state otherwise. These estimates are more robust than those for policies adopted before the LCTP ("pre-LCTP").

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<sup>27</sup> The policies considered in this publication's projections do not include those announced by the Chancellor of the Exchequer on 8th July 2020 to increase the energy efficiency of buildings. These include £2 billion to improve the energy efficiency of housing with the Green Homes Grant; £50m for social housing; and £1 billion to improve the public sector's buildings' energy efficiency. The impact of these policies will be considered in the next publication.

<sup>28</sup> See Box 1.

### 3.1 Policies for non-traded emissions reduction

Table 3.1 shows that we estimate that government policies will reduce non-traded emissions by 785 MtCO<sub>2e</sub> over carbon budgets three to five<sup>29</sup>. We report policy savings in Annex D: this gives brief information about the policies we include.

**Table 3.1:** Non-traded GHG emissions savings from policies, MtCO<sub>2e</sub>

	Carbon budget			Total (2018-32)
	CB3 (2018-22)	CB4 (2023-27)	CB5 (2028-32)	
Savings from pre-LCTP policies	68	60	49	177
Savings from post-LCTP policies	121	204	283	608
<i>Savings from all policies</i>	<i>189</i>	<i>264</i>	<i>333</i>	<i>785</i>

### 3.2 Changes to non-traded policy savings since EEP 2018

In the short and medium term, we project lower non-traded GHG savings from government policies in EEP 2019 compared with the 2018 projections. Savings for the third carbon budget have decreased from 204 to 189 MtCO<sub>2e</sub> (16 MtCO<sub>2e</sub> less) while those for the fourth carbon budget have decreased from 275 to 264 MtCO<sub>2e</sub> (11 MtCO<sub>2e</sub> less).

In the long term we project higher policy savings than in EEP 2018. Savings for the fifth carbon budget have increased overall in EEP 2019, from 314 to 333 MtCO<sub>2e</sub> (a change of 18 MtCO<sub>2e</sub>).

Policies with the largest change in non-traded policy savings from last year's projections include:

- **Resources and Waste Strategy:** the Deposit Return Scheme, the Reform of the UK Packaging Producer Responsibility System, and the Consistency in Household and Business Recycling Collections policies are new to EEP 2019. Together, they contribute 1 MtCO<sub>2e</sub> and 4 MtCO<sub>2e</sub> of non-traded savings in the fourth and fifth carbon budget periods, respectively.
- **Vehicle Efficiency Policies:** for EEP 2019, the savings we attribute to Road Vehicle Efficiency policies are 5 MtCO<sub>2e</sub> lower in the fourth carbon budget period than in EEP 2018, driven by statistics which show consumers opting for larger and less efficient

<sup>29</sup> Our projections do not include the potential impacts of the Government's consultation on proposals to end the sales of new petrol, diesel and hybrid cars and vans by 2035 or earlier. We will include these when policy is more developed. The projections also do not include the £5 billion in new funding announced for cycling and buses in February 2020, but we will include this policy in EEP 2020.

vehicles in recent years. However, savings are 21 MtCO<sub>2</sub>e higher in the fifth carbon budget period than in the last edition. The main drivers are new CO<sub>2</sub> regulations for cars, vans and HGVs and an increased forecast of electric vehicle uptake.

- Agricultural policies<sup>30</sup>: projected agriculture sector savings for England are lower than EEP 2018 by 10 MtCO<sub>2</sub>e in the fourth and the fifth carbon budget periods. We revised savings of 4 MtCO<sub>2</sub>e per year (mostly associated with English agricultural policies) in EEP 2018 to 2 MtCO<sub>2</sub>e based on updated outturn evidence for the sector. Savings mostly come from improved nutrient management and land and soil management.

### 3.3 Emissions savings from policies in electricity supply

The EU ETS covers most emissions from electricity supply. These are traded emissions and do not affect the UK's Net Carbon Account<sup>31</sup>. A range of government policies have reduced emissions in the Electricity Supply Industry (ESI) since the 2009 Low Carbon Transition Plan.

Supply-side policies comprise:

- Large Combustion Plant Directive
- Industrial Emissions Directive
- EU ETS
- UK Carbon Price Support
- Feed-in-Tariffs (for small scale generation)
- Renewables Obligation and Contracts for Difference (for large-scale generation)
- Phase out of coal-fired generation

Power supply markets are highly interconnected. This means we cannot disentangle the impacts of individual policies. However, we estimate that in total these reduced emissions from the power sector by 41 MtCO<sub>2</sub>e in 2018 alone.

We project ESI policy savings will be 245 MtCO<sub>2</sub>e during the fourth carbon budget period. This compares with the 292 MtCO<sub>2</sub>e we projected in EEP 2018. The change in modelling approach we discuss in Chapter 5 explains most of this difference.

We report aggregated emissions savings from power supply policies in the "All, by sector" section of Annex D.

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<sup>30</sup> "Agricultural policies" covers a range of resource efficiency and land management emission reduction measures. Please see Annex D for more information. Note that savings in the agriculture sector are not limited to these policies. There are impacts from other measures which do not have agriculture as their sole focus (see Annex D).

<sup>31</sup> See Box 1.

## 4 Demand for energy

- Our projections suggest that total final energy demand in 2040 will be around 135 million tonnes of oil equivalent (Mtoe)<sup>32</sup>. This is about 5 Mtoe (4%) lower than the demand in the year 2018. This represents around a 14% reduction in per capita demand.
- We project total primary energy demand in 2040 will be around 183 Mtoe, about 17 Mtoe (9%) less than the 2018 value.
- We project the proportion of all final energy demand met from electricity or renewables will rise from 23% in 2018 to 27% in 2035 and to 28% in 2040. In EEP 2018 the 2035 figure was 26%.

In this chapter we summarise the latest projections for final and primary energy demand.

### 4.1 Final energy demand

We project that total Final Energy Demand (FED)<sup>33</sup> will fall until the year 2026—to 133 Mtoe from 140 Mtoe in 2018 (a decrease of around 5%). Demand then rises slowly as the effects of policies diminish<sup>34</sup> and macroeconomic drivers continue to push it up. By 2040, we project total FED will be around 135 Mtoe, 4% lower than in the year 2018 (Fig 4.1 a). This represents around a 14% reduction in per capita demand.

In EEP 2019 we project slightly lower total final energy demand than in EEP 2018: in 2035 it is 5% lower than in the previous edition. This is mainly due to decreased demand for oil products in transport and for natural gas in the residential and industry sectors.

In this edition, FED for electricity is slightly lower than in EEP 2018. By 2035 the difference is around 2% (638 Mtoe less). Lower demand in the residential and services sectors outweighs higher demand for industrial and (especially) transport electricity.

The proportion of all FED met from electricity or renewables rises slowly from 23% in 2018 to 27% in 2035, and to 28% in 2040.

Patterns of demand vary across the four major energy consuming sectors of transport (Figure 4.1 b), residential (Figure 4.1 c), industry (Figure 4.1 d) and services (Figure 4.1 e).

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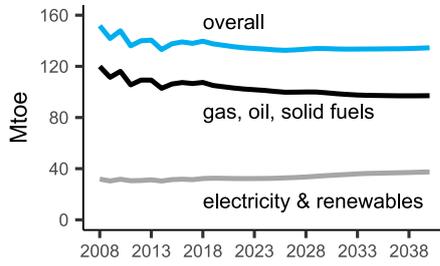
<sup>32</sup> These are the same units as DUKES uses for historical data.

<sup>33</sup> Final energy consumption is energy consumed by the final user—i.e. it excludes any losses during the transformation into other forms of energy. We follow the DUKES approach here and include international aviation but not international shipping demand. The emissions projections we discuss exclude both.

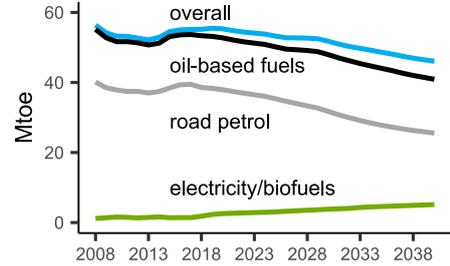
<sup>34</sup> The model projects energy demand and emissions in the absence of policy. We then remove emissions to match the emissions reductions we expect for the policies the scenario includes. So, if policy savings diminish (for example when a policy expires), the model's emissions increase towards the policy-off level.

**Figure 4.1:** Final energy demand by fuel and consumer sector, 2008 to 2040, Mtoe

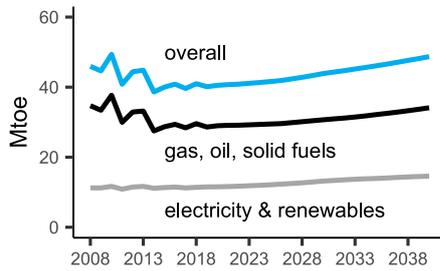
a) total



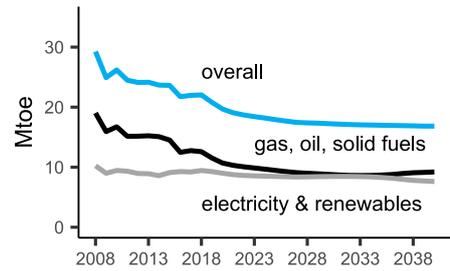
b) transport



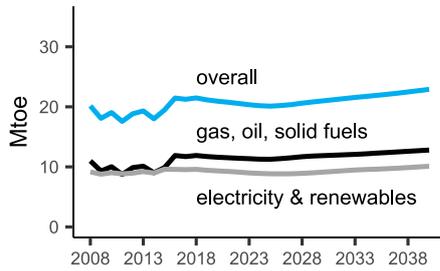
c) residential (households)



d) industry



e) services (including agriculture)



## Final energy demand by sector

The main trends in final energy demand for each sector are:

Transport (including international aviation; Figure 4.1 b)

- This had the largest final energy demand in 2018 (40% of the total).
- We project transport final energy demand will fall by 16% between 2018 and 2040. It will then be the second biggest sector behind the residential sector (34% of the total).
- In 2018, 97% of transport FED was from oil-based fossil fuels but by 2040 we project this will fall to 89%. This reflects more electric vehicles and increasing biofuels use.
- We project final energy demand in 2035 will be 8% lower than EEP 2018. The main reason is that new CO<sub>2</sub> regulations establishing emissions targets for cars, vans and HGVs lead to reduced demand for petroleum products.

Residential (Figure 4.1 c)

- This sector had the second highest final energy demand in 2018 (29% of the total).
- We project total residential FED will increase by 19% between 2018 and 2040 when the sector overtakes transport to become the largest sector (36% of the total demand). This change is a consequence of our assumptions about: the growth in the number of households, changes in household income, future weather and how retail fuel prices will change.
- In 2018, 28% of residential FED came from electricity and renewables<sup>35</sup>. We project this proportion will increase slightly to 30% by 2040.
- Our projection for overall residential final energy demand in 2035 is 4% lower than EEP 2018. Our projections for demand from each fuel are lower too. This is mainly because we assume lower future household numbers than in the previous edition.

Industry (Figure 4.1 d)

- This sector was 16% of total final energy demand in 2018.
- We project total industry FED will fall by 24% between 2018 and 2040.
- In 2018 around 43% of industrial final energy demand was for electricity or renewables. In 2040 this rises slightly to 45%.
- We project industry FED in 2035 will be 10% lower than EEP 2018 levels. Demand for electricity, solid fuels and renewables is higher, while FED for petroleum products and natural gas is lower. The main reasons are the DUKES 2019 reallocation of oil from

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<sup>35</sup> The DUKES category "Bioenergy & waste". This includes geothermal, solar heat and heat pumps but excludes renewable electricity generation.

industry to service sectors<sup>36</sup> and improvements to our industry equations (see Section 6.2).

Services<sup>37</sup> (Figure 4.1 e)

- Services final energy demand was 15% of the total in 2018.
- We project this to increase by 7% between 2018 and 2040, reaching 17% of total FED.
- In 2018, 45% of services final energy demand was from electricity and renewables<sup>38</sup>. We project this share will remain roughly the same up to 2040.
- In EEP 2019 our projection for services FED in 2035 is 2% higher than in EEP 2018. We project final energy demand from electricity will decrease and demand for oil will increase. This follows from the demand equation improvements and the DUKES 2019 reallocation of oil from industry to service sectors which we describe in Section 6.2.2.

We give final energy demand projections by sector in annex F.

## 4.2 Primary energy demand

We project total primary energy demand<sup>39</sup> will fall by 11% between 2018 and 2025: from 200 to 179 Mtoe. It then stays at around this level before increasing from the mid-2030s. In 2040 it reaches 183 Mtoe, a reduction of 9% from the year 2018.

Total primary energy demand in 2035 is 7% lower than EEP 2018. This is driven by reduced demand for nuclear, renewables and waste and for oil in the 2019 edition. However, higher demand for imported electricity and natural gas offsets this somewhat.

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<sup>36</sup> The impact of the DUKES changes is that the statistics now assign around 40% of industrial oil demand to other sectors. For more information see:

<https://www.gov.uk/government/publications/energy-trends-june-2019-special-feature-article-change-to-method-of-estimating-sector-demand-for-oil-products>

<sup>37</sup> Services comprises the commercial sector, public sector and agriculture.

<sup>38</sup> The DUKES category "Bioenergy & waste". This includes geothermal, solar heat and heat pumps but excludes renewable electricity generation.

<sup>39</sup> Fuels obtained directly from natural sources, e.g. coal, oil and natural gas. Primary energy includes primary electricity.

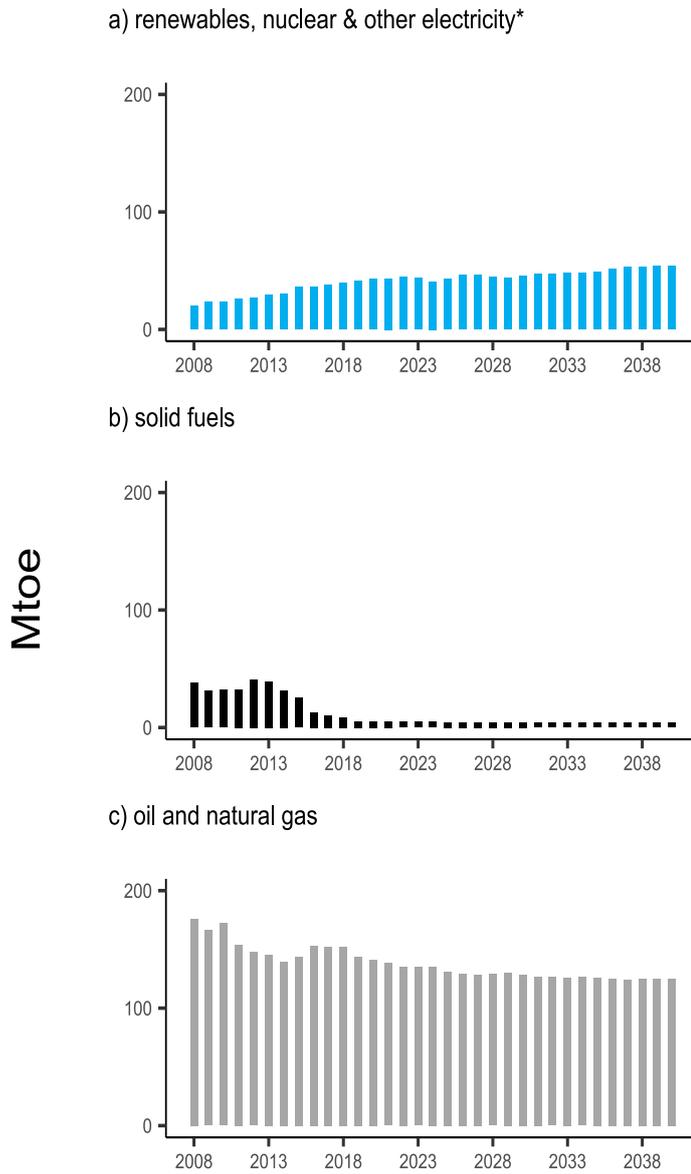
## Primary energy demand by fuel group

The trends we project for primary energy demand from different sources are similar to those in the previous edition (Figure 4.2):

- Renewables, nuclear and other electricity (Fig 4.2 a) demand increases steadily. Between 2018 and 2040, primary energy from these sources increases by 36% to reach 29% of total primary energy demand or 54 Mtoe.
- Solid fuels (mostly coal: Fig 4.2 b) use has fallen rapidly since 2013 as electricity generation has switched to using more renewables, waste and natural gas. By 2040 it meets only 2% (4 Mtoe) of demand. There is no coal-fired electricity generation after the government deadline of 2025.
- Demand for primary energy from oil and natural gas (Fig 4.2 c) declines by 18% between 2018 and 2040. Electricity and biofuels meet an increasing proportion of road fuel demand. Renewables and nuclear displace electricity generation from natural gas.

We give primary energy demand projections for each fuel in Annex E.

**Figure 4.2: Primary energy demand by fuel, Mtoe**



Notes:  
 \* Other electricity is mainly electricity from waste.

## 5 Electricity supply

- For this year’s publication, we aligned the power sector modelling approach with the rest of EEP by only including assumptions that reflect implemented, adopted and planned policy<sup>40</sup>. BEIS will also publish two illustrative strategic scenarios showing what a Net Zero-consistent power sector could look like. These go beyond current government policy and do not indicate a preferred outcome<sup>41</sup>.
- We project that the low carbon share of UK electricity generation<sup>42</sup> will rise from 51% in 2018 to 83% in 2040. This is the proportion of all generation from renewables, nuclear or Carbon Capture and Storage (CCS) power producers.

We undertook the electricity supply sector modelling in March 2020 using BEIS’s “Dynamic Dispatch Model” (DDM)<sup>43</sup>. The DDM models the impact of relevant policies including small scale Feed-in Tariffs, the Renewables Obligation, Contracts for Difference (CfD), Carbon Price Support, the Capacity Market and Industrial Emissions Directive.

This year, we have changed the modelling approach slightly so the power sector is more in line with the rest of EEP modelling. Our reference scenario assumptions now attempt to reflect implemented, adopted and planned policy<sup>44</sup>. In previous editions the modelling assumed current government policy continued. For example, some of the impacts of this are that the EU ETS trajectory is now the same as other sectors post 2030 and there are no CfD auctions after 2030. Some of the installations included within these projections depend on future decisions by government and regulators. These decisions will be taken on a case-by-case basis at the appropriate moment and will be subject to value for money assessment if additional funding is required.

As in previous years, the report annexes give separate results for “Major Power Producers” (MPPs: annexes G-I) and “All Power Producers” (which includes autogenerators: annexes J-L). In 2018, MPPs accounted for around 95% of the UK’s electricity generation.

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<sup>40</sup> This equates to expired, implemented, adopted, and planned policies as defined by the United Nations Framework Convention on Climate Change (UNFCCC). See Part II, Section V(A) paragraph 13, page 83 of: <http://unfccc.int/resource/docs/cop5/07.pdf>

This is a UNFCCC “with additional measures” (WAM) scenario. Annex D gives details of the policies we include.

<sup>41</sup> We will give more detail about these in the report published as Annex O once published.

<sup>42</sup> The figures we quote in this chapter are for “All Power Producers”. They do not include electricity imports or exports.

<sup>43</sup> For background information on the DDM please see:

<https://www.gov.uk/government/publications/dynamic-dispatch-model-ddm>

<sup>44</sup> This equates to expired, implemented, adopted, and planned policies as defined by the United Nations Framework Convention on Climate Change (UNFCCC). See Part II, Section V(A) paragraph 13, page 83 of: <http://unfccc.int/resource/docs/cop5/07.pdf>

This is a UNFCCC “with additional measures” (WAM) scenario. Annex D gives details of the policies we include.

## 5.1 Summary of projections

The projections show a slightly lower overall demand for electricity than in EEP 2018. We discuss this in Section 4.1. The biggest power sector changes from last year's edition are in the generation mix.

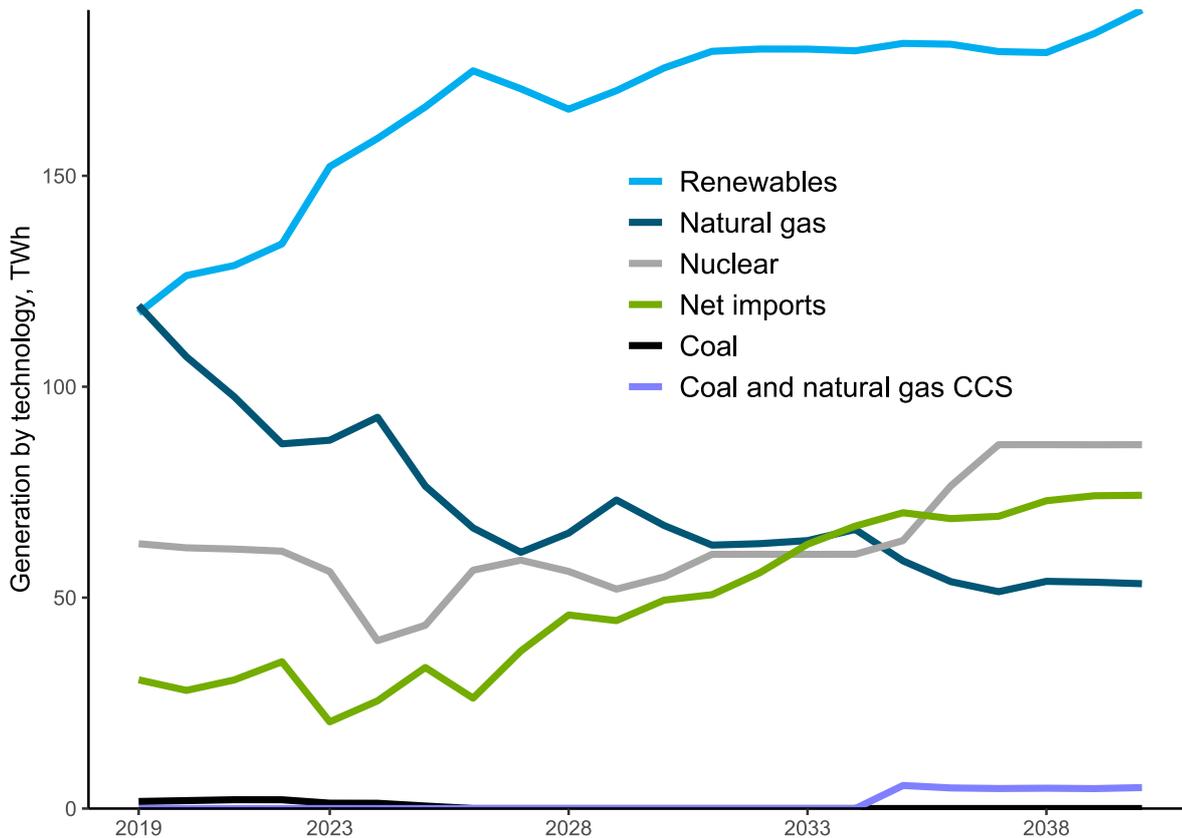
Figure 5.1 shows our projections of generation by technology for all power producers up to 2040:

- Over time, low carbon generation (renewables, gas CCS and nuclear) increases. It makes up 83% of UK generation by 2040. This is around a 32 percentage point increase in the low carbon share from 51% in 2018.
- As in the previous EEP edition, we project generation from renewables will rise. However, this year's modelling approach (which reflects implemented and planned policies rather than a trajectory consistent with an 80% emissions reductions target as we assumed in EEP 2018) means the increase is lower as there is less capacity throughout the 2030s. In 2035 this amounts to 30 TWh (14%) less generation compared with EEP 2018: imports and gas generation make up the shortfall. Total renewables generation reaches 56% of UK generation by 2040.
- Natural gas generation responds to increasing low carbon generation by falling rapidly until the late 2020s. It then stabilises as less new low carbon generation capacity comes online. By 2035 it will be around 59 TWh, 55% lower than 2018 levels. This compares with 34 TWh in the previous edition (25 TWh higher). In 2040, 53 TWh of demand is from gas generation, 16% of the total.
- Nuclear generation increases with the opening of new capacity between the mid-2020s and mid-2030s. There are dips as existing plants retire. Our assumption of lower capacity<sup>45</sup> in EEP 2019 means less nuclear generation than in EEP 2018 (41 TWh lower in 2035).
- We project net imports from interconnectors will rise as more connections with neighbouring markets open in the 2020s. Imports are higher than in EEP 2018 as they largely offset the lower increases in renewables and nuclear generation.

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<sup>45</sup> The modelling takes into account the suspension of work on Wylfa Newydd nuclear power station and the subsequent withdrawal of Hitachi from the project.

**Figure 5.1:** Electricity generation by fuel source, TWh



We project emissions from electricity production will fall steadily as generation switches away from fossil fuels (annexes B and C).

## 5.2 Net Zero-consistent power sector scenarios

BEIS has worked extensively on the Net Zero target since EEP 2018. This includes modelling two illustrative scenarios showing what a Net Zero-consistent power sector could look like. These will be published in the *Net Zero and the Power sector* publication as Annex O to EEP 2019. This will discuss this modelling and its implications in more detail.

## 6 Detailed comparisons with EEP 2018

This chapter gives more information about the major changes to the projections since EEP 2018. We presented summary figures in Section 1.3.

### 6.1 Changes in territorial projections since EEP 2018

**Table 6.1:** Changes which affect total territorial emissions (in comparison with EEP 2018), MtCO<sub>2e</sub>

Type of change since EEP 2018	Carbon budget period		
	CB3 (2018-22)	CB4 (2023-27)	CB5 (2028-32)
Model inputs	72	35	24
Policy savings updates	12	9	-19
Modelling improvements	-36	-37	-28
<b>Total change since EEP 2018</b>	<b>48</b>	<b>7</b>	<b>-23</b>

The differences between this edition and EEP 2018 stem from model improvements, and updates to policy savings and other inputs. We summarise the main changes since EEP 2018 which affect overall *territorial emissions* in table 6.1. These are:

- Policy savings updates for climate change policies lead to higher projected territorial emissions in the third and fourth carbon budgets (by 12 MtCO<sub>2e</sub> and 9 MtCO<sub>2e</sub> respectively), but lower territorial emissions (by 19 MtCO<sub>2e</sub>) in the fifth carbon budget. The biggest changes from policy updates are in the transport sector. For example, compared with EEP 2018, updated outturn data for vehicle emissions cause higher emissions in the third and fourth carbon budgets (by 7 MtCO<sub>2e</sub> and 4 MtCO<sub>2e</sub>) but 20 MtCO<sub>2e</sub> lower emissions in the fifth carbon budget as changes in electric vehicle ownership and efficiency have an impact. We discuss policy savings in Chapter 3.
- Revisions to model inputs mean that territorial emissions projections are higher than EEP 2018 in each of carbon budget periods three to five. The emissions are higher by 72, 35 and 24 MtCO<sub>2e</sub> respectively. The main reason is a fall in fossil fuel prices since EEP 2018 which encourages their greater use. However, lower household numbers somewhat offset this in the fourth and fifth carbon budget periods.
- Modelling improvements lead to lower territorial emissions than in EEP 2018 in each of carbon budget periods three to five. The emissions are lower by 36, 37 and 28 MtCO<sub>2e</sub> respectively. We have lowered projected iron and steel demand since the last edition to

better match recent energy use trends in the sector<sup>46</sup>. This model change caused the greatest fall in territorial emissions.

In this report our main focus has been the *non-traded emissions* element of territorial emissions. This is because these affect performance against carbon budgets (see Box 1 for more details).

## 6.2 Changes in non-traded projections since EEP 2018

This section focuses on changes in non-traded emissions since EEP 2018. Table 6.2 below shows the main changes and their impacts on non-traded emissions in the third, fourth and fifth carbon budget periods.

**Table 6.2:** Changes which affect non-traded emissions (in comparison with EEP 2018), MtCO<sub>2e</sub>

Type of change since EEP 2018	Carbon budget		
	CB3 (2018-22)	CB4 (2023-27)	CB5 (2028-32)
Model inputs	40	26	11
Modelling improvements	10	14	18
Policy savings updates	13	8	-21
<b>Total change since EEP 2018</b>	<b>62</b>	<b>49</b>	<b>8</b>

The main reasons for changes in projected non-traded emissions<sup>47</sup> since the last edition are:

- Revised model inputs mean projections of non-traded emissions are 40, 26 and 11 MtCO<sub>2e</sub> higher than in EEP 2018 in the third, fourth and fifth carbon budget periods respectively. We cover the impact of input updates in Section 6.2.2.
- Modelling improvements led to projected non-traded emissions which are 10 MtCO<sub>2e</sub> higher in the third, 14 MtCO<sub>2e</sub> higher in the fourth and 18 MtCO<sub>2e</sub> higher in the fifth carbon budget periods. The main improvements in the projection methodology were to emissions accounting for industry and services (the traded/non-traded split), and to demand projections for commerce, public oil, residential oil and industry. We give more information about this in Section 6.2.1.
- Policy savings updates for climate change policies led to 13 MtCO<sub>2e</sub> and 8 MtCO<sub>2e</sub> higher projected non-traded emissions in the third and fourth carbon budgets

<sup>46</sup> Recent changes in the sector include the closure of Redcar's steel plant in 2015 and declining production of manufactured solid fuels such as coke oven coke.

<sup>47</sup> Our attributions are approximate here. It is not possible to fully isolate the impact of every change.

respectively. In the fifth carbon budget period, these changes result in 21 MtCO<sub>2e</sub> lower non-traded emissions. We discuss policy savings in detail in Chapter 3.

## 6.2.1 Improvements in the projection methodology

Since we published EEP 2018, the BEIS modelling team have concentrated on quality assurance<sup>48</sup> and modelling methodology updates. All model changes use more up to date data and evidence to improve the accuracy of the projections. Our modelling improvements cause non-traded emissions to be higher in each of carbon budget periods three to five: by 10, 14 and 18 MtCO<sub>2e</sub> respectively.

**Table 6.3:** Improvements in the projection methodology which affect non-traded emissions (in comparison with EEP 2018), MtCO<sub>2e</sub>

Modelling improvements	Carbon budget		
	CB3 (2018-22)	CB4 (2023-27)	CB5 (2028-32)
Traded/non-traded emissions split	11	12	12
Commerce and public demand projections	3	7	10
Industry demand projections	-4	-3	-2
Residential demand projections	-3	-3	-3
Other [1]	2	1	2
<b>Total change from modelling improvements</b>	<b>10</b>	<b>14</b>	<b>18</b>

Notes:

1. "Other" includes inputs with impacts less than 5 MtCO<sub>2e</sub> across the combined total of carbon budgets three, four and five.

The main modelling improvements that affected non-traded emissions projections are:

- Revisions to the traded/non-traded emissions split: We improved the alignment of the model to the GHG Inventory and EU ETS data. This made the proportion of non-traded emissions in the projections higher.
- Commerce and public demand projections: We revised commerce and public oil demand upwards to match the revised estimates of past consumption in DUKES<sup>49</sup>.

<sup>48</sup> See BEIS Modelling Quality Assurance tools and guidance here:

<https://www.gov.uk/government/collections/quality-assurance-tools-and-guidance-in-decc>

<sup>49</sup> The impact of the DUKES changes is that the statistics now assign around 40% of industrial oil demand to other sectors. For more information see:

<https://www.gov.uk/government/publications/energy-trends-june-2019-special-feature-article-change-to-method-of-estimating-sector-demand-for-oil-products>

- Industry demand projections: Changes to these caused lower industry gas and oil consumption projections. We revised the equations because changes in the sector meant the model no longer matched recent trends<sup>50</sup>.
- Residential demand projections: Our revised approach led to lower residential oil consumption projections. We made this change because our existing equations were not reflecting past trends as well as in other sectors.

## 6.2.2 Changes due to input updates

We list the main input updates and their effects on emissions in Table 6.4. The overall impact of changes to inputs is to give higher emissions: by 40, 26 and 11 MtCO<sub>2e</sub> in carbon budget periods three, four and five.

**Table 6.4:** Input updates which affect non-traded emissions (in comparison with EEP 2018), MtCO<sub>2e</sub>

Input update	Carbon budget		
	CB3 (2018-22)	CB4 (2023-27)	CB5 (2028-32)
LULUCF and Non-CO <sub>2</sub>	29	27	25
Fossil fuel price projections	14	16	14
GHG Inventory (2019)	15	7	7
Transport	3	7	6
DUKES [1]	-8	-3	-4
Power sector updates & interaction	-1	-3	-11
GHG Inventory (2020)	-6	-12	-11
Household numbers	-7	-13	-16
Other [2]	1	-1	0
<b>Total change due to input updates</b>	<b>40</b>	<b>26</b>	<b>11</b>

*Notes:*

1. The DUKES update row does not include transport: the “Transport” row captures these changes. It also excludes the indirect impact of our projection equation adjustments which we made after the DUKES revisions to past oil demand.

2. “Other” includes inputs with impacts less than 5 MtCO<sub>2e</sub> across the total of carbon budgets three to five.

<sup>50</sup> We last reviewed industry in depth in 2016.

Compared with EEP 2018, the biggest upwards revisions to non-traded emissions come from updates to:

- LULUCF and Non-CO<sub>2</sub> emission data: updated historic data and new projections of Land Use, Land Use Change and Forestry (LULUCF) / non-CO<sub>2</sub> emissions mean that emissions are higher than in EEP 2018—by 29 MtCO<sub>2</sub>e in the third, 27 MtCO<sub>2</sub>e in the fourth and 25 MtCO<sub>2</sub>e in the fifth carbon budget periods. The main reason for the increases was a correction to GHG removals from forest land in the GHG Inventory (2019)<sup>51</sup> (this also affected the main Inventory CO<sub>2</sub> emissions inputs: see below).
- Fossil fuel price projections: we assume future prices of fossil fuels will be lower than in EEP 2018<sup>52</sup>. This makes it economically attractive to use more of them. The higher fossil fuel use leads to higher emissions than in EEP 2018. Non-traded emissions are 14, 16 and 14 MtCO<sub>2</sub>e higher in the third, fourth and fifth carbon budget periods respectively.
- GHG Inventory (2019): this update led to higher non-traded emissions. In the third carbon budget period, emissions were 15 MtCO<sub>2</sub>e higher. In the fourth and fifth budget periods emissions are also higher—by 7 MtCO<sub>2</sub>e in the fourth and 7 MtCO<sub>2</sub>e in the fifth. The main reason for the upward revisions was a correction to GHG removals from forest land<sup>53</sup>.
- Transport: the latest statistics showed higher than expected fuel consumption from road transport<sup>54</sup>. This led us to revise our fuel efficiency assumptions downwards. The impact is higher emissions.

Compared with EEP 2018, the biggest downwards revisions to non-traded emissions come from updates to:

- DUKES: DUKES 2019 made significant revisions to oil consumption<sup>55</sup>. It reallocated a lot from the industry sector to commerce, public and agriculture. These changes lead to slightly lower non-traded emissions in the projections. This reflects our projection that emissions will fall more quickly in the sectors receiving the reallocations than in industry.
- Power sector updates and interaction: we have revised the power sector assumptions since EEP 2018. Most of the sector is in the EU ETS and so its emissions are traded.

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<sup>51</sup> See Section 6.2.7 of UK Greenhouse Gas Inventory, 1990 to 2017: Annual Report for Submission under the Framework Convention on Climate Change:

[http://uk-air.defra.gov.uk/reports/cat07/1905151122\\_ukghgi-90-17\\_Main\\_Issue\\_2\\_final.pdf](http://uk-air.defra.gov.uk/reports/cat07/1905151122_ukghgi-90-17_Main_Issue_2_final.pdf)

<sup>52</sup> We give these assumptions in Annex M.

<sup>53</sup> See Section 6.2.7 of UK Greenhouse Gas Inventory, 1990 to 2017: Annual Report for Submission under the Framework Convention on Climate Change:

[http://uk-air.defra.gov.uk/reports/cat07/1905151122\\_ukghgi-90-17\\_Main\\_Issue\\_2\\_final.pdf](http://uk-air.defra.gov.uk/reports/cat07/1905151122_ukghgi-90-17_Main_Issue_2_final.pdf)

<sup>54</sup> Latest transport statistics:

<https://www.gov.uk/government/statistical-data-sets/energy-and-environment-data-tables-env#fuel-consumption-env01>

<sup>55</sup> The impact of the DUKES changes is that the statistics now assign around 40% of industrial oil demand to other sectors. For more information see:

<https://www.gov.uk/government/publications/energy-trends-june-2019-special-feature-article-change-to-method-of-estimating-sector-demand-for-oil-products>

However, some generation from Combined Heat and Power (CHP) plants is outside the scheme and its emissions are non-traded. We no longer assume any new CHP plants will be built. This means our projections now only reflect generation from existing CHP installations. We assume that any of these plants which close will not be replaced. The lower projected non-traded emissions reflect reduced future CHP generation.

- GHG Inventory (2020): this update led to lower non-traded emissions. They are 6 MtCO<sub>2e</sub> lower in the third, 12 MtCO<sub>2e</sub> lower in the fourth and 11 MtCO<sub>2e</sub> lower in the fifth carbon budget periods.
- Household numbers: non-traded emissions are lower by 7, 13 and 16 MtCO<sub>2e</sub> in carbon budgets three, four and five respectively. This reflects lower household number forecasts than in EEP 2018<sup>56</sup>. The demand for energy in the residential sector is closely linked to household numbers and is therefore lower. This leads to reduced emissions.

## 6.3 Changes in traded projections since EEP 2018

Compared with EEP 2018, the biggest downwards revisions to traded emissions come from:

- Changes to our projections of future iron and steel demand (see Section 6.1)
- Our revisions to the traded/non-traded emissions split (Section 6.2.1) and
- Our changes to the commerce and public demand projections (Section 6.2.1).

Of these, the changes to the iron and steel demand projections had the largest impact.

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<sup>56</sup> We give these assumptions in Annex M.

# 7 Lists of supporting material

## 7.1 Annexes

Annex A: Greenhouse gas emissions by source

Annex B: Carbon dioxide emissions by source

Annex C: Carbon dioxide emissions by IPCC category

Annex D: Policy savings in the projections

Annex E: Primary energy demand

Annex F: Final energy demand

Annex G: Major power producers' generation by source

Annex H: Major power producers' cumulative new electricity generating capacity

Annex I: Major power producers' total electricity generating capacity

Annex J: Total electricity generation by source

Annex K: Total cumulative new electricity generating capacity

Annex L: Total electricity generating capacity

Annex M: Growth assumptions and prices

Annex N: 2019 non-CO<sub>2</sub> GHG emissions projections report

Annex O: Net Zero and the power sector scenarios

Our annexes contain projections for the following scenarios which we publish each year:

<b>Scenario</b>	<b>Description</b>
<b>Reference Scenario</b>	Based on central estimates of economic growth and fossil fuel prices. Contains all policies where decisions on policy design are sufficiently advanced to allow robust estimates of impact (i.e. including “planned” policies). See annex D on policy savings for definitions of each policy implementation status.
<b>Low Prices</b>	Similar assumptions to reference scenario but with lower projected fossil fuel prices.
<b>High Prices</b>	Similar assumptions to reference scenario but with higher projected fossil fuel prices.
<b>Low Growth</b>	Similar assumptions to reference scenario but with lower projected economic growth.
<b>High Growth</b>	Similar assumptions to reference scenario but with higher projected economic growth.
<b>Existing Policies</b>	Contains central price and growth assumptions but without planned policies included.
<b>Baseline Policies</b>	Contains central price and growth assumptions but only policies that existed before the Low Carbon Transition Plan of July 2009.

Once Annex O (Net Zero and the power sector scenarios) has been published, we will also provide annexes G to L for the Net Zero strategic reference scenarios:

<b>Scenario</b>	<b>Description</b>
<b>Net Zero (Higher)</b>	Net Zero strategic reference scenario with higher power sector electricity demand.
<b>Net Zero (Lower)</b>	Net Zero strategic reference scenario with lower power sector electricity demand.

## 7.2 Web tables and figures

We publish web tables and figures alongside this report. Some of these replicate tables and figures in the report text while others are supplementary.

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This publication is available from: [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019)

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Department for  
Business, Energy  
& Industrial Strategy

# Digest of UK Energy Statistics

## Annual data for UK, 2020

### About this release

Information on energy production, trade, and consumption in the UK for total energy and by specific fuels.

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### Data tables

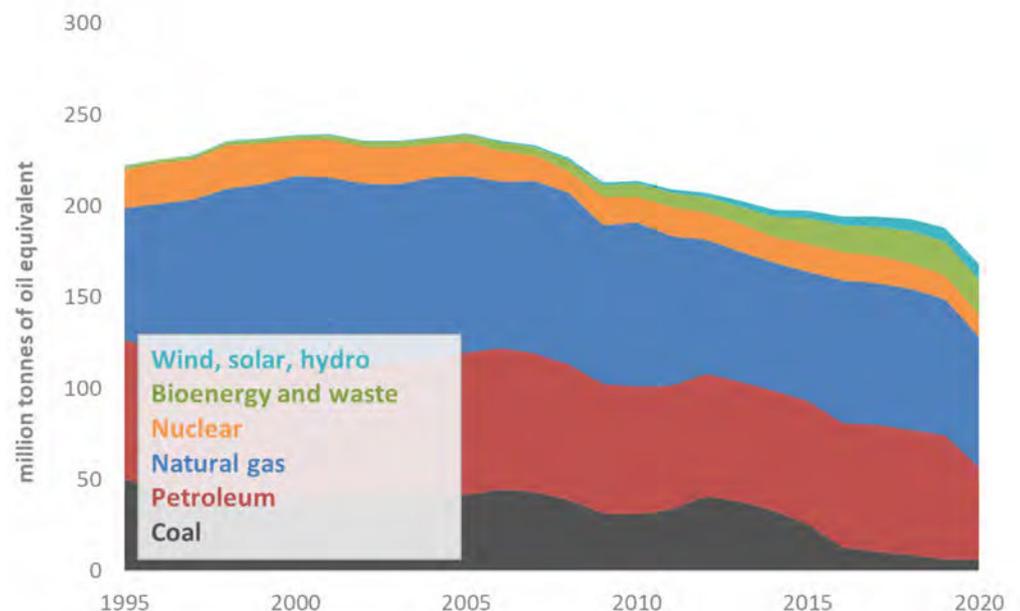
See the [full list of tables](#) and [annexes](#) for more information. Additional data are available online as part of the DUKES series:

- [Total energy](#)
- [Coal and derived gases](#)
- [Oil and oil products](#)
- [Gas](#)
- [Electricity](#)
- [Renewables](#)

This publication is based on a snapshot of survey data from energy suppliers. New data are incorporated in line with the [revisions policy](#).

**Last year saw an unprecedented drop in energy demand** as lockdown restrictions in place to curb the spread of Covid-19 affected economic output, leisure, and travel. The demand for energy in 2020 was similar to that seen in the 1950s when the UK has a far smaller population and notably different demands.

### Demand for energy in the UK, 1995 – 2020



The fall in demand was most keenly felt in transport as people travelled less for work and leisure. **Transport demand dropped by 29 per cent compared to 2019**, led by a fall in aviation demand, down 60 per cent.

Diesel demand was down 17 per cent and petrol demand down 21 per cent, taking demand for all transport fuels back to the 1980s. **Industrial demand and demand for energy in shops, hotels, and offices also fell** broadly in line with the activity in the wider economy.

Whilst the annual drop was unprecedented, it was not in any way sustained. The reduced demand for fuel was most evident in the second quarter of the year and **demand increased month-on-month from June through to the end of the year** as activity levels returned to closer to normal.

The UK's electricity generation landscape continued to evolve and move away from fossil fuels and towards renewable alternatives. Windy conditions in the Spring of 2020 meant that renewable generation reached record levels and **contributed a 43.1 per cent share of generation, outpacing for the first-time annual fossil fuel generation** which contributed 37.7 per cent of generation, a record low and down from 75.4 per cent in 2010. Despite record low output from nuclear, **strong renewable performance pushed low carbon generation to a record 59.3 per cent.**

# Chapter 1: Total energy

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## Key headlines

**Energy demand in 2020 was at levels last seen in the 1950s** as Covid-19 restrictions affected industrial output, work, leisure, and travel. **Energy requirements for industrial use and services (e.g. shops, restaurants, offices) are both down 6 per cent on 2019.** Despite warmer weather, domestic demand was up as more people stayed at home.

**Transport fuel demand dropped 29 per cent compared to 2019**, led by a fall in aviation fuel, down 60 per cent to levels last seen in the mid-1980s. Diesel demand was down 17 per cent and petrol down 22 per cent. These decreases also takes road transport fuel demand back to the 1980s.

For both transport and other consumption, **the decrease in demand was closely linked to activity** with the indices of production and services both showing substantial contraction during 2020 and substantially reduced demand for air and road transport. **Monthly data available show consumption hitting near record lows in the summer then increasing throughout the year as restrictions eased.**

**Total final consumption was down 13 per cent on last year, and 11 per cent on a temperature and seasonally adjusted basis.** On the adjusted basis, falls in transport (down 29 per cent), industry (down 6 per cent), and services (down 4 per cent) were not offset by an increase in domestic demand (up 6 per cent).

Renewable generation, as a percentage of generation, continued to grow and **reached a record 43.1 per cent in 2020, outpacing for the first-time annual fossil fuel generation.** Over the last ten years, renewable generation has increased from 6.9 per cent to the current record high. Wind generation is a critical element of renewable's performance, reaching a record high 24.2 per cent up from 2.7 per cent in 2010.

**Fossil fuel generation reached a record low**, dropping from 75.4 per cent of generation to 37.7 per cent over the last ten years. **Coal generation fell to a new record low**, generating just 1.8 per cent in 2020 down from 28.2 per cent in 2010.

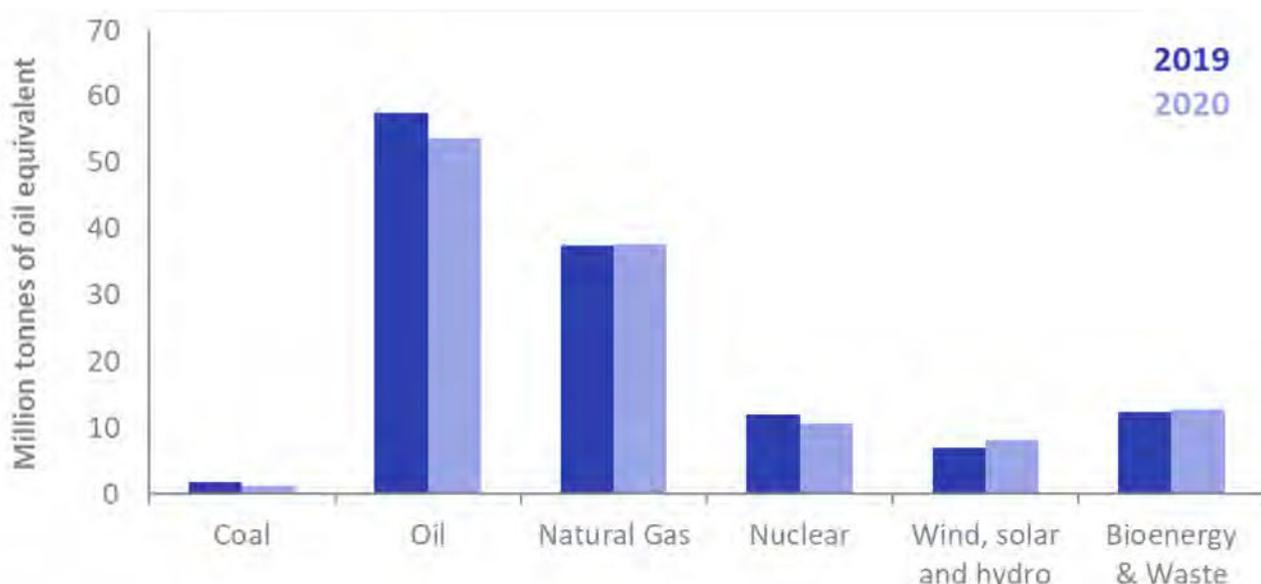
**Low carbon generation also reached a record high of 59.3 per cent** despite a **drop in nuclear output** due to maintenance outages.

In contrast, **renewable generation capacity changed very little in 2020**, up only 2 per cent on last year. The strong generation figures owe much to the storm activity of the first quarter of 2020. Whilst capacity has grown five-fold since 2010, the growth rate in recent years has been smaller.

**Energy production dropped 3 per cent in 2020**, with falls in petroleum production and nuclear production, the latter dropping to a record low due to maintenance outages. Coal production also reached a new record low, down to 1.7 million tonnes from 18.3 million tonnes in 2010.

**Total renewables** accounted for 13.6 per cent of total energy consumption in 2020, up from 11.7 per cent in 2019.

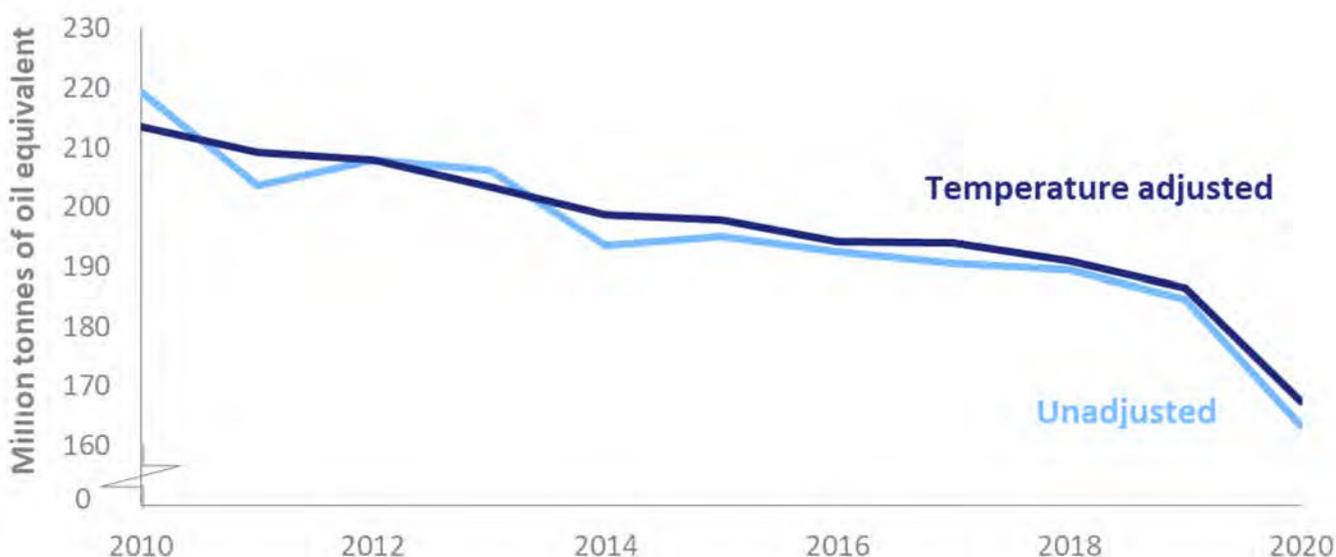
**Chart 1.1 Production by fuels, 2019 and 2020 (DUKES Tables 1.1-1.3)**



**In 2020 total production was 124.1 million tonnes of oil equivalent (mtoe), 3.1 per cent lower than in 2019.** Growth in renewable sources (bioenergy & waste, wind, solar & hydro) was offset by reduced fossil fuel (coal, oil & gas) and nuclear output, due to reduced demand and disruption arising from the Covid-19 pandemic, and numerous outages at UK nuclear power stations. UK production has fallen year on year since 2018, and production is now 58 per cent below the peak recorded in 1999.

In 2020 coal production fell by 35 per cent to a record low level, whilst output from oil & gas fell by 3.7 per cent due to maintenance activities being delayed in 2020 to the second half of the year because of the Covid-19 pandemic. Nuclear output fell by 11 per cent to a record low level due to prolonged maintenance outages throughout the year which reduced operational capacity at some time for all eight of the UK's nuclear power stations. Wind, solar and hydro output rose by 16 per cent, to a record high level, due to small increases in offshore wind and solar capacity, and more favourable weather conditions. In 2020 the average wind speed was 9.1 knots, 0.8 knots higher than in 2019, as ten named storms affected the UK during the year. Production of bioenergy and waste rose by 3.2 per cent.

**Chart 1.2 Primary energy consumption, 2010 to 2020 (DUKES Tables 1.1-1.3)**

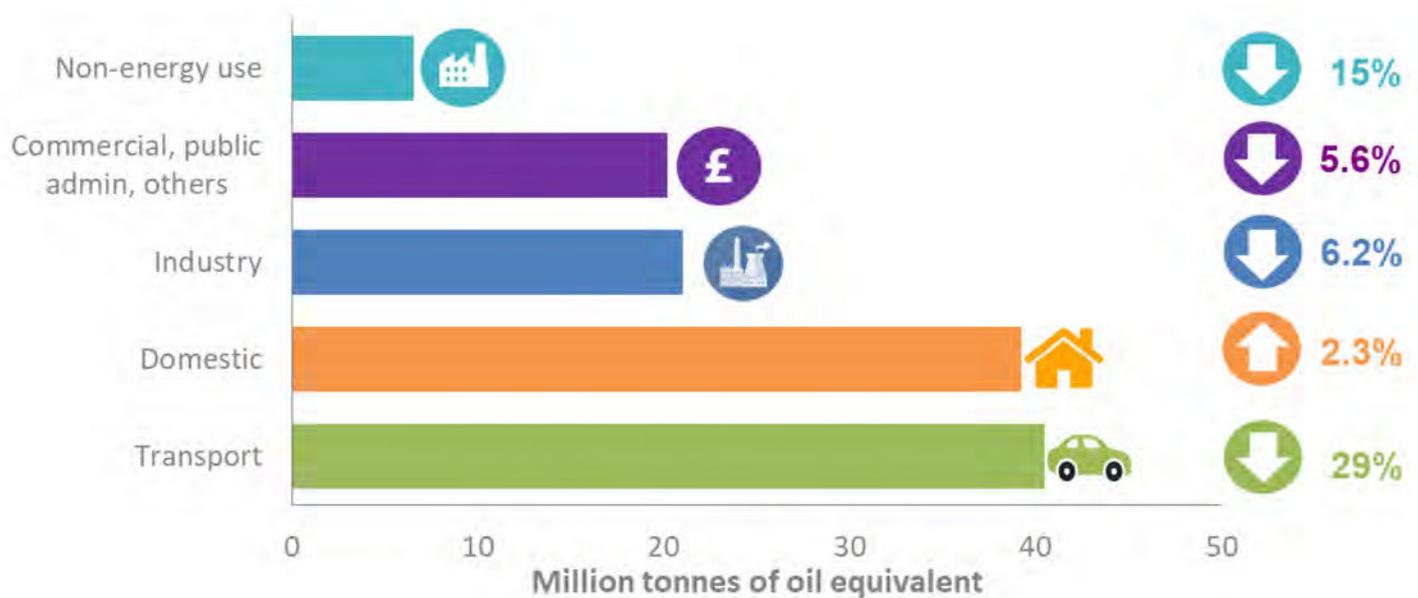


**In 2020 total primary energy consumption was 163.3 mtoe, 11 per cent lower than in 2019, and to levels last seen in the 1950s.**

Primary energy consumption includes use by consumers, fuel used for electricity generation and other transformation. On a seasonally adjusted and annualised rate that removes the impact of temperature on demand consumption was 167.3 mtoe, 10 per cent lower than in 2019.

In 2020 total primary energy consumption shrank massively, with a noticeably sharp reduction in petroleum consumption as demand for transport fuels fell due to the Covid-19 pandemic lockdowns in place in the UK throughout 2020. Consumption of oil fell by a quarter, to a record low, with sharp falls in petrol, diesel and aviation fuel due to travel restrictions imposed during the Covid-19 lockdown periods. Consumption of coal and other solids fell by 8.2 per cent, to a record low, and consumption of natural gas fell by 5.7 per cent as electricity generators made more use of renewable sources. Consumption of bioenergy & waste rose by 2.9 per cent. Primary electricity consumption fell by 2.5 per cent, within which nuclear fell by 11 per cent to a record low level due to prolonged outages during 2020, but wind, solar and hydro rose by 16 per cent to a record high level, due to small increases in offshore wind and solar capacity and more favourable weather conditions.

**Chart 1.3 Final energy consumption by sector, 2020** ([DUKES Tables 1.1-1.3](#))



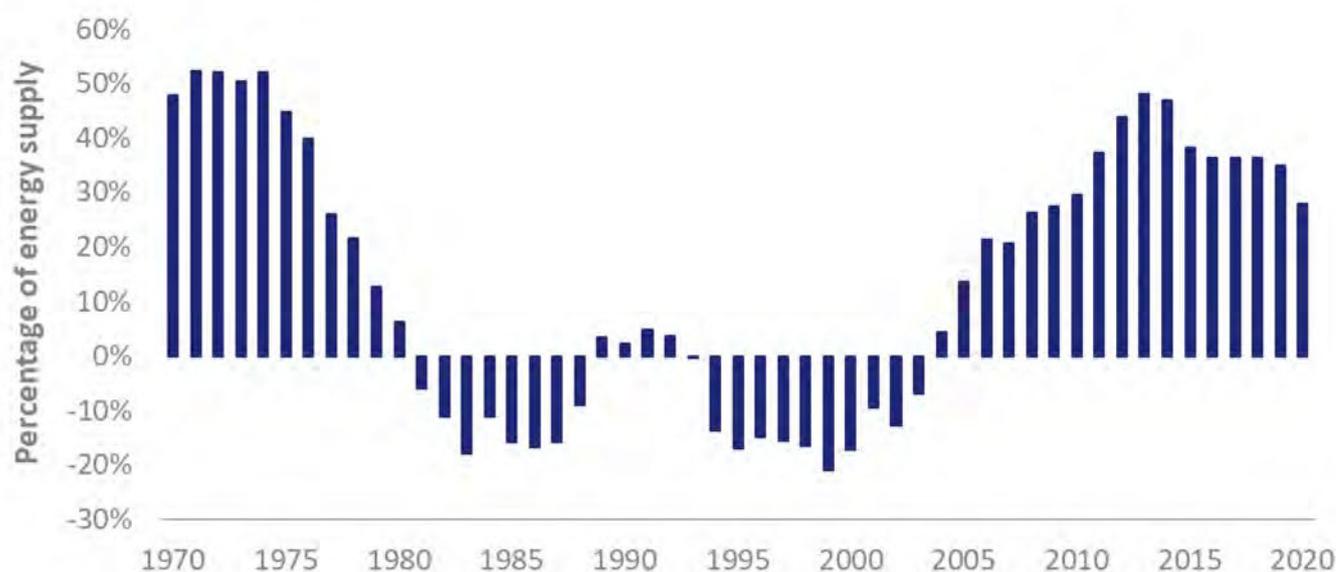
**In 2020 total final energy consumption including non-energy use was 127.5 mtoe, 13 per cent lower than in 2019, again matching demand levels from earlier decades.**

Consumption levels in 2020 were severely impacted by the Covid-19 pandemic lockdowns imposed from March 2020 onwards. Consumption was also reduced by warmer temperatures in 2020 with the average number of heating degree days down from 5.4 to 5.1.

Domestic sector consumption rose by 2.3 per cent reflecting increased home working, however transport sector consumption fell by 29 per cent due to the introduction of travel restrictions during lockdown, with road transport consumption falling by 18 per cent and air consumption falling by 60 per cent. Industrial sector consumption fell by 6.2 per cent and service sector consumption fell by 5.6 per cent as factories, shops, offices and schools were all forced to closed for a period of time during lockdown.

Final energy consumption excluding non-energy use also fell by 13 per cent, whilst on a temperature corrected basis consumption fell by 11 per cent. Domestic consumption on a temperature corrected basis rose by 6.4 per cent.

Chart 1.4 Net import dependency, 1970 to 2020 (DUKES Table 1.1.3)



In 2020 net import dependency was 27.8 per cent<sup>1</sup>, 7.1 percentage points lower than in 2019, and at the lowest level since 2009.

Imports in 2020 at 122.4 mtoe were 18 per cent lower than in 2019, and 32 per cent lower than their peak in 2013. The UK imported less fuel to meet reduced demand in 2020 due to the impact of the Covid-19 pandemic, with falls in imports of coal, primary oil, petroleum products, gas and electricity. The fall in imports of primary oil led to the UK becoming a net exporter of primary oil for the first time since 2004. Exports in 2020 at 74.6 mtoe were 7.5 per cent lower, as rises in coal, gas and electricity imports were offset by falls in primary oils and petroleum products.

Net imports at 47.7 mtoe were 30 per cent lower than in 2019 and accounted for 27.8 per cent of consumption in 2020, down from 34.8 per cent in 2019.

Whilst net imports were down, **the UK continued to increase the use of low carbon fuels**. The main fossil fuel sources in the UK are coal, gas and oil. The low carbon sources include nuclear and renewables such as wind; hydro; solar photovoltaics (pv) and biofuels. In 2020, the share of primary energy consumption from fossil fuels decreased further to a record low of 76.5 per cent, whilst that from low-carbon sources increased to a record 21.5 per cent share, up from 18.9 per cent last year and 10.1 per cent in 2010.

<sup>1</sup> Net imports as a proportion of primary supply (including an addition for the energy supplied to marine bunkers).

# Chapter 2: Solid fuels and derived gases

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## Key headlines

**Demand for coal fell by 11 per cent in comparison with 2019** to 7.1 million tonnes in 2020. This decrease was driven by a drop in consumption by electricity generators, as coal-fired generation is phased out of the UK energy mix.

**Consumption of coal for electricity generation fell to a record low, down 20 per cent from 2019** to 2.3 million tonnes in 2020. This decline reflected a lower overall demand for generation in the face of Covid-19 pandemic, the closure of two coal-fired generation plants in March 2020 and included a record time spent using coal-free electricity generation in the Spring of 2020.

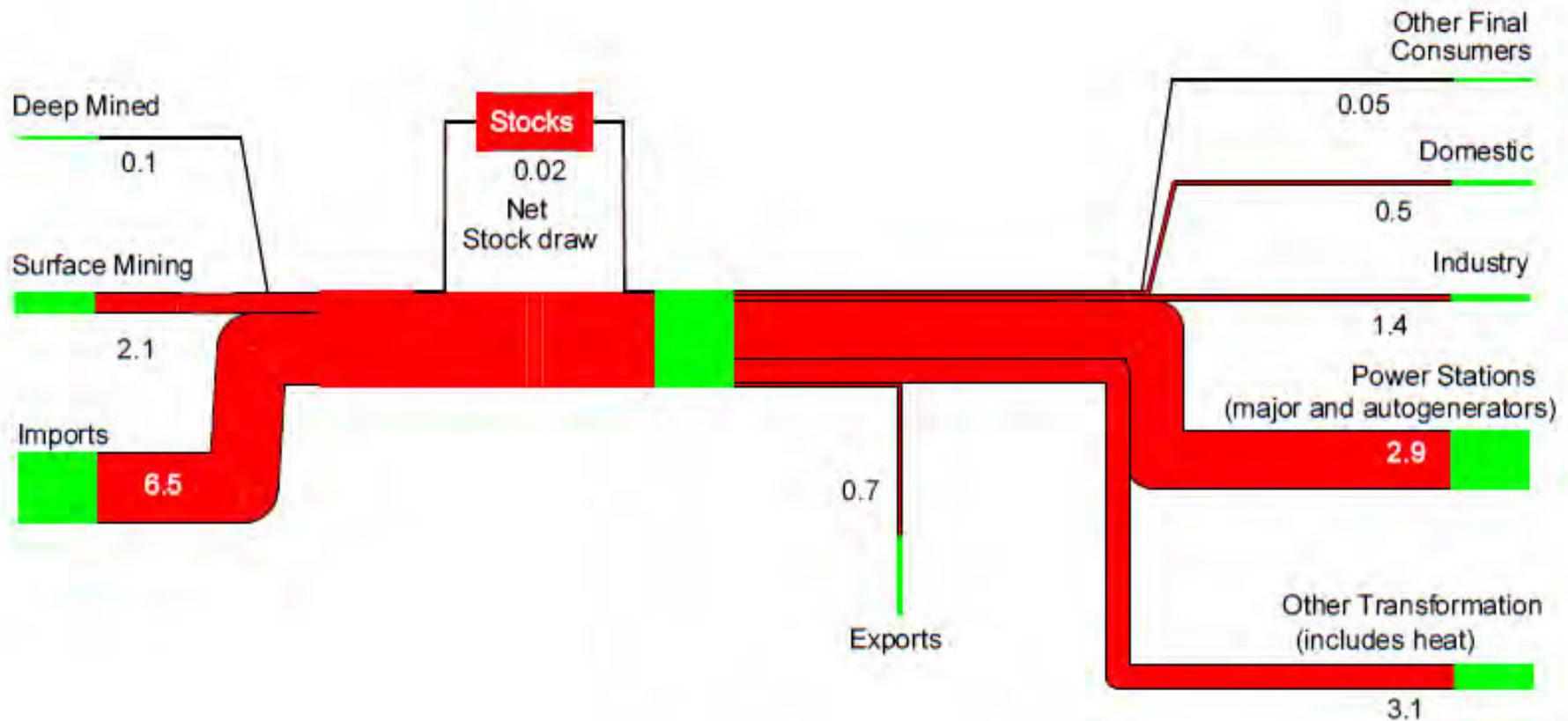
**Production of coal fell to another record low, down 35 per cent from 2019** to 1.7 million tonnes. Surface mining production fell to a record low of 1.6 million tonnes due to mine closures, restrictions in coal mines due to Covid-19, bad weather and a flood in one of the mines as well as the falling demand for coal by electricity generators. In the last ten years, UK coal production has fallen by 91 per cent.

**Coal imports fell 27 per cent in comparison with 2019** to just 4.5 million tonnes in 2020. Net imports accounted for 45 per cent of supply in 2020. Three countries accounted for 79 per cent of total coal imports: Russia (36 per cent), the USA (22 per cent) and Venezuela (21 per cent).

In 2020, coal comprised 2.9 per cent of UK energy demand, up slightly from 2.8 per cent in 2019 as demand for other fuels contracted more sharply due to the Covid-19 pandemic. Over a longer period, the trend reflects the transition away from coal in the UK's energy mix; coal demand has fallen from a 16 per cent share of UK energy demand in 2000. Most of this coal is used for electricity generation, coke manufacture, or in blast furnaces in the steel industry.

The chart on the next page shows flows of coal from production and imports, through to consumption. It is a way of simplifying the figures that can be found in the commodity balance for coal in Table 2.4. The chart illustrates the flow of coal from the point of supply (on the left) to its eventual final use (on the right).

## Coal flow chart 2020 (million tonnes)

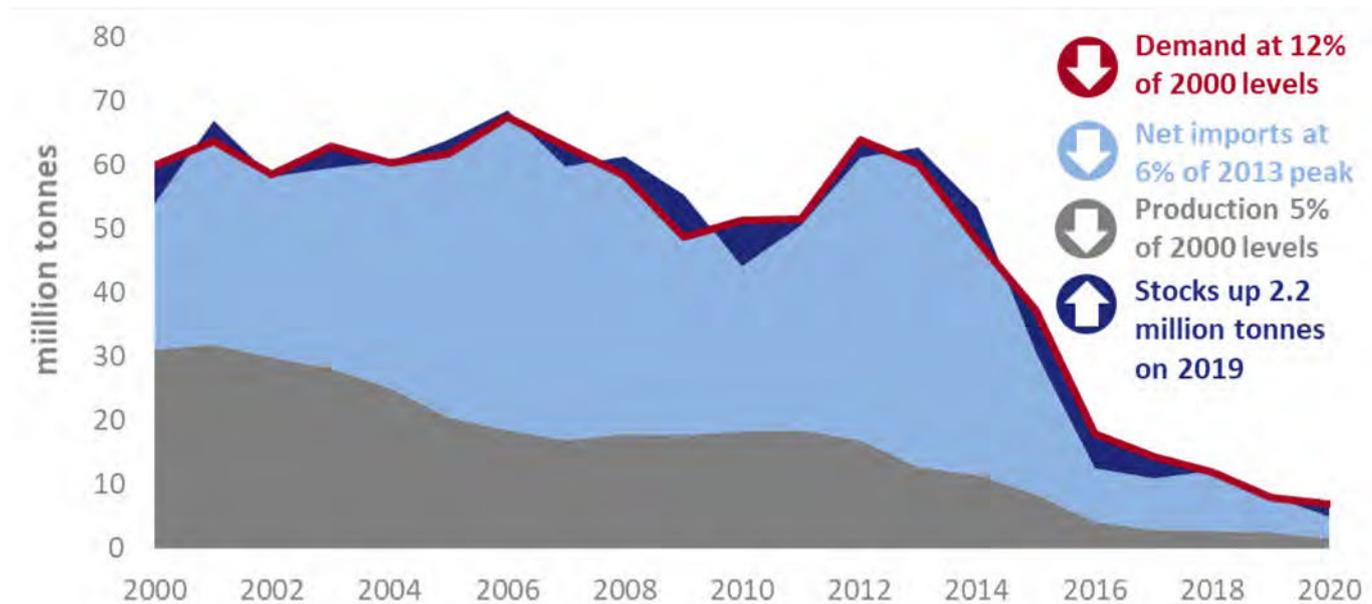


### Note:

This flow chart is based on the data in Tables 2.1 and 2.4.  
The numbers on either side of the flow chart will not match due to losses in transformation.

**Reduced demand for coal drove a substantial contraction in supply, with UK coal production down 91 per cent in the past ten years.** In 2020, coal production fell to a record low of 1.7 million tonnes, down 35 per cent on 2019 (Chart 2.1). In that period just under a quarter of demand was met by domestic production, 45 per cent by net imports and 31 per cent was drawn from stocks.

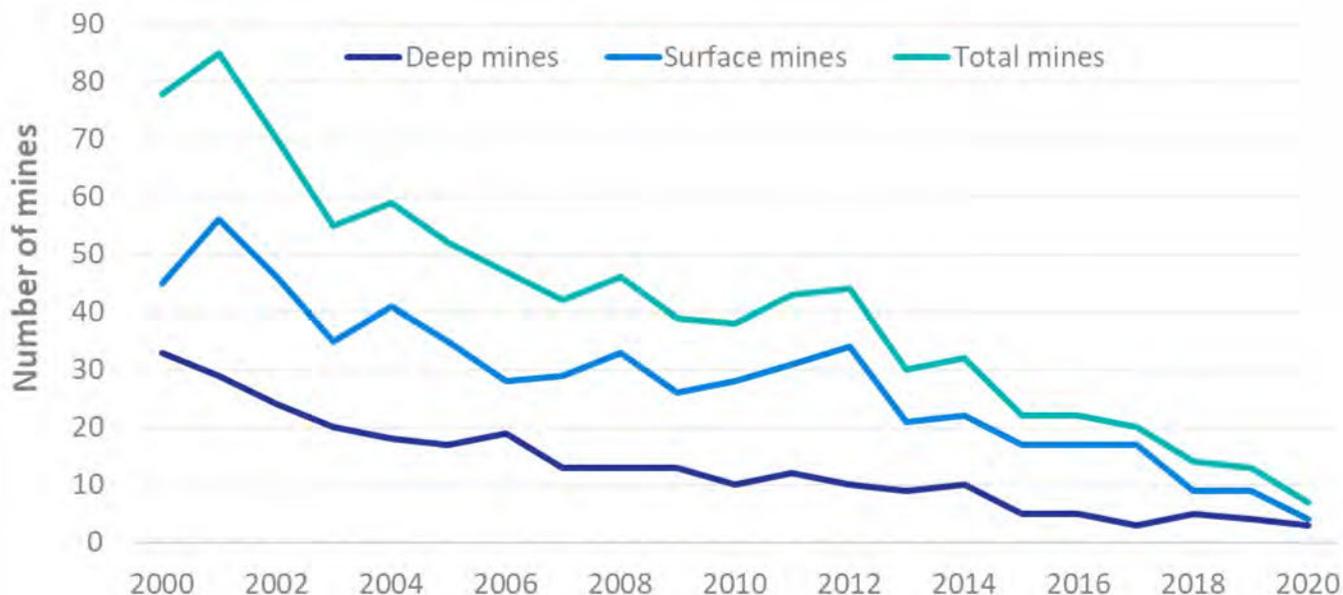
**Chart 2.1 UK coal supply and demand, 2000 – 2020 (Table 2.1)**



Deep mined production rose to 107 thousand tonnes, mainly due to Aberpergwm colliery increasing production, and was 6.4 per cent of total production. In 2015 deep mined production provided nearly a third of total coal production. This was the year that the last large three deep mines in operation closed - Hatfield, Thoresby and Kellingley. There were no further closures of deep mines in 2020 with nine remaining open, of which two were under care and maintenance. Three deep mines reported coal production in 2020.

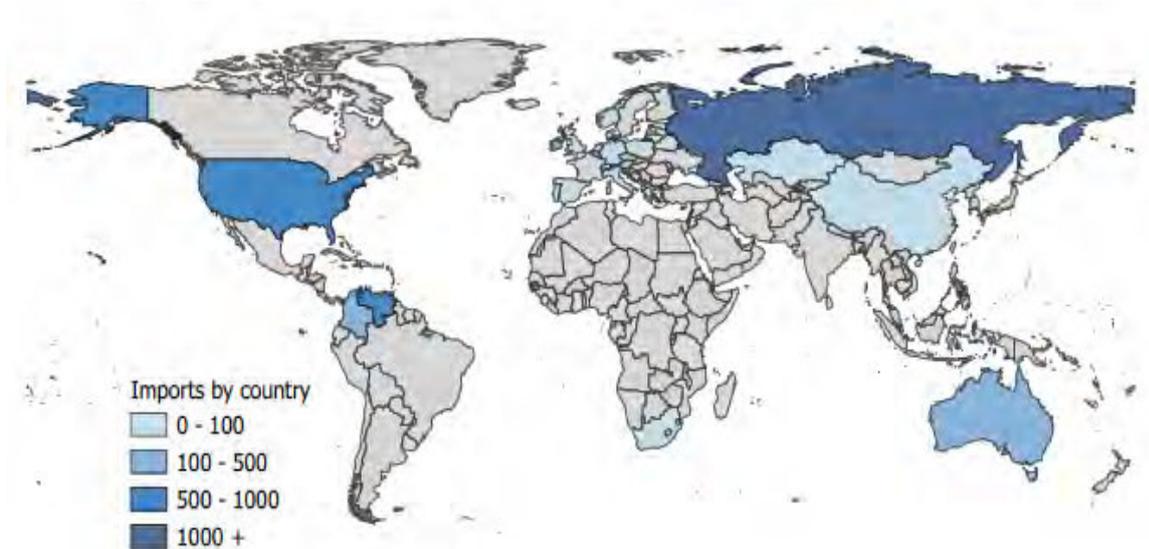
Surface mine production was down 37 per cent, to a new record low of 1.6 million tonnes due to lower demand for electricity generation, restrictions in coal mines due to Covid-19, bad weather and a flood in one of the mines. Six surface mines closed in 2020, with just four remaining.

**Chart 2.2 Number of coal mines producing in the UK, 2000 – 2020 (Table 2.7)**



**Net imports of coal also fell substantially, down 91 per cent from the peak in 2013.** This is again a result of the sharp fall in demand for coal. In 2020, net imports fell by 27 per cent from 2019 levels to just 4.5 million tonnes. However, this reduction in imported coal has occurred at a slower pace than the reduction in domestic production, leading to the proportion of net imports in the UK coal supply increasing over the past 20 years. In 2020 imports accounted for 45 per cent of the UK’s supply, up 7 percentage points from the proportion in 2000.

**Map of UK Coal Imports in 2020 (thousand tonnes)**



For more detail on coal imports and exports see DUKES table G.2:  
<https://www.gov.uk/government/statistics/dukes-foreign-trade-statistics>

Steam coal imports were 39 per cent lower at 2.4 million tonnes in 2020 compared to 2019. In 2020 Venezuela became the highest supplier of steam coal imports for the first time rising from 126 thousand tonnes in 2019 to 968 thousand tonnes. There was also a decrease of steam coal imports from Russia of 47 per cent. Steam coal imports from Colombia fell by 86 per cent. Venezuela (40 per cent) Russia (37 per cent) in 2020 represented 77 per cent of steam coal imports. Steam coal accounted for 53 per cent of total coal imports.

Coking coal imports were down 5.5 per cent at 2.1 million tonnes compared to 2019. The decrease was mainly due to the fall of 24 per cent from Australia.

**Coal stocks continued to decline year-on-year.** In line with much of what we see with coal, the main change to coal stocks came post 2014 when stocks began to decline each year and power plants closed. Coal stocks fell to 3.2 million tonnes in 2020, which was 41 per cent lower than in 2019.

**As of June 2021, the Coal Authority estimates that overall there are 3,814 million tonnes of coal resources,** including prospects (Table 2.8), down 2.4 per cent from 3,906 million tonnes assessed in June 2020. Of the economically recoverable and minable coal resource in current operations (including those in the planning or pre-planning process) 986 million tonnes is in underground mines and 46 million tonnes in surface mines. Overall England had a 84 per cent share of UK current mines and licenced resources, followed by Scotland with 9 per cent and Wales 7 per cent.

In prospects, there were 2,050 million tonnes suitable for underground mining and 778 million tonnes suitable for surface mining. Table 2.8 gives details of the resource assessment by England, Scotland and Wales as at 22 June 2021.

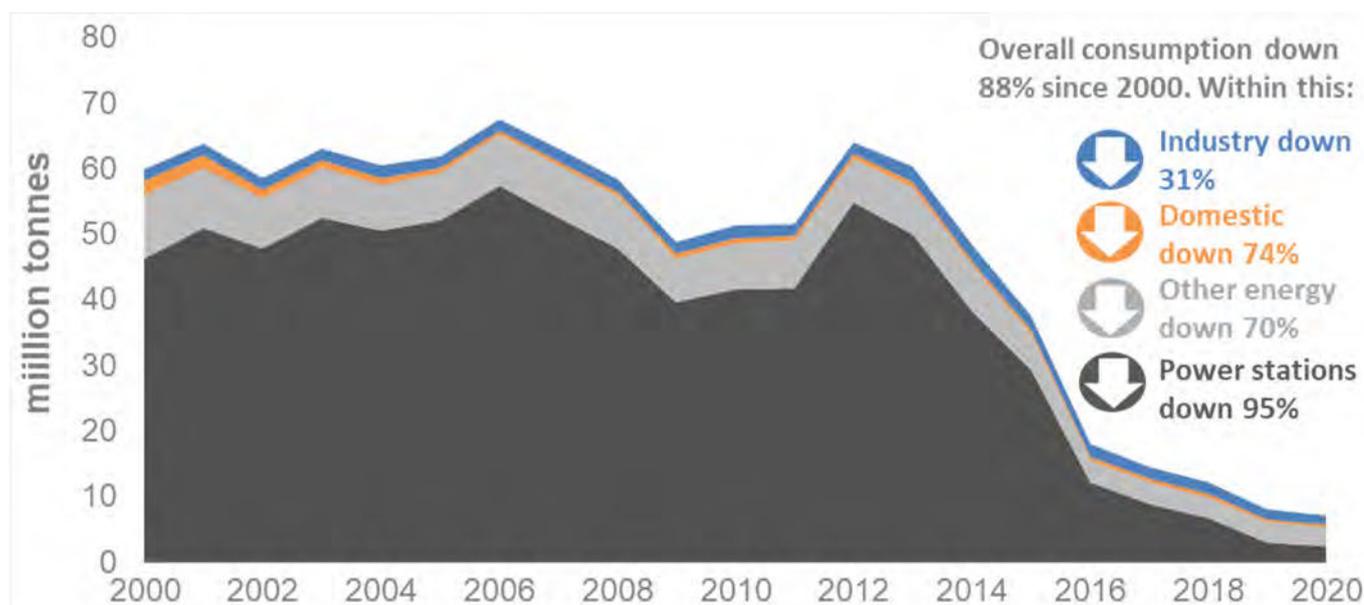
**Demand for coal fell by 11 per cent to 7.1m tonnes in 2020, compared to 2019 (table 2.4).** Amongst this, demand for coal for electricity generation fell by 20 per cent, final consumption by industry fell by 9 per cent, and transformation for coke manufacture and in blast furnaces fell by 6 per cent.

**The Covid-19 pandemic led to a significant fall in demand for electricity, and therefore a fall in demand for coal from power stations for coal-fired generation.** Restrictions began on 23<sup>rd</sup> March 2020 and resulted in closures across the private and public sector, with wide scale closures of schools, shops, offices and industrial facilities.

During this period, Great Britain set a record for its longest coal-free period of generation, with no coal-fired electricity being produced for 67 days from 10<sup>th</sup> April 2020. On 16<sup>th</sup> June, one of the remaining coal-fired power stations came briefly back online during maintenance work, adding power to the national grid. However, there was no coal-fired electricity on the GB grid for a further 55 days from 18<sup>th</sup> June to 12<sup>th</sup> August 2020. The period without coal-fired generation ended in August, as coal-fired generators were required due to maintenance outages in nuclear plants, low wind speeds, and as gas-fired generators struggled to generate at their maximum capacity in unusually high temperatures. Great Britain operates on a separate electricity network to Northern Ireland, where some coal generation continued during this period. However, coal-fired generation remained less economically favourable due to low gas prices and higher carbon pricing.

**A reduction in generation capacity contributed to the downwards trend in coal consumption.** There have been multiple closures of coal-fired power plants in recent years, and March 2020 saw the closures of Fiddlers Ferry and Aberthaw B. This trend appears set to continue in the coming years, with plans to phase out the remaining four coal-fired power plants in the UK by 2024. Coal use has declined since the early 1970's as new fuels (gas and renewables) entered the market, and 2020 saw an increase in renewable electricity generation, with favourable weather conditions for increased wind generation.

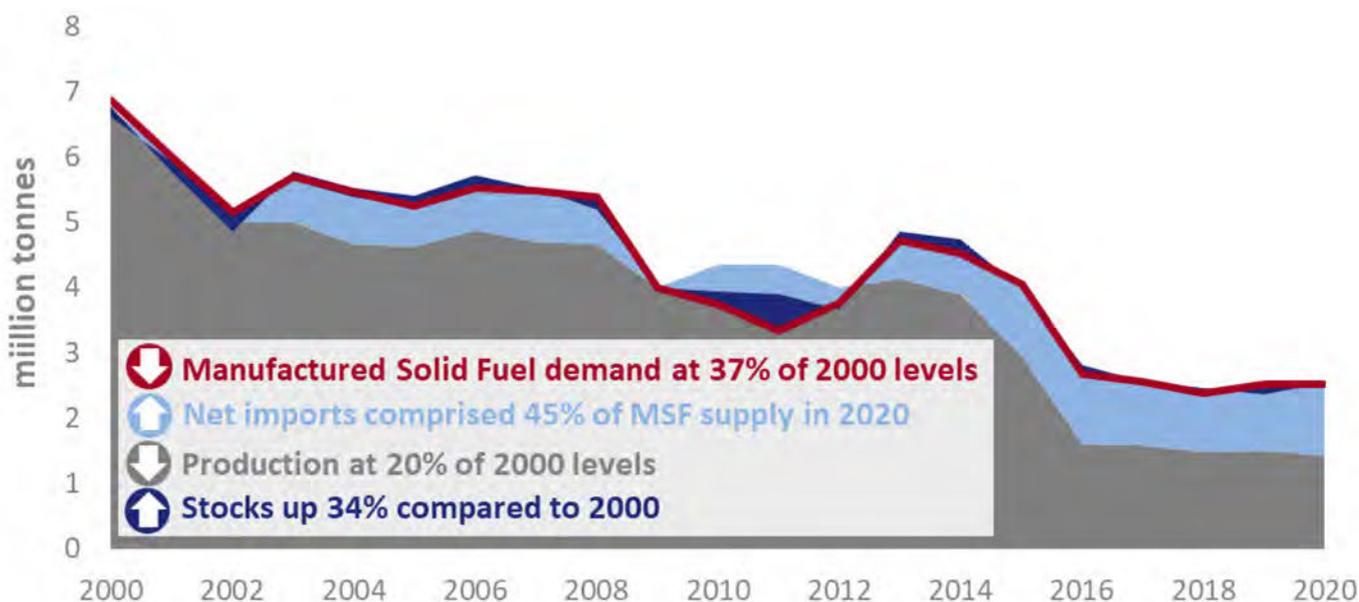
**Chart 2.2 Coal consumption, 2000 – 2020 (Table 2.4)**



The iron and steel industry is one of the main non-generation users of coal. In 2015, it used 5.2 million tonnes compared to 2.8 million tonnes in 2020 (47 per cent drop). In terms of total share, it comprised 14 per cent of UK coal consumption in 2015, and 39 per cent in 2020.

**In addition to coal production and consumption, the UK has significant (but decreasing) supply and demand for a range of manufactured solid fuels that are used for domestic, industrial and transformational processes.** Coke is the solid product obtained from the carbonisation of coal, principally coking coal, at high temperature and is used for smelting iron and steel.

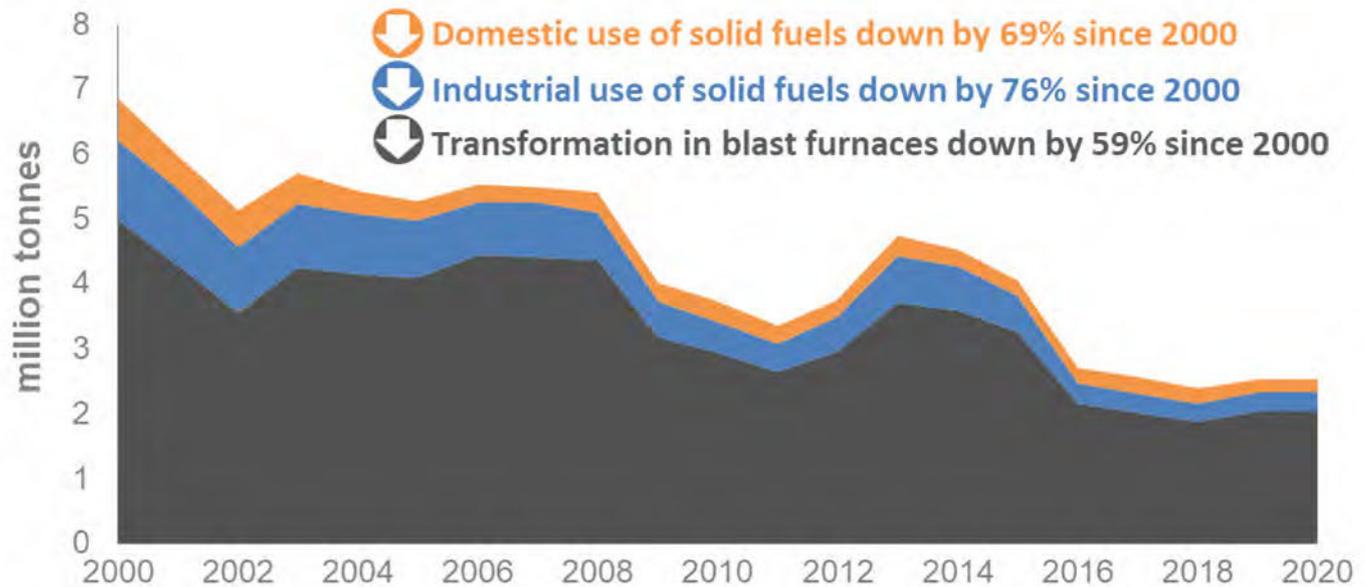
**Chart 2.3 Total manufactured solid fuels supply and demand, 2000 - 2020 (Table 2.5)**



**In 2020, indigenous coke oven coke fell by 7.2 per cent to 1.2 million tonnes compared to 2019 (Chart 2.5).** It has been relatively stable in the last four years. Monckton Coke and Chemicals, the only dedicated coke plant in the UK closed in December 2014. There has been a fall in steel production in the UK since 2015. Notably, SSI steelworks at Redcar ceased production in mid-September 2015 (with the subsequent closure in October). Since then coke has still being produced and used at steelworks, mainly Port Talbot and

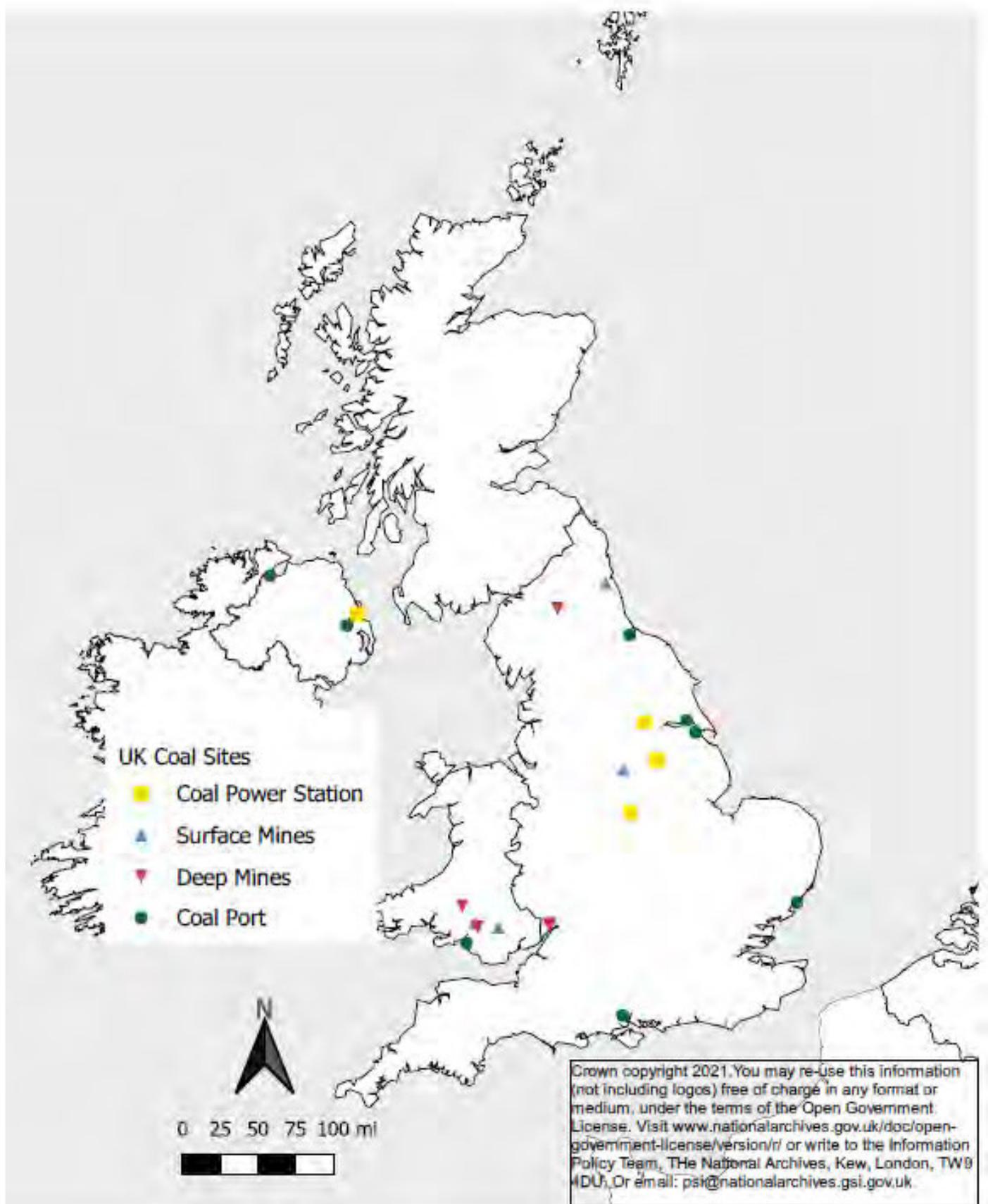
Scunthorpe. Coke breeze fell 16 per cent to 16 thousand tonnes. Other manufactured solid fuels (patent fuels) rose by 8.8 per cent to 198 thousand tonnes.

**Chart 2.4 Total manufactured solid fuels consumption in the UK, 2000 – 2020** ([Table 2.5](#))



**In 2020, coke oven coke comprised 69 per cent of demand for manufactured solid fuels**, with coke breeze at 23 per cent and other manufactured solid fuels at 8 per cent. Almost all coke oven coke and coke breeze in the UK is used in blast furnaces for steelmaking. As the iron and steel industry is a critical industry it was less impacted by the Covid-19 pandemic and volumes have been broadly stable in recent years.

## Map 2A Showing location of UK coal production sites and ports as at end 2020



# Chapter 3: Oil and Oil Products

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## Key headlines

**Oil formed one-third of total energy demand in 2020 compared to nearly half in 2019.** Demand for petroleum products reached a record low in 2020, down 23 per cent compared to 2019 as restrictions from the Covid-19 pandemic limited activity. Most oil demand is typically for transport fuels which were heavily impacted as movement was restricted. The largest contraction was in demand for jet fuel, down 60 per cent on 2019, the lowest level since 1984. Demand for road fuels was also reduced, petrol fell to the lowest level since 1963 and down by 22 per cent on 2019; diesel also fell by 17 per cent.

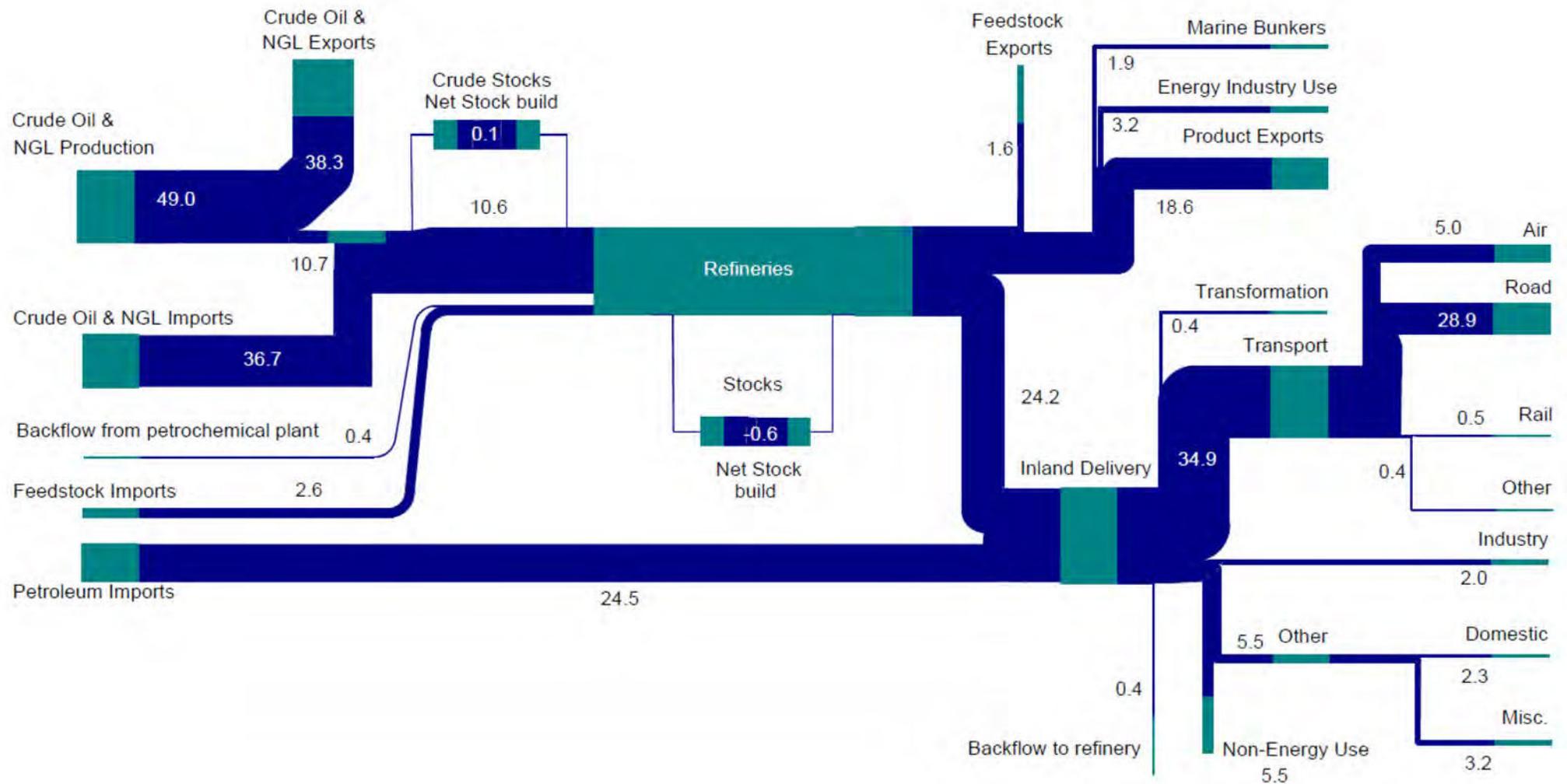
**The impact of the Covid-19 pandemic also affected trade.** Net imports of petroleum products halved in 2020 as the UK imported less fuel to meet the reduced demand. The UK became a net exporter of primary oils, by 0.5 million tonnes, for the first time since becoming a net importer in 2004.

**In 2020 the UK's total production of oil from the North Sea exceeded refinery demand for the first time since 2004.** Total demand for primary oils was down 18 per cent on 2019 with refinery production following suit, dropping to its lowest ever level. In contrast production of crude from the UK Continental Shelf (UKCS) retained its 42 per cent share of total UK energy production. Much of this was exported abroad.

Other sectors were also impacted by Covid-19 restrictions. For example, non-energy use fell 9.6 per cent in 2020 compared to 2019 after several years of growth. Conversely, domestic consumption saw an increase of 5 per cent because of low prices early in the year and as more people stayed at home.

The flow chart on the following page shows the movement of primary oils and petroleum products, illustrating how crude oils are supplied and transformed in refineries, and products imported (on the left) to transformation and consumption in the various sectors of the UK's economy (on the right). The widths of the bands are proportional to the size of the flow they represent.

## Petroleum flow chart 2020 (million tonnes)

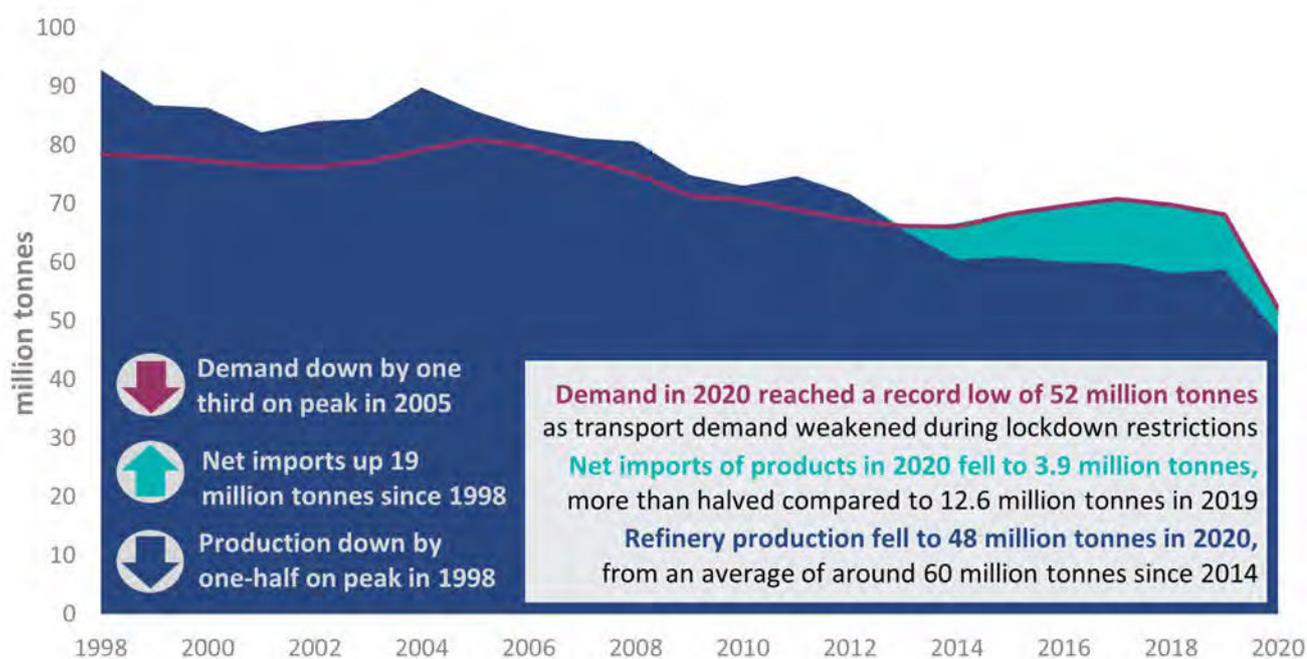


### Note:

This flow chart is based on the data in Tables 3.1 and 3.2.  
 The numbers on either side of the flow chart will not match due to losses in transformation.  
 Biofuels are not included.

**Demand for petroleum products reached a record low in 2020, down by 23 per cent compared to 2019.** Most oil demand is for transport fuels, lockdown and other restrictions put in place to curb the spread of Covid-19 reduced demand substantially. Overall demand for petroleum products in 2020 was the lowest since 1962 at 52.1 million tonnes (see [DUKES Table Crude oil and petroleum: Production, imports and exports](#)).

**Chart 3.1 Supply and demand for petroleum products, 1998 – 2020 ([DUKES Table 3.1](#))**



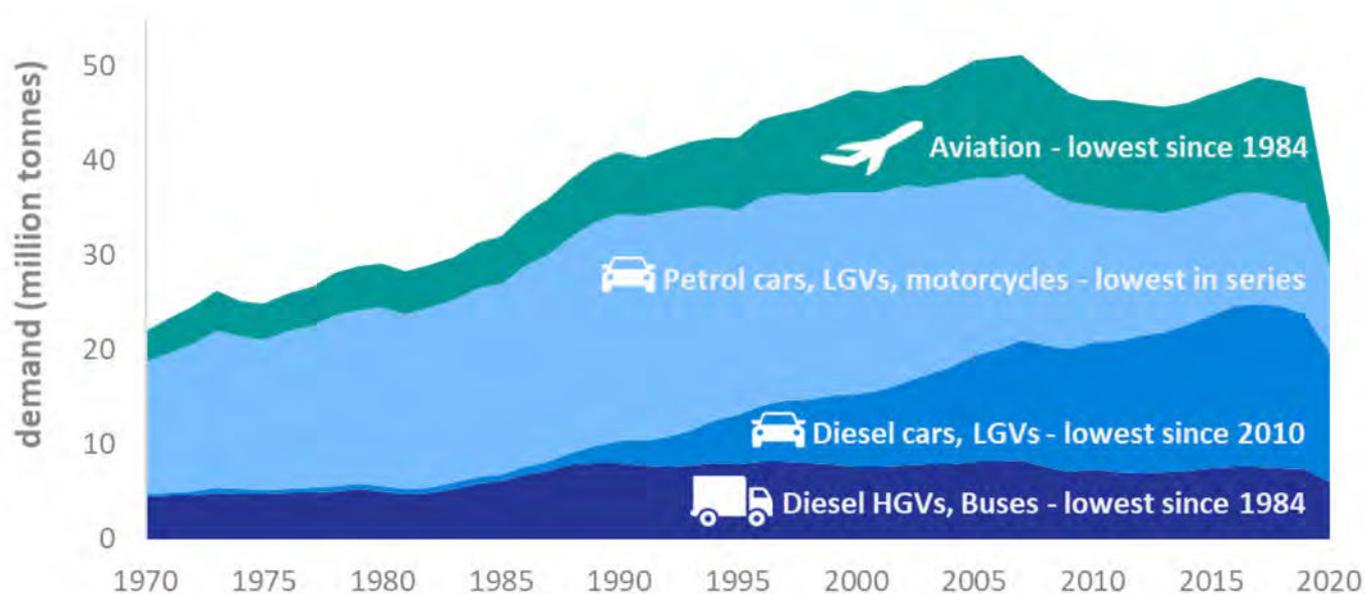
Refinery operators reacted by slowing production in response to the demand destruction brought about by the pandemic, meaning that refinery production also reached a record low of 48 million tonnes in 2020. This was down by more than 10 million tonnes compared to 2019<sup>2</sup>. While the UK remained a net importer of petroleum products, with net imports up by 19 million tonnes since 1998, in 2020 there was a sharp fall and net imports dropped by half to just 6.0 million tonnes from 12.1 million tonnes in 2019.

**Covid-19 restrictions saw demand for road fuels fall markedly in 2020 compared to 2019.** This follows several years of static demand at around 35 million tonnes. In 2020, demand for petrol and diesel fell 22 and 17 per cent respectively compared to 2019. Staggeringly, over the year demand for petrol reached the lowest recorded since 1963 owing to the sharp dip in the second quarter. This was less dramatic for diesel, demand reaching the lowest recorded since 2005. There are several reasons for this disparity; demand for petrol was impacted more than diesel because commercial fleets tend to be diesel-engine vehicles, and these continued to operate during the UK's periods of restricted movement. In addition, there has been slowing growth in the diesel vehicle fleet in recent years following changes to vehicle taxation and diesel vehicles have become more efficient. As 2020 progressed and restrictions were lifted demand continued to recover through the year, reaching near normal levels despite subsequent lockdowns by the end of the year (for quarterly data see [Energy Trends Table 3.4](#)).

**Demand for jet fuel was down 60 per cent in 2020 compared to 2019,** at just 5.0 million tonnes this was the lowest level since 1984. This was caused by international travel restrictions which remained in place for large parts of the year. Unlike the road fuels, which have shown remarkable signs of recovery, demand for aviation fuel remained flat in 2020.

<sup>2</sup> For further detail on the UK's refineries and nameplate capacity, please see [Table 3A](#) and the map of UK refineries and major import terminals in the [methodology note](#).

**Chart 3.2 Annual demand for road and aviation fuels since, 1970 - 2020 (DUKES Table 3B)**



**The restrictions imposed in response to the pandemic had differing effects on specific sectors.**

Domestic consumption increased by 5.0 per cent as more people stayed at home due to the pandemic. In addition, low oil prices in early 2020 caused by excess stocks, and an oil price war between Russia and Saudi Arabia, led to a bump in demand early in the year as consumers took advantage of lower prices to fill domestic heating tanks.

Chart 3.3 shows that consumption by industry and other final users decreased by 1.6 per cent, although this masks variation within the subsector. Domestic demand was up by 5.7 per cent, largely because of exceptional demand early in the year during a period of very low prices owing to the collapse of OPEC+ talks. However, industry demand was down by 3.2 per cent and commercial by 5.0 per cent because of closures due to restrictions in place to control the spread of Covid-19.

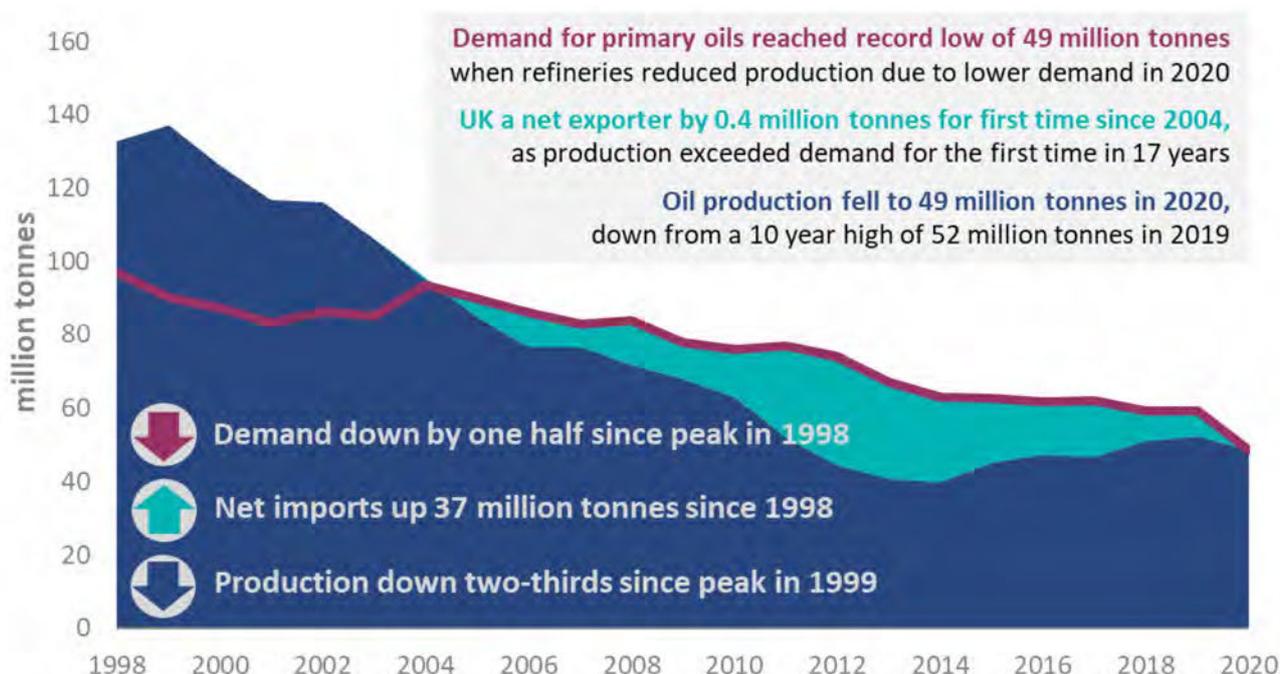
Non-energy use of oil products was down by 9.6 per cent compared to 2019. Use of oil in the energy industry dropped by 15 per cent as demand for generation fell to a record low during a year of record renewables generation.

**Chart 3.3 Oil consumption in the UK, 2019 to 2020 (DUKES Table 3.2 to 3.4)**



**In 2020 the UK's total production of primary oils exceeded refinery demand for the first time since 2004.** Demand for primary oils was down by 18 per cent on 2019 whereas production remained relatively robust, down just 7.0 per cent compared to 2019.

**Chart 3.4 Supply and demand for primary oils, 1998 – 2020 (DUKES Table 3.2 to 3.4)**



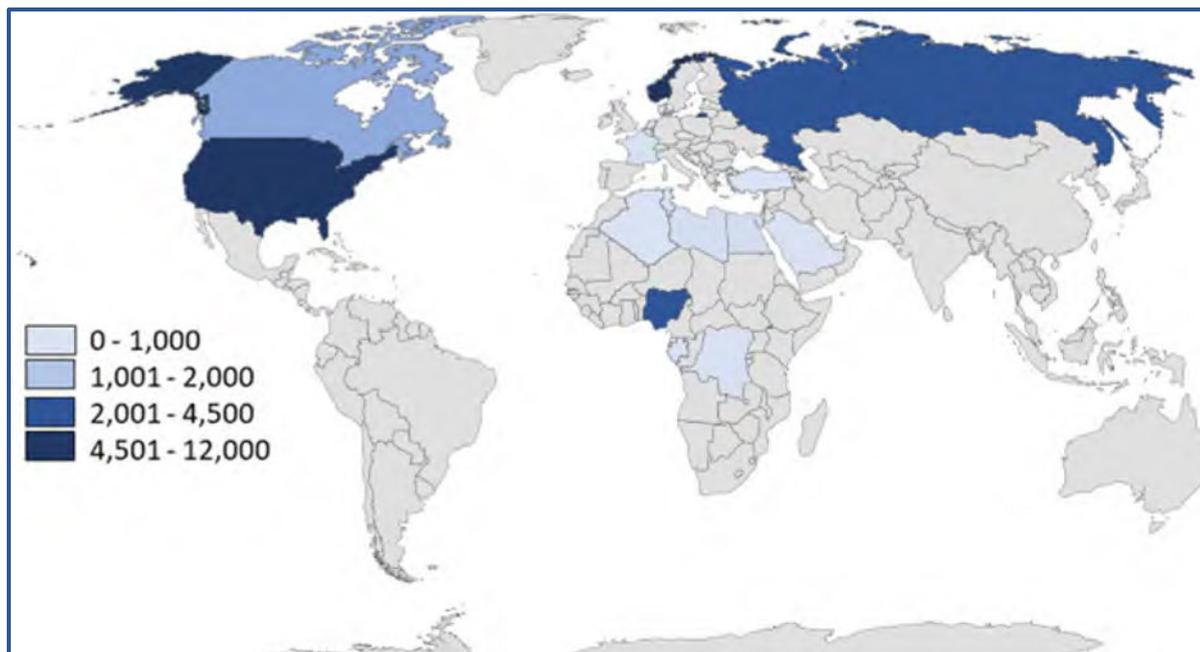
In the longer term, from a peak of 137 million tonnes in 1999 UKCS production of primary oils has dropped by nearly two-thirds to 49 million tonnes in 2020. The UK became a net importer of primary oils in 2005, but net imports fell to a 17-year low in 2020, and the UK became a net exporter for the first time since 2004.

**Despite this, the UK remains reliant on imports to meet refinery demand for specific crude blends.** UK refineries took receipt of 8.6 million tonnes of crude produced from the UKCS in 2020 (a five-year high, see Energy Trends Table 3.10), this met 18 per cent of refinery demand. This in addition to reduced demand saw imports of crude fall by a quarter in 2020 compared to 2019.

Sources of crude imports are shown in Map 3A; the main source has historically been Norway given its proximity to the UK. Imports from Norway remained stable in 2020 compared to 2019, with Norway providing 34 per cent of total UK imports. However, this stability follows recent sharp decreases; in 2016 Norway provided 62 per cent of UK imports (Table 3.9). Imports from the US remained stable in 2020 at the record set in 2019 of 11.4 million tonnes.

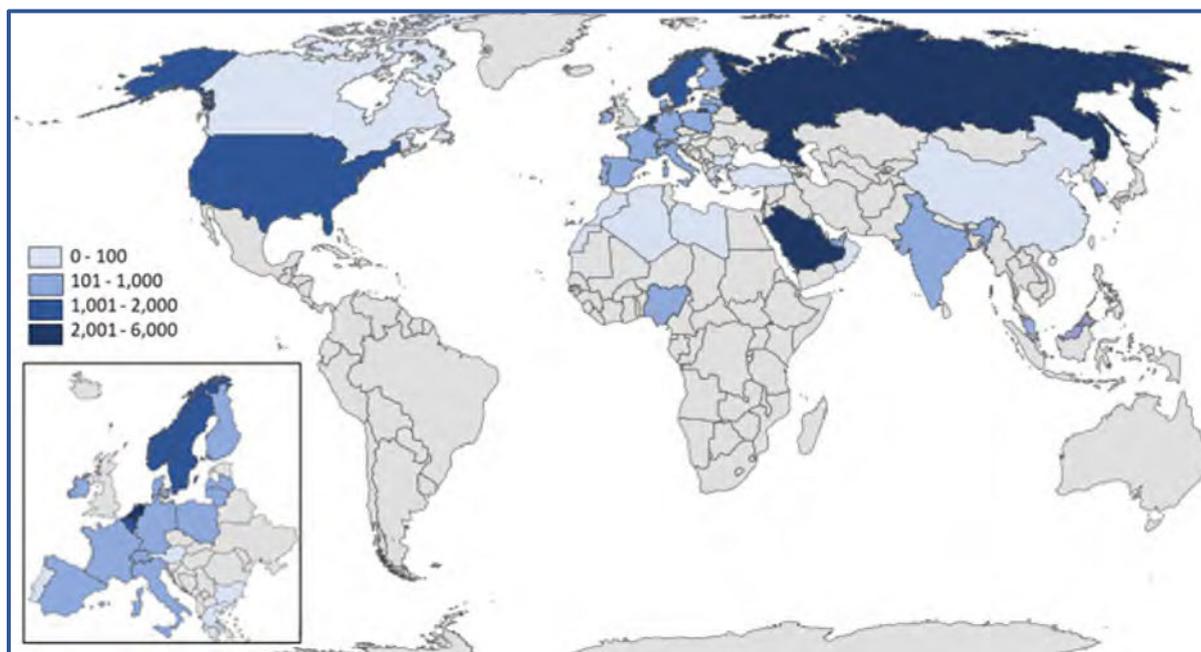
The US share of UK imports reached 32 per cent in 2020 from 26 per cent in 2019 mainly at the expense of imports from Norway and Algeria. Imports from OPEC countries accounted for 13 per cent of the UK's crude imports in 2020 at 4.6 million tonnes, this is almost half the figure for 2019. The UK is a significant exporter of crude oils, and these remained comparatively stable at 36 million tonnes in 2020 compared to 41 and 40 million tonnes in 2019 and 2018 respectively, which followed strong production and favourable price spreads resulting in strong demand for Brent crude from Asia (Table 3.10).

**Map 3A Sources of UK crude oil imports 2020 (thousand tonnes, [DUKES Table 3.9](#))**



**As with crude oil, imports of petroleum products are critically important to meet UK demand.** Despite the Covid-19 pandemic leading to as sharp reduction in imports of petroleum products in 2020, the UK has been a net importer since 2013 and remained so in 2020. In common with many other countries, domestic supply and demand are not matched on a product-by-product basis. The UK's refineries were developed to produce petrol and fuel oil for electricity generation. However, as demand for diesel and jet fuel have increased UK refineries have not been able to keep pace and now produce a surplus of petrol. To balance demand the UK trades widely and is one of the largest importers of jet fuel and road diesel in the OECD, and one of the largest exporters of petrol.

**Map 3B Sources of UK petroleum product imports 2020 (thousand tonnes, [DUKES Table 3.9](#))**



Map 3B shows the principal product trading partners with the UK. Historically the bulk of products have come via the Netherlands, which acts as a major trading hub (the fuel might have been refined elsewhere in Europe or beyond). Russia, the Netherlands, and Saudi Arabia were large sources of road diesel in 2020; these three countries accounted for 62 per cent of total road diesel imports in 2020.

**Another effect of the pandemic has been the impact on emergency reserves of oil.** Under international commitments to the International Energy Agency, and until 1 January 2021 the European Union, the UK is obliged to hold oil stocks to offset the impact of significant disruptions to the global oil market. Such disruptions are relatively rare, but since the Arab Israeli war of 1974 there have been three globally co-ordinated releases of oil in response to the Gulf War (1990–1991), Hurricane Rita (2005), and the civil war in Libya (2011).

At the end of 2020, the UK held 14.9 million tonnes of stocks (DUKES Table 3.7). Of this total, 12.8 million tonnes were held for emergency purposes, broadly equivalent to just over 61 days of typical consumption. These stocks have historically been held both in the UK, and overseas under contractual arrangements that allow stocks to be repatriated to the UK if necessary. At the end of 2020, just over 3.8 million tonnes were held in other EU countries, most notably in the Netherlands. However, following the demand destruction brought about in 2020, stocks held in the UK reached a ten year high of 11.1 million tonnes.

Leaving the EU has also had an impact on emergency oil reserves, notably because previously the UK was obliged to hold stocks as a Member State of the EU as well as the International Energy Agency (IEA). However, because since 1 January 2021 the UK has no longer been an EU Member State, we are now only required to meet the IEA obligation. The level obligation under the IEA accounts for the fact that the UK has significant volumes of offshore production, meaning that since January 2021 companies have been directed to hold less stock than under the EU obligation. Impacts of this on more recent data can be seen in [Energy Trends Table 3.11](#).

# Chapter 4: Natural Gas

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## Key headlines

**Natural gas demand was down 6.0 per cent compared to 2019**, to 811 TWh, the lowest level seen since 2015 because of reduced activity across the economy during restrictions in place to curb the spread of Covid-19.

**There were declines in gas demand for electricity generation, industry, and services** because large parts of the economy shutdown in line with government restrictions. Demand from industry fell to a new record low.

**Domestic demand for gas marginally up from 2019.** Despite the warmer weather in 2020, and the warmest year since 2014, domestic demand increased because of stay-at home orders.

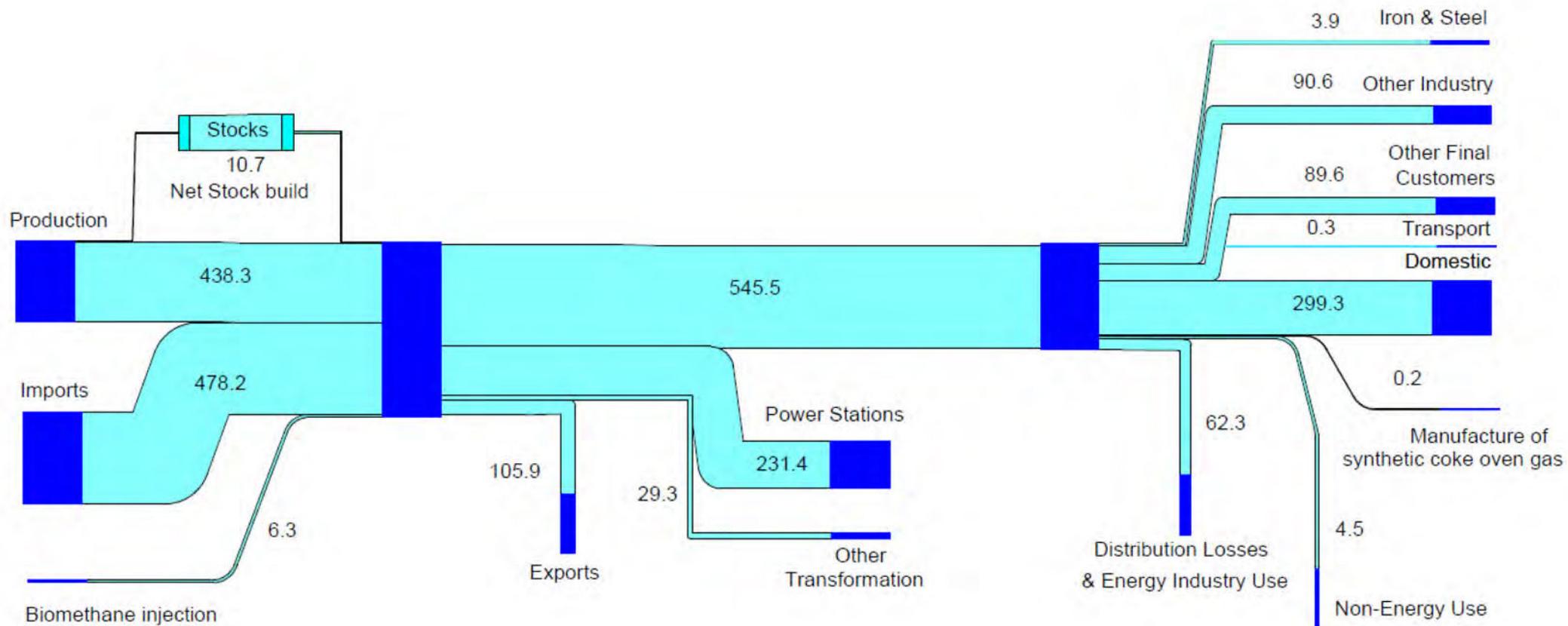
**Net imports fell 12 per cent on 2019**, in line with reduced demand. Despite this a growing Liquefied Natural Gas (LNG) market saw another record year for LNG imports, which reached the highest level since the peak in 2011. Global liquefaction capacity has increased consecutively for the last six years, and notably UK imports from the US were up by more than 70 per cent compared to 2019 as the US shale revolution continues to take hold.

**Exports were up by almost a fifth on 2019** as the Bacton-Balgzand Line (BBL) was converted from an import pipeline to an interconnector allowing for trade in both directions. This conversion aims to support a UK oversupply in summer months as well as meet Dutch demand. As a result, there were record exports to the Netherland in 2020.

**Gross gas production was stable compared to 2019** despite a challenging year for maintenance. Gas production has been broadly stable for close to a decade and the UK remains the third largest natural gas producer in Europe.

The flow chart on the following page shows the flows of natural gas from production and imports through to consumption. It illustrates the flow of gas from the point at which it becomes available from indigenous production or imports (on the left) to the final use of gas (on the right), as well as volumes transformed into other forms of energy or exported. The widths of the bands are proportional to the size of the flow they represent.

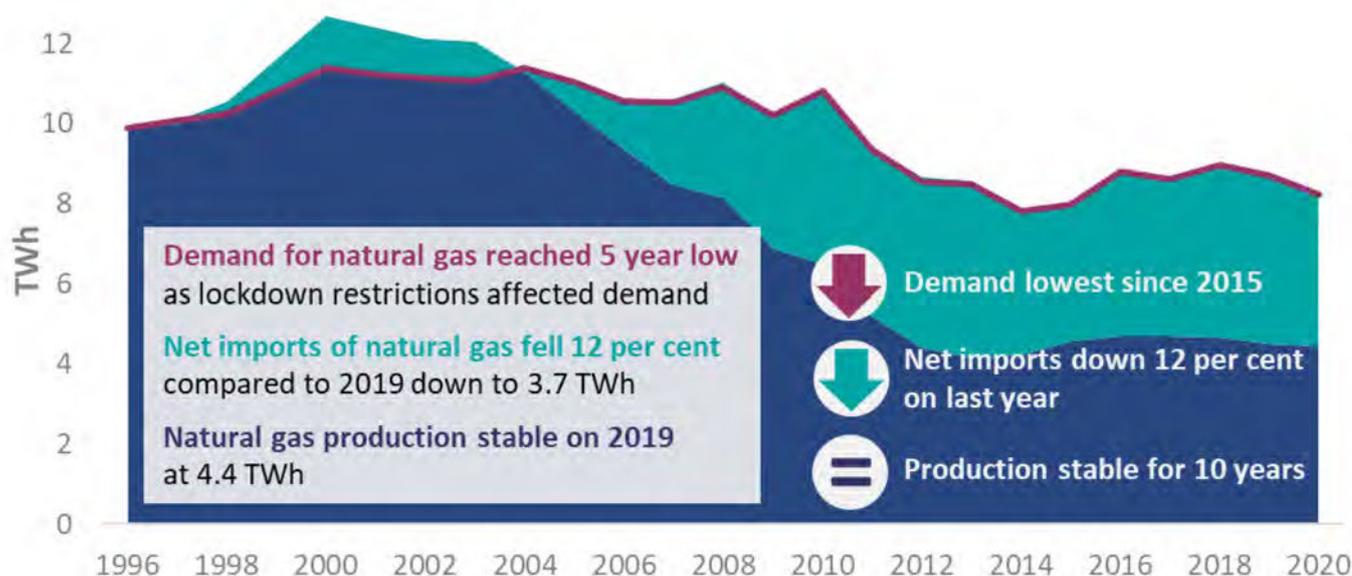
## Natural gas flow chart 2020 (TWh)



### Note:

This flow chart is based on data that appear in Table 4.1, excluding colliery methane.

**Chart 4.1 Supply and demand for natural gas, 1996-2020 (DUKES Table 4.1)**

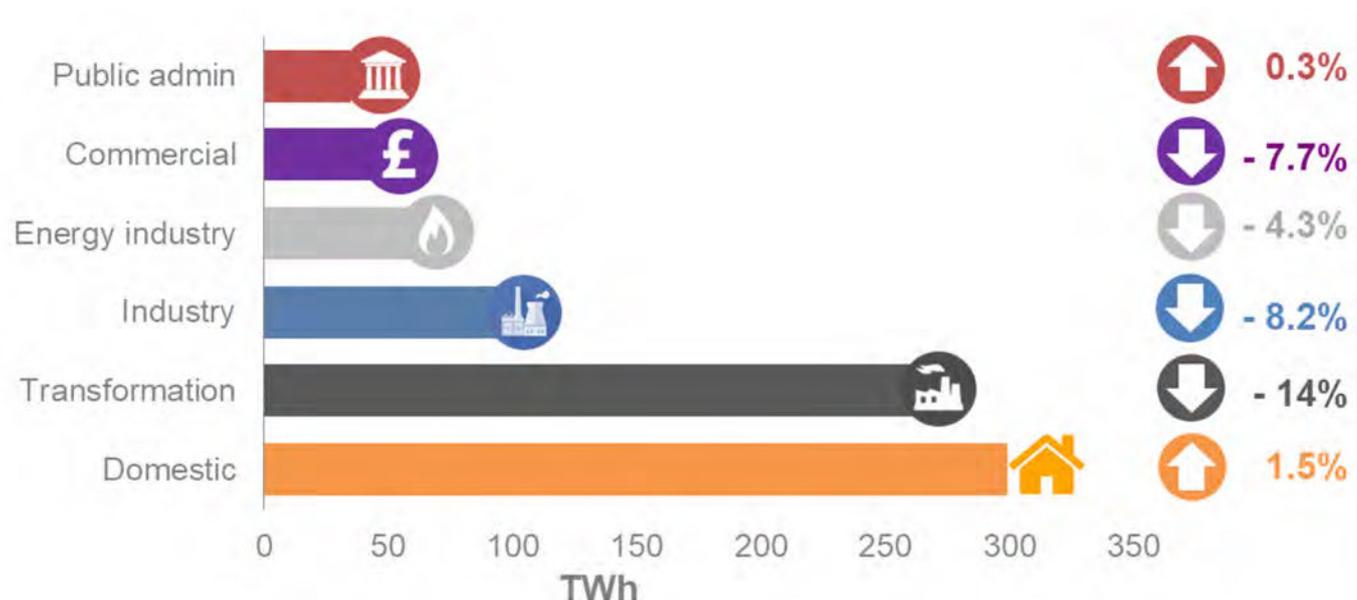


Natural gas is an important part of the UK energy mix, accounting for 30 per cent of UK energy production in 2020, and 40 per cent of demand. **UK gas demand decreased 6.0 per cent in 2020 compared to 2019**, following several years of stable demand and was largely a result of restrictions in place to curb the Covid-19 pandemic. However, trends in demand varied by sector.

**In 2020, UK gross gas production was 439 TWh, stable on 2019.** UK gas production has been broadly stable for close to a decade following several years of decline since the peak in 2000. Despite this the UK remains a major producer of natural gas, sitting within the top 20 gas producing countries globally and the third largest in Europe. The Oil and Gas Authority produces analysis on oil and gas reserves which can be found [in the Oil and Gas reserves publication](#).

In 2020, indigenous production met more than half of demand with the remainder supplied via imports. Net imports fell by 12 per cent in 2020 compared to 2019 despite exports increasing 17 per cent as the Bacton to Balgzand Line (BBL) was converted to an interconnector allowing trade in both directions. Conversely imports fell to a 10-year low because demand was impacted by restrictions put in place to curb the spread of Covid-19.

**Chart 4.2 Sectoral consumption of natural gas, 2019 to 2020 (DUKES Table 4.1)**



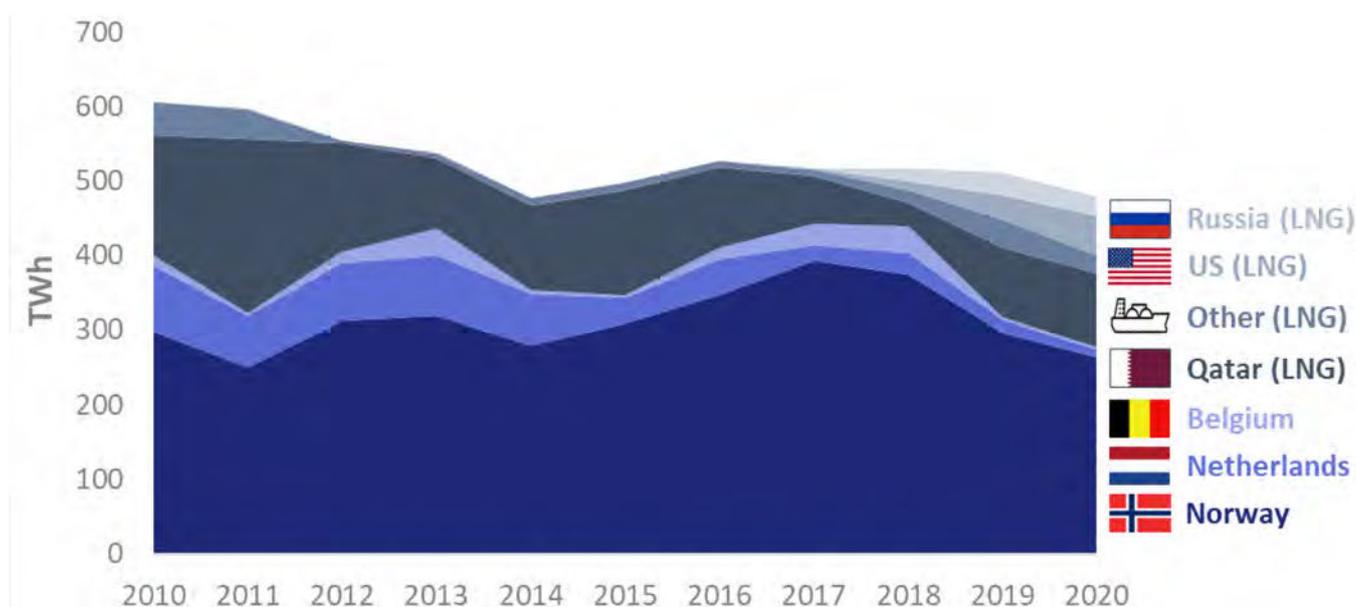
**Domestic demand increased marginally, up 1.5 per cent in 2020 compared to 2019.** This was despite warmer temperatures and a result of national restrictions in place to control the spread of Covid-19. Most domestic natural gas consumption is used for space and water heating as well as in appliances such as ovens and hobs. More people stayed at home changing their behaviour in line with national lockdowns and other restrictions. Overall, natural gas met two-thirds of total domestic energy demand in 2020.

**In contrast, gas demand for electricity generation fell 15 per cent compared to 2019.** This was due to a combination of reduced demand for electricity because of restrictions in place to curb the Covid-19 pandemic and from strong renewable generation reducing generation from fossil fuels (see [Chapter 5](#)).

**Demand for gas by industry fell 8.3 per cent compared to 2019.** At 95 TWh demand for gas by industry was the lowest on record in 2020 because industries slowed or ceased production in line with social distancing guidelines, particularly in the second quarter of the year, which reduced energy consumption across the sector.

**Demand for natural gas by services fell 3.9 per cent in 2020 compared to 2019.** Gas demand by the commercial sector was down 7.7 per cent as non-essential retail and hospitality venues were closed for large parts of the year. Conversely, gas demand by public administration was relatively stable in the face of warmer weather; despite school, university and office closures, hospitals remained open through periods of exceptional demand on their services.

**Chart 4.3 Imports of natural gas, 2010-2020 ([DUKES Table 4.5](#))**



**In 2020, imports were down 6.5 per cent on 2019.** This was partly due to low demand. Imports arrive via pipeline; the UK imports natural gas via pipeline from Norway, Belgium and the Netherlands, or as liquefied natural gas (LNG) via ship.

**Pipeline imports from Norway accounted for a third of total supply,** the second largest source of natural gas following indigenous production. Imports of natural gas from Norway account for more than half of total imports. This is largely because of the UK's proximity to Norway and shared infrastructure in the North Sea. However, whilst substantial, imports of natural gas from Norway were down 11 per cent in 2020 compared to 2019 as imports of LNG displaced Norway's share to some extent.

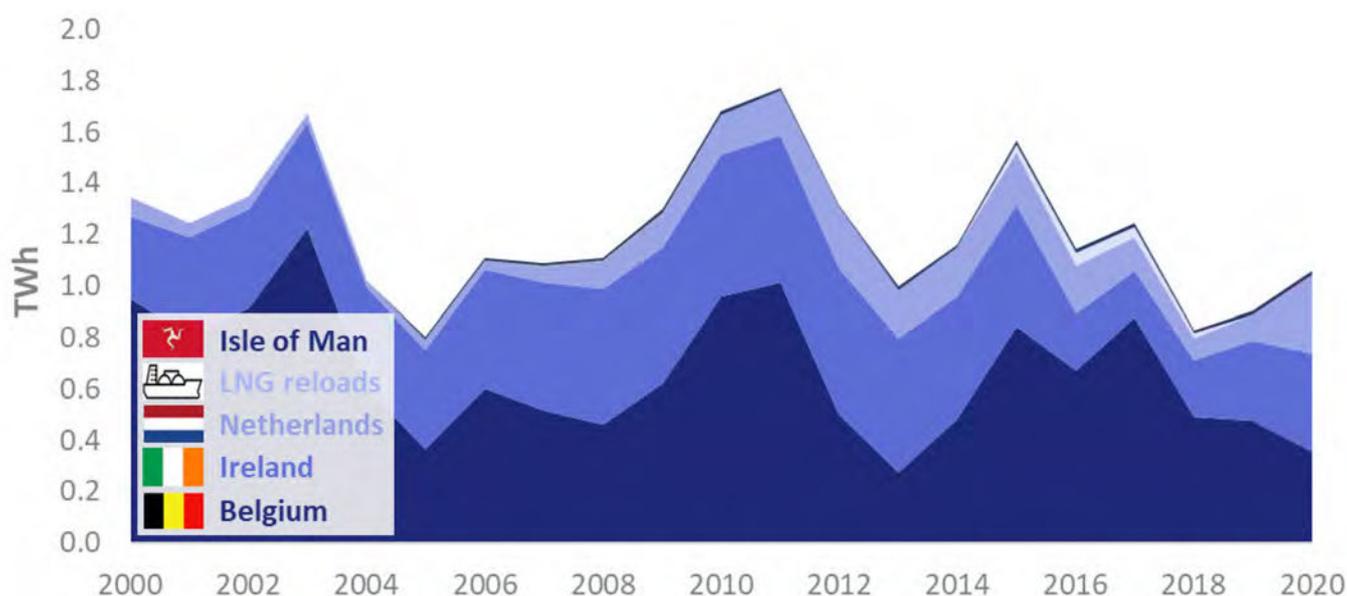
**Imports of LNG increased again reaching near record highs.** Despite low demand in 2020 market changes meant imports of LNG remained substantial. This follows record growth in 2019 when imports of LNG more than doubled as the UK played an important role in balancing an oversupplied market. Growth in 2020 was muted, up 2.9 per cent compared to 2019, because of substantial levels of gas in European storage followed by restrictions in response to the Covid-19 pandemic. For more information on the [supply of LNG see the special feature article](#).

Chart 4.4 UK LNG import sources by volume, 2020 ([DUKES Table 4.5](#))



**LNG import sources have diversified, so improving UK security of supply.** Historically, a large proportion of LNG imports have come from Qatar and this accounted for just under half of total LNG imports in 2020, compared to 98 per cent when they peaked in 2011. The UK imported LNG from a further nine sources; notably imports from the US increased by 72 per cent in 2020 compared to 2019. Increased import sources are attributable to growing global LNG liquefaction capacity and a rapidly growing commodity market.

Chart 4.5 Exports of natural gas, 2000-2020 ([DUKES Table 4.5](#))



\*Minimal exports to Norway have been excluded from this chart.

**Exports increased by almost a fifth in 2020 compared to 2019,** largely due to record exports to the Netherlands following the conversion of the Bacton-Balgzand Line (BBL) from an import pipeline to an interconnector in 2019, allowing trade in either direction and with substantial exports beginning in spring 2020. This aims to manage UK oversupply in summer months following the closure of storage facilities and will also support Dutch security of supply as production at Groningen gas field, the largest in Europe, will halt in 2022.

Exports to the Republic of Ireland continue to grow, up 22 per cent in 2020 compared to 2019. This follows declining production at the Corrib gas field which accounts for most Irish indigenous production. Increasing exports to the Netherlands and Republic of Ireland outstrip a decline in exports to Belgium. Exports to Belgium continue to fall, down a quarter in 2020 compared to 2019, the second lowest level recorded. This decline is due to the termination of the Bacton-Zeebrugge interconnector contract.

# Chapter 5: Electricity

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## Key headlines

**Electricity demand reached a record low in 2020 of 330.0 TWh, down 4.6 per cent compared to 2019.**

Though electricity demand has been declining year on year since 2015, the larger reduction seen in 2020 was primarily a result of the response to the Covid-19 pandemic.

**Restrictions in response to Covid-19 led to decreased industrial and commercial electricity consumption, but higher domestic consumption.** Industrial use of electricity, including iron and steel, was down 9.3 per cent in 2020 compared to 2019, and consumption by other final users, including the commercial sector, decreased by 11.2 per cent. Conversely, domestic consumption increased by 3.9 per cent in 2020, in comparison with 2019.

**Renewable technologies generated more electricity than fossil fuels in 2020 for the first time in the published time series.** Renewable sources generated 134.6 TWh in 2020, a 12.6 per cent increase compared to 2019 and higher than the 117.8 TWh from fossil fuel. This was in the context of electricity generation falling to record low levels in 2020, with total electricity generation in 2020 of 312.0 TWh. This reflects the lower demand for electricity during 2020 as a result of the UK's Covid-19 restrictions. In 2020, 43.1 per cent of UK generation came from renewables.

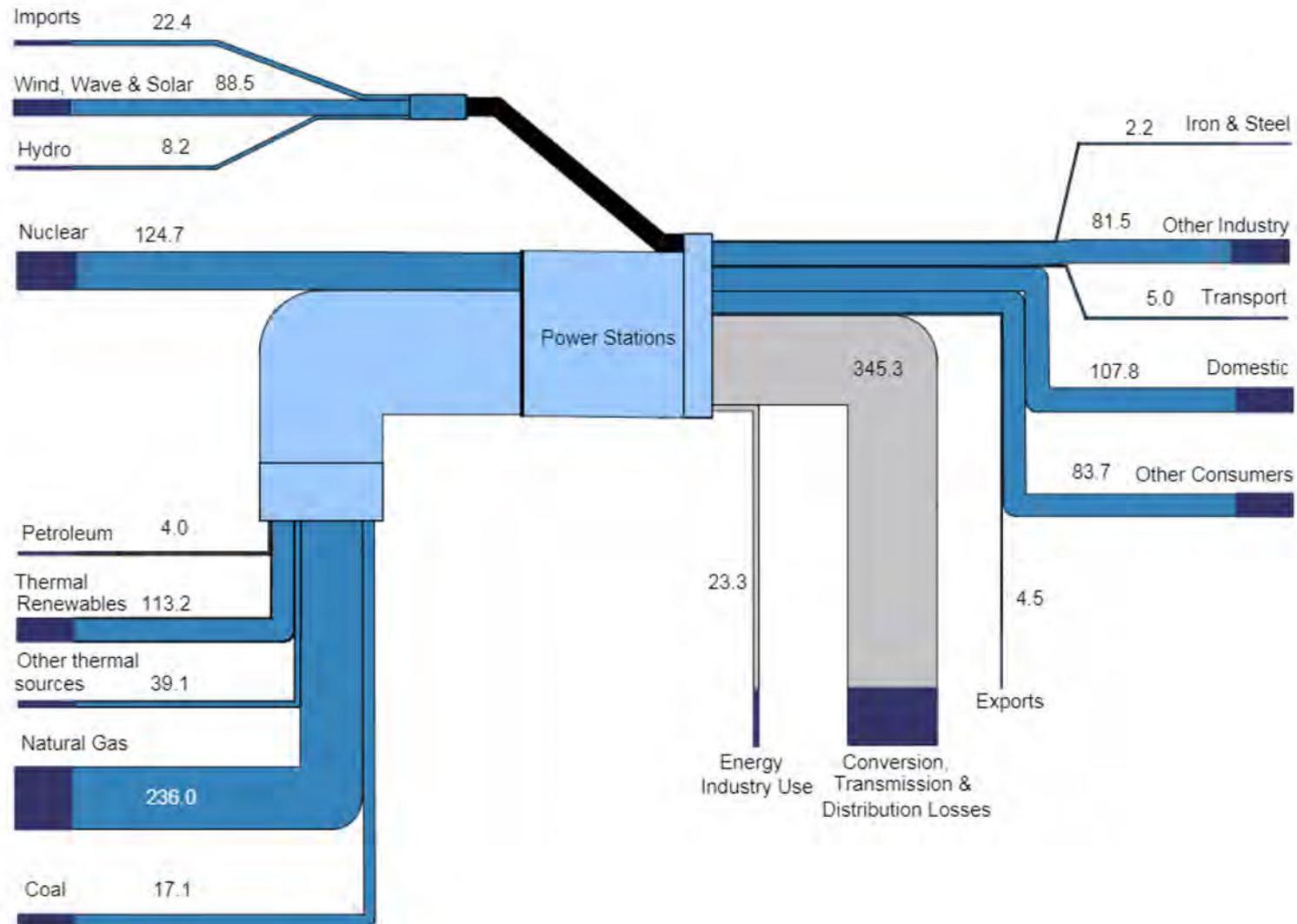
**Fossil fuel generation was at a record low in 2020.** Low demand for electricity and high generation from renewable sources reduced the need for generation from fossil fuels. Gas continued to be the dominant fuel, but generation was down 16 per cent compared to 2019. Nuclear electricity generation was down 11 per cent due to a series of statutory and unplanned outages at the UK's nuclear plants over the year. In 2020, 37.7 per cent of UK generation came from fossil fuels.

**The total fuel used for electricity generation decreased substantially in 2020 down 5.2 per cent to 55.6 Million Tonnes of Oil Equivalent (Mtoe).** Fuel use has fallen year on year since 2013 due to decreasing demand for electricity and growth in non-thermal renewables, but the larger decrease in 2020 was because of the unusually low demand and generation as a result of the Covid-19 restrictions.

**Net imports in 2020 were 17.9 TWh, the lowest level since 2017.** Net imports were 5.4 per cent of electricity supplied in 2020.

**Total generation capacity decreased in 2020 to 75.8 GW, a 2.7 per cent decrease on the 77.9 GW capacity in 2019.** While there were increases in renewable capacity, in particular off-shore wind, this was offset by the closure of coal power station Fiddler's Ferry and nuclear station Dungeness B.

## Electricity flow chart 2020 (TWh)



### Notes on flow chart

This flow chart is based on the data in Tables 5.1 (for imports, exports, use, losses and consumption) and 5.6 (fuel used).

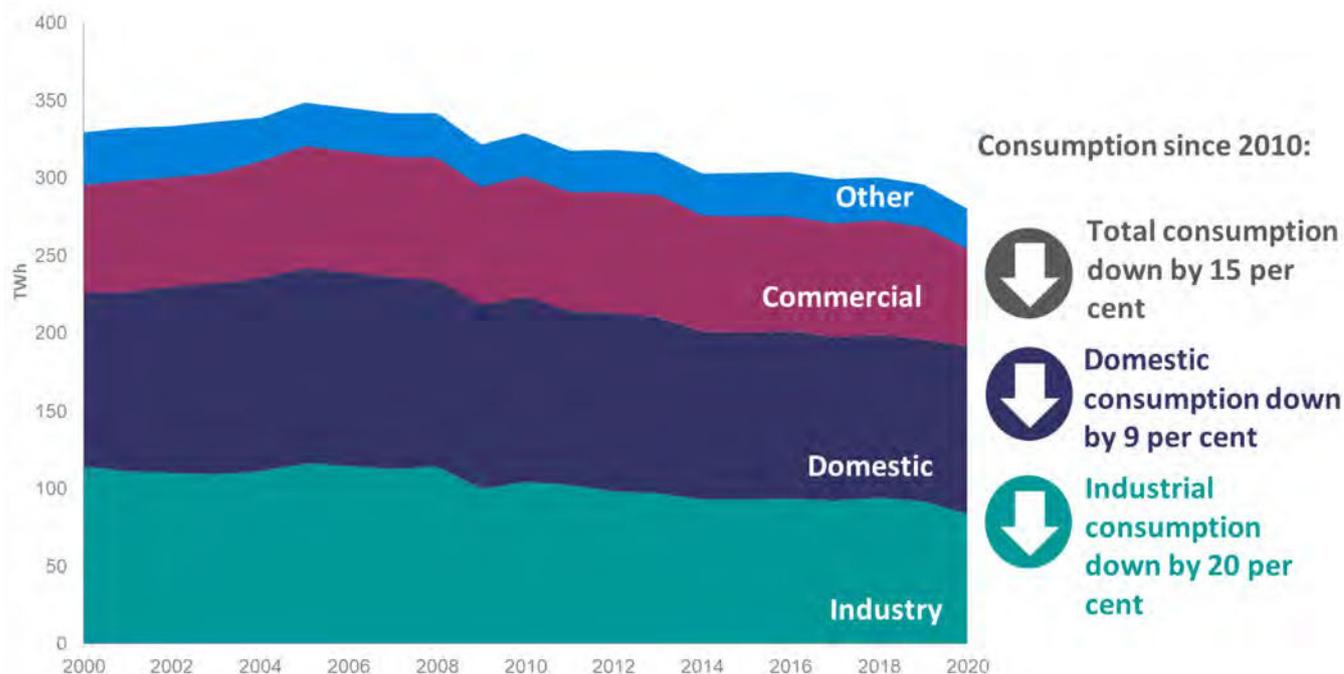
1. Hydro includes generation from pumped storage while electricity used in pumping is included under Energy Industry Use.

2. Conversion, Transmission and Distribution Losses are calculated as fuel used (Table 5.6) minus generation (Table 5.6) plus losses (Table 5.1).

**Electricity demand reached a record low in 2020 of 330.0 TWh, down 4.6 per cent compared to 2019.**

Though electricity demand has been declining year on year since 2015, the larger reduction seen in 2020 was primarily a result of the response to the Covid-19 pandemic, which restricted the activity of business and industry from March. Similarly, there was a 5.3 per cent fall in levels of final consumption of electricity compared to 2019. 'Final consumption' refers to electricity consumption by end users, excluding electricity consumed in the process of generation and transmission or distribution losses.

**Chart 5.1 Electricity consumption by sector, 2000-2020 (Table 5.1)**

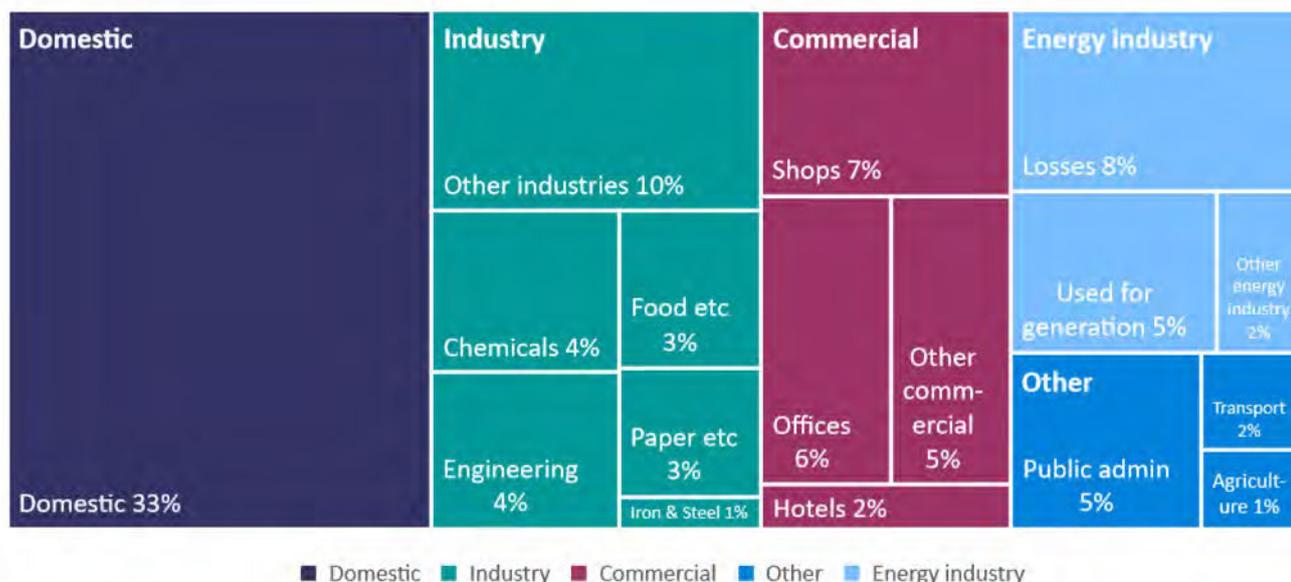


**Restrictions in response to Covid-19 led to decreased industrial and commercial electricity consumption, but higher domestic consumption.**

Industrial use of electricity, including iron and steel, was down 9.3 per cent in 2020 compared to 2019, and consumption by other final users, including the commercial sector, decreased by 11.2 per cent. This was due to restrictions placed on the activity of business and industry in response to the Covid-19 pandemic. Conversely, domestic consumption increased by 3.9 per cent in 2020, in comparison with 2019. This reflects the increase in time spent at home, including working from home, raising domestic consumption. This increase is despite higher average temperatures in 2020 than in 2019, which would usually be expected to reduce domestic electricity demand for heating.

Total electricity demand is larger than electricity consumption. This is because total demand also accounts for electricity consumed in the process of generation or to produce fuel for generation, as well as for electricity lost in transmission or distribution from where it is generated to where it is consumed.

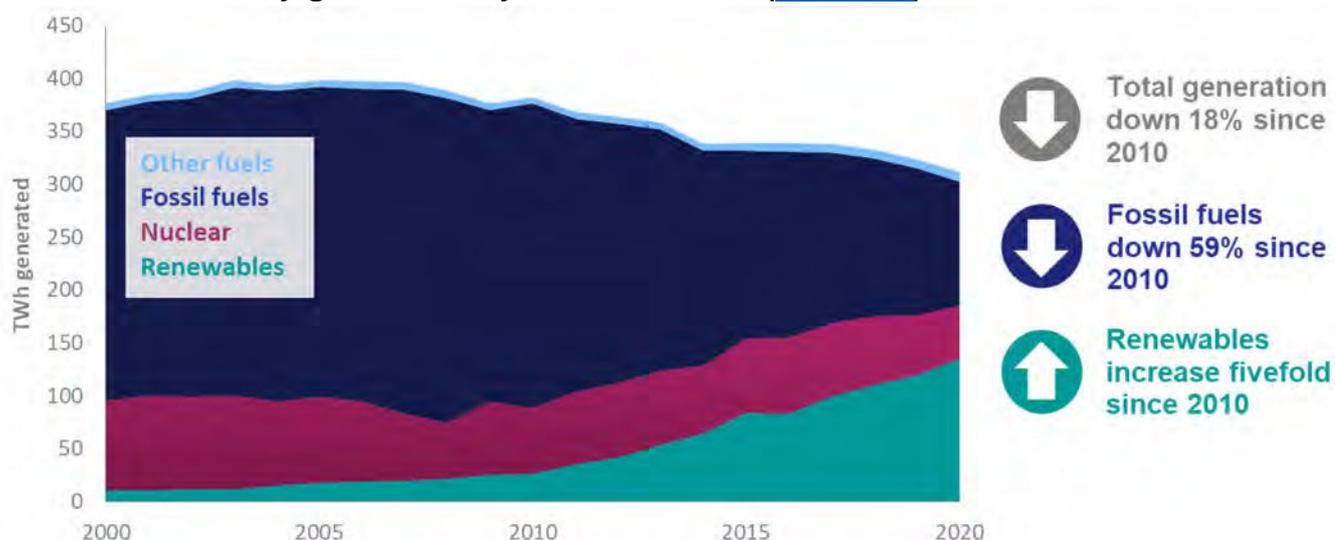
**Chart 5.2 Share of total electricity demand split by sector, 2020** (Table 5.2)



**Domestic users accounted for almost a third (32.7 per cent) of total electricity demand in 2020, higher than the share in 2019 (30.0 per cent).** Consumption by industry represented 25 per cent and commercial consumption represented 19 per cent. Compared to 2019, the domestic share increased by 2.7 percentage points, whereas the industrial share decreased 1.3 percentage points and the commercial share by 1.7 percentage points, in line with the effects of Covid-19 restrictions in 2020.

**Electricity generation and supply fell in 2020, due to reduced demand for electricity.** Demand for electricity is mainly met by UK generation and supplemented with imports from Europe. Electricity generation measures what is generated while electricity supply measures what was supplied to the grid, excluding the electricity used in the process of generation. Total electricity supplied plus imports needs to match with demand to ensure there is always enough electricity available. Total electricity supplied in 2020 was 329.9 TWh, with net imports of 17.9 TWh, 5.4 per cent of electricity supplied.

**Chart 5.3 Electricity generation by fuel, 2000-2020** (Table 5.6)



**Electricity generation fell to record low levels in 2020, with total electricity generation in 2020 of 312.0 TWh, 3.6 per cent less than in 2019.** This reflects lower demand for electricity during 2020 as a result of the UK's Covid-19 restrictions. 2020 also continued the shift away from generation by Major Power Producers (MPPs), which was down 5.1 per cent to 253.9 TWh, partly offset by a 3.8 per cent increase in generation from autogenerators and other generators to 56.7 TWh. The generation by MPPs was the lowest value on the published data series, partly due to the lower demand but also the ongoing trend towards smaller renewable sites.

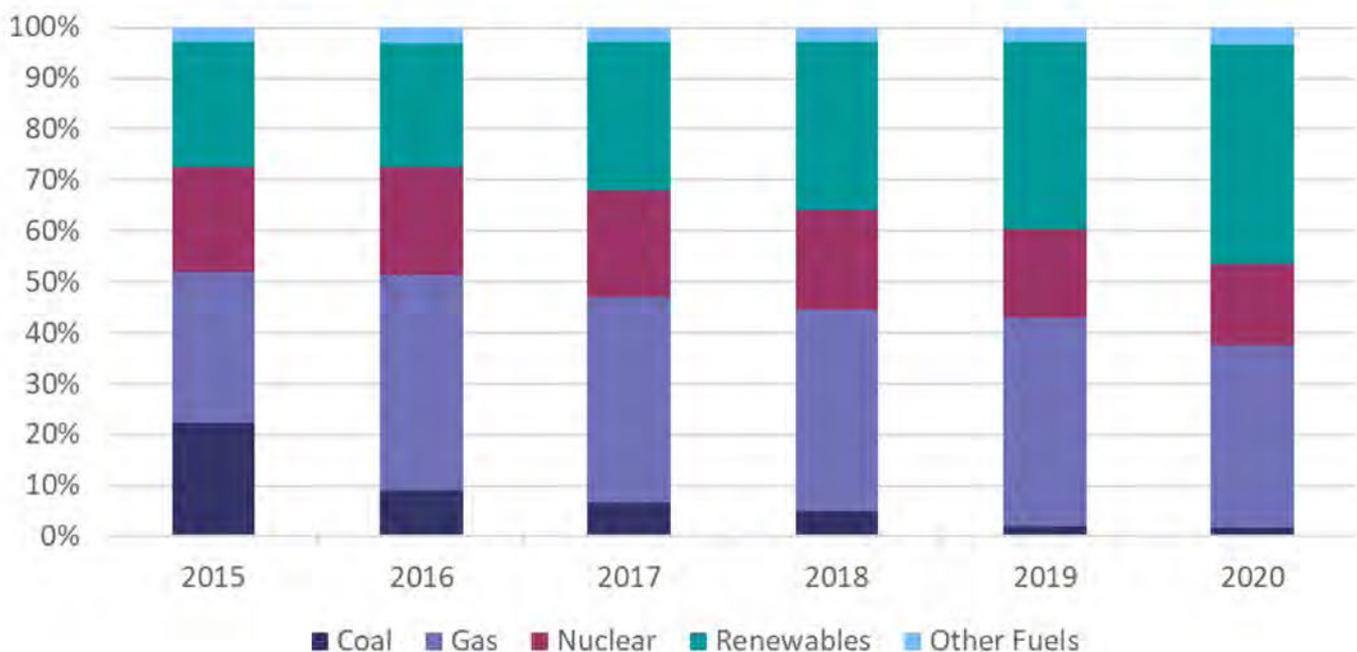
**Generation from renewable sources in 2020 was higher than fossil fuels for the first time in the published time series.** Renewable sources generated 134.6 TWh in 2020, a 12.6 per cent increase compared to 2019 and higher than the 117.8 TWh from fossil fuel. The high renewable generation was driven by increased wind generation, up by 18 per cent compared to 2019 to 75.4 TWh. This reflected favourable conditions for generation and increased capacity, particularly for offshore wind, which generated 27 per cent more electricity in 2020 than in 2019. In particular, the East Anglia One offshore wind farm became fully operational in 2020, adding 0.7 GW to the UK's offshore wind capacity. Weather conditions were also favourable for hydro generators, which saw a 15.5 per cent increase compared to 2019, to 6.8 TWh. There was also a 5.4 per cent increase in generation from bioenergy, in line with increased capacity.

**Fossil fuel generation was at a record low in 2020, down 15.9 per cent to 117.8 TWh.** This came as low demand for electricity and high renewables generation reduced the need for generation from fossil fuels. Gas continued to be the dominant fuel, generating 111.4 TWh in 2020 but this was down 16 per cent compared to 2019. During 2020 there were several substantial periods with no coal-fired generation in Great Britain, including a record 67 day period between April and June 2020. Northern Ireland operates on a separate electricity network where some coal generation continued. Just four coal-fired power stations remain in the UK, following the closure of Fiddlers Ferry and Aberthaw B in March 2020, with plans to phase these out by 2025.

**Nuclear electricity generation was 50.3 TWh in 2020, down 11 per cent compared to the previous year.** This was the lowest amount in more than twenty years as all of the UK's nuclear plants were on outage at times during the year. While some of these were statutory outages (planned in advance for maintenance purposes), there were also a number of unplanned outages for repairs, including Dungeness B being unable to generate all year. This also included Sizewell B operating at half capacity from May to September at the request of National Grid because of the lower demand for electricity.

As well as absolute generation, it is also useful to consider the overall shares of generation, which are less affected by changes in demand. This is particularly important for 2020, which saw unusual demand patterns as a result of Covid-19 restrictions.

**Chart 5.4 Shares of electricity generation by fuel, 2015-2020 (Table 5.6)**



**In 2020, the proportion of electricity generation coming from renewable sources exceeded that of fossil fuels for the first time in the published data series.** The renewable share rose sharply in 2020, to 43.1 per cent of UK generation, an increase of 6.2 percentage points compared to 2019. This was substantially higher than the share of generation from fossil fuels (37.7 per cent) for the first time in the published data series. All the renewable technologies including bioenergy saw increases in generation shares

in 2020, with the largest being a 3.7 percentage point increase in wind generation share. Wind provided 24 per cent of the total generation in 2020. The share of generation from low carbon sources increased again in 2020 to 59.3 per cent, up 5.0 percentage points compared to 2019, because of the high share of generation from renewables.

**The fossil fuel share of generation was the lowest on the published data series, down by 5.5 percentage points to 37.7 per cent.** Gas continues to be the dominant fuel in the UK generation mix, generating 35.7 per cent of the total in 2020, although this was down 5.0 percentage points on 2019. The fall in the use of fossil fuels has largely been driven by a significant reduction in coal generation, which has fallen from a fifth of generation in 2015 to just 1.8 per cent in 2020.

**Nuclear share of electricity generation fell to its lowest level since 2010, accounting for 16.1 per cent of generation in 2020,** down 1.2 percentage points on 2019.

**The total fuel used for electricity generation decreased substantially in 2020, down 5.2 per cent to 55.6 Million Tonnes of Oil Equivalent (Mtoe).** This was the lowest value on the published data series with fuel use falling year on year since 2012. In the last ten years, total fuel use has fallen 28 per cent due to decreasing demand for electricity and growth in non-thermal renewables which do not incur conversion losses<sup>3</sup>. The larger decrease in 2020 compared to 2019 was because of the unusually low demand and generation as a result of the Covid-19 restrictions.

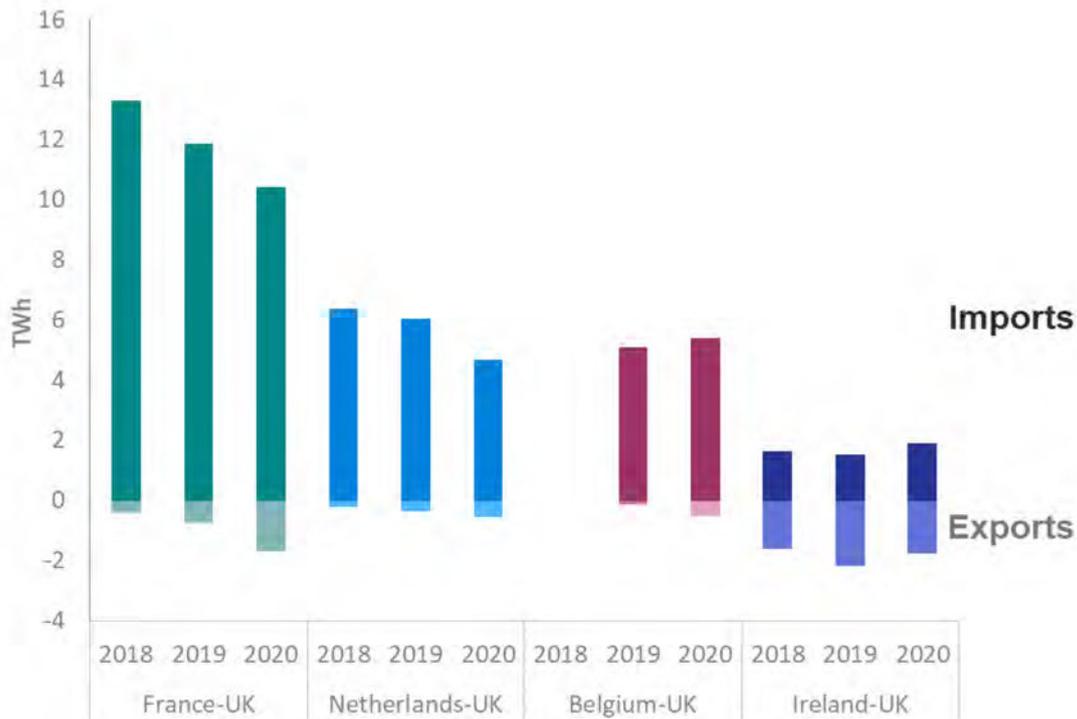
Trends in fuel used mirror those in electricity generation, with record low amounts of fossil fuel used, record low use of nuclear fuel and record highs for fuel used by renewable generators. Gas continues to dominate the UK generation mix, with 20.3 Mtoe used in 2020, while coal use has continued to decline with just 1.47 Mtoe used in 2020. This was a 21 per cent reduction on 2019 and 94 per cent lower than 2010 levels.

**The UK continued to support its own generation by importing electricity from Europe to meet demand, though total net imports were down by 15 per cent in 2020.** Net imports in 2020 were 17.9 TWh, the lowest level since 2017 and represented 5.4 per cent of total electricity supplied, down 0.7 percentage points on 2019. Total imports were 22.4 TWh in 2020 (down 8.8 per cent compared to 2019) while total exports were up 32 per cent on 2019 to 4.5 TWh.

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<sup>3</sup> For wind, hydro and solar, the fuel used is assumed the same as the electricity generated, unlike thermal generation where conversion losses are incurred. Therefore, for example, if one unit of electricity produced from coal is switched to wind, the fuel used will show a fall from around three units (as coal's thermal efficiency is around one-third) to one unit.

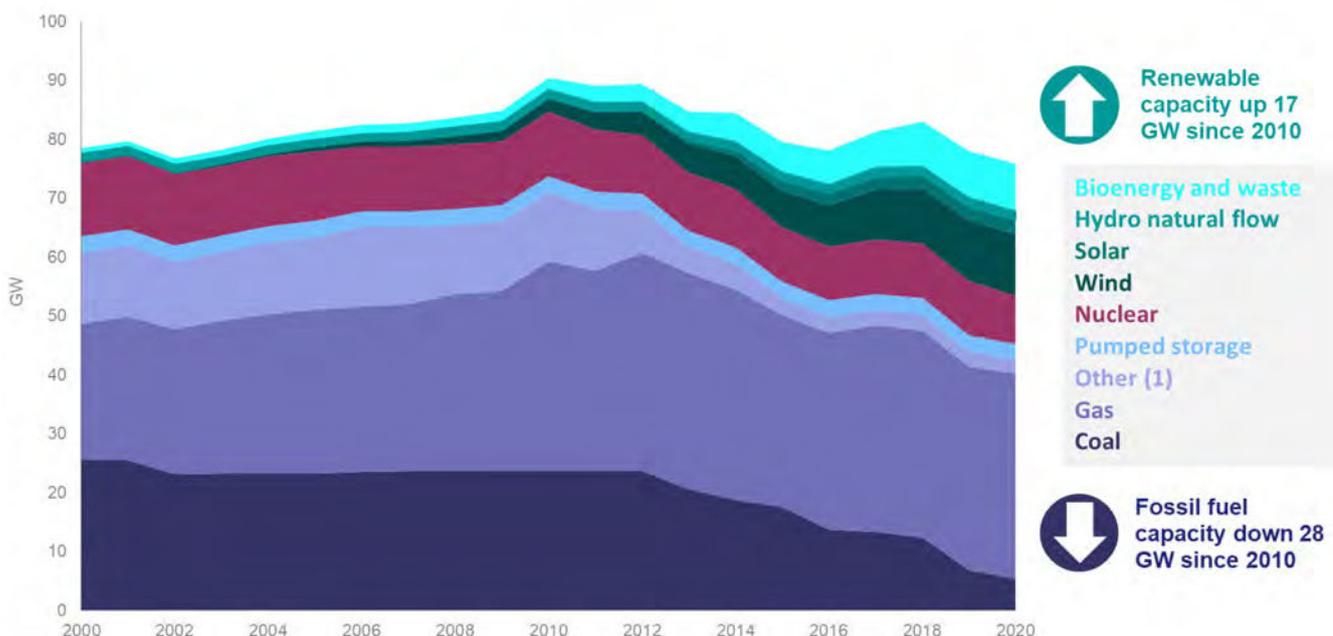
**Chart 5.5 Electricity imports from Europe (Table 5.13)**



Just under half of the UK’s electricity imports (47 per cent) were from France, with the French IFA interconnector providing net imports of 8.7 TWh, although this was down 22 per cent on 2019. Belgium and the Netherlands also have substantial amount of net imports, 4.9 and 4.1 TWh respectively, though the lower demand in 2020 meant that both saw a decrease compared to 2019. The Northern Ireland – Ireland interconnector remains the only interconnector where exports of electricity exceed imports with net imports of –0.8 TWh in 2020.

UK electricity is generated from a range of technologies and fuels which will be used at different times in response to demand and to changes in weather. Monitoring capacity along with load factors allows us to see how the capacity is being used and monitor the security of electricity supply.

**Chart 5.6 Installed capacity of UK electricity generation assets by fuel, 2000 to 2020 (Table 5.7)**



**Total generation capacity decreased in 2020 to 75.8 GW, a 2.7 per cent decrease on the 77.9 GW capacity in 2019.** While there were increases in renewable capacity, in particular offshore wind, these were offset by the closure of two large coal power stations and nuclear station Dungeness B. These large plant closures meant that the peak demand for electricity during the winter 2020/21<sup>4</sup> was equivalent to 75.5 per cent of UK MPP generation capacity, up 3.2 percentage points compared to 2019. In this section, wind, small scale hydro and solar PV capacity is de-rated to account for intermittency, to enable direct comparison with conventional fuels which are less dependent on the weather.

**The largest reduction in generation capacity during 2020 was seen in coal-fired generation, which fell to 5.4 GW,** with the closure of Fiddlers Ferry (2.0 GW). This leaves just four coal plants operating in the UK, with plans to phase these out by 2025, and reflects the shift away from coal for electricity generation. Nuclear capacity fell by 12.1 per cent with the closure of Dungeness B<sup>5</sup>. Gas-fired generation capacity remained relatively stable, up by 0.6 per cent.

**Renewable generation capacity continued to increase in 2020,** with 0.4 GW of renewable capacity added to take the total to 22.4 GW. Without derating, this is an increase of 1.0 GW which brings the total installed capacity for renewable generation to 47.8 GW, as detailed in Table 6.4. Half of the additional capacity was for offshore wind generation, including the opening of East Anglia One which added 0.5 GW over the course of the year. Solar generators and municipal solid waste generation also saw additional capacity.

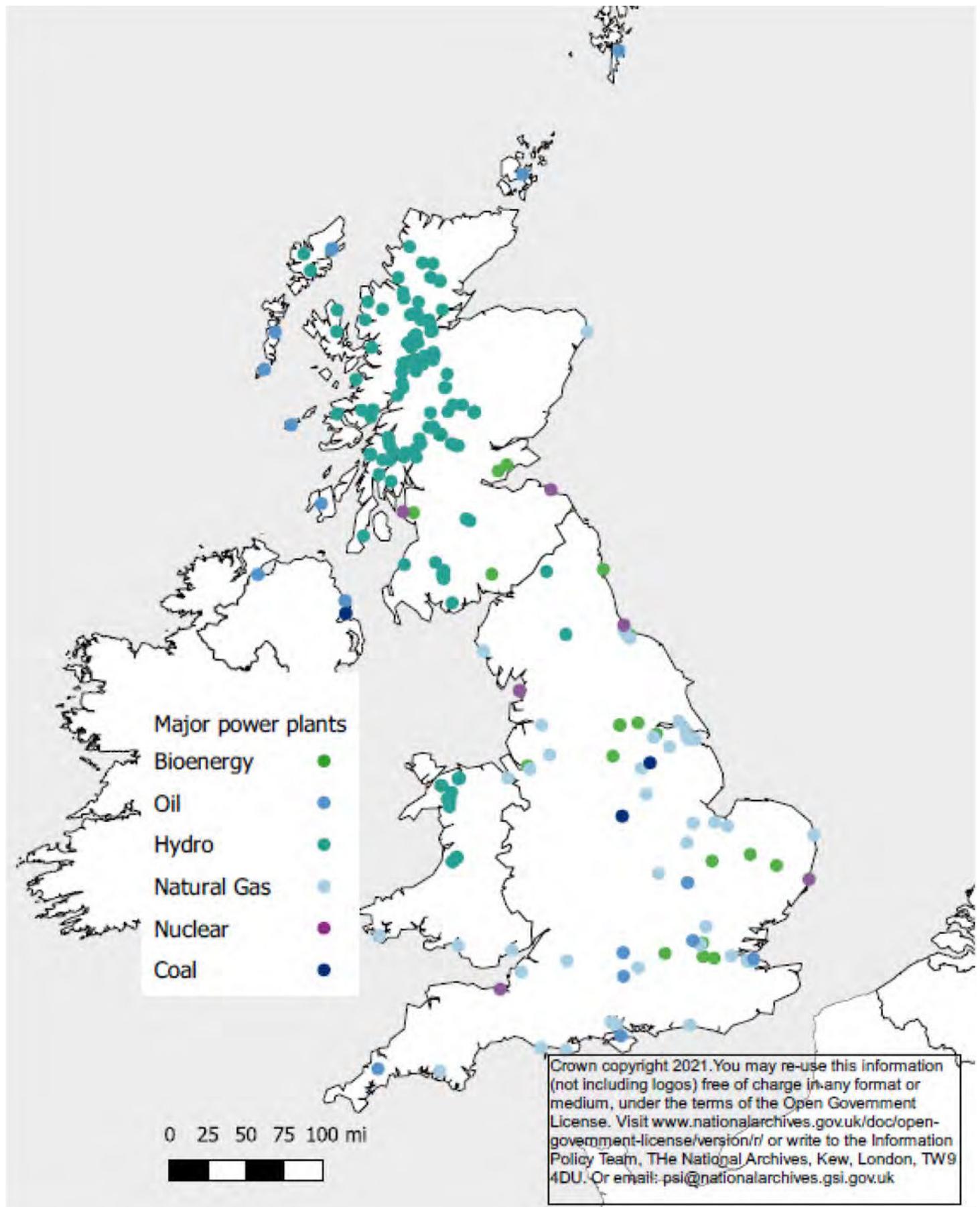
**In addition to decreased capacity, the MPP power plants were less intensively deployed than they were last year, with a load factor of 41.6 per cent.** Load factors indicate the proportion of the time the plant is producing electricity and decreased by 0.7 percentage points compared to 2019. Load factors vary by technology, with nuclear stations the highest at 59.8 per cent and the lowest being pumped storage hydro at 5.8 per cent. Full load factors for renewable generation are given in Table 6.5.

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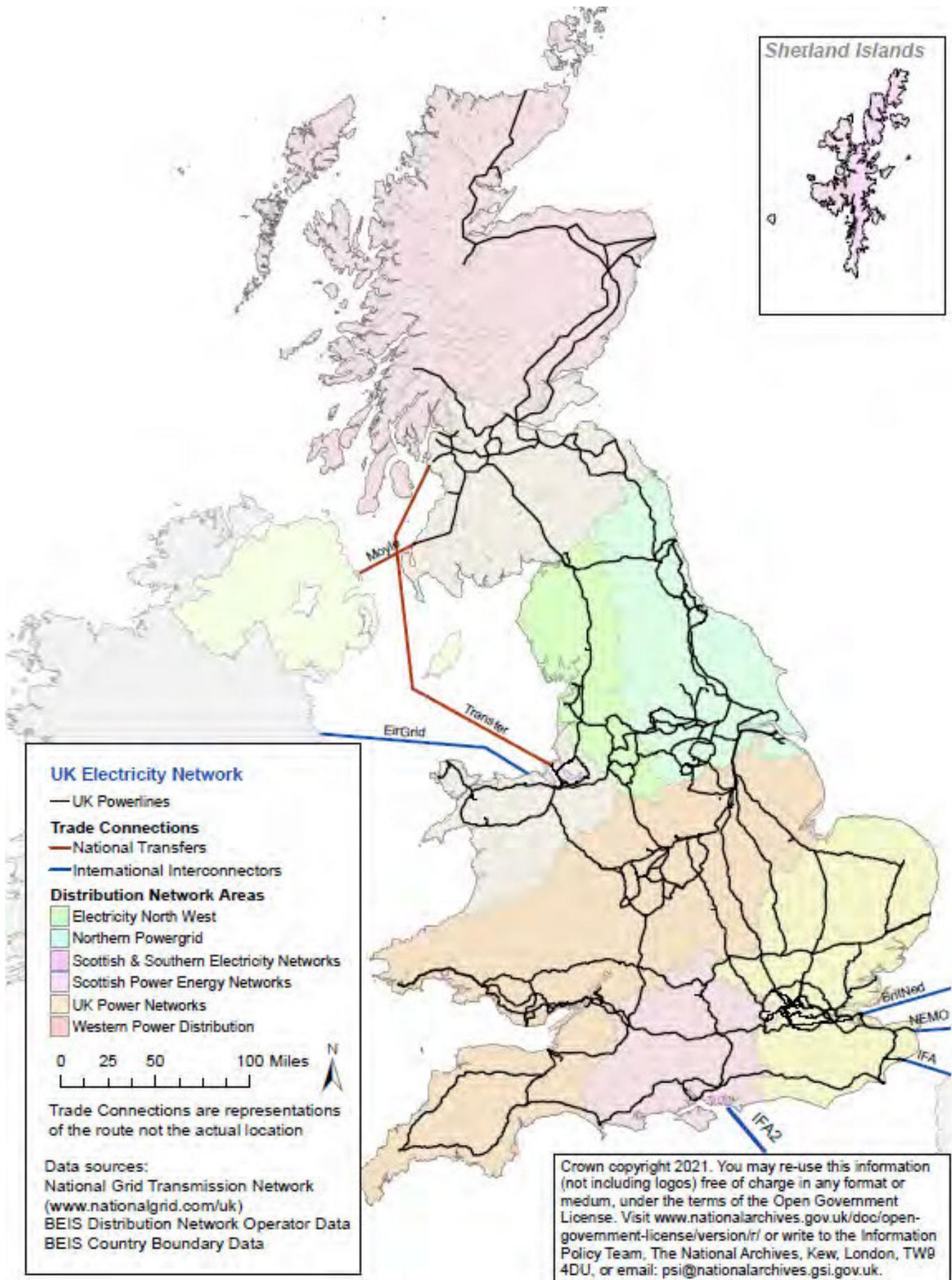
<sup>4</sup> 7<sup>th</sup> January 2021 in the half hour ending 17:00

<sup>5</sup> It was announced in June 2021 that Dungeness B would begin defueling prior to closure. It has not generated since 2018, so has been excluded from the 2020 capacity tables.

## Map of Major Power Producers in the UK (operational May 2021)



# UK Distribution Network Operating Areas and GB Power Lines Map



# Chapter 6: Renewable sources of energy

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## Key headlines

**The proportion of renewable generation outstripped fossil fuels for the first time in 2020 as a result record renewable generation.** Renewable electricity now represents 43.1 per cent of total generation, up from 36.9 per cent in 2019.

**Growth in new renewable capacity continued to slow with just 1.0 GW added in 2020, the lowest since 2007.** Covid-19 restrictions are likely to have contributed to the slowdown in growth in 2020 but at just 2.1 per cent, this is the slowest growth rate since 2002.

**Renewable generation increased by 15.1 TWh (13 per cent), 11.6 TWh of which can be attributed to wind generation** (2.9 TWh onshore, and 8.7 TWh offshore). Despite the modest increase in capacity, favourable weather conditions (notably the exceptionally high wind speeds during storms Ciara and Dennis in the first quarter of 2020) contributed to the increase in wind generation.

**Total renewable fuel use increased by 1.6 mtoe (6.8 per cent);** as renewable fuel use continues to be dominated by those used for electricity generation (74 per cent), almost two thirds of the increase can be attributed to the increase in wind generation. **Renewable heat increased by 0.3 mtoe (6.3 per cent) and grid injected biogas increased by 9.0 per cent, though from a relatively low base (0.5 mtoe).**

The renewable energy flow chart overleaf summarises the flows of renewables from fuel inputs through to consumption for 2019 and includes energy lost in conversion. The data are sourced from the commodity balance Table 6.1 and Table 6.4 for electricity outputs.

It also shows net imports for those renewable fuels which are transportable; utilising natural resources such as wind, solar and hydro are localised in nature resulting in a high proportion of domestically produced renewable sources which in 2020, represented approximately 80 per cent of renewable demand. Excluding primary generation and biogases, net imports represent around half of the demand, the majority of which is wood pellets used in electricity generation.

Renewable energy flow chart (Tables 6.1 and 6.4)

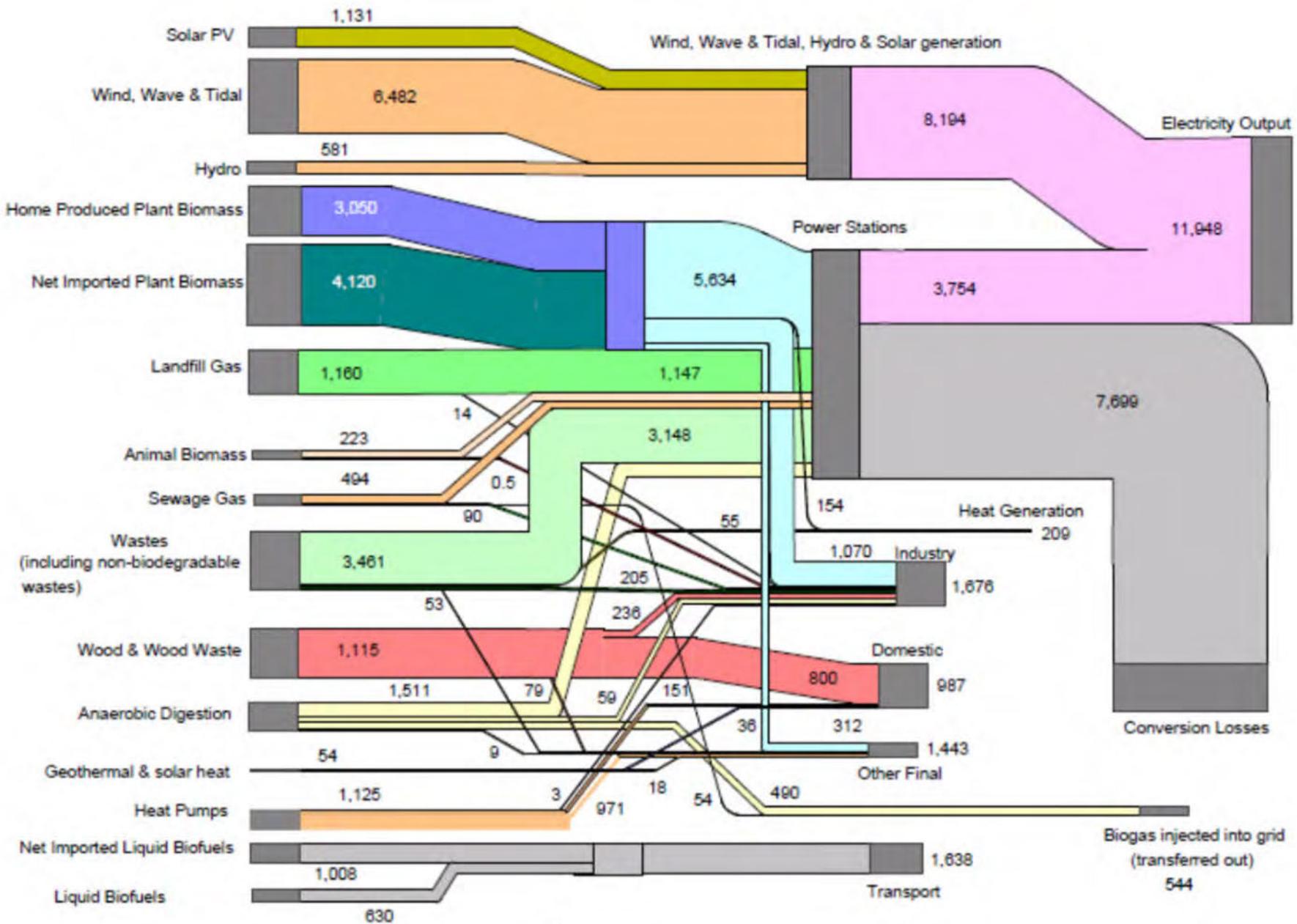
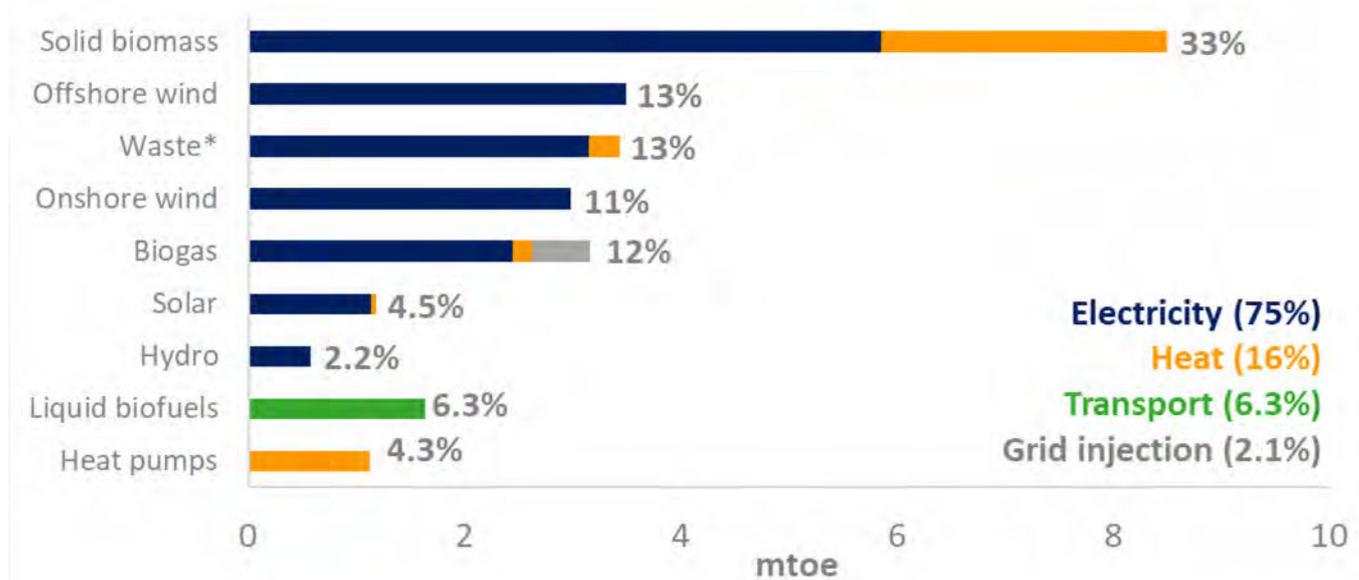


Chart 6.1 shows each of the renewable fuels and the end use of these fuels be that for electricity, heat, transport, or injection of biogas into the national grid.

**Chart 6.1 Use of renewable fuels, 2020 (Table 6.6)**

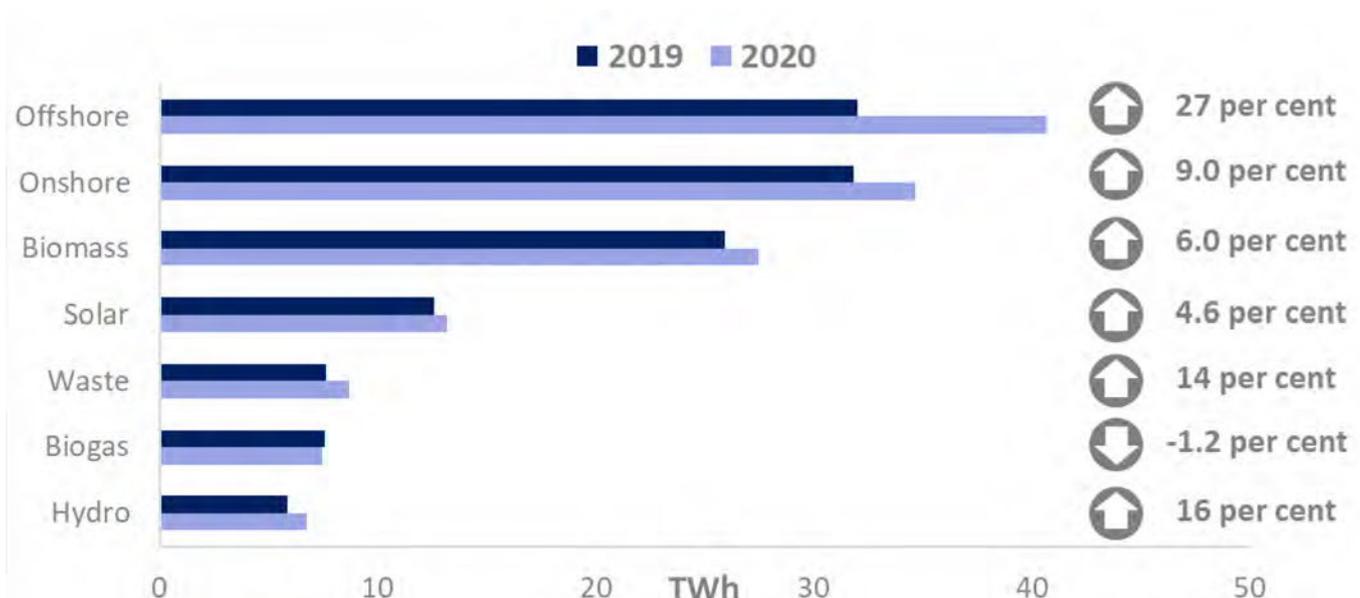


\*Including non biodegradable waste

Solid biomass, including wood, waste wood, animal and plant biomass, represented 33 per cent of total renewable demand in 2020 with approximately two thirds being used in electricity generation and the remaining third to produce heat. Biogas (landfill and sewage gas, and anaerobic digestion) has historically been used in generation and heat but has more recently been injected into the gas grid. Over three quarters, however, is still being used for electricity generation with 17 per cent being injected into the grid (up from 11 per cent in 2016, the first year data became available).

Although solid biomass accounts for the largest share of renewable fuel, on an output basis (i.e. generation after conversion losses in thermal generation), offshore and onshore wind show a higher share at 29 per cent and 25 per cent respectively in 2020. Chart 6.2 shows the change in generation between 2019 and 2020. With low-capacity growth in 2020 generally, some weather dependent renewable sources showed higher growth rates compared to thermal generation due to favourable wind speeds and rainfall.

**Chart 6.2 Growth in generation by fuel 2019 – 2020 (Table 6.4)**



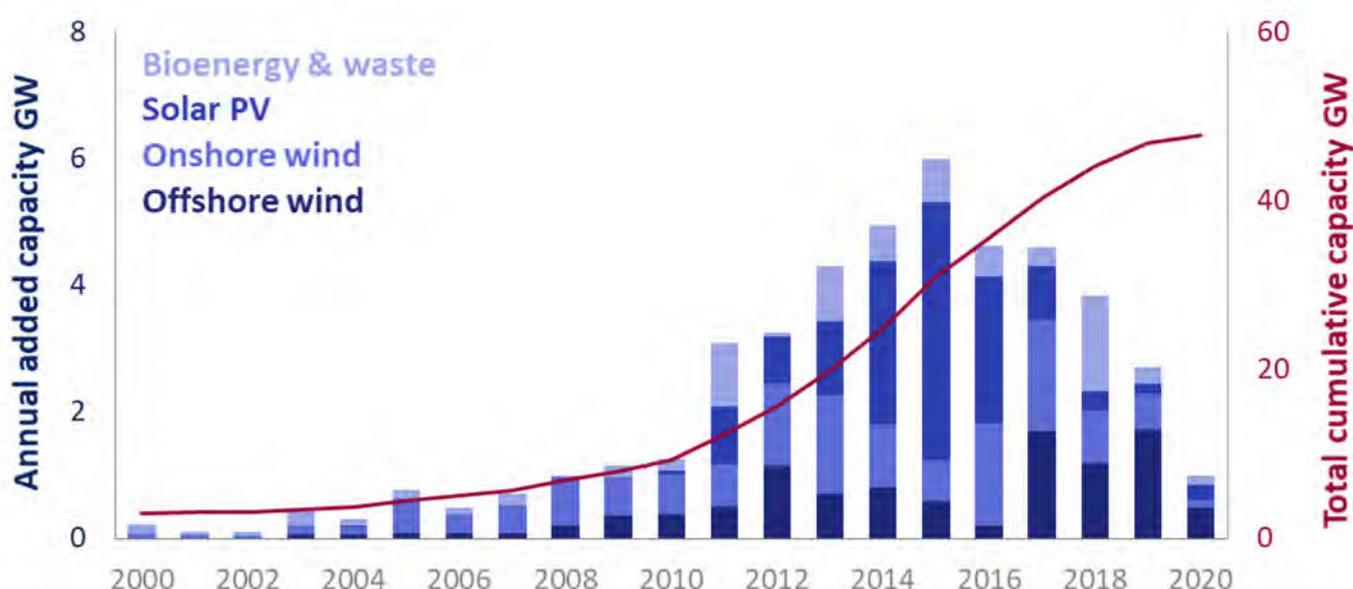
**Offshore wind generation showed the highest increase in both absolute and percentage growth terms (by 8.7 TWh or 27 percent)**, with onshore also growing strongly (by 2.9 TWh, or 9.0 per cent). Although offshore wind did see some added capacity during 2020 (0.5 GW, or 5.0 per cent), the dominant effect on wind generation was the exceptionally high windspeeds particularly during the first quarter when Storms Ciara and Dennis hit the UK.

**Generation from hydro also increased in 2020, by 0.9 TWh to 6.8 TWh**, a 16 per cent rise. Installed capacity for hydro is stable and the additional growth was due to higher levels of rainfall compared to 2019. Energy from waste plants increased their capacity in 2020 which provided an additional 0.5 TWh in generation (1.1 TWh including non-biodegradable waste).

**Only biogas saw a reduction in generation** due to falling extraction rates at landfill gas sites, generation reached a peak in 2011 and has fallen by 34 per cent since then to 3.5 TWh.

Chart 6.3 shows the growth in new capacity over time. **New capacity reached a peak in 2015** when a total of 6.0 GW was installed, 4.1 GW of which was in solar PV. In 2020, just 1.0 GW was installed though some projects may have been deferred due to Covid-19 restrictions. Chart 6.3 shows new capacity in the year of installation by technology compared to the cumulative total capacity.

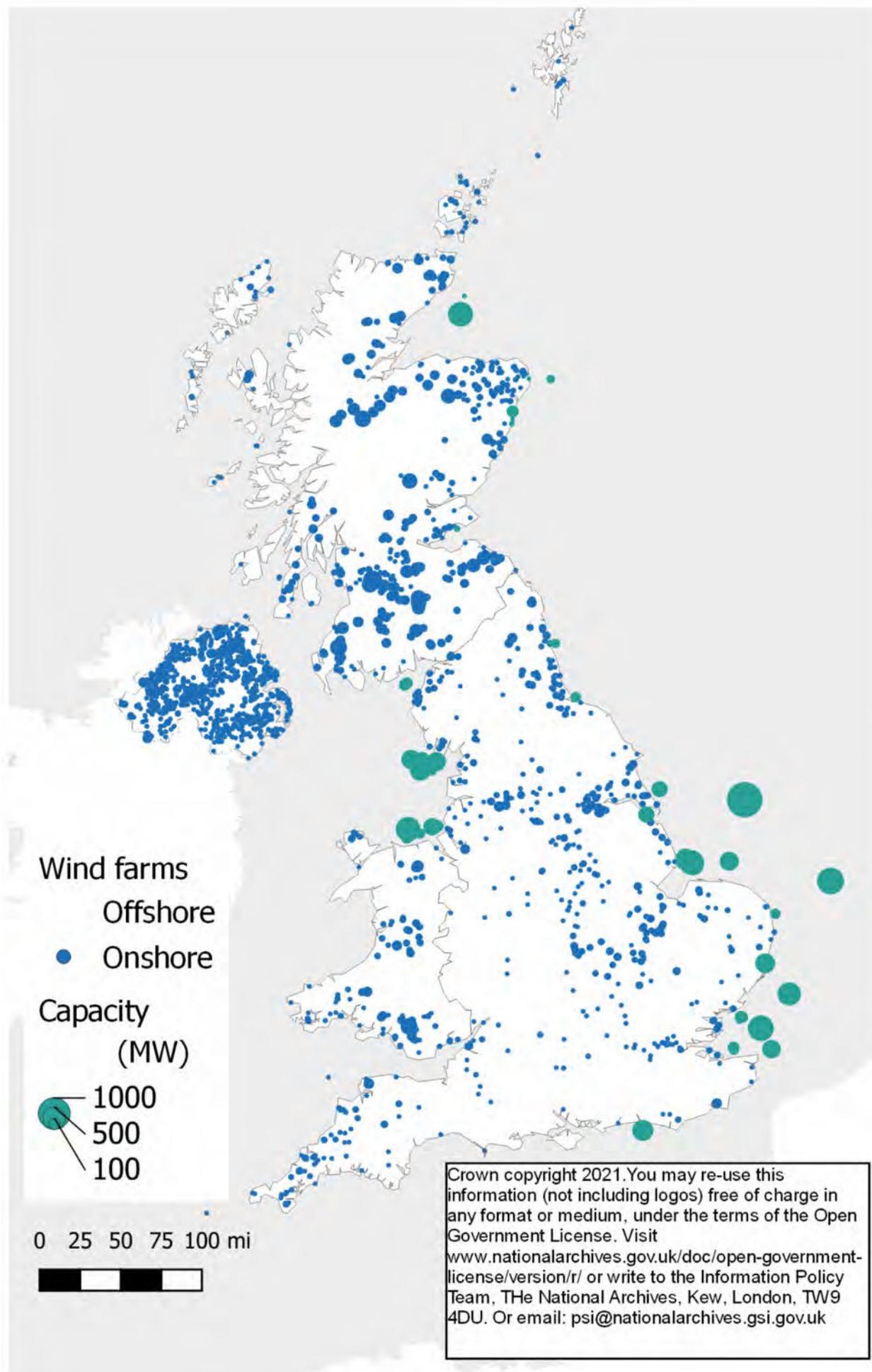
**Chart 6.3 Annual added capacity 2000 to 2020 (Table 6.4)**



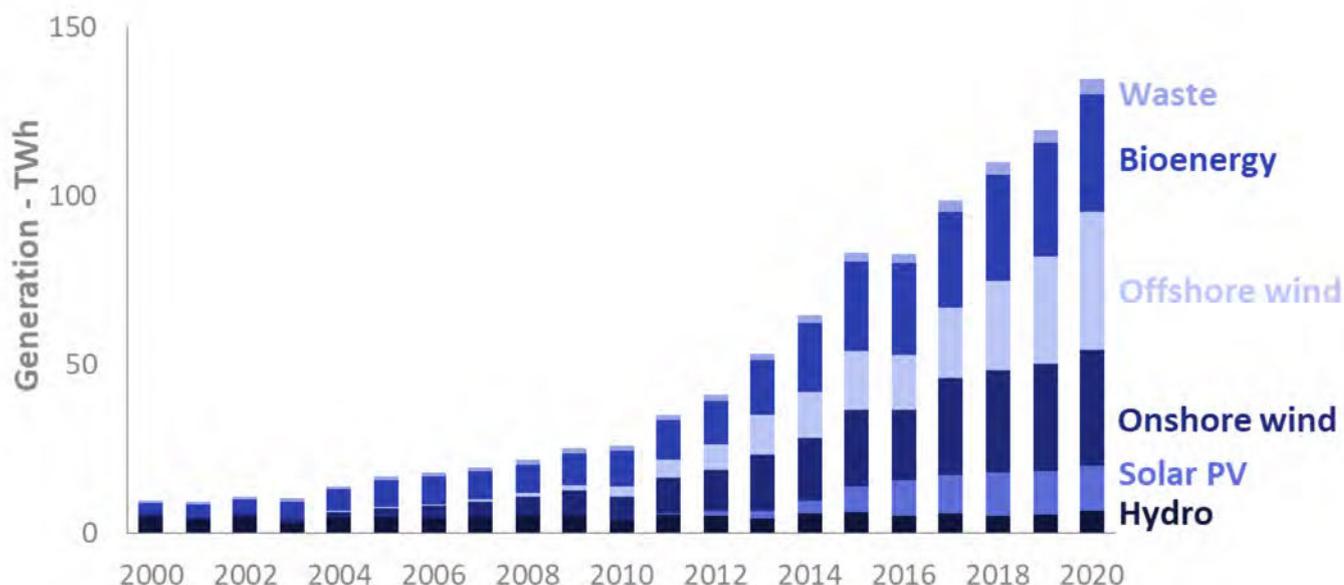
Prior to 2011, solar PV capacity formed a very small part of the renewable energy mix representing just 1.0 per cent of total capacity. However, since then and up until 2017, it increased significantly with capacity added during those years accounting for 87 per cent of the current installed capacity. Although growth has slowed since 2017, solar PV's share of the renewable mix stands at 28 per cent in 2020. Growth in new wind sites has been more stable particularly onshore wind, though it has slowed markedly over recent years with just 0.1 GW added in 2020, an increase less than one per cent. Offshore wind has seen higher levels of new capacity in recent years with almost half being installed since 2016. Wind now represents over half total installed capacity (see wind map on next page showing location by capacity band).

Despite the slowdown in new capacity, the overall picture of increasing generation since 2000 remains positive with new records regularly being set including total generation in 2020 which at 134.6 TWh was 13 per cent higher than in 2019. Chart 6.4 shows how each technology has contributed to this strong growth.

## Map of UK wind capacity 2020



**Chart 6.4 Trends in generation by technology 2000 to 2020** ([Table 6.4](#))

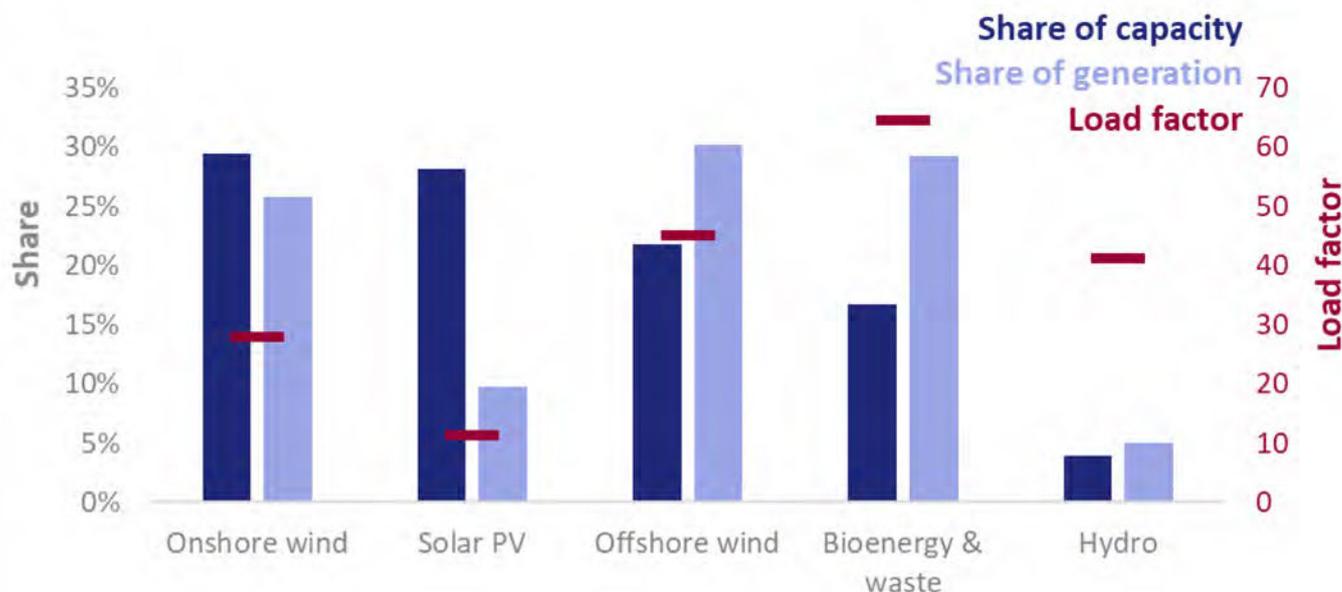


Hydro is a mature technology and generation tends to fluctuate from year to year in line with rainfall. In contrast, solar PV generation only started proliferating from 2012 reflecting the surge in new capacity incentivised via the Feed in Tariff (FiT) support scheme, increasing its share of renewable generation from 3.3 per cent in 2012 to 9.8 per cent in 2020.

Bioenergy saw rapid growth in the years from 2012 as several large power stations converted from coal to plant biomass. Generation from biogas had been fairly stable initially with some generation from landfill and sewage gas plants but as extraction rates have declined at landfill sites, increasing amounts of anaerobic digestion have offset this decrease.

Technologies with a high share of capacity do not necessarily have the highest share of generation because generation is dependent on the load factor. Load factors are the ratio of how much electricity was generated as a proportion of the total generating capacity. Within renewables, load factors can be heavily influenced by weather conditions, wind speeds on wind load factors, sun hours for the load factor for solar PV and, to a lesser extent, rainfall on load factor for hydro. Chart 6.5 compares the key technologies' share of capacity and generation alongside the load factor for 2020.

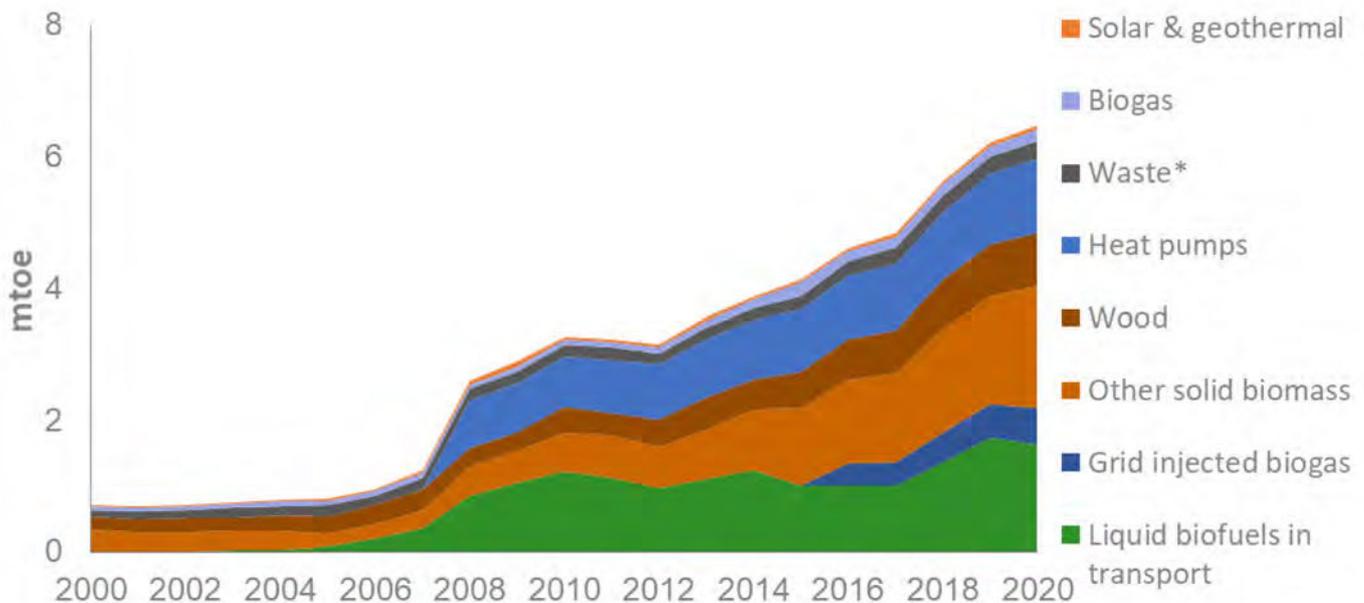
**Chart 6.5 Relative share of capacity and generation and load factors 2000** ([Table 6.5](#))



Thermal generation such as bioenergy and waste tend to have high load factors as indicated by the relatively high share of generation compared to capacity. Conversely, solar PV has a very low load factor due to limited hours of sunlight.

In 2020, the load factor for overall renewables was the highest ever reported. On an unchanged configuration basis, where only sites operating for the full year are included, the load factor was 41.6 per cent, the highest since 2008. Favourable weather conditions such as strong wind speeds and high rainfall contributed to the increase, and potentially increasing efficiencies in thermal generation.

**Chart 6.6 Other renewable fuel uses; heat, transport, and grid injected biogas (Table 6.6)**



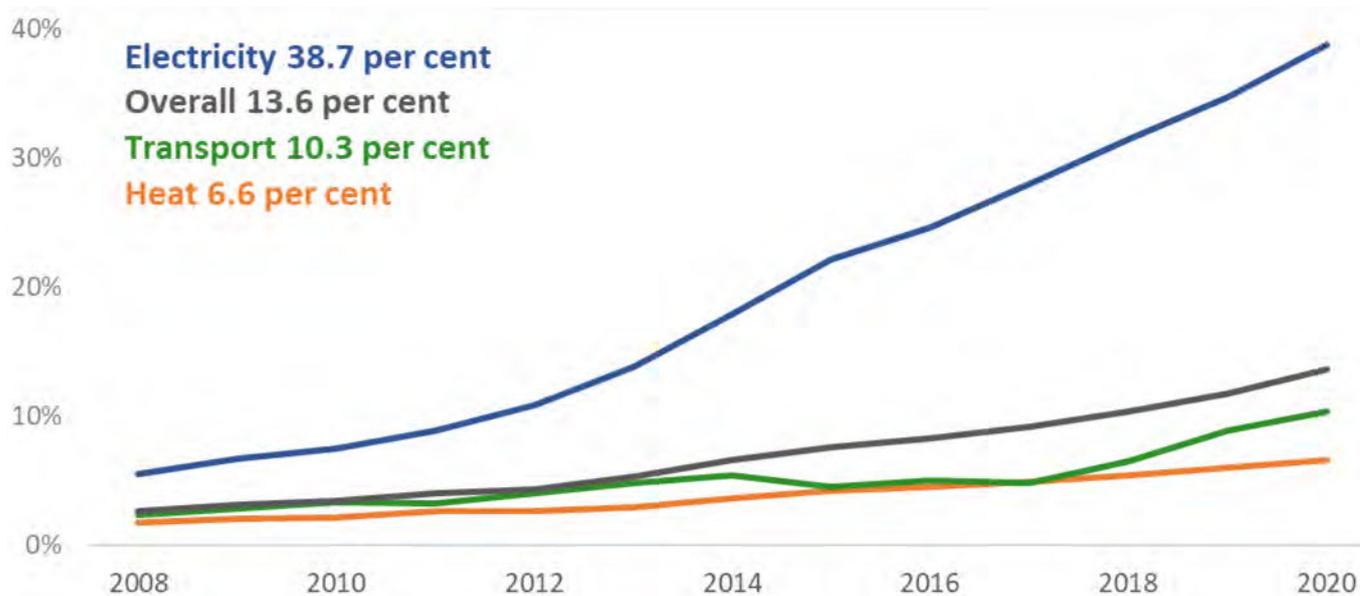
\*Including non biodegradable waste

Whilst electricity generation represents three quarters of renewable fuel demand, heat also accounts for a sizable proportion (16 per cent) with liquid biofuels (6.3 per cent) and of increasing importance, biogas injected into the grid (2.1 per cent). Between 2019 and 2020, renewable heat increased by 7.6 per cent with most of the increase in plant biomass though heat pumps also increased by 4.1 per cent with new installations.

Liquid biofuel in transport fell in 2020 by 5.6 per cent. Liquid biofuels are blended with diesel and motor spirit and the drop in demand is due to markedly lower demand for transport fuels due restrictions arising from the Covid-19 pandemic.

Until 2016, only minimal amounts of biogas from anaerobic digestion sites were injecting into the grid; with support from the Renewable Heat Incentive, it is of increasing importance in the renewable energy mix increasing by 9.0 per cent in 2020. It also now includes some sewage gas being injected (still just representing 10 per cent but increasing at a higher rate than anaerobic digestion sites).

Chart 6.7 Renewable energy as a proportion of total final consumption ([Table 6.7](#))



Progress in the growth of renewable energy as a proportion of final consumption was separately monitored as part of a European Union Directive, the Renewable Energy Directive (RED). The RED set the UK a target to derive 15 per cent of total energy consumption by 2020 from renewable sources. The overall target covered electricity<sup>6</sup>, heat<sup>7</sup>, and transport, there was a separate target for transport to derive 10 per cent from renewable sources, including liquid biofuels and renewable electricity. The final outcome for the RED was **13.6 per cent against the 15 per cent overall target and 10.3 per cent for transport, an 11 percentage point increase since 2008.**

<sup>6</sup> The proportion of renewable electricity using RED methodology was 38.7 per cent, lower than the 43.1 per cent referenced in the key points section. This is due to the 'normalised' methodology in the RED, whereby wind generation is calculated using an average of the load factors.

<sup>7</sup> Domestic wood consumption has been revised downwards following new estimates arising from a Defra study on domestic consumption. This resulted in a change from 2,241 ktoe to 733 ktoe in the 2018 reference year which has been applied to the time series to 2008. The heat pump series has also been back corrected to 2008, removing a previous step change in 2015. The methodology note ([link](#)) provides further detail.

# Chapter 7: Combined Heat and Power (CHP)

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## Key headlines

In 2020, there were 2,659 CHP sites, 81 more than in 2019. This represented an additional 50 MW of electrical capacity, a 0.8 per cent increase.

CHP qualifying output represented 7.7 per cent of total electricity generation, a 0.4 percentage point increase on 2019.

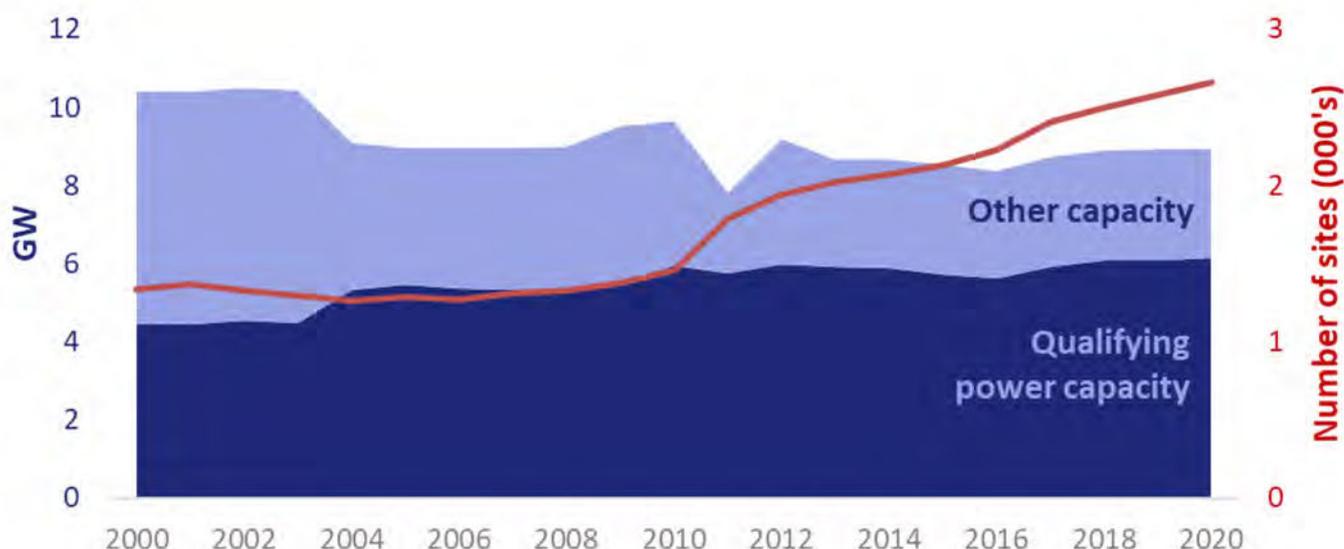
Gas continues to be the main fuel consumed in CHP plants (almost three quarters of fuel input), representing 8.5 per cent of gas demand.

In 2020, renewable fuel accounted for 15 per cent of total CHP fuel, similar to 2019.

Emissions savings from cogeneration (compared to generating electricity and heat separately) was 9.66 MtCO<sub>2</sub> in 2020 compared to all fossil fuels, 3.14 MtCO<sub>2</sub> when including renewables and nuclear.

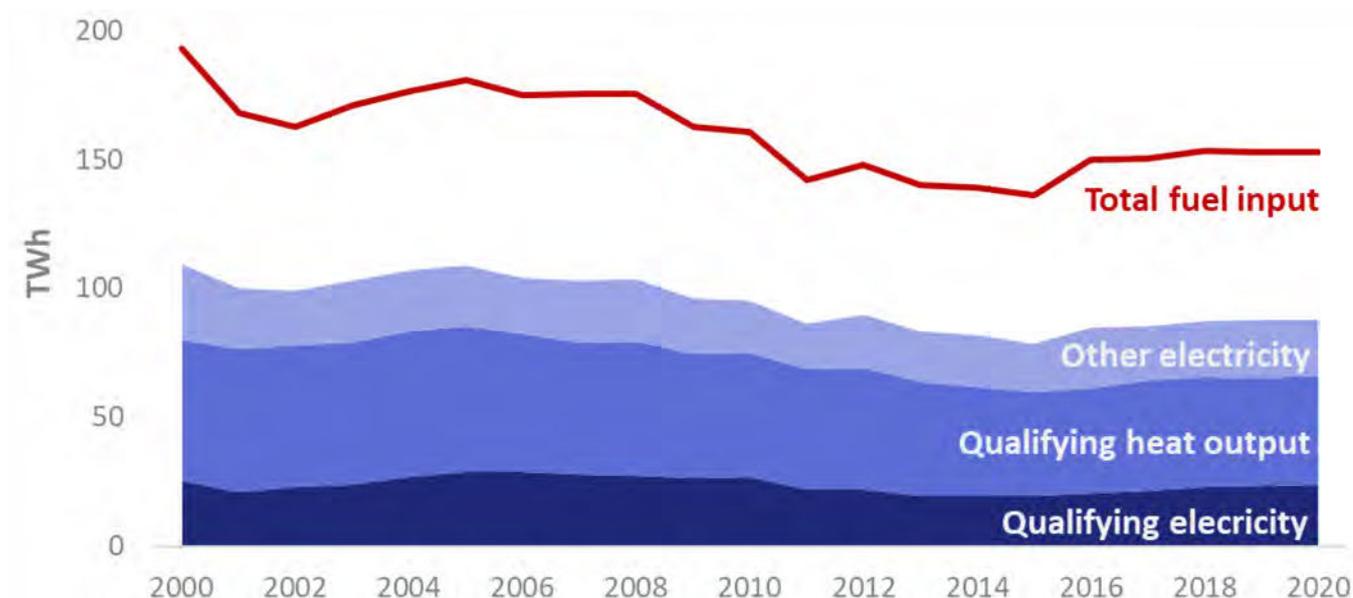
CHP, sometimes referred to as cogeneration, is the simultaneous generation of electricity and heat resulting in improved efficiencies when compared to meeting electricity and heat demands separately. The data for this section is primarily collected in support of the CHP Quality Assurance programme (CHPQA) but is supplemented with other sources to provide as comprehensive a picture as possible for UK CHP statistics. The CHPQA programme assesses and certifies schemes eligible for various incentives; not all output from a scheme is eligible, but where it is, it is referred to as 'good quality', or qualifying. Chart 7.1 shows the qualifying and other (non-qualifying) capacity compared to the number of schemes.

Chart 7.1 Comparison of total and qualifying electrical capacity from 2000



Since 2000, the number of schemes has almost doubled and although total capacity has fallen by 14 per cent, qualifying capacity has increased by 38 per cent resulting in its share increasing from 43 per cent in 2000 to 69 per cent in 2020. Chart 7.2 shows CHP outputs qualifying and non-qualifying compared to total fuel input.

**Chart 7.2 Comparison of total fuel and CHP outputs from 2000**

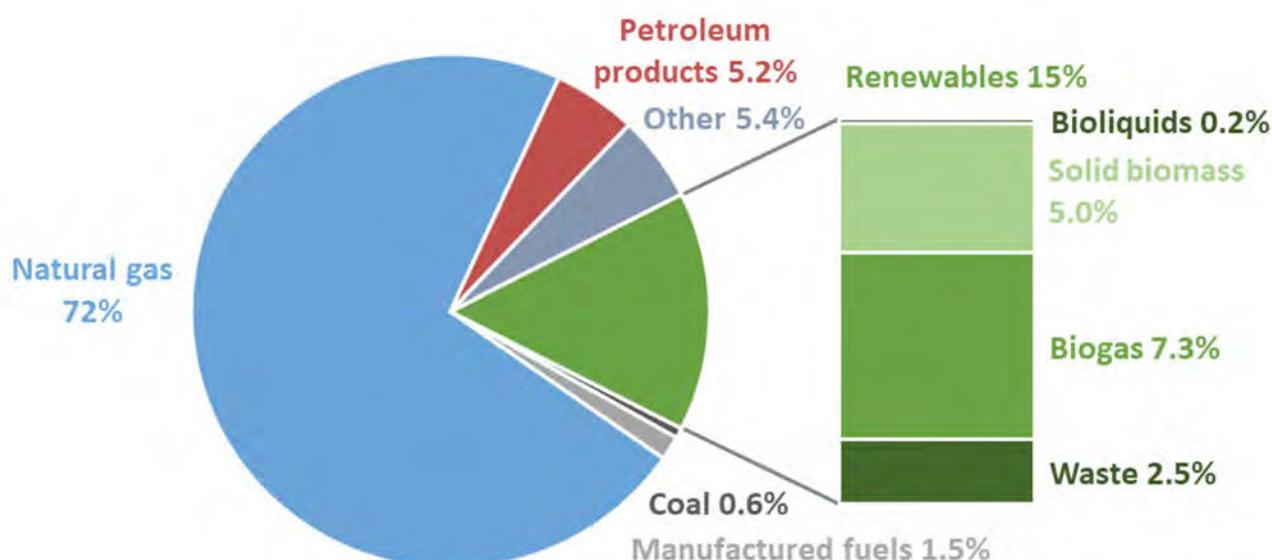


In 2020, three quarters of CHP outputs were deemed to be qualifying, around two thirds of which was heat. Although not a perfect relationship, CHP outputs tend to be driven by the underlying difference between the price of gas and electricity, the spark gap; the larger the gap, the cheaper gas is relative to electricity which makes cogeneration more economically viable. This explains the decline from 2006 to 2015 and the subsequent turnaround following a widening of the spark gap in 2013.

**The efficiency of CHP schemes in 2020 is estimated at 69.1 per cent** for qualifying electricity and heat. This compares with 48.5 per cent when taking into account qualifying electricity only; although this estimate relies on a notional methodology for allocating CHP fuel to heat and electricity, it is in line with the overall electricity efficiency for combined cycle gas turbines ([Table 5.10](#)), the leading CHP technology accounting for half of all schemes.

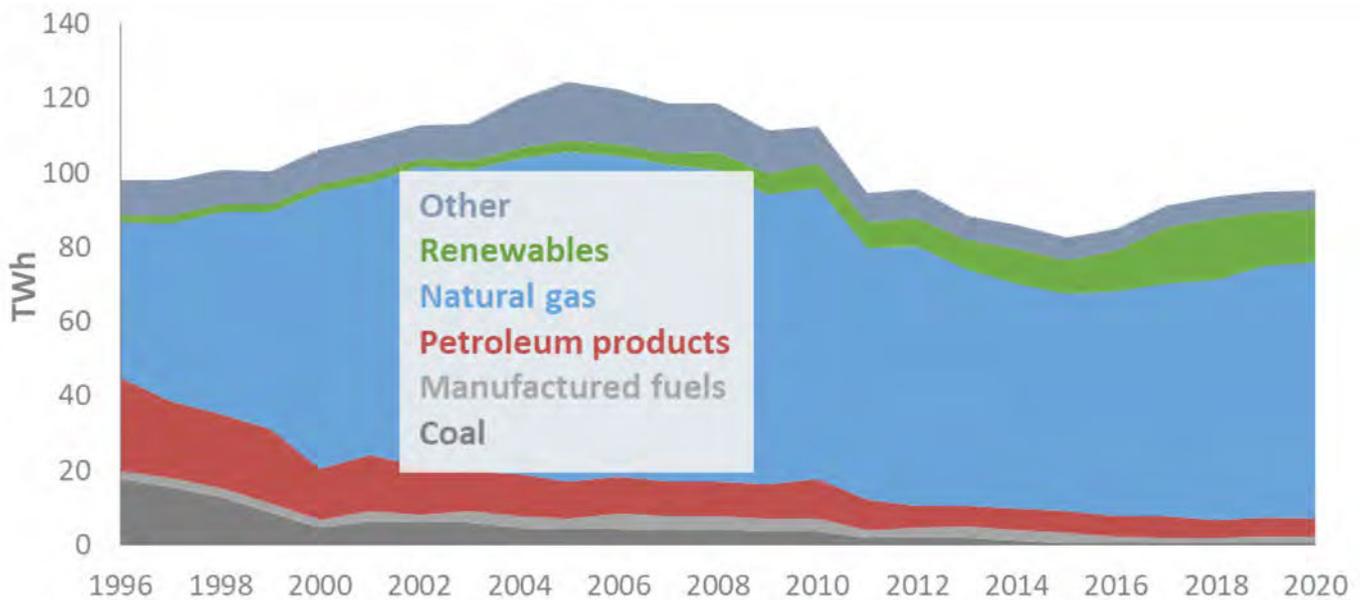
**Gas remains the main fuel consumed by CHP schemes representing 72 per cent of the total in 2020**, with renewables accounting for the next highest share at 15 per cent. Fossil fuels other than gas now account for just 7.5 per cent.

**Chart 7.3 Fuel mix in 2020 ([Tables 7.2 and 7.9](#))**



Over the longer term, the fuel mix has changed little since 2000 following rapid changes between 1996 (the first year data became available) and 2000. Chart 7.4 shows this long-term trend with the increasing share of natural gas evident alongside the falling use of coal.

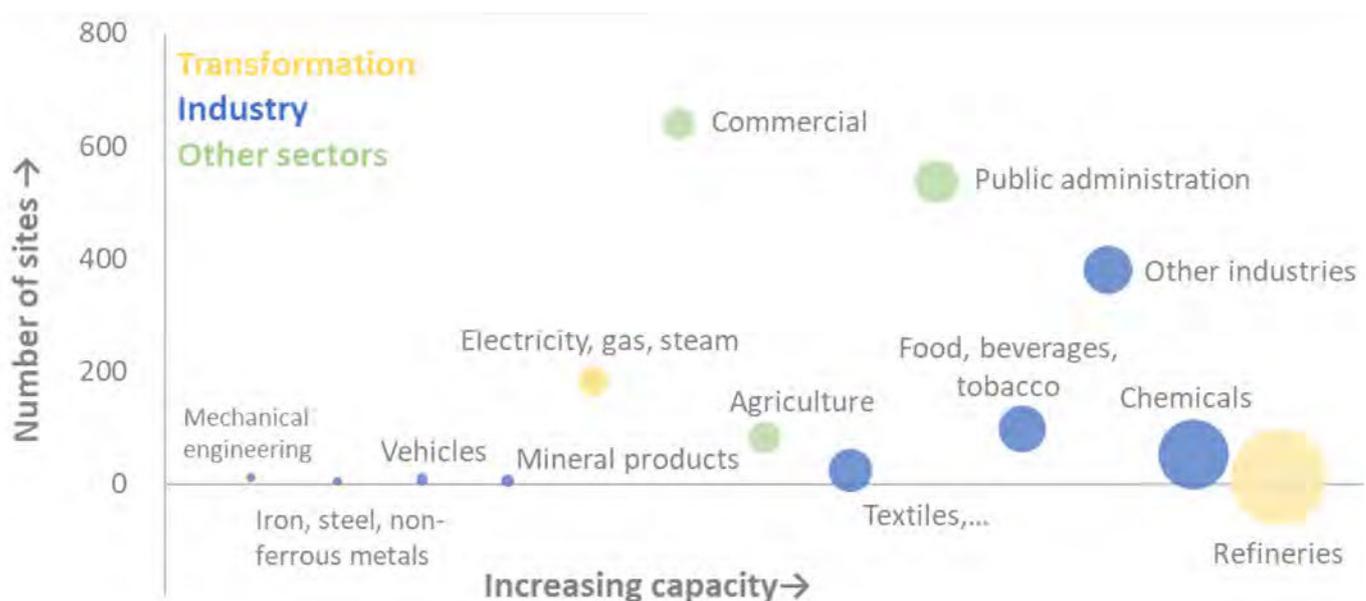
**Chart 7.4 Trends in fuel demand for CHP 1996 to 2020** ([Table 7.9](#))



In 1996, natural gas' share was just 49 per cent. By 2000, it had risen to 70 per cent and has remained fairly consistent since. Conversely, coal and manufactured fuels' share represented 20 per cent in 1996 but had plummeted to 6.3 per cent by 2020. Use of renewables was fairly constant at around 2 per cent until as recently as 2008 but has steadily increased to a maximum of 2018 at 18 per cent, though it has fallen off slightly to 15 per cent in 2020.

CHP is deployed across a variety of sectors including power generation, refineries, industry and commercial. Chart 7.5 shows the relationship between capacity by sector and the number of schemes.

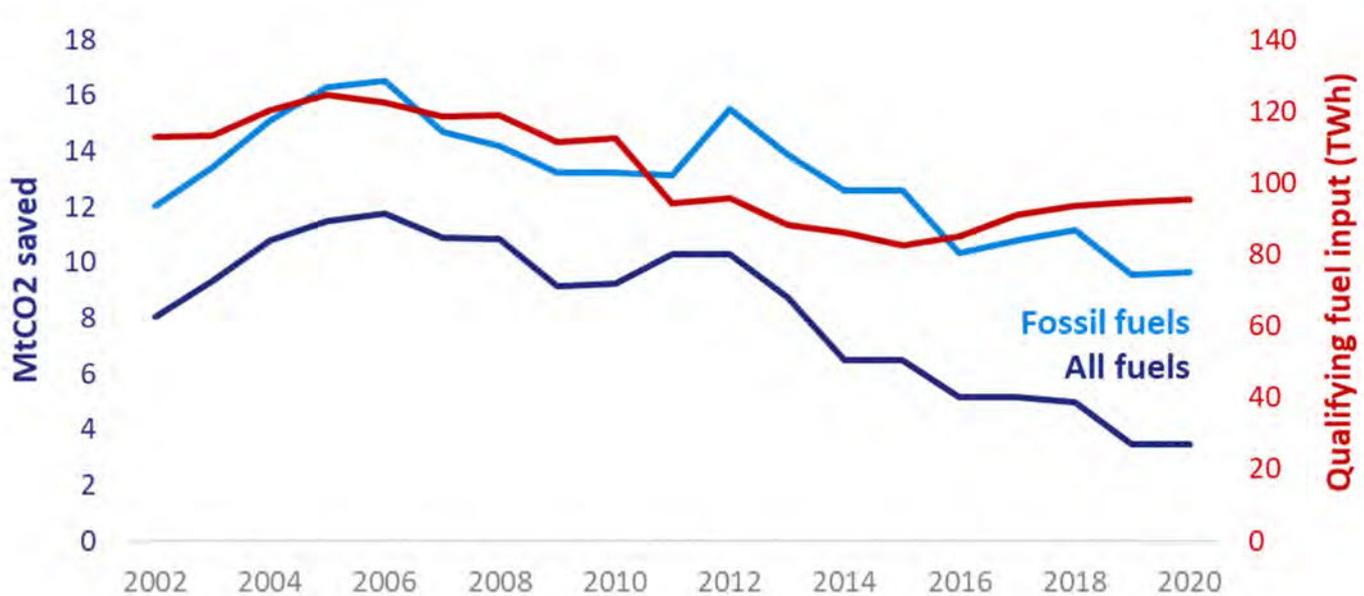
**Chart 7.5 CHP capacity and proliferation by sector** ([Table 7.8 \(b\)](#))



Although refineries account for the largest share of capacity, 36 per cent, it represents just 0.6 per cent of the number of sites. In contrast, the commercial sector has 31 per cent of the sites but accounts for just 3.8 per cent of the capacity.

The efficiency gains through cogeneration offer emissions savings, the key driver behind government support for CHP. An estimate of these savings is shown in Table 7.11, a new table included this year to show a longer time series. Total emissions from CHP are dependent on the fuel consumed by schemes but the emissions saved are additionally dependent on the fuel mix of the electricity displaced, i.e., the carbon intensity of the grid which is falling due to the increasing proportions of primary nuclear and renewables from wind, solar, and hydro. As CHP is mostly thermal generation, a comparison is also made with fossil fuels only.

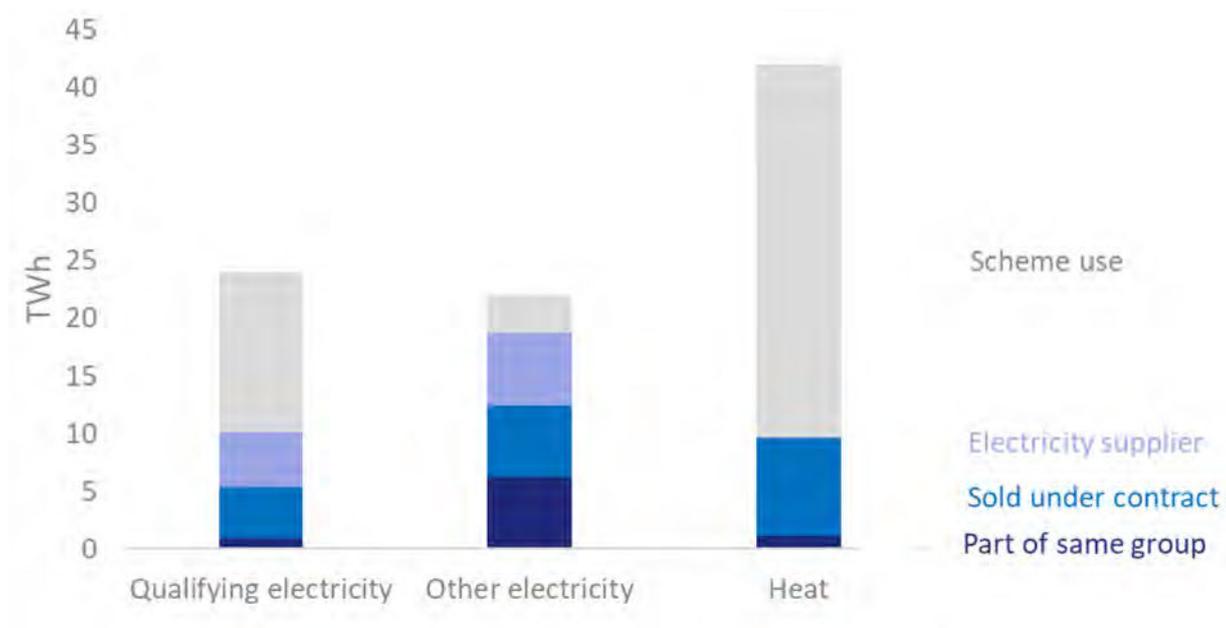
**Chart 7.6 Emissions saved through qualifying CHP 2002-2020**



Carbon savings for CHP are falling in line with the carbon intensity of the grid overall though when considering fossil fuels only, the trend is more stable with fluctuations year on year rather than a definite trend.

**In 2020, 30 per cent of qualifying outputs (heat and electricity) were exported** with the remaining 70 per cent being used within the scheme. Exports are classified as being either exported to a consumer within the same qualifying group of companies, to an electricity supplier, or sold under contract (i.e. to a consumer not part of the same group). Chart 7.7 shows a comparison for exports compared to own use by heat, qualifying and other electricity generation.

**Chart 7.7 CHP exports and own use 2020**



Less than half of qualifying electricity is exported (42 per cent) with the majority being split between power suppliers and sold under contract. Other generation, however, is mostly exported (85 per cent) with exports fairly evenly distributed across the output sectors. Heat is mostly consumed within the CHP scheme but of the heat which is exported, the majority is sold under contract (this heat is reported under the 'heat sold' column in [DUKES Table 1.1](#)).

# Data tables in this release

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- 1.4-1.6 Value balance of traded energy
- 1.7 Sales of electricity and gas by sector

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- 1.1.2 Availability and consumption of primary fuels and equivalents (energy supplied basis)
- 1.1.3 Comparison of net imports of fuel with total consumption of primary fuels and equivalents
- 1.1.4 Primary energy consumption, gross domestic product, and the energy ratio
- 1.1.5 Energy consumption by final user (energy supplied basis)
- 1.1.6 Expenditure on energy by final user
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- 3.9 Imports of crude oil and petroleum products by country of origin
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- 4.2 Supply and consumption of natural gas and colliery methane
- 4.3 UK continental shelf and onshore natural gas production and supply
- 4.4 Gas storage sites and import/export facilities in the United Kingdom, November 2020
- 4.5 Natural gas imports and exports
- 4.6 Liquefied Natural Gas imports by terminal

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- 5.3 Fuel used in generation
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- 7.1 CHP installations by capacity and size range
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- 7.3 Fuel used by types of CHP installation
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- 7.5 CHP - electrical capacity by fuel and type of installation
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- 7.8 CHP capacity, output, and total fuel use by sector
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### **CHP long term trends**

- 7.1.1 Combined Heat and Power: capacity, generation, and fuel use
- 7.1.2 Combined Heat and Power: capacity and electricity generation by capacity band

## **Symbols used in data tables**

.. not available                    - nil or not separately available                    r revised since the previous edition

Individual entries in the tables are rounded independently and this can result in totals, which are different from the sum of their constituent items. Some of the data shown in this Digest may contain previously unpublished revisions and estimates of trade from HM Revenue and Customs and the Office for National Statistics. These data are included in Annex G.

# Annexes and annex tables

Full annex documents and tables can be found by visiting [the DUKES collection page](#).

## **Annex A: Energy and commodity balances, conversion factors, calorific values and density of fuels**

- A.1 Estimated average calorific values of fuels 2020
- A.2 Estimated average gross calorific values of fuels 1980, 1990, 2000, 2010 and 2018 to 2020
- A.3 Estimated average net calorific values of fuels, 1980, 1990, 2000, 2010 and 2018 to 2020
- A.4 Estimated average density of fuels 2002 to 2020

## **Annex B: Glossary and acronyms**

## **Annex C: Further sources of UK energy publications**

## **Annex D: Major events in the energy industry**

## **Annex E: Energy and the environment**

- E.1 Gas flared and vented by oil and gas fields and terminals

## **Annex F: Oil and gas resources**

- F.1 Crude oil and Natural Gas Liquids production
- F.2 Gas production
- F.3 Natural Gas Liquids net production
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## **Annex G: Foreign Trade**

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- G.2 Imports and exports of solid fuels
- G.3 Imports and exports of crude oil and petroleum products
- G.4 Imports and exports of crude oil by country
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## **Annex H: Flow charts**

## **Annex I: Energy balance net calorific values**

- I.1 Aggregate energy balance: net calorific values, 2004 to 2020

## **Annex J: Heat reconciliation**

- J.1 Heat sold reallocation, 1999 to 2020

# Additional information

This section outlines the key principles when presenting energy statistics to help you understand the balance data tables. More information can be found in Annex A: Energy and commodity balances, conversion factors, calorific values and density of fuels. Annex B contains a glossary, which provides definitions of technical terms used. Annexes A and B can be accessed from [the main DUKES page](#).

## Balance principles

Balances are divided into two types, each of which performs a different function:

1. Commodity balance - a balance for each energy type that uses specific measurement units usually associated with that commodity. It shows the flow of the commodity from its sources of supply through to its final use. Commodity balances are presented in the individual fuel chapters of this publication.
2. Energy balance - presents the commodity balances in a common unit and places them alongside one another in a manner that shows the dependence of the supply of one commodity on another. The energy balance format is used in Chapter 1.

Both types show the flow of the type of energy from its supply through to its final use. The following sections give an overview of the supply and demand flows shown in each type of balance.

## Supply to the energy balances

### Production

This covers indigenous production and generation or manufacture of energy using other energy sources as fuel (for example, heating water using gas to produce steam turbine electricity).

### Other sources

This covers sources that do not represent “new” supply. These may be recycled products, recovered fuels (slurry or waste coal), electricity from pumped storage plants, or transfers of ethane, propane, and butane from gas stabilisation plants at North Sea terminals.

### Imports and exports

These figures relate to energy moving into or out of the UK. Exported commodities are produced in the UK and imported commodities are for use within the UK. The figures thus exclude commodities that move into and out of HM Revenue and Customs bonded areas.

### Marine bunkers

These are deliveries of fuels (usually fuel oil or gas oil) to ships of any flag for consumption during their voyage to other countries.

### Stock changes

Additions to and withdrawals from stocks held by producers and transformation industries correspond to withdrawals from (- sign) and additions to supply (+ sign), respectively.

### Transfers

A movement of a fuel out of one type is shown with a negative sign, to indicate that it has been withdrawn from supply. The movement into the other fuel is shown as a positive. The transfers row would ideally sum to zero, but differences in calorific values can result in non-zero values. There are several reasons why quantities may be transferred from one commodity balance to another:

- a commodity may no longer meet the original specification and be reclassified.
- the name of the commodity may change through a change in use.
- to show quantities returned to supply from consumers. These may be by-products rather than fuels.

The total supply available for national use is obtained by summing these flows in the balance.

## Statistical differences

Any excess or shortfall in supply compared to demand is shown as a statistical difference. A negative figure indicates that demand exceeds supply. These arise because data has been gathered from a variety of independent sources and reflect differences in timing, in definition of activity or commodity. Differences also arise in the measurement of the flow of the commodity. A non-zero statistical difference is normal and, within reason, is preferable to a statistical difference of zero, which would suggest that a data provider has adjusted a figure to balance the account.

## Demand in the energy balances

The demand section is divided into demand for transformation, for use in the energy industries, and a section covering uses by final consumers.

### Transformation

This covers processes and activities that transform the original primary (and sometimes secondary) commodity into another type. Most transformation corresponds to an industry whose main business is to manufacture a particular type of energy such as electricity generators. Some activities produce another commodity as a by-product. All are included in the energy balances.

### Electricity generation

Quantities of fuels burned for the generation of electricity. The activity is divided into two parts, covering the major power producers (for whom the main business is the generation of electricity) and autogenerators (who produce electricity as a by-product of another process). Where a generator uses combined heat and power plant, the figures include only the part of the fuel use corresponding to the electricity generated.

### Heat generation

Quantities of fuel burned to generate heat that is sold under contract to a third party. This includes heat that is generated and sold by combined heat and power plants and by community heating schemes (also called district heating).

### Petroleum refineries

Crude oil, natural gas liquids and other oils needed by refineries for the manufacture of finished oil products.

### Coke manufacture and blast furnaces

Quantities of coal for coke ovens and all fuels used within blast furnaces. The consumption of fuels for heating coke ovens and the blast air for blast furnaces are shown under Energy industry use.

### Patent fuel manufacture

Coals and other solid fuels used for the manufacture of solid patent fuels.

### Other

Any minor transformation activities not specified elsewhere.

### Energy industry use

Consumption by both extraction and transformation industries to support the transformation process (but not for transformation itself). Typical examples are the consumption of electricity in power plants, or the use of extracted gases on oil and gas platforms.

### Losses

Intrinsic losses that occur during the transmission and distribution of electricity and gas (including manufactured gases). Other metering and accounting differences for gas and electricity are within the statistical difference, as are undeclared losses in other commodities.

## Final consumption

This covers consumption of commodities for energy and non-energy uses. The energy disappears from the account after use. Final consumption for energy purposes is divided into use by sector of economic activity. The classification of consumers according to their main business follows, as far as practicable, Standard Industrial Classification codes (SIC 2007). The section on Sector breakdowns below shows the breakdown of final consumers used, and how this corresponds to SIC codes 2007.

## Sector breakdowns

Categories for final consumption are defined by Standard Industrial Classification codes 2007:

Category of user	SIC 2007
Fuel producers	05-07, 09, 19, 24.46, 35
Iron and steel	24 (excluding 24.4, 24.53 and 24.54)
Other industry	08, 10-18, 20-23, 24.4 (excluding 24.46), 24.53, 24.54, 25-33, 36-39, 41-43
Transport	49-51
Agriculture	01-03
Commercial	45-47, 52-53, 55-56, 58-66, 68-75, 77-82
Public administration	84-88
Other services	90-99
Domestic	Not covered by SIC, defined as deliveries to residential properties

The qualifications to, and constraints on, use of the classification are described in [the energy balance methodology note](#).

# Technical information

## Methodology

More detailed notes on the methodology used to compile the figures and data sources are available on the collection pages for each fuel. The figures have not been adjusted for temperature or seasonal factors except where noted. Percentage changes relate to the corresponding period a year ago. They are calculated from unrounded figures. They are shown as (+) or (-) when very large. Figures relate to the United Kingdom unless otherwise indicated. Further information is available from the Oil & Gas Authority at [www.ogauthority.co.uk/](http://www.ogauthority.co.uk/).

## Standard conversion factors

This Digest uses the tonne of oil equivalent (toe) as the common unit of energy for comparing and aggregating fuels. The following table gives factors for converting between this unit and alternative units of energy found in this and other publications (see Chapter 1, Technical notes and definitions and Annex A).

To	Ktoe	TJ	GWh	million therms	To	toe	GJ	kWh	therms
From	Multiply by				From	Multiply by			
Ktoe	1	41.868	11.63	.39683	toe	1	41.868	11.63	396.83
TJ	.023885	1	.27778	.0094778	GJ	.023855	1	277.78	9.4778
GWh	.085985	3.6	1	.034121	kWh	.000085985	.003600	1	.034121
million therms	2.52	105.51	29.307	1	therms	.00252	.105510	29.307	1

toe = tonne of oil equivalent

ktoe = thousand tonne of oil equivalent

## A selection of estimated average gross calorific values for 2020 (see also Annex A)

Fuel category	GJ per tonne	Fuel category	GJ per tonne
Solid fuels		Renewable sources	
Coal		Domestic wood	16.3
All consumers (weighted average)	26.9	Industrial wood	20.3
Power stations (including imports; weighted average)	26.5	Municipal solid waste	9.9
Iron and steel	30.4	Petroleum	
Other industries (weighted average)	26.7	Crude oil (weighted average)	45.7
Imported coal (weighted average)	28.4	Petroleum products (weighted average)	46.2
Exported coal (weighted average)	28.0	Petrol	47.0
Coke	29.8	Gas/diesel oil	45.3
Coke breeze	29.8	Road diesel	45.6
Other manufactured solid fuel	29.6	Fuel oil	43.4
Gases			
Natural gas (produced)	39.9		
Landfill gas	21-25		
Sewage gas	21-25		

## Geographical coverage

The geographical coverage of the statistics is the United Kingdom. However, within UK trade statistics, shipments to the Channel Islands and the Isle of Man from the United Kingdom are not classed as exports. Supplies of solid fuel and petroleum to these islands, from the UK, are therefore included as part of United Kingdom inland consumption or deliveries.

## Revisions policy

Figures for the latest periods are provisional and are liable to subsequent revision. The [BEIS statistical revisions policy](#) sets out the revisions policy for these statistics, which has been developed in accordance with the UK Statistics Authority [Code of Practice for Statistics](#). BEIS's [statements of compliance with the Code](#) are available online, as well as the [UK Statistics Authority reports on their regular assessments of BEIS's energy statistics](#). The authority's recommendations have been incorporated into this publication and other BEIS energy statistical publications and outputs.

DUKES tables contain revisions to some of the previously published figures, and where practicable the revised data have been indicated by an 'r'. The 'r' marker is used whenever the figure has been revised from that published in the prior Digest, even though some figures may have already been amended on the published version of the tables. A table showing the size of revisions to key aggregates is shown below. Statistics on energy in this Digest are classified as National Statistics. This means that they are produced to high professional standards as set out in the UK Statistics Authority's Code of Practice for Official Statistics. The Code of Practice requires that all the public bodies that produce official statistics "Publish a revisions policy for those outputs that are subject to scheduled revisions, and provide a statement explaining the nature and extent of revisions at the same time that they are released". The following statement outlines the policy on revisions for energy statistics.

It is intended that any revisions should be made to previous years' data only at the time of the publication of the Digest. In exceptional circumstances previous years' data can be amended between Digest publication dates, but this will only take place when quarterly Energy Trends is published. The reasons for substantial revisions will be explained in the 'Highlights' sheet of the table concerned.

Valid reasons for revisions of Digest data include:

- Revised and validated data received from a data supplier.
- The figure in the Digest was wrong because of a typographical or similar error.
- In addition, when provisional annual data are published in Energy Trends in March, growth rates are liable to be distorted if the prior year's data are constrained, when revisions are known to be required. In these circumstances the prior year's data will be amended for all affected tables in Energy Trends and all affected Digest tables will be clearly annotated to show that the data has been updated in Energy Trends.

All validated amendments from data suppliers will be updated when received and published in the next statistical release.

All errors will be amended as soon as identified and published in the next statistical release.

Data in energy and commodity balances format will be revised on a quarterly basis, to coincide with the publication of Energy Trends.

This year, the revisions window for DUKES has been opened back to 2008 to include more accurate data on the supply and demand of domestic wood and heat pumps in the bioenergy and waste commodity balances.

## Revisions since DUKES 2020

Thousand tonnes of oil equivalent	2018	2019	Percentage revisions to 2019 data
Production	-1,119	-2,039	-1.6%
Primary supply	-2,841	-4,990	-2.5%
Primary demand	-2,369	-4,532	-2.3%
Transformation	-57	1,082	-3.3%
Energy industry use	-47	-163	-1.3%
Final consumption	-2,240	-3,122	-2.1%
Industry	185	80	0.4%
Transport	18	-20	0.0%
Other	-2,444	-3,203	-5.1%
Non energy use	0	21	0.3%

## Background to the Digest

This issue of the Digest of United Kingdom Energy Statistics (DUKES) continues a series which commenced with the Ministry of Fuel and Power Statistical Digest for the years 1948 and 1949, published in 1950. The Ministry of Fuel and Power Statistical Digest was previously published as a Command Paper, the first being that for the years 1938 to 1943, published in July 1944 (Cmd. 6538).

The current publication consists of seven chapters and four annexes. The first chapter deals with overall energy. The other chapters cover the specific fuels, renewable sources of energy and combined heat and power. The annexes cover conversion factors and calorific values, a glossary of terms, further sources of information and major events in the energy industries.

Where necessary, data have been converted or adjusted to provide consistent series. However, in some cases changes in methods of data collection have affected the continuity of the series. The presence of remaining discontinuities is indicated in the chapter text or in footnotes to the tables.

Chapters 6 and 7 summarise the results of surveys conducted by Ricardo Energy & Environment on behalf of BEIS, which complement work undertaken by BEIS. These chapters estimate the contribution made by renewable energy sources to energy and combined heat and power (CHP) production and consumption in the United Kingdom.

## Acknowledgements

Acknowledgement is made to the main coal producing companies, the electricity companies, the oil companies, the gas pipeline operators, the gas suppliers, National Grid, the Institute of Petroleum, the Coal Authority, the United Kingdom International Steel Statistics Bureau, Ricardo Energy & Environment, the Department for Environment, Food and Rural Affairs, the Department for Transport, OFGEM, Building Research Establishment, HM Revenue and Customs, the Office for National Statistics, and other contributors to the enquiries used in producing this publication.

# National Statistics and user engagement

## National statistics

This is a National Statistics publication. National Statistics status means that our statistics meet the highest standards of trustworthiness, quality, and public value, and it is our responsibility to maintain compliance with these standards.

The United Kingdom Statistics Authority has designated these statistics as National Statistics, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the UK Statistics Authority: Code of Practice for Statistics.

The continued designation of these statistics as National Statistics was confirmed in September 2018 following a compliance check by the Office for Statistics Regulation. The statistics last underwent a full assessment against the Code of Practice in June 2014.

Designation can be broadly interpreted to mean that the statistics:

- meet identified user needs.
- are well explained and readily accessible.
- are produced according to sound methods, and
- are managed impartially and objectively in the public interest.

Once statistics have been designated as National Statistics it is a statutory requirement that the Code of Practice shall continue to be observed.

## Pre-release

Some ministers and officials receive access to these statistics up to 24 hours before release. Details of the arrangements for doing this and a list of the ministers and officials that receive pre-release access to these statistics can be found in the [BEIS statement of compliance](#) with the Pre-Release Access to Official Statistics Order 2008.

## User engagement

Users are encouraged to provide comments and feedback on how these statistics are used and how well they meet user needs. Comments on any issues relating to this statistical release are welcomed.

Enquiries about statistics in this publication should be made to the contact named at the start of the relevant chapter. Brief extracts from this publication may be reproduced provided that the source is fully acknowledged. General enquiries about the publication, and proposals for reproduction of larger extracts, should be addressed to BEIS.

The Department for Business, Energy and Industrial Strategy (BEIS) reserves the right to revise or discontinue the text or any table contained in this Digest without prior notice.

# Related statistics

The Department for Business, Energy and Industrial Strategy make available other publications related to energy supply and demand that may be of interest. A full list of these and other related energy publications can be found in DUKES Annex C: Further sources of UK energy publications.

## **Energy Trends**

More frequent monthly and quarterly data are available for total energy, solid fuels and derived gases, petroleum, gas, electricity, and renewables:

[www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics](http://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics)

## **Energy prices**

Monthly and quarterly prices by consumption sector and international comparisons of prices paid:

[www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics](http://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics)

## **Energy Flow Chart**

Annual publication illustrating the flow of primary fuels from home production and imports to their eventual final uses. They are shown in their original state and after being converted by secondary fuel producers:

[www.gov.uk/government/collections/energy-flow-charts](http://www.gov.uk/government/collections/energy-flow-charts).

## **UK Energy in Brief**

Annual publication summarising the latest statistics on energy production, consumption, and prices in the United Kingdom. The figures are taken from this Digest of UK Energy Statistics:

[www.gov.uk/government/collections/uk-energy-in-brief](http://www.gov.uk/government/collections/uk-energy-in-brief)

## **Sub-National Energy Consumption**

Annual publication supporting local and regional decision making to deliver national energy policy objectives:

[www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics](http://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics)

## **UK Greenhouse Gas Emissions**

Show progress against the UK's goals, both international and domestic, for reducing greenhouse gas emissions:

[www.gov.uk/government/collections/uk-greenhouse-gas-emissions-statistics](http://www.gov.uk/government/collections/uk-greenhouse-gas-emissions-statistics)



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## Annex E: Energy and the environment

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### Carbon dioxide emissions

Provisional 2020 results for UK Greenhouse Gas emissions and progress towards targets were published on 25<sup>th</sup> March 2021. A copy of the statistical release and associated data tables are available at:

<https://www.gov.uk/government/collections/provisional-uk-greenhouse-gas-emissions-national-statistics>

### Oil pollution and oil releases

The total amount of oil released offshore during 2020 was approximately 7.9 tonnes. The amount of oil released around the coast of the United Kingdom and offshore in the North Sea is small in relation to total oil production. The number of oil release reports recorded in 2020 was 167, down from 215 in 2019. There was 1 incident where oil released exceeded 1 tonne (1.7 tonnes), down from 4 in 2019.

In 2020, the average content of oil in water was 23.9 milligrams per litre, compared to 19.8 in 2019. The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (OPPC) came into effect in August 2005. Under OPPC installations are granted a permit for activities discharging oil contaminated water to sea, but the oil content must not exceed 20 milligrams per litre.

Data on oil releases is available via the [Environmental and Emissions Monitoring System \(EEMS\)](#) which is maintained by the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED).

### Gas flaring

Under the terms of petroleum production licenses, gas may be flared only with the consent of the Oil and Gas Authority (OGA) (formerly the Secretary of State). Flaring in 2020 was estimated to be 992 million cubic this was down more than 20 per cent on 2020. This reduction was largely due to fewer planned shutdowns because of the Covid-19 pandemic. In addition, 2020 saw an increase in use of flare reduction technology.

An additional 265 million cubic metres was vented. Cumulatively gas flared and vented accounted for the equivalent of 3.2 per cent of gross gas production, down from 4 per cent in 2019.

Gas flared and vented has declined in line with production since 2001. A time series of gas flared and vented at terminals, oil fields and gas fields can be found in [Table E.1](#).



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# Annex F: Oil and gas resources

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Data are received via the Oil and Gas Authority's (OGA) Petroleum Production Reporting System (PPRS). Further information is available via the [OGA](#). The following supplementary tables can be downloaded [here](#):

- Table F.1 Crude oil and Natural Gas Liquids Production
- Table F.2 Gas Production
- Table F.3 Natural Gas Liquids Net Production
- Table F.4 Disposals of Crude Oil
- For long term trends:
  - Oil 3.1.1 Crude oil and petroleum products: production, imports and exports
  - Gas 4.1.1 Natural gas and colliery methane production and consumption

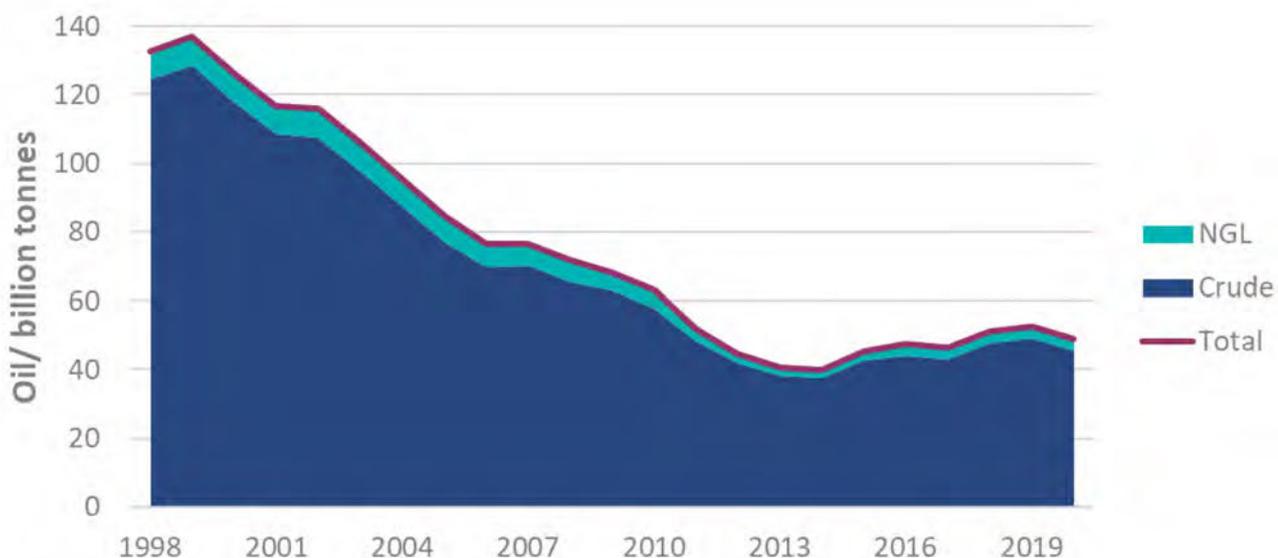
## Oil and gas reserves

Data on oil and gas reserves is available from the [OGA](#).

## Production

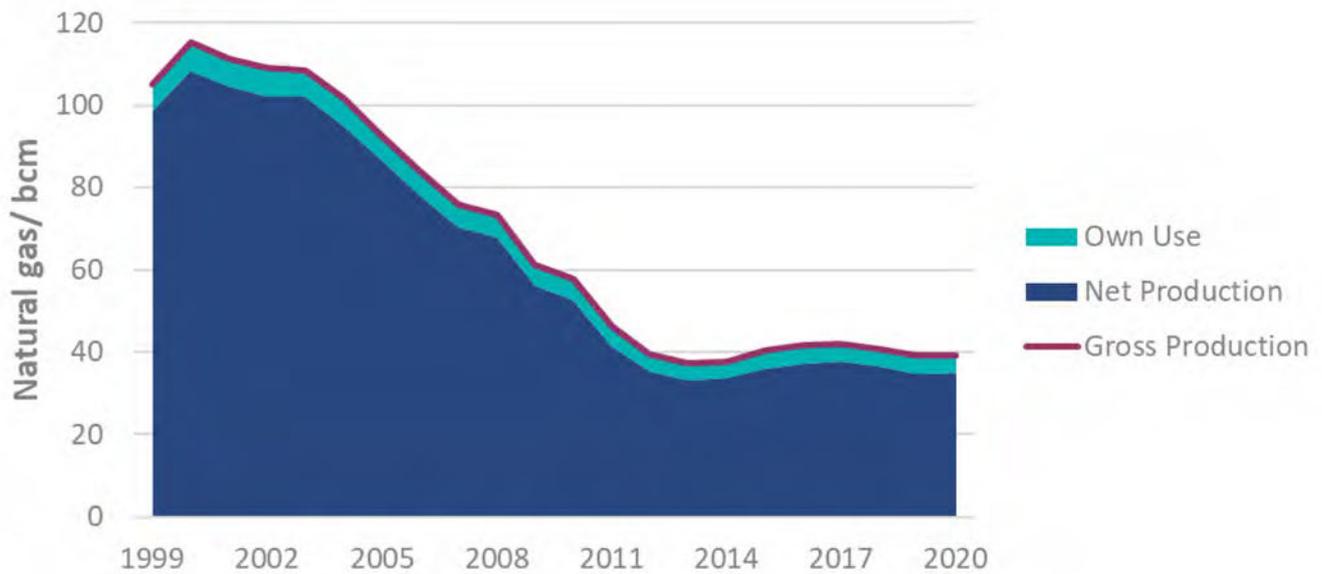
Tables F.1-F.3 show production of crude oil, natural gas and natural gas liquids (NGLs). Following the introduction of the Petroleum Production Reporting System (PPRS) in 2001, aggregate production figures are calculated using mainly terminal level data. Prior to this aggregate production figures were calculated using field level well-head data. The new method is more accurate because oil that leaves the terminal has been stabilised, that is any water, NGLs or other organic compounds have been removed. Field level data is still available via the [OGA](#).

**Chart F.1 Oil and NGL production 1998-2020, UK**



Crude oil production peaked in 1999 at 137 million tonnes. Following this production has generally declined. Small increases from 2014 are due to new investment and the completion of new projects. In 2020, oil production was 48 million tonnes, 35 per cent of the peak but stable on 2019.

**Chart F.2 Gas Production 1999-2020, UK**

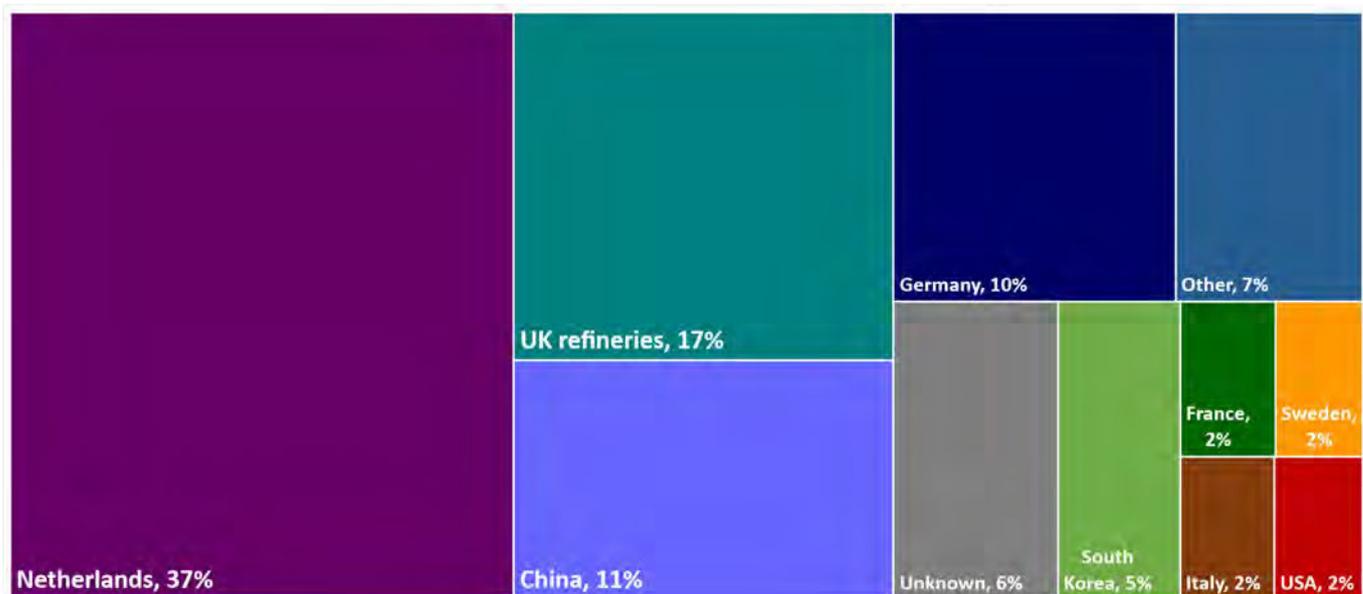


Natural gas production peaked in 2000 at 115 billion cubic metres. Similar to oil production, this peak was followed by several years of decline until 2015. Unlike oil, since 2017 declines in production from well-established fields have outstripped any gains following investment. In 2020, gas production was 39 billion cubic metres, 34 per cent of the peak. However, this was stable on 2019 despite a challenging year for maintenance.

### Disposals of Crude Oil

Table F.4 and chart F.3 show the disposals of crude oil following extraction from the UKCS in 2020; disposals include deliveries to UK refineries and exports abroad. Disposals to the Netherlands were the largest accounting for 37 per cent of the total, this was followed by disposals to UK refineries which accounted for 17 per cent. The other category includes 13 countries each accounting for 1 per cent or less of the total. The UK exported to Brunei for the first time in 2020.

**Chart F.3 Disposals of crude from the UK in 2020**



Other of which, Portugal 1.3%, Norway 1.2%, Spain 1.0%, Gibraltar 0.9%, Poland 0.6%, Brunei 0.6%, India 0.3%, Canada 0.2%, Greece 0.2%, Bulgaria 0.2%, Finland 0.2%, Belgium 0.1%, Denmark 0.1%.

The export figure in table F.4 and chart F.3 may differ from those in Chapter 3 or published by the United Kingdom Petroleum Industry Association (UKPIA). These figures also include oil that has previously been imported and therefore is not part of UKCS production.



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## Annex G: Foreign trade

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### Main points for 2020

Provisional data from HMRC show that:

- There was a total of 125.6 million tonnes of oil equivalent (mtoe) of fuels for energy use imported to the UK in 2020 which was 13 per cent lower than the amount imported in 2019 (Table G.1).
- Exports of fuels rose in 2020 by 2 per cent to 88.2 mtoe (Table G.1).
- The energy trade deficit stood at £1.3 billion (Overseas Trade Statistics basis), 62 per cent less than in 2019 (Table G.7).

By fuel type:

- Coal imports fell by 24 per cent to 5.4 million tonnes in 2020 (Table G.2).
- The UK was, for the first time since 2004, a net exporter of crude oil in 2020, net exports were 0.7 million tonnes (Table G.3).
- HMRC data shows that the UK was a net importer of petroleum product in 2020 by 2.2 million tonnes which was 80 per cent less than in the previous year (Table G.3).
- Gas imports in 2020 at 478 TWh were 8 per cent lower than previous year. There was an 11 per cent drop in imports of gas via the Norway pipelines to 200 TWh (Table G.5).

### Introduction

This annex provides an overview of published trade data by HM Revenue and Customs (HMRC) on energy products in the UK. The data for this annex are presented in Tables G.1 – G.7 of DUKES, also available from [the HMRC website](#); it provides an overview of the UK energy trade commodities which also corresponds with that published in the Overseas Trade Statistics for the United Kingdom. The first section covers energy trade volumes and the second covers energy trade value.

Volume information focuses on the declaration made to HMRC on UK imports and exports in relation to countries outside the European Union (EU) as well as on arrivals and despatches (equivalent to imports and exports respectively) in relation to EU member states. In Table G.1 BEIS has converted HMRC data into million tonnes of oil equivalent (mtoe), so that energy sources can be combined to provide an overview of total trade. The value information previously corresponded to that published by the Office for National Statistics energy trade value data but data for 2016 onwards uses data direct from source, the HMRC UK Trade Info data.

In this annex, BEIS has used estimates based on its industry trade reports for some recent gas data to improve on the accuracy and quality of the data. Those estimates are indicated and footnoted in the tables. There are some differences in methodology between the HMRC energy trade data and the Department for Business, Energy and Industrial Strategy's data presented in the main chapters of DUKES. In the main chapters, the trade data are produced from a combination of data from HMRC and direct from companies responding to BEIS statistical surveys.

### Volume

#### Overview - Import and export of fuels

In the 1970s the UK was a net importer of energy. Discoveries of oil and gas from the North Sea and the price spikes of 1973 led to a large rise in domestic UK crude oil production. In the early 1980s the UK became a net exporter of energy. However, because of the Piper Alpha disaster in 1988 oil production fell, leading to the UK reverting to being a net importer of energy. The UK once again became a net exporter in the mid-1990s because of growth in the North Sea production, but after the peak in 1999, North Sea production slowed and

since 2004 the UK once again became and has remained a net importer of fuels. Chart G.1 shows the UK net import dependence level (net imports compared to supply) from 1970 to 2020, based on BEIS data. Following the peak in 2013 net import dependency has fallen, with a sharp fall in 2015 (down 8.7 percentage points). Net import dependency also fell sharply in 2020 (down 7.1 percentage points on the previous year).

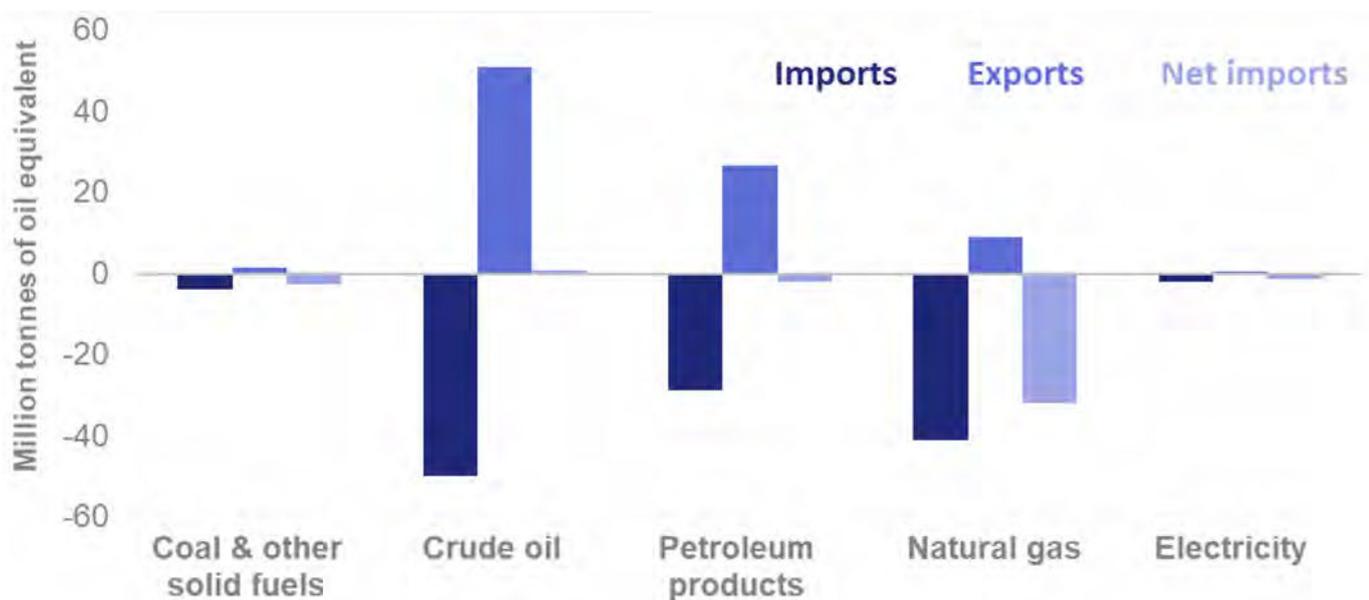
**Chart G.1: UK import dependency, 1970 – 2020**



Source: BEIS

Chart G.2 illustrates trade by fuel type based on HMRC volume data for coal, crude oil, and petroleum products and BEIS energy trends data on natural gas and electricity. The UK had for a long time been a net exporter of petroleum products. However, since 2014 the UK has become and remains a net importer of petroleum products (though remained a net exporter for some of the refined products). In 2020, the UK net import of petroleum products was around 2 million tonnes of oil equivalent which was 82 per cent less than in the previous year.

**Chart G.2: Imports and exports by fuel type, 2020**



#### Coal and manufactured solid fuels

Imports of coal peaked in 2006. Since then, there has been a gradual decrease, as coal demand for electricity generation has fallen. Generation from coal became more attractive again between 2012 and 2013 as gas prices peaked, resulting in increased imports.

Coal imports have since fallen steeply as less coal is used in electricity generation. In 2020, the UK recorded 5,147 hours of no coal use in generating electricity, up from 3,666 in 2019. In 2020, the UK imported 5.4 million tonnes of coal and other solid fuels, 24 per cent (1.7 million tonnes) less than in the previous year. Chart G.3 illustrates the trends in the imports of coal by country for the years 2004-2020.

**Chart G.3 Imports of coal by country of origin, 2004 – 2020**

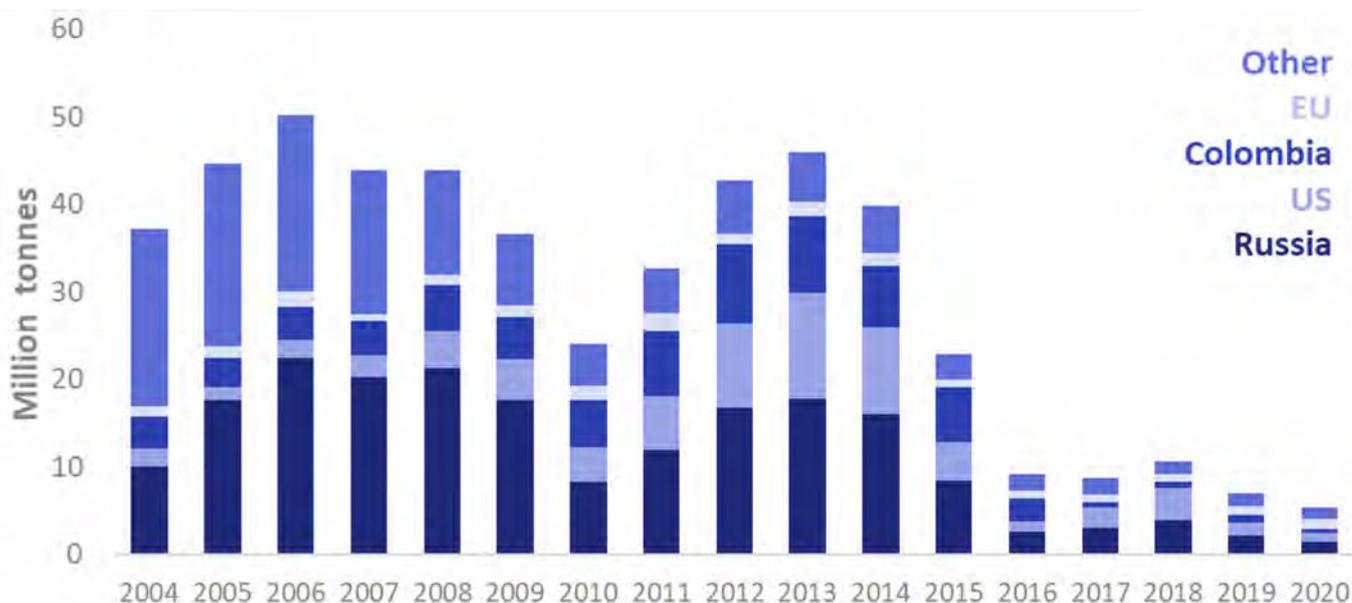


Table G.2, provides a breakdown of HMRC imports and exports of steam coal, coking coal (including coke and semi-coke of coal), anthracite and other solid fuels by country of origin and destination. Coal imports from Russia have been steadily increasing and in 2005, Russia overtook South Africa to become the UK's largest coal provider. Though it has since continued to be so; over the recent years imports of coal from Russia have declined sharply.

The bigger shares of coal imports in 2020, have been from Russia (27 per cent) and the EU (22 per cent). The EU taking over the second place from the US. In 2020 coal imports decreased by 24 per cent as imports from Russia and the US decreased by 33 per cent. Imports from the EU increased by 17 per cent. In 2020, coal from the US made up 19 per cent, and coal from Colombia made up 8 per cent of coal imports to the UK.

Of the total coal imported in 2020, 27 per cent was steam coal, 61 per cent was coking coal and the rest anthracite and other solid fuels. In 2020, steam coal imports were down by 53 per cent with imports from Russia down by 56 per cent to 0.6 million tonnes, from the US imports were down by 97 per cent to 0.02 million tonnes and from Colombia steam coal imports were down by 73 per cent to 0.1 million tonnes.

In 2020, 30 per cent of the UK coking coal imports (including coke and semi-coke of coal) came from the US followed by 26 per cent from Russia and another 15 per cent from Australia. The bulk of anthracite and other solid fuels imports were from EU countries.

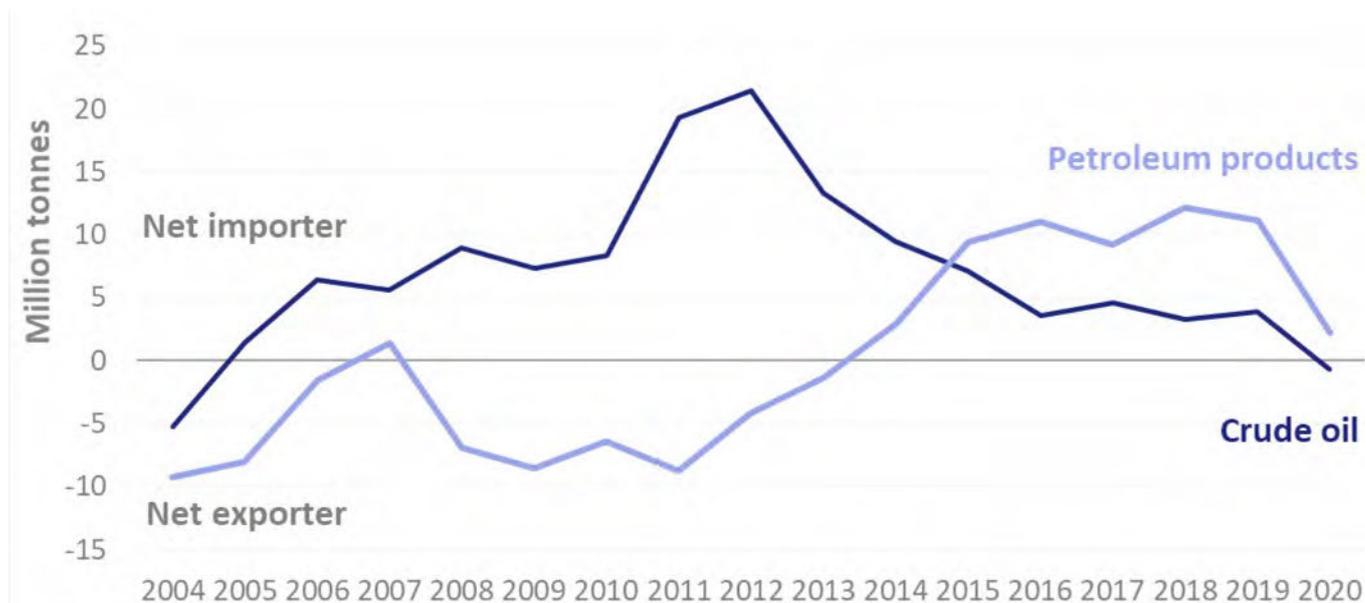
Exports of coal and other solid fuels rose by 88 per cent to 1.9 million tonnes in 2020 of which 23 per cent were to Germany and 19 per cent were to the Irish Republic.

### Crude oil and petroleum products

Trade quantities, in thousands of tonnes, of crude oil and refined petroleum products are shown in in Table G.3. In the table, the import values per tonne are expressed on a cost, insurance and freight (c.i.f) basis while the export values are on a free on board (f.o.b) basis (e.g., costs of goods to the purchaser abroad) – see Value section for more details.

Table G.4 provides trade data in crude oil by country where the import data, as far as possible, are on a 'country of origin' (or production) basis. Since becoming a net importer of crude oil in 2005, the UK's net imports of crude oil have steadily increased, rising significantly between 2010 and 2012. Net imports of crude oil as reported by HMRC (and BEIS) have since been on the decline. In 2020, the UK became a net exporter of crude oil for the first time since 2004 (Chart G.4).

**Chart G.4 Net trade of crude oil and petroleum products, 2004 – 2020**

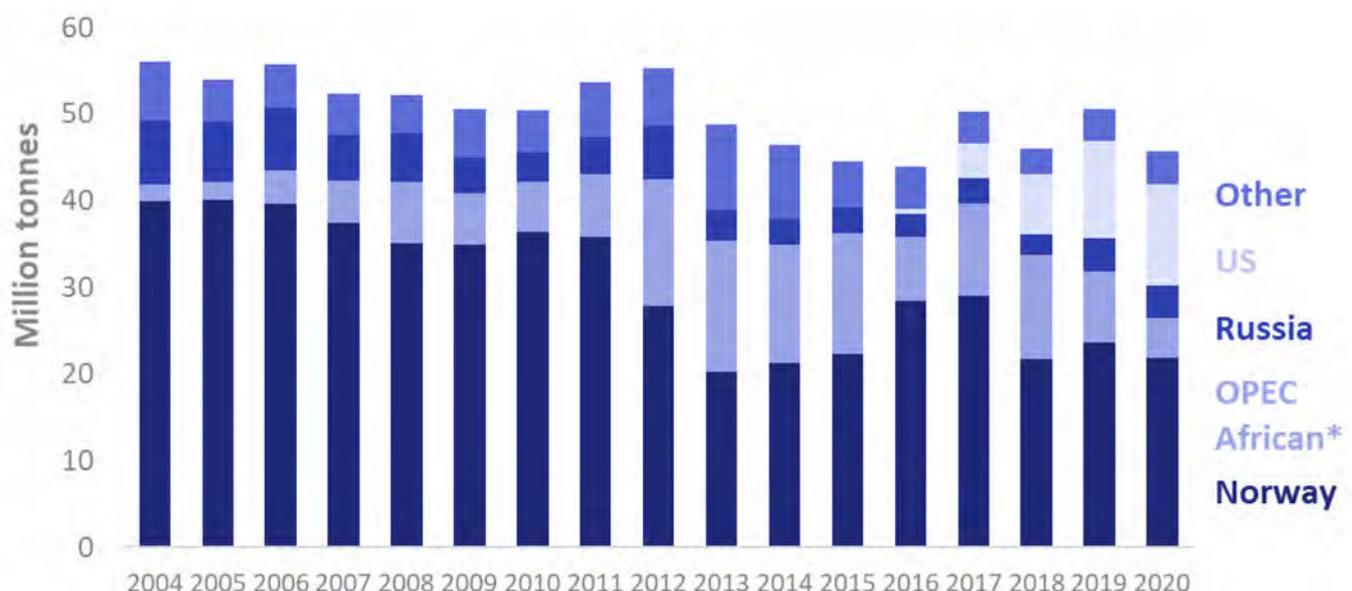


Norway remains the major crude oil supplier to the UK, supplying 48 per cent of all imports (chart G.5). In 2020, Norway imports were 7.5 per cent lower than the previous year and 24 per cent lower than the recent high in 2017. Of the remaining total crude imports 10 per cent (which was 44 per cent less than in the previous year) was from the OPEC African countries, namely Algeria, Libya, and Nigeria; 25 per cent was from the US while imports from Russia were 8.3 per cent of the total.

In 2020, exports of crude oil dropped by 0.9 per cent on the previous year while exports to EU countries were up by 14 per cent and accounted for 75 per cent of the UK's total exports of crude oil.

The UK's two largest markets in the EU are the Netherlands (up 27 per cent), followed by Germany (up 18 per cent); the bulk of the exports to Germany are for refining and consumption, whilst exports to the Netherlands include oil destined for onward trade to other countries. The largest non-EU markets for crude oil in 2020 were China, down 43 per cent on the previous year and accounting for 55 per cent of the total non-EU exports.

**Chart G.5 Imports of crude oil by country of origin, 2004 – 2020**



\* OPEC African members are Algeria, Angola, Nigeria and Libya

The main refined petroleum products imported into the United Kingdom remained as gas diesel oil, which accounted for 43 per cent of the total followed by jet fuel (kerosene type jet fuel), which accounted for 22 per

cent. The main refined petroleum products exported in 2020 were motor & aviation spirits which accounted for 22 per cent of the total exported. Other light oils and spirit accounted for 21 per cent and gas diesel oil accounted for a further 19 per cent and fuel oils 19 per cent. Jet fuel exports accounted for 6 per cent.

On a net trade basis, in 2020 HMRC data show that the UK was again a net importer of petroleum products with net imports of 2.2 million tonnes (Chart G.4), which was 8.9 million tonnes less than in the previous year. In 2020 the UK net imports of jet fuel were 4.5 million tonnes and of gas diesel oil 6.9 million tonnes. However, in 2020 the UK was also a net exporter of some petroleum products, including petrol (3.2 million tonnes) and fuel oils (2.5 million tonnes).

### Imports and exports of natural gas

Between 1997 and 2003 the UK was a net exporter of gas. UK gas production peaked in 2000 and has since been in general decline and broadly flat in recent years. As a result, the UK has sought to access additional supplies of gas from a range of sources to bridge the gap between indigenous production and demand as reserves on the UK Continental Shelf deplete.

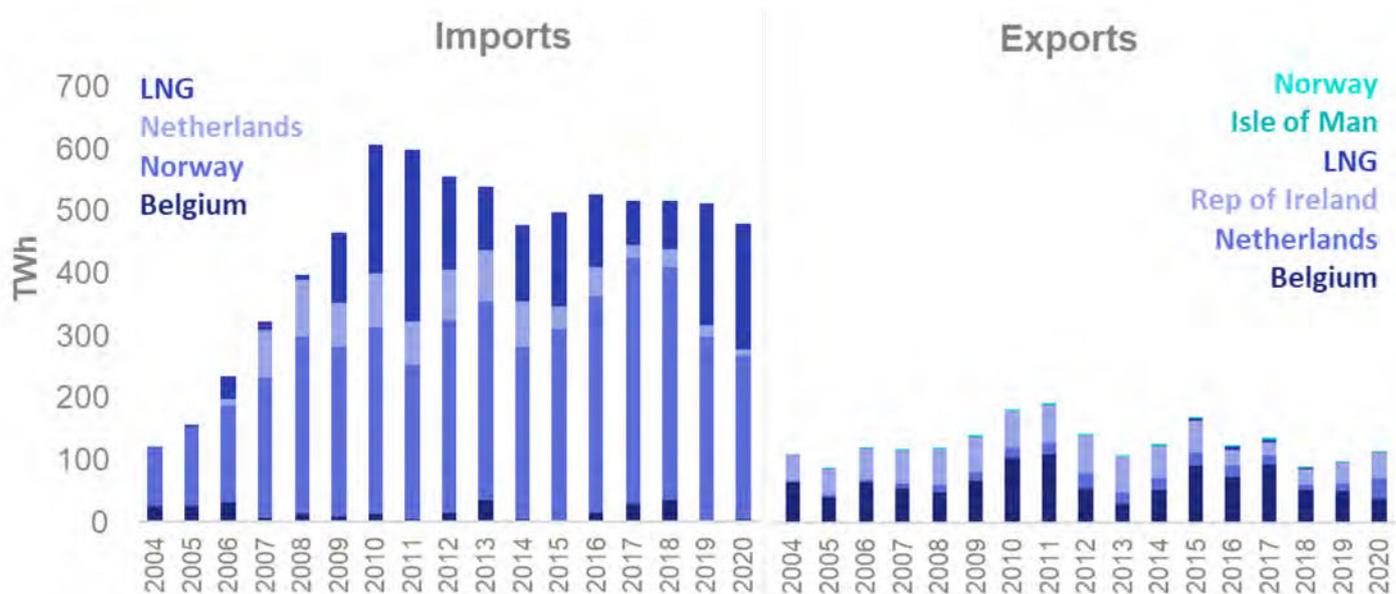
Since 1999 natural gas imports had been increasing sharply, reaching a peak in 2010 since when imports levels have declined, remaining broadly level in recent years. In 2020 gas imports were down by 6.5 per cent from the previous year. More than half (55 per cent) of gas imports came via the Norway pipelines, with 42 per cent coming via LNG. Chart G.6 depicts the trends in natural gas imports and exports by country. It also includes trends in the volume of LNG imports (see Chart G.7 for country breakdown of LNG imports).

The UK has one of the world's largest LNG import capacities, and the largest at a single installation in Europe at South Hook near Milford Haven. The UK also has an established pipeline structure to trade natural gas with the continent. Between 2015 and 2018 the UK exported LNG as 'reloads' because a long-term supply contract fixed lower acquisition prices, making it financially viable to export. However, following the ending of this contract the UK has not exported LNG but has taken advantage of the low spot market prices to secure LNG supply from a diverse range of sources.

Table G.5 gives a breakdown of imports and exports of natural gas by country of origin and destination. The data in the table are physical flows as reported by the pipeline or terminal operators to BEIS. Whilst the data presented in the table differ from the nominated flows reported in Chapter 4, the overall net flows (e.g., net imports or net exports) are the same.

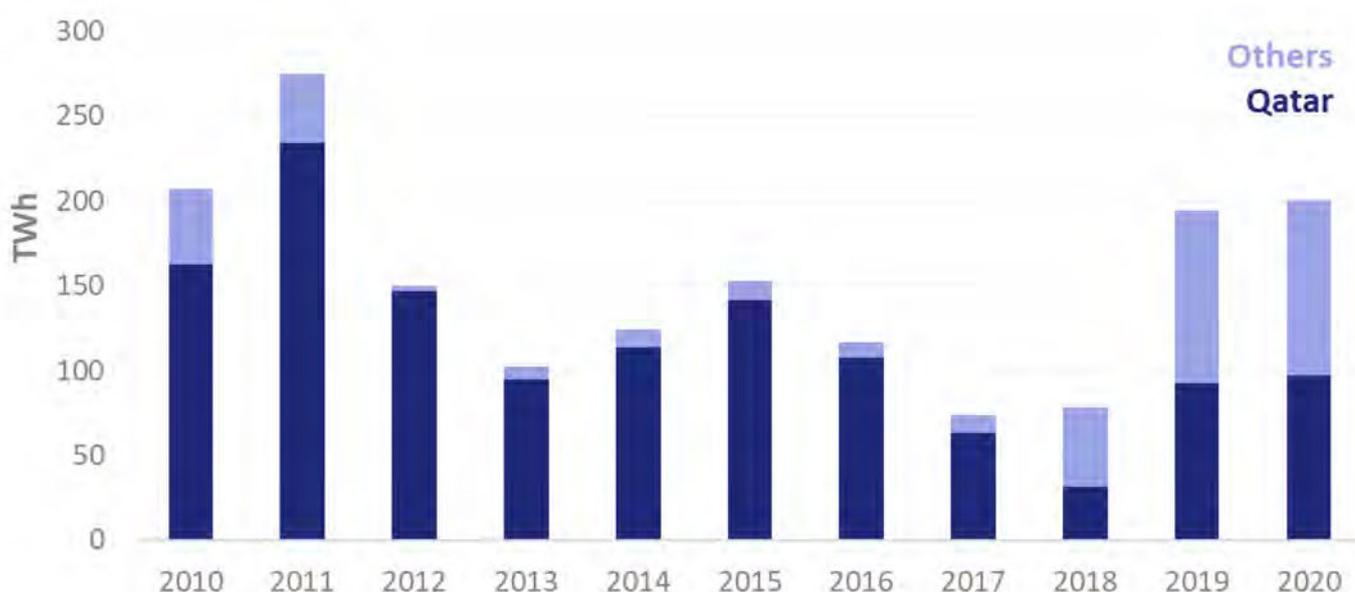
In 2020 the UK exported 106 TWh of gas which was 17 per cent higher than in 2020. Belgium was one of the main destinations of UK gas exports (from where it could be shipped elsewhere in mainland Europe), exporting 36 TWh of gas in 2020, a 25 per cent drop on the previous year. The Republic of Ireland was another where 38 TWh was exported, a 22 per cent increase on the previous year. The other main destination of UK gas exports was the Netherlands via the UK share gas fields using the Dutch WGT pipeline system to Den Helder and Uithuizen. The UK exported 31 TWh of gas to the Netherlands in 2020, more than tripling the volume in 2019.

**Chart G.6 Imports and exports of natural gas by country, 2004 – 2020**



LNG imports from various sources (Chart G.7) almost trebled and accounted for 38 per cent of total gas imports in 2019. These levels of LNG imports have continued into 2020, with LNG making up 42 per cent of all gas imports. LNG imports from Qatar accounted for 48 per cent of total LNG imports in 2020. Other sources of LNG came from the US, 27 per cent of the total, and Russia, 12 per cent of the total.

**Chart G.7 Imports of LNG by country, 2010 – 2020**



### Imports and exports of electricity

For over a decade, the UK has been a net importer of electricity. In 2020, imports of electricity were mainly from France (10.4 TWh) and the Netherlands (4.7 TWh); whilst exports were mainly to Ireland (1.8 TWh) and France (1.7 TWh). In 2020, imports of electricity fell by 9 per cent to 22.4 TWh as falls in imports from France and Netherlands were only partially offset by increases in imports from Belgium and Ireland. Exports of electricity rose by 32 per cent to 4.5 TWh as exports to France, Belgium and the Netherlands rose. Overall net imports of electricity in 2020 was down by 15 per cent from 21.2 TWh to 17.9 TWh.

### Imports and exports of renewables

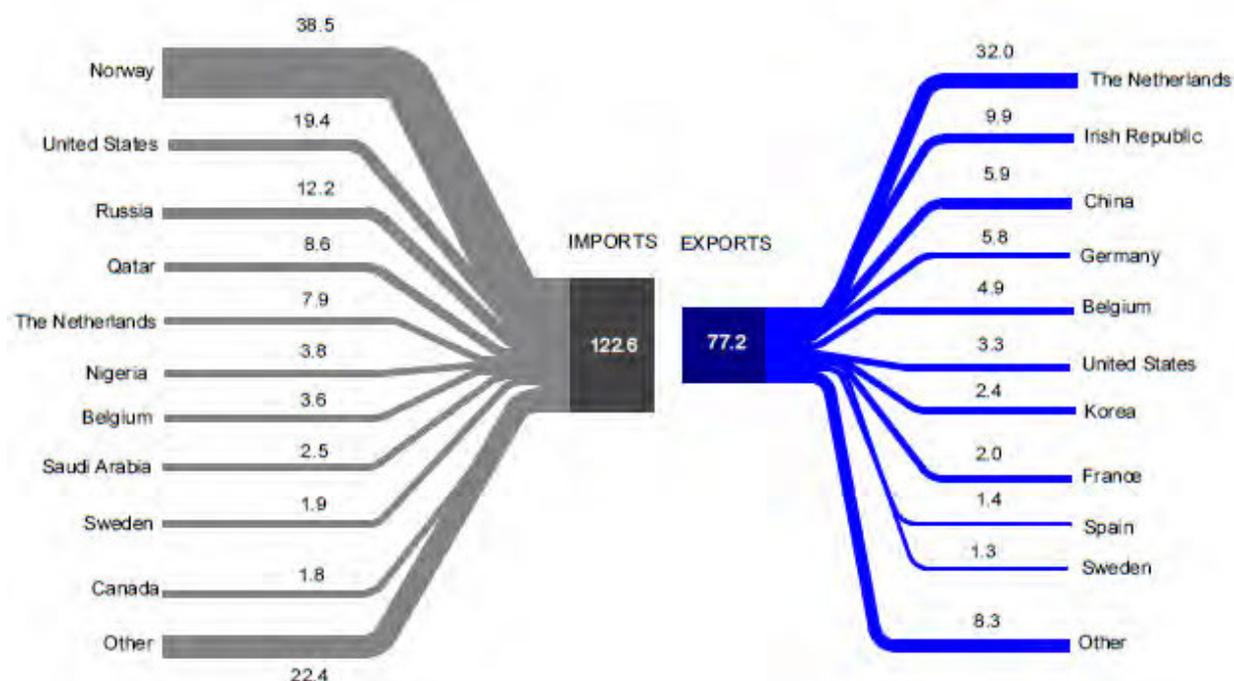
Apart from wood pellets and biodiesel, HMRC do not collect any other specific data on the imports of renewables intended to be used for energy purposes. In 2020, wood pellet imports to the UK, mainly from the United States, were around 8.9 million tonnes, an increase of 3 per cent on the previous year (table G.6). In 2020 BEIS estimates of total renewables imports to the UK which include wood, wood waste, biomass and

liquid biofuels were 5.7 mtoe, up 3 per cent on the previous year. Liquid fuels imports remained broadly stable (down just 0.2 per cent) and wood and wood waste imports were the same on the previous year.

### UK markets in 2020

Chart G.8 shows the UK's ten largest markets in volume trade of coal, primary oils and oil products, gas, electricity, and renewables in 2020. Nearly one-third (31 per cent) of the total imports to the UK were from Norway, followed by 16 per cent from the United States and 10 per cent from Russia. Just over 40 per cent (42 per cent) of total UK exports were to the Netherlands and 13 per cent were to the Irish Republic.

**Chart G.8 UK trade by country for imports and exports, million tonnes of oil equivalent**



Source DUKES 2021

## Value

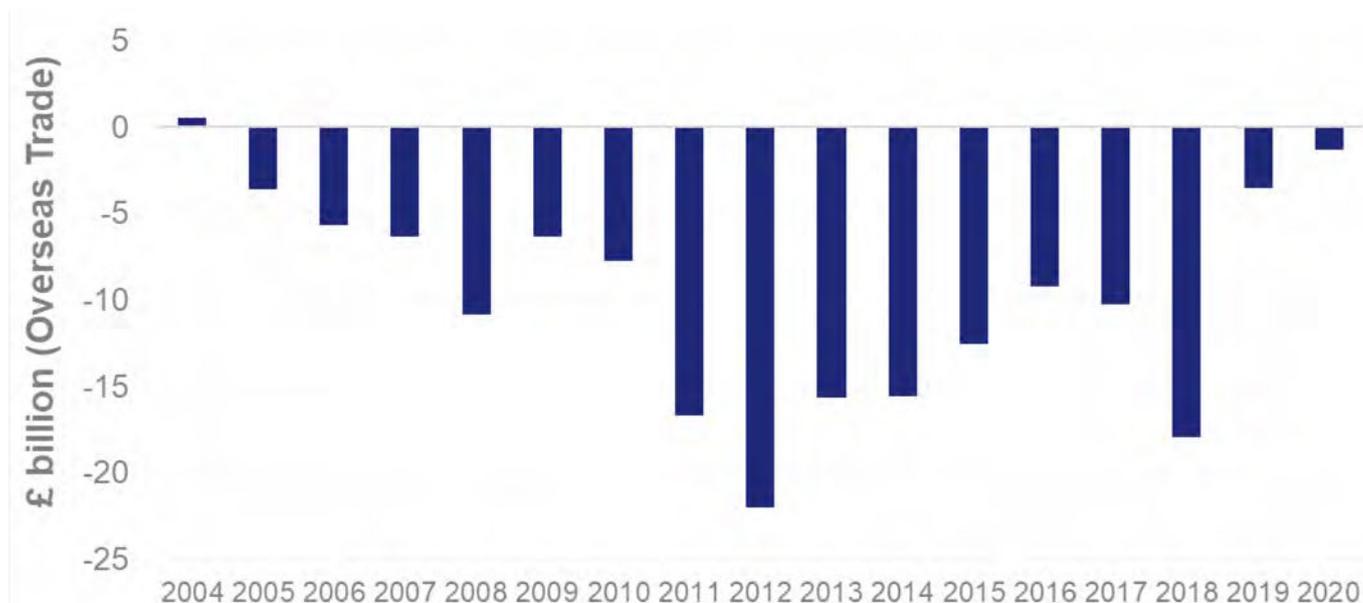
### Imports and exports of fuels (Overseas Trade Statistics basis)

For statistical purposes, the UK adopts the valuation basis for overseas trade statistics as recommended in the International Merchandise Trade Statistics Concepts & Definitions published by the United Nations. This means that the valuation of exports and dispatches is on a free on board (fob) basis (e.g., costs of goods to the purchaser abroad) while the valuation of imports and arrivals is on a cost, insurance, and freight (cif) basis which includes all the incurred expenses in moving the goods to the point of entry into the UK but excludes any duty or tax chargeable in the UK.

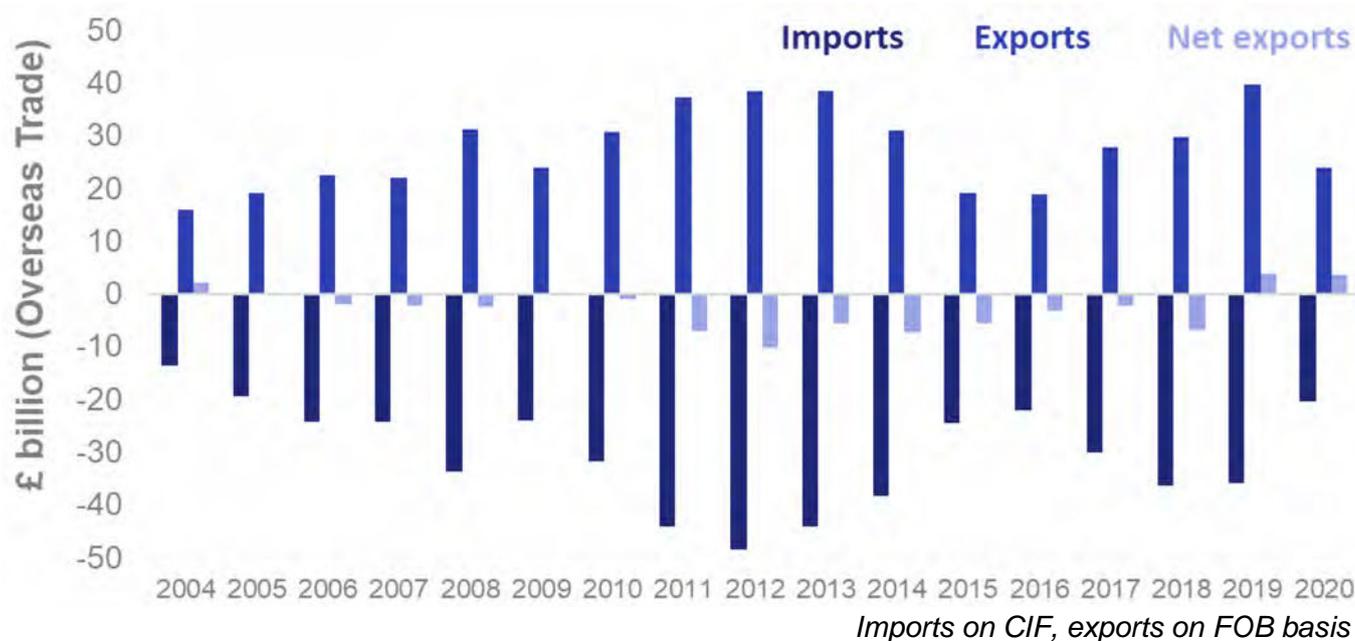
On an Overseas Trade Statistics basis, following the switch from the energy trade surplus of £0.6 billion in 2004, the UK has remained in deficit (Chart G.9). Between 2005 and 2008, the energy trade deficit grew steadily but fell back in 2009 reflecting lower oil prices. It then continued to grow significantly reaching £22 billion in 2012 before falling back again between 2013 and 2016 driven by a fall in the deficit of crude oil and petroleum products. In 2018 the energy trade deficit rose by 73 per cent to around £18.1 billion including an increase in deficit in oil and petroleum products as crude oil and gas prices increased.

In 2020 the energy trade deficit at £1.3 billion, was 62 per cent lower than in the previous year and on the same Overseas Trade Statistics basis there was a surplus in crude oil given the falls in crude oil prices. As a result, the combined surplus in crude oil and petroleum products at £3.5 billion (compared to a £2.2 billion surplus in 2004 – see chart G.10) was down by 9 per cent on the previous year.

**Chart G.9 Value of net exports of fuel, 2004 – 2020**



**Chart G.10 Value in trade of oils, 2004 – 2020**



### Imports and exports of fuels (Balance of Payment basis)

To conform with the International Monetary Fund (IMF), the Office for National Statistics (ONS) compiles their energy trade data on a Balance of Payment basis in which the value of goods is the value at the point of the exporting country (e.g., the freight and insurance costs to the UK is excluded from the value recorded by HMRC).

Chart G.11 shows the net exports of fuels in value terms on a Balance of Payments basis since 1970. The United Kingdom's trade in fuels was dominated by imports until exports started to grow substantially in the mid-1970s, when production from the North Sea started, resulting in a trade surplus in 1981. This surplus was sustained between 1981 and 2003, except for a small deficit in 1989, and amounted to just under £80 billion over that period. However, these surpluses were reduced by the fall in oil prices in 1986, and then by the fall in North Sea production following the Piper Alpha accident in 1988 and the resulting safety works. Although the trade surplus increased steadily from 1992 to 1996, there were falls in 1997 and 1998 due to the drop in the price of crude oil. Prices of crude oil and petroleum products increased in 1999 and again in 2000 giving it, in current price terms, the highest net surplus. In 2001 the value of the trade surplus fell, reflecting falls in the

price of crude oil and petroleum products; however, this was partly reversed by a 6.2 per cent increase in the net trade surplus during 2002.

Since 2005 the UK has been a net importer of fuels. The deficit increased sharply in 2008 due to a sharp rise in the price of crude oil with Brent prices increasing by \$26 per barrel to \$98 per barrel, before falling back to \$63 per barrel in 2009. In 2011 there was another sharp increase in the size of the energy trade deficit, which more than doubled that in 2010, from £9.5 billion to £20.2 billion; this was mainly due to the oil deficit increasing from £4.3 billion to £10.9 billion, as oil prices rose sharply from an average of \$80 per barrel in 2010 to \$111 per barrel in 2011. Between 2013 and 2017 deficit fell as crude oil prices fell, reaching a low of \$45 in 2016. In 2018 deficit increased, as the other fuels deficit increased.

In 2019 and 2020, the total deficit fell and was £2.4 billion in 2020, £1.6 billion less than in the previous year. This has been driven by a fall in the deficit in other fuels and a surplus in oil net exports. The price of crude oil fell by \$22 per barrel to \$42 in 2020.

**Chart G.11: Value of net exports of fuels on a balance of payment basis, 1970 – 2020**

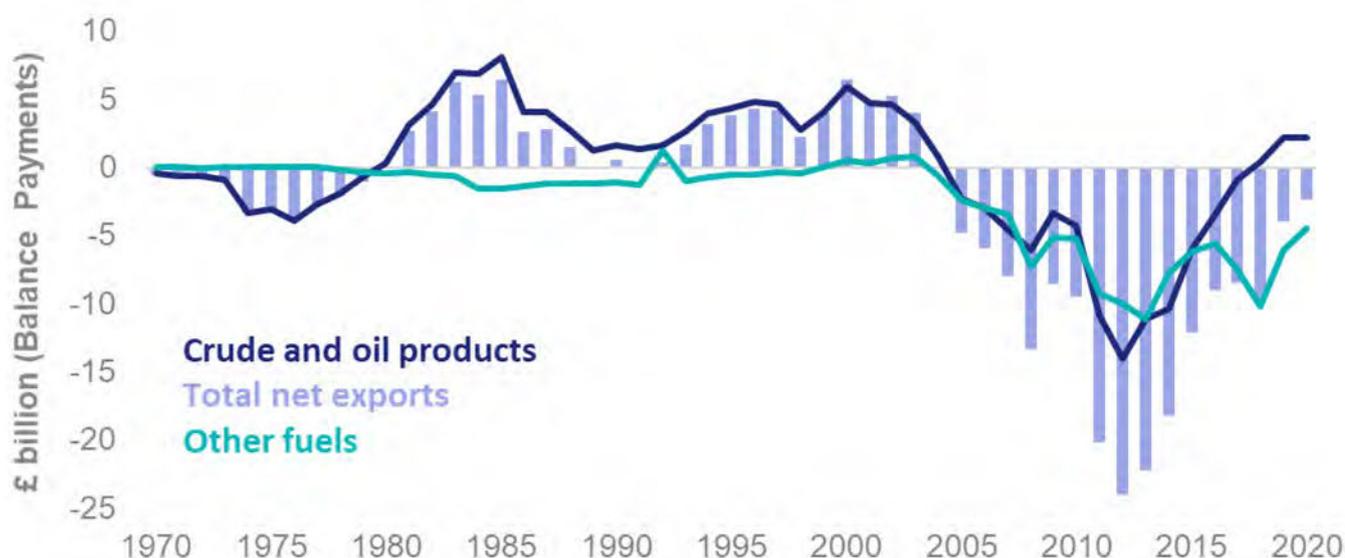


Table G.7 shows the trends in the UK trade values from 1970 to 2020 both on an Overseas Trade Statistics and Balance of Payments basis. Import values on a f.o.b. basis are also included in the table, to allow net exports to be presented on a comparable f.o.b. basis over the same period.

## Technical notes and definitions

The figures of imports and exports quoted in this annex are derived from notifications to HM Revenue and Customs and may differ from those for actual arrivals and shipments, derived from alternative and/or additional sources, in the sections of the Digest dealing with individual fuels. Data in Table G.1 also include unpublished revisions to Customs data, which cannot be introduced into Tables G.3 to G.5.

All quantity figures in Table G.1 have been converted to million tonnes of oil equivalent to allow data to be compared and combined. This unit is a measure of the energy content of the individual fuels; it is also used in the Energy section of this Digest and is explained in Annex A, paragraphs A.45 to A.46. The quantities of imports and exports recorded in the Overseas Trade Statistics, in their original units of measurement, are converted to tonnes of oil equivalent using weighted gross calorific values and standard conversion factors appropriate to each division of the Standard International Trade Classification (SITC). The electricity figures are expressed in terms of the energy content of the electricity traded.

Except as noted in Table G.7, values of imports are quoted "c.i.f.". Briefly this value is the price that the goods would fetch at that time, on sale in the open market between buyer and seller independent of each other, with delivery to the buyer at the port of importation, the seller bearing freight, insurance, commission, and all other costs, etc, incidental to the sale and delivery of the goods except for any duty or tax chargeable in the United Kingdom. Values of exports are "f.o.b.", which is the cost of the goods to the purchaser abroad, including packing, inland and coastal transport in the United Kingdom, dock dues, loading charges and all other costs, charges and expenses accruing up to the point where the goods are deposited on board the exporting vessel or at the land boundary of Northern Ireland.

Figures of the value of net exports in Tables G.7 are derived from exports and imports measured on a Balance of Payments basis. The figures are consistent with the European System of Accounts 1995, the basis on which they are published by the Office for National Statistics and since 2016 HMRC through their UK Trade Info dataset. This means exports as recorded by HM Revenue and Customs on any other basis, will differ from those recorded by the Office for National Statistics and UK Trade Info on a Balance of Payment basis.

### **G.41 Figures correspond to the following items of [SITC \(Rev 3\)](#):**

Coal	321.1 and 321.2
Other solid fuels	322 and 325 (part)
Crude oil	333
Petroleum products	334,335,342,344 (plus Orimulsion reclassified to division 278 in 1994)
Natural gas	343
Electricity	351

In 1993, the Single European Market was created. At that time, a new system for recording the trade in goods between member states, called INTRASTAT, was introduced. As part of this system only obliges small traders to report their annual trade and as some trading supply returns are late, it is necessary to include adjustments for unrecorded trade. This is particularly true of 1993, the first year of the system and of coal imports in that year.



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# Annex H: Flow charts

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## Introduction

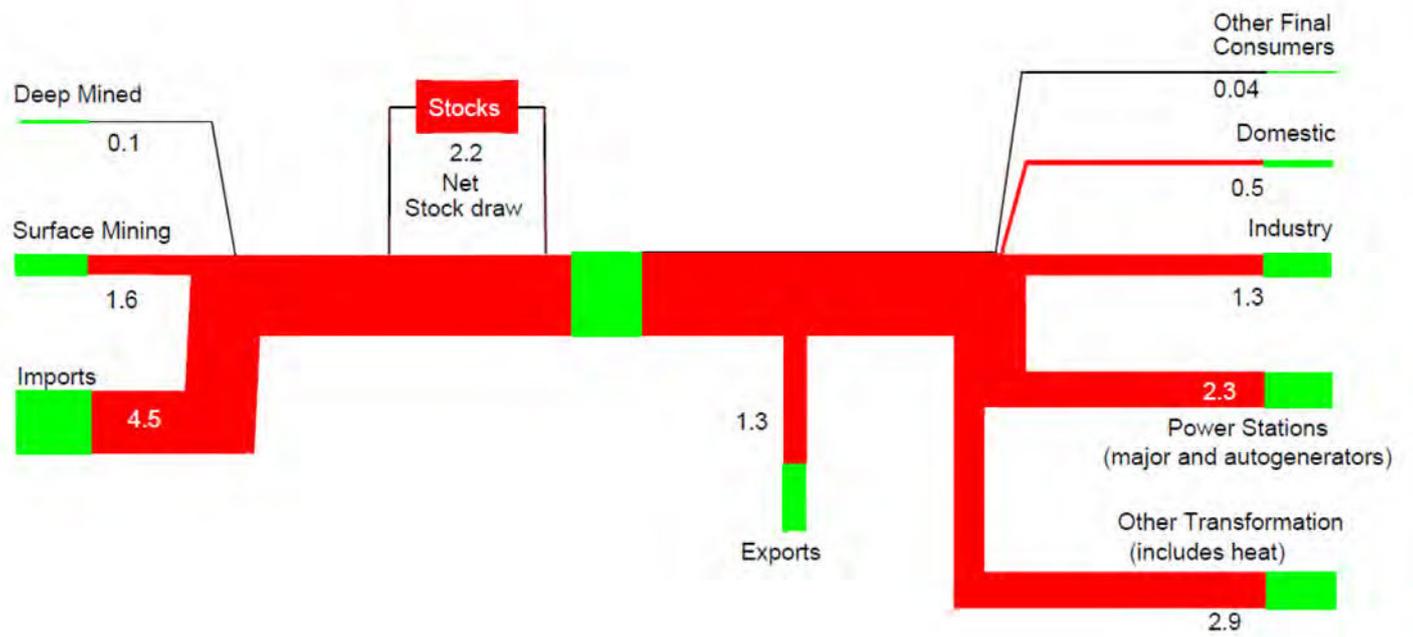
This section brings together the flow charts for individual fuels contained in the main Digest publication. Chart H.1 is for Coal, Chart H.2 is for Petroleum, Chart H.3 is for Natural Gas, Chart H.4 is for Electricity and Chart H.5 is for Renewables. Annual updates will appear in subsequent editions of the main Digest publication and on the BEIS section of the GOV.UK website.

Also included within the annex is an additional flow chart for Manufactured Solid Fuels (H.6). Annual updates will appear on the BEIS section of the GOV.UK website.

## Summary flow chart

The summary flow chart updates the last energy flow chart which showed data for 2019. It is based on statistics taken from the main Digest publication, [Table 1.1 – Energy Balance 2020](#). The chart is a simplification of the energy balance figures, illustrating the flow of primary fuels from the point at which they become available from home production or imports (on the left) to their eventual final uses (on the right). They are shown in their original state and after being converted into different kinds of energy by the secondary fuel producers. The flows are measured in million tonnes of oil equivalent, with the widths of the bands approximately proportional to the size of the flow they represent. The flow charts for individual fuels have been produced on a similar basis.

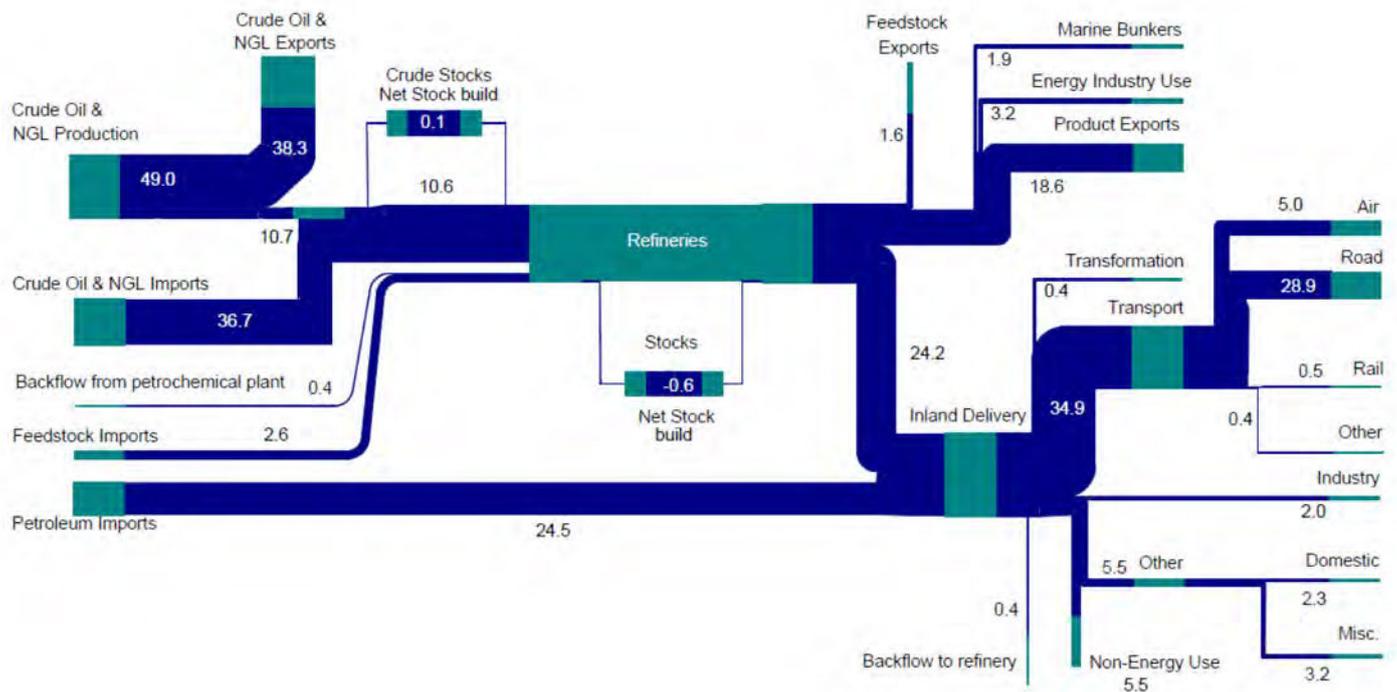
**Chart H.1: Coal flow chart 2020 (million tonnes of coal)**



**Note:**

This flow chart is based on the data that appear in [DUKES tables 2.1 and 2.4](#).

**Chart H.2: Petroleum flow chart 2020 (million tonnes)**



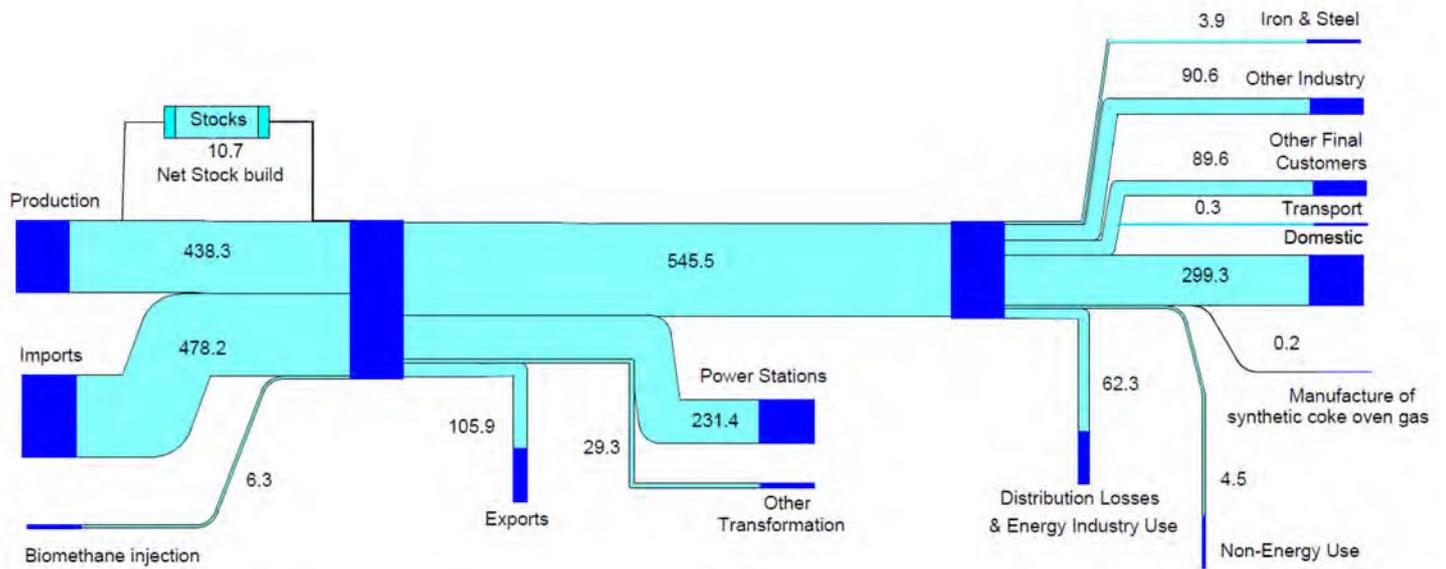
**Notes:**

This flow chart is based on the data that appear in [DUKES tables 3.1 and 3.2](#).

The numbers on either side of the flow chart will not match due to losses in transformation.

Biofuels are not included.

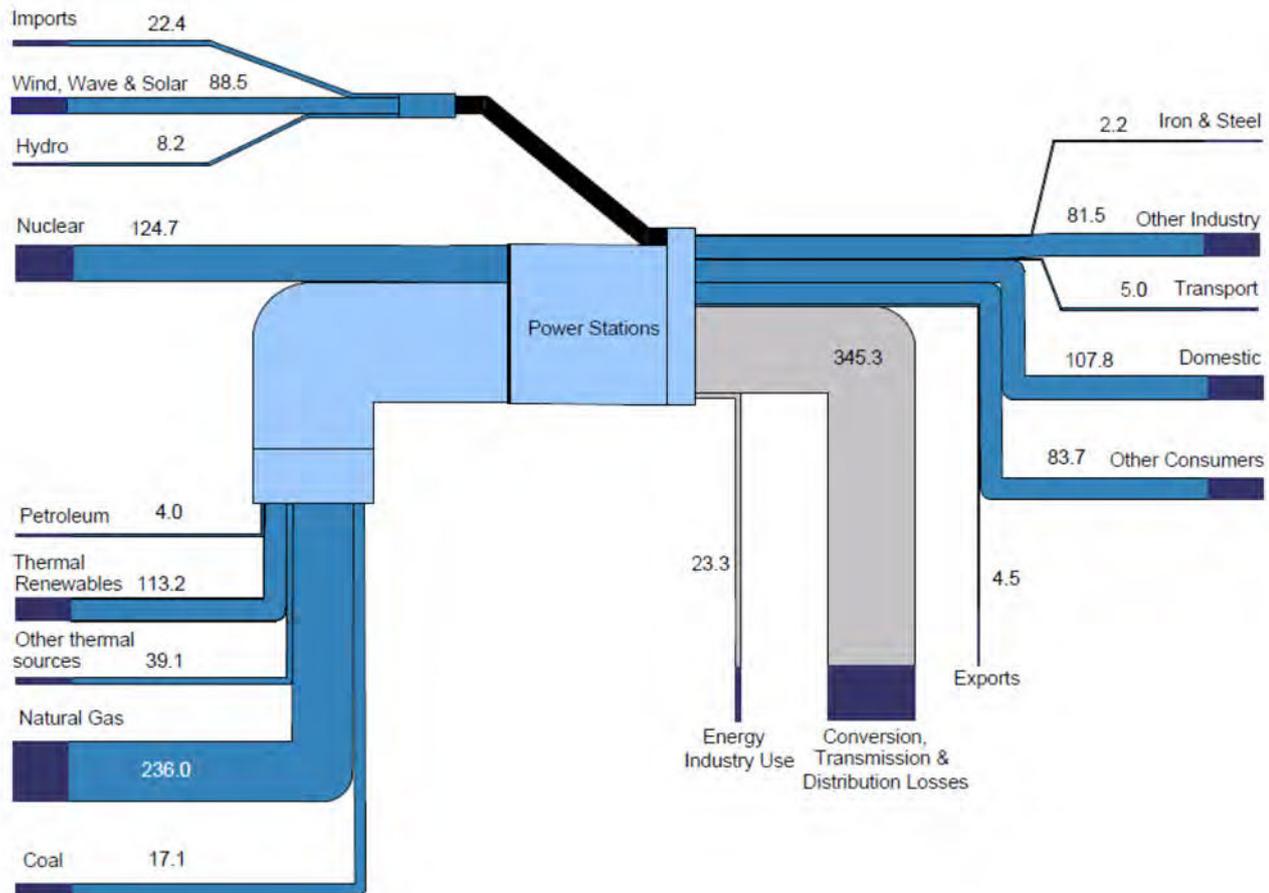
**Chart H.3: Natural gas flow chart 2020 (TWh)**



Note:

This flow chart is based on the data that appear in [DUKES table 4.1](#), excluding colliery methane.

**Chart H.4: Electricity flow chart 2020 (TWh)**



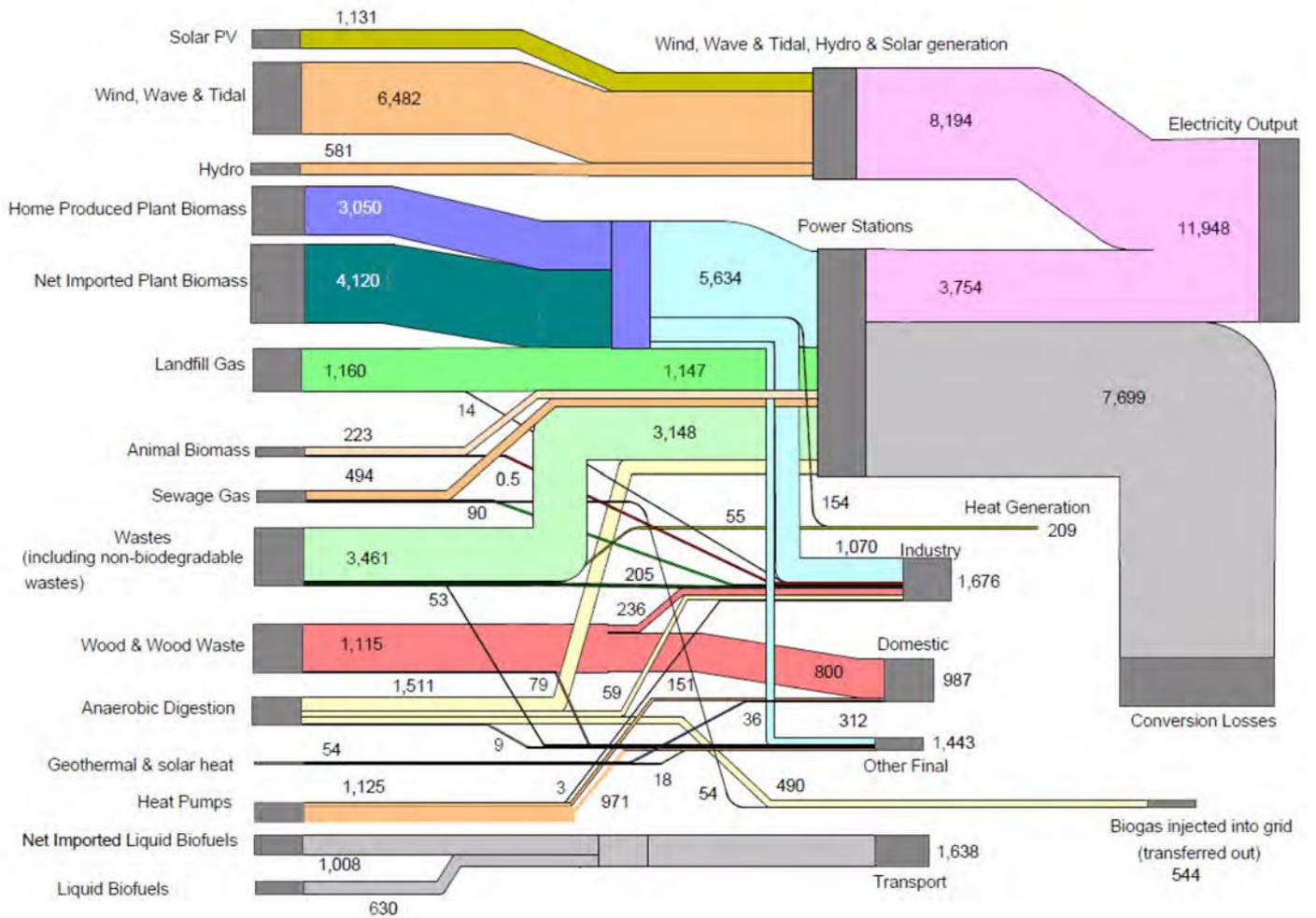
**Notes:**

This flow chart is based on the data in [DUKES tables 5.1 \(for imports, exports, use, losses and consumption\) and 5.6 \(fuel used\)](#).

Hydro includes generation from pumped storage while electricity used in pumping is included under Energy Industry Use

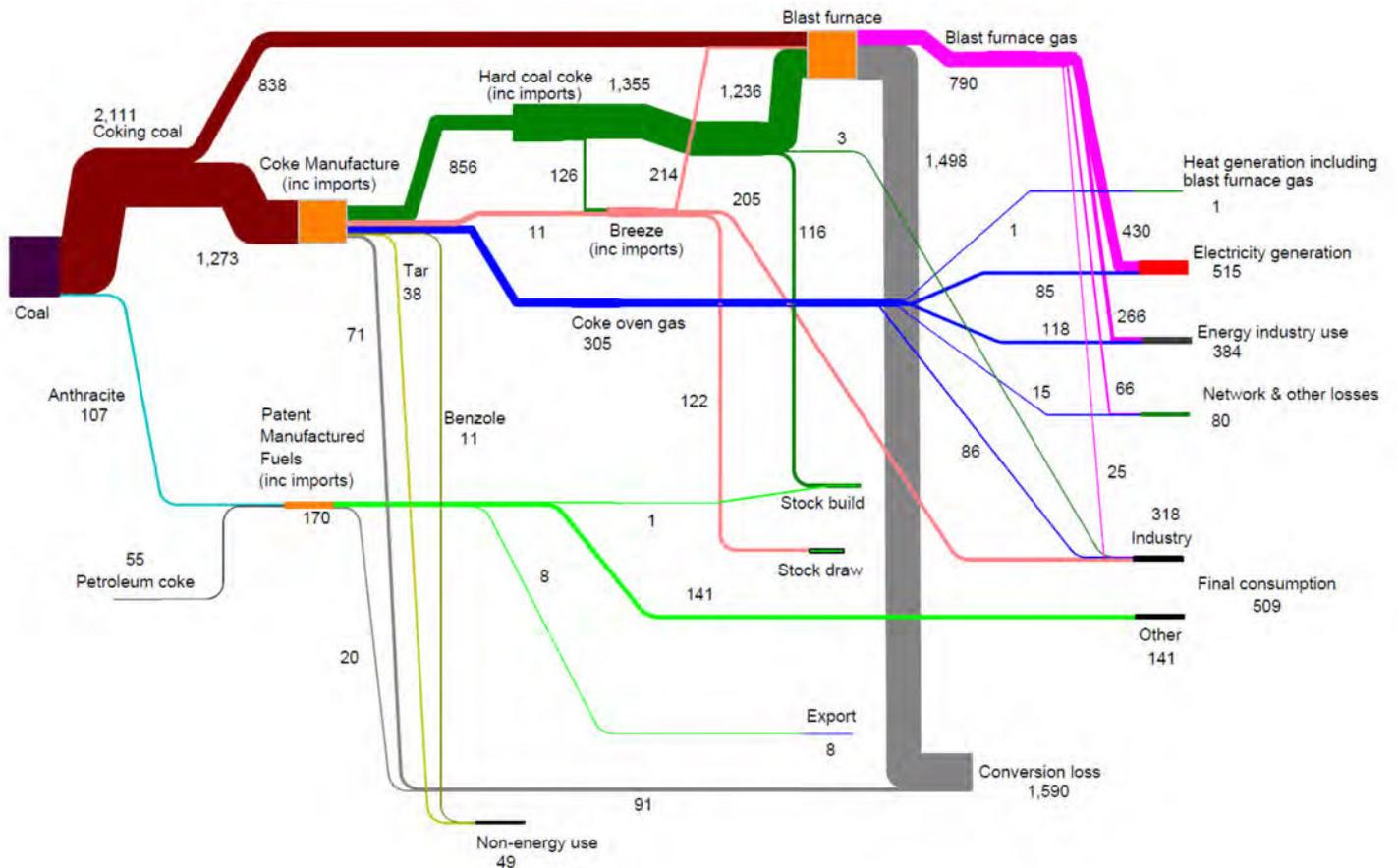
Conversion, Transmission and Distribution Losses is calculated as fuel used (Table 5.6) minus generation (Table 5.6) plus losses (Table 5.1)

**Chart H.5: Renewables flow chart 2020 (thousand tonnes of oil equivalent)**



Note: This flow chart is based on data that appear in [DUKES tables 6.1 and 6.4](#).

**Chart H.6: Manufactured Solid Fuels flow chart 2020 (thousand tonnes of oil equivalent)**





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## Annex I: Energy balance net calorific values

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### Aggregate energy balance (Table I.1)

These tables show the flows of energy in the United Kingdom from production to final consumption through conversion into secondary fuels such as coke, petroleum products, secondary electricity and heat sold using Net Calorific Values (NCV) from 2004 to 2020. The NCVs used are detailed in table A.3 of DUKES available at: <https://www.gov.uk/government/statistics/dukes-calorific-values>.



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# Annex J: Heat reconciliation

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## Introduction

Heat sold has been separately identified in the energy balances since 1999. It is defined as heat that is produced and sold under the provision of a contract. The introduction of heat sold into the energy and commodity balances did not affect the individual fuel totals, since the energy used to generate the heat has been deducted from the final consumption section of the energy balances and transferred to the transformation section. Annex J tables show the detailed analysis of the heat generation row of the main energy balances, by sector generating the heat, and are available at:

[www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes](http://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes)

For transparency, data on the quantity of fuel by consuming sector used to produce heat that is subsequently sold are being made available in the tables that accompany this annex.

## Methodology

Data sources used to compile heat generation and heat sold are primarily from the Combined Heat and Power Quality Assurance Program (CHPQA) <sup>1</sup> and also data collected for the Heat Metering and Billing Regulations<sup>2</sup> with some assumptions being carried over from the previous estimates prior to these regulations being in force.

### CHPQA data

These data are supplied to BEIS annually by Ricardo Energy and Environment and form the basis of DUKES Chapter 7; Combined Heat and Power<sup>3</sup>. The data include heat exported and whether it's being exported to an entity declared 'not part of same qualifying group', in which case it is deemed to be sold under a contract thus satisfying the definition set out above.

A sectoral analysis of heat generators has shown that certain suppliers are classified as 'Electricity, gas, steam, and air conditioning supply'. This sector falls within the transformation sector in the energy balances and as such can't be deducted from any sector in final consumption and their main business is deemed to be supplying a heat network. It is therefore included in the heat generation row and for transparency, as an 'of which heat networks' row below this in the annex tables.

### Non CHPQA data

Following the publication of experimental statistics collected in respect of the Heat, Metering and Billing Regulations (HMBR) database in the March 2018 edition of Energy Trends<sup>4</sup>, the data have been evaluated and incorporated into the heat generation figures presented in this annex. As there are gaps in this data, CHPQA data have been used where possible. For other schemes, various assumptions were applied to the HMBR dataset:

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<sup>1</sup> [www.gov.uk/guidance/chpqa-guidance-notes](http://www.gov.uk/guidance/chpqa-guidance-notes)

<sup>2</sup> [www.gov.uk/guidance/heat-network](http://www.gov.uk/guidance/heat-network)

<sup>3</sup> [www.gov.uk/government/statistics/combined-heat-and-power-chapter-7-digest-of-united-kingdom-energy-statistics-dukes](http://www.gov.uk/government/statistics/combined-heat-and-power-chapter-7-digest-of-united-kingdom-energy-statistics-dukes)

<sup>4</sup> [www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks](http://www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks)

- Heat supplied was assumed to be heat sold
- The fuel input has been estimated by assuming the previous efficiency
- Where the fuel categories are not sufficiently disaggregated, historic proportions have been applied
- For those networks which have mixed final consumers, it is difficult to assign heat supplied to each sector. To address this, the average generation for domestic consumers (residential properties display considerably less variation compared to industrial and commercial consumers) was used with the remainder being allocated across industrial consumers, and the commercial and public sectors.

The decision not to use the HMRB data set for CHP schemes was deemed to be appropriate due to the CHPQA administration data being timely and subject to quality assurance. It also provides the correct level of detail such as fuel type, sector generating heat, and final customer types. In contrast, the previous non-CHP estimates were previously derived from the Building Research Establishment's "National Survey of Community Heating" that was carried out in 1997, a database of community heating schemes in social housing in 2000, and Community Heating Sales Surveys undertaken between 2003 and 2005. The estimates from these sources have been used to derive heat sold figures since 1999; these estimates are now considered less relevant than the more up to date data collected in the HMRB database despite having to use assumptions to achieve the correct estimates across generators and final customers.



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Department for  
Business, Energy  
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# The UK's Integrated National Energy and Climate Plan

Completed as per 31 January 2020



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On 31 January 2020, the UK left the European Union (EU) and the Withdrawal Agreement we concluded with the EU entered into force. The UK is seeking a relationship with the EU which is based on friendly cooperation between sovereign equals, centred on free trade. At the end of 2020, the process of transition to that relationship will be completed. The UK will no longer be a part of the EU Single Market or the EU Customs Union. As the UK is no longer a Member State, we will not contribute to EU targets in the areas of energy and climate change.

The UK is submitting this National Energy and Climate Plan in order to uphold our commitments under the Withdrawal Agreement. The content within is wholly accurate up to 31 January 2020, the date the UK left the EU.<sup>1</sup> Since then, analysis in the National Energy and Climate Plan has been updated to ensure it provides an accurate overall picture of the UK's plans. However, policy announcements and publications after 31 January 2020 have not been incorporated and the National Energy and Climate Plan does not supersede those announcements that we have made domestically. This means that impacts from COVID-19 are also not taken into account.

The UK's approach to tackling and responding to climate change is set in legislation through the Climate Change Act 2008. The Act also established the Committee on Climate Change, the independent statutory body that provides expert advice to the UK government on climate change mitigation and adaptation.

On 27 June 2019, the UK government set a legally binding target to achieve net zero greenhouse gas emissions from across the UK economy by 2050, which will bring to an end our contribution to climate change. In the lead-up to COP26 in Glasgow in 2021, we continue to drive climate ambition on the global stage. As COP26 President, the UK will work with all partners to deliver on the Paris Agreement. Further policies and strategies to meet our net zero target will be set out in domestic publications, such as our Energy White Paper.<sup>2</sup>

This Plan has been completed according to the EU's reporting framework for National Energy and Climate Plans (italicised in each section), as specified in Annex I to the EU Regulation 2018/1999 on the Governance of the Energy Union and Climate Action.<sup>3</sup>

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<sup>1</sup> Analysis based on data up to 31 January 2020, does not account from impacts resulting from COVID-19.

<sup>2</sup> [www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future](https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future)

<sup>3</sup> <https://eur-lex.europa.eu/eli/reg/2018/1999/oj>

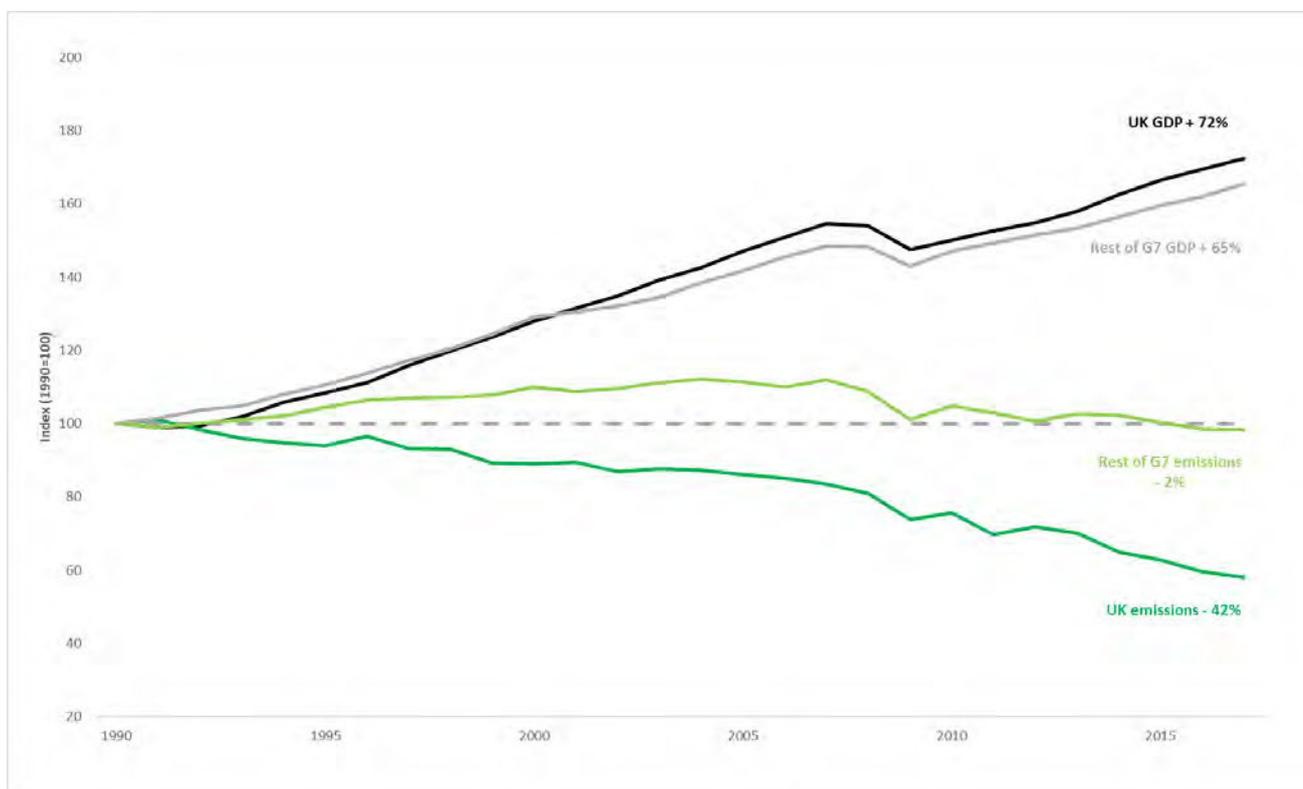
# 1. Overview and process for establishing the plan

## 1.1 Executive summary

### *i Political, economic, environmental, and social context of the plan*

The UK was one of the first countries to recognise and act on the economic and security threats of climate change and has been among the most successful countries in the developed world at growing its economy while reducing emissions. Since 1990, the UK has cut emissions by over 40% whilst growing the economy by over two-thirds (see Figure 1).

**Figure 1: GDP and emissions for the UK and G7<sup>4</sup>**



Internationally, the UK together with the EU played a central role in securing the United Nations (UN) 2015 Paris Agreement. The UK is fully committed to working with other countries to achieve the Paris Agreement goals. The UK is one of the largest contributors of international climate finance, having committed to spending £5.8 billion on this between 2016 and 2021<sup>5</sup> and at least £11.6 billion between 2021/22 and 2025/26.<sup>6</sup> Additionally, the UK is promoting global alliances to encourage clean growth, such as the Powering Past Coal Alliance, to reduce emissions from the most polluting fuel.

<sup>4</sup> Data sourced from World Bank, UNFCCC National Inventory Submissions, ONS and BEIS Greenhouse Gas inventory.

<sup>5</sup> International Climate Finance, UK government, [www.gov.uk/guidance/international-climate-finance](http://www.gov.uk/guidance/international-climate-finance)

<sup>6</sup> UK aid to double efforts to tackle climate change, [www.gov.uk/government/news/uk-aid-to-double-efforts-to-tackle-climate-change](http://www.gov.uk/government/news/uk-aid-to-double-efforts-to-tackle-climate-change)

## The Climate Change Act

The Climate Change Act 2008 set in legislation the UK's approach to tackling and responding to climate change. It introduced the UK's long-term legally binding 2050 target to reduce greenhouse gas emissions by at least 80% relative to 1990 levels. It also introduced 'carbon budgets', which cap emissions over successive five-year periods and must be set 12 years in advance. The Act also established the Committee on Climate Change (CCC), the independent statutory body that provides expert advice to the UK government on climate change mitigation and adaptation.

Policies and proposals for mitigating climate change go through an established development process. As the development is completed, the impact of policies is quantified in updated Energy and Emissions Projections (EEP), which are published by the UK government annually. This is a continuous process and the latest EEP, published in April 2019, shows future emissions under the suite of policies that were fully developed as of 2018.

The Climate Change Act also requires the UK to produce a UK Climate Change Risk Assessment (CCRA) every 5 years. The CCRA assesses current and future risks to and opportunities for the UK from climate change. In addition, the Climate Change Act requires the UK government to produce a National Adaptation Programme to respond to the risk assessment. Finally, the Climate Change Act gives powers to the UK government to require certain organisations to report on how they are adapting to climate change through the Adaptation Reporting Power.

## Net zero

The UK is committed to maintaining a robust climate framework that takes into account evolving scientific knowledge on climate change. Following the publication in October 2018 of the Intergovernmental Panel on Climate Change's (IPCC) special report on global warming of 1.5°C, the UK government, Welsh Government and Scottish Government asked our independent experts, the CCC, for their advice on the implications of the Paris Agreement for the UK's long-term emissions reduction targets, including on setting a net zero target.<sup>7</sup>

In May 2019, the CCC provided that advice, recommending that the UK legislate as soon as possible to reach net zero greenhouse gas emissions by 2050.

On 27 June 2019, the UK government set a legally binding target to achieve net zero greenhouse gas emissions from across the UK economy by 2050, via an amendment to the Climate Change Act. This world-leading target will bring to an end our contribution to climate change.

## The Clean Growth Strategy and Clean Growth Grand Challenge

In October 2017, the UK government published its Clean Growth Strategy (CGS)<sup>8</sup> setting out ambitious policies and proposals, through to 2032 and beyond, to reduce emissions across the economy and promote clean growth.

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<sup>7</sup> UK climate targets: request for advice from the Committee on Climate Change, October 2018, [www.gov.uk/government/publications/uk-climate-targets-request-for-advice-from-the-committee-on-climate-change](http://www.gov.uk/government/publications/uk-climate-targets-request-for-advice-from-the-committee-on-climate-change)

<sup>8</sup> Clean Growth Strategy: [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

In November 2017 the UK government published its Industrial Strategy, which includes a Clean Growth Grand Challenge<sup>9</sup>. The Grand Challenge aims to put the UK at the forefront of industries of the future, by maximising the advantages for UK industry from the global shift to low-carbon.

## 25 Year Environment Plan

Building on the proposals set out in the CGS, the UK outlined its plans to improve the environment in the 25 Year Environment Plan. The 25 Year Environment Plan<sup>10</sup> was published in January 2018 and sets out the UK's approach to deliver on our ambition to leave our environment in a better state than we inherited, and to fully seize the opportunities of clean growth.

## The second National Adaptation Programme (NAP) and the third strategy for Adaptation Reporting Power (ARP)

The Climate Change Act mandates that on a five-yearly cycle the UK government produce a Climate Change Risk Assessment (CCRA), followed by a National Adaptation Programme (NAP), setting out actions to address the risks identified in the CCRA.<sup>11</sup> The second CCRA (published January 2017) endorsed the six priority risk areas identified by the independent evidence report produced by the Adaptation Sub-Committee in July 2016. These are:

- Flooding and coastal change risks to communities, built environment and infrastructure
- Risks to health and wellbeing and productivity from high temperatures
- Risk of shortages in the public water supply and for agriculture, energy generation and industry with impacts on freshwater ecology
- Risks to natural capital including terrestrial, coastal, marine and freshwater ecosystems, soils and biodiversity
- Risks to domestic and international food production and trade
- New and emerging pests and diseases, and invasive non-native species affecting people, plants and animals

The second NAP was published in July 2018 and addresses the key risks highlighted in the second CCRA, showing the actions the UK government is, and will be, taking to address the risks and opportunities posed by a changing climate over the following five-year period. This was developed working with and drawing on the UK government's 25 Year Environment Plan. The NAP presents a set of actions in a broad range of areas: natural environment, infrastructure, people and the built environment, business and industry, and local government. This includes actions related to building resilience of energy infrastructure to flooding.

The NAP is primarily for England but also covers reserved and non-devolved matters. Devolved Administrations lead their own adaptation programmes. In October 2019, the government responded to the Adaptation Sub-Committee's biennial report on adaptation

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<sup>9</sup> The UK's Industrial Strategy: [www.gov.uk/government/topical-events/the-uks-industrial-strategy](http://www.gov.uk/government/topical-events/the-uks-industrial-strategy)

<sup>10</sup> 25 Year Environment Plan: [www.gov.uk/government/publications/25-year-environment-plan](http://www.gov.uk/government/publications/25-year-environment-plan)

<sup>11</sup> Climate change: a second national adaptation programme (2018 to 2023), July 2018, [www.gov.uk/government/publications/climate-change-second-national-adaptation-programme-2018-to-2023](http://www.gov.uk/government/publications/climate-change-second-national-adaptation-programme-2018-to-2023)

progress under the second NAP<sup>12</sup>. In 2019, Scotland, Wales and Northern Ireland all published their climate adaptation programmes, setting out planned adaptation action over the next five years.<sup>13</sup>

## Adaptation Reporting Power (ARP)

The Adaptation Reporting Power (ARP)<sup>14</sup>, a discretionary power under the Climate Change Act 2008, helps ensure that ‘persons or bodies with a function of a public nature’ and ‘statutory undertakers’ (reporting organisations) are taking actions to adapt to climate change by reporting on how they are addressing current and future climate impacts. The adaptation reporting process has been through two complete cycles so far. Reports submitted in the second round of adaptation reporting are available on GOV.UK.<sup>15</sup>

In the second cycle of adaptation reporting in 2013, the UK government chose a voluntary and flexible approach to reporting. Similarly, the third Adaptation Reporting strategy, published alongside the NAP in 2018, adopts a voluntary and sector-focused approach, with the reporting cycle running from the beginning of 2019 to the end of 2021. As of December 2018, over 90 organisations have committed to submit a report on their preparedness to climate change risks.<sup>16</sup> Gas and electricity companies, including transmission and distribution, are among those who will report on how they are strengthening resilience to the risks set out in the second CCRA, and what actions are being taken to reduce the vulnerability of core national infrastructure. In the third Strategy for Adaptation reporting, a number of key CCRA risks were identified for the energy sector to report on, including: cascade failures due to interdependencies; risks from flooding; risks to pipelines from high river flows and bank erosion; risks from high winds and lightning; risks to offshore infrastructure from storms and high waves. As part of the Resilient Electricity Networks for Great Britain (RESNET) consortium, researchers from the University of Manchester and Newcastle University have developed models that combine climate change projections with information about the National Grid to assess its long-term resilience. Electricity network companies spent £130 million on flood defence work from 2010-15, with a further £100 million due to be spent on flood defence by networks before 2021. Work is based around revised design guidelines (ETR138), which state that primary substations with over 10,000 connections should be defended against 1/1000-year flood events.<sup>17</sup>

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<sup>12</sup> Government response to the Committee on Climate Change, 2019, [www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses](http://www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses)

<sup>13</sup> Climate Ready Scotland: climate change adaptation programme 2019-2024, [www.gov.scot/publications/climate-ready-scotland-second-scottish-climate-change-adaptation-programme-2019-2024/pages/10/](http://www.gov.scot/publications/climate-ready-scotland-second-scottish-climate-change-adaptation-programme-2019-2024/pages/10/)

Prosperity for All: A Climate Conscious Wales, <https://gov.wales/prosperity-all-climate-conscious-wales>  
Northern Ireland Climate Change Adaptation Programme 2019-2024, [www.daera-ni.gov.uk/publications/northern-ireland-climate-change-adaptation-programme-2019-2024](http://www.daera-ni.gov.uk/publications/northern-ireland-climate-change-adaptation-programme-2019-2024)

<sup>14</sup> ARP, proposals for the third round of adaptation reporting: <https://consult.defra.gov.uk/environmental-quality/adaptation-reporting/>

<sup>15</sup> Adaptation Reporting, Second round reports, [www.gov.uk/government/collections/climate-change-adaptation-reporting-second-round-reports](http://www.gov.uk/government/collections/climate-change-adaptation-reporting-second-round-reports)

<sup>16</sup> List of organisations reporting under adaptation reporting power: third round, December 2018. [www.gov.uk/government/publications/climate-change-adaptation-reporting-third-round/list-of-organisations-reporting-under-adaptation-reporting-power-third-round](http://www.gov.uk/government/publications/climate-change-adaptation-reporting-third-round/list-of-organisations-reporting-under-adaptation-reporting-power-third-round)

<sup>17</sup> Government response to the Committee on Climate Change, 2019 Report to Parliament - Progress in preparing for climate change, [www.gov.uk/government/collections/government-responses-to-the-committee-on-climate-change-ccc-annual-progress-reports](http://www.gov.uk/government/collections/government-responses-to-the-committee-on-climate-change-ccc-annual-progress-reports)

## Strategies and legislation in Northern Ireland, Scotland and Wales

Energy policy is mainly devolved to Northern Ireland and partly devolved to Wales and Scotland. Climate change policy is devolved to Wales, Scotland and Northern Ireland, although the UK government retains control over many energy policy areas and also some other important policy areas which deliver emissions reductions.

### Northern Ireland

In Northern Ireland energy policy and the independent regulation of energy companies are devolved matters. Northern Ireland's current energy strategy is set out in the Strategic Energy Framework (SEF) for the period 2010-2020. Northern Ireland's future energy strategy is likely to concentrate on a more consumer-led decentralised energy system and decarbonisation in areas such as electricity, heat and transport. The Department for the Economy NI is currently developing a new Energy Strategy for NI. A Call for Evidence will close in early 2020 and the department intends to publish an options paper for consultation by the end of March 2021, following the consultation, and subject to securing Ministerial and Executive approval, the aim is for the final strategy to be in place by November 2021.

The Single Electricity Market (known as the 'SEM') is a single, shared wholesale electricity market between Ireland and Northern Ireland. It was formed in November 2007 and underwent a reform programme in 2018 called the Integrated Single Electricity Market (or 'I-SEM'). These reforms to the market aim to integrate the all-island electricity market with European energy markets (as part of the internal energy market – or 'IEM'). They are designed to introduce efficiencies of interconnector flows, encourage new investment in the market, apply downward pressure on prices, create enhanced trading opportunities and options through the introduction of continuous trading in the intra-day, day-ahead, forwards, and balancing timeframes and facilitate the integration of renewables and continue to provide security of supply. The SEM one year ahead auction in December 2018 secured just under 2 gigawatts (GW) of capacity for Northern Ireland, which ensured that there would be sufficient capacity to meet demand in Northern Ireland during winter 2019-20.

The four year ahead capacity auction on 28 March 2019 secured 1.9GW of capacity for Northern Ireland with an auction clearing price of £43,030 per megawatts (MW) per year, which ensures sufficient capacity to meet expected demand for the year 2022-23.

### Scotland

Scotland's climate change legislation requires Scottish Ministers to reduce emissions in Scotland to net-zero by 2045, with interim targets of 56% reduction (from a 1990 baseline) by 2020, 75% reduction by 2030, 90% reduction by 2045 and annual targets for each other year to net-zero.

The Climate Change Plan published in February 2018 sets out the Scottish Government's comprehensive package of policies and proposals for meeting emissions reduction targets under the Climate Change (Scotland) Act 2009 over the period to 2018 to 2032 – these targets have subsequently been increased (as above) through the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019. The second annual report monitoring progress towards the Plan was published in December 2019.<sup>18</sup> The Scottish Government has committed to update the Plan in December 2020 to reflect the increased ambition of the 2019 Act targets. The Climate Change (Scotland) Act 2009 required Scottish Ministers to reduce emissions in

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<sup>18</sup> Second annual report monitoring progress towards Scotland's 2018 Climate Change Plan, Dec 2019, [www.gov.scot/publications/climate-change-plan-monitoring-report-2019/](http://www.gov.scot/publications/climate-change-plan-monitoring-report-2019/)

Scotland by at least 80% by 2050, with an interim target of 42% by 2020 and annual targets for each year to 2050.

The Scottish Government also published an Energy Strategy<sup>19</sup> in December 2017, which sets out a vision for the future of energy in Scotland to 2050. The Energy Strategy was developed alongside, and is fully consistent with, the existing Climate Change Plan, taking a wider view of the long-term transformational change required in the energy sector. Together, the Energy Strategy and the Climate Change Plan provide the strategic framework for Scotland's transition to an inclusive, innovative, low-carbon economy; reducing greenhouse gas emissions whilst maximising the social and economic opportunities. The framework covers reserved areas as well as devolved, focusing action on those areas that the Scottish Government can directly affect.

## **Wales**

The Environment (Wales) Act 2016<sup>20</sup> requires Welsh Ministers to reduce emissions in Wales by at least 80% by 2050. This Act also requires Welsh Ministers to set interim emissions reduction targets for the years 2020, 2030 and 2040, and establish a system of carbon budgeting that together create an emissions reduction pathway to the 2050 target.

Regulations passed by the National Assembly for Wales in December 2018 set the 2020 target at 27%, the 2030 target at 45% and the 2040 target at 67%. The first two carbon budgets (2016-20 and 2021-25) were also set in legislation. Since then, the Welsh Government has accepted the CCC's recommendation to increase Wales' 2050 target to 95% and has requested the CCC's advice on how this affects the interim targets and carbon budgets set in 2018. It has also asked the CCC to explore how Wales might go beyond 95%. The Welsh Government will ask the Senedd (Welsh Parliament) to amend the targets and budgets legislation early in 2021.

The Act requires Welsh Ministers to publish a plan for meeting each carbon budget. The plan for the first carbon budget, Prosperity for All: A Low Carbon Wales, was published in March 2019 and contains 100 policies and proposals from all emissions sectors and Ministerial portfolios.<sup>21</sup> The plan for the second carbon budget will be published in 2021.

The Welsh Government has set targets to drive deployment of renewables and to ensure Wales benefits from new energy developments. Wales has targets to produce 70% of the electricity used from renewable sources by 2030, and of 1GW of locally owned renewable energy capacity by 2030. There is also an expectation that new all renewable energy projects developed in Wales from 2020 have an element of local ownership. The National Development Framework will set out the Welsh Government's vision for how renewable energy should be delivered in Wales to help respond to the climate emergency.

### *ii Strategy relating to the five dimensions of the EU's Energy Union*

## **Decarbonisation**

Through the Climate Change Act, the UK has established in law the first five carbon budgets covering the period from 2008-32, with the sixth carbon budget due to be set in 2021. The UK

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<sup>19</sup> Scottish Energy Strategy: The Future of Energy in Scotland, 2017, [www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/](http://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/)

<sup>20</sup> Environment (Wales) Act 2016, <https://gov.wales/topics/environmentcountryside/consmanagement/natural-resources-management/environment-act/?Lang=en&skip=1&lang=en>

<sup>21</sup> Prosperity for all: A low carbon Wales, <https://gov.wales/prosperity-all-low-carbon-wales>

has met the first two carbon budgets (2008-12 and 2013-17) and latest emissions projections suggest we are on track to meet the third (2018-22). We recognise the need for further action to meet the fourth and fifth carbon budgets (2023-2032).

Scotland has statutory annual emissions reduction targets. The most recently reported target (for 2017) was missed, but the preceding three years (2014, 2015 and 2016) were all met. Actual emissions from Scotland have been reduced by almost half (47%) between the 1990 baseline and 2017.<sup>22</sup>

The most recent data for Wales estimates that emissions totalled 42.2 metric tonnes of carbon dioxide equivalent (MtCO<sub>2</sub>e) in 2017, a fall of 25% compared to base year emissions.<sup>23</sup> This represents a 13% decrease compared to 2016, reflecting the volatile nature of Welsh emissions. The CCC believes that “if Wales can maintain this progress it will be on track to meet its first carbon budget”.<sup>24</sup>

## Energy efficiency

To meet the UK's 2050 net zero climate change target, emissions from buildings will need to be near zero, coupled with action on industrial processes. This requires improving energy efficiency and energy management and decarbonising nearly all heating and cooling of buildings. Adapting to climate change risks, including overheating, can also reduce energy demand. New building developments can incorporate mechanical or passive ventilation systems to provide natural cooling limiting air conditioning use. The UK is taking a range of actions including addressing barriers to energy efficiency and low-carbon investment, such as supporting organisations to access finance.

The CGS provides a framework for driving UK policy on energy efficiency. Some policies and measures on energy efficiency that have already been implemented include commitments to fund energy efficiency improvements in the public sector, industry, business and homes. On 15 October 2019, the UK government published its response to the CCC's annual report, which included key proposals to improve the energy performance of non-domestic buildings. The UK government launched consultation on a future target of Energy Performance Certificate (EPC) Band B by 2030 for minimum energy efficiency standards in non-domestic rented buildings, and committed to consult in 2020 on introducing mandatory in-use energy performance ratings for non-domestic buildings in the private sector, which will be key to helping businesses to understand and improve the actual energy performance of their buildings.

Northern Ireland contributes to the UK's energy efficiency targets with the Northern Ireland Sustainable Energy Programme (NISEP) delivering up to 200GWh per year of energy savings as required by Article 7 of the Energy Efficiency Directive<sup>25</sup>. Northern Ireland is currently developing a new Energy Strategy, a key theme of which will be energy efficiency. Through the work to develop the Energy Strategy, the aim is to ensure co-ordinated and effective delivery of

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<sup>22</sup> Scottish greenhouse gas emissions 2017, June 2019 [www.gov.scot/publications/scottish-greenhouse-gas-emissions-2017/](http://www.gov.scot/publications/scottish-greenhouse-gas-emissions-2017/)

<sup>23</sup> Devolved Administrations - Greenhouse Gas Reports, National Atmospheric Emissions Inventory (2019) [http://naei.beis.gov.uk/reports/reports?section\\_id=4](http://naei.beis.gov.uk/reports/reports?section_id=4). The baseline year for each greenhouse gas is 1990 (carbon dioxide, methane, nitrous oxide) or 1995 (hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, nitrogen trifluoride)

<sup>24</sup> The Committee on Climate Change (2019), Reducing UK emissions – 2019 Progress report to Parliament, [www.theccc.org.uk/publication/reducing-uk-emissions-2019-progress-report-to-parliament/](http://www.theccc.org.uk/publication/reducing-uk-emissions-2019-progress-report-to-parliament/)

<sup>25</sup> UK National Energy Efficiency Action Plan 2014, [www.gov.uk/government/publications/the-uks-national-energy-efficiency-action-plan-and-building-renovation-strategy](http://www.gov.uk/government/publications/the-uks-national-energy-efficiency-action-plan-and-building-renovation-strategy).

energy efficiency policies and programmes across Northern Ireland and to examine the merits of establishing a new energy efficiency target for Northern Ireland if appropriate.

In Scotland, Energy Efficient Scotland was launched in May 2018.<sup>26</sup> This ambitious 20-year programme contains a set of actions to make Scotland's buildings near zero carbon wherever feasible by 2050 and to do so in a way that is socially and economically sustainable.

Energy Efficient Scotland will help to remove poor energy efficiency as a driver for fuel poverty and will reduce greenhouse gas emissions through more energy efficient buildings and decarbonising Scotland's heat supply. Over the lifetime of Energy Efficient Scotland, an estimated £10 to £12bn from public and private sources will be invested in improving the energy efficiency of Scotland's buildings generating economic opportunity across the whole of Scotland.

In Wales, the Welsh Government has invested more £265m in the Warm Homes Programme demand led Nest Scheme and Arbed area-based scheme since 2009, which has improved the energy efficiency of over 50,000 homes. By the current funding period in March 2021, Welsh Government investment will have reached £344m in the Warm Homes Programme and benefitted more than 75,000 homes. Nearly 130,000 people have received energy efficiency advice through the Warm Homes Programme since 2011.

### **Energy security**

The UK is committed to ensuring there are secure supplies for consumers, regardless of the energy mix, and the CGS sets out actions to enhance energy security by delivering a more diverse and reliable energy mix. The UK is supporting smarter, flexible networks thereby enabling the integration of clean generation. Further detail on strengthening the resilience of the energy sector to climate change risks can be found in the section above (see - the third strategy for Adaptation Reporting Power (ARP)).

The UK government recognises a range of benefits that interconnection can provide and strongly supports greater electricity trading with our European partners. The electricity system in Great Britain is currently connected to north-west Europe via 4GW of interconnector capacity. 1GW of interconnection also links Great Britain with the Single Electricity Market on the island of Ireland. In addition to the 5GW already operational, 4.8GW of capacity is already in construction, and a further 8.1GW is progressing through regulatory process. This is expected to increase our level of interconnection by 2030.

We continue to support developing liberalised markets and successfully using competition to drive down energy prices. We are embracing the opportunity to increase renewable generation, decarbonise the economy and maintain affordability. We are implementing rules for a well-functioning UK market and our Electricity Market Reform introduced measures on, for example, Contracts for Difference and wholesale market liquidity. The CGS outlines the UK's commitment to move towards a more dynamic market, empowering the consumer and realising the potential of renewables, small scale generation, greater flexibility, smart metering and the digital revolution.

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<sup>26</sup> Energy Efficient Scotland Route Map, May 2018, [www.gov.scot/publications/energy-efficient-scotland-route-map/pages/1/](http://www.gov.scot/publications/energy-efficient-scotland-route-map/pages/1/)

## Research, innovation and competitiveness

The UK's early action on clean growth means that it has nurtured a broad range of low-carbon industries, including some sectors in which we have world leading positions. This success is built upon wider strengths – the UK's scientific research base, expertise in high-value service and financial industries, and a regulatory framework that provides long-term direction and support for innovation and excellence in the design and manufacturing of leading-edge technology.

This progress has been aided by the falling costs of many low-carbon technologies: renewable power sources like solar and wind are comparable in cost to coal and gas in many countries; energy efficient light bulbs are over 80% cheaper today than in 2010; and the price of lithium-ion batteries has fallen by 85% since 2010<sup>27</sup> and is expected to more than halve again by 2030 according to industry.<sup>28</sup> As a result of this technological innovation, new high value jobs, industries and companies have been created. This is driving a new, technologically innovative, high growth and high value 'low-carbon' sector of the UK economy.

Due to the UK's world leading expertise in technologies such as offshore wind, power electronics for low-carbon vehicles and electric motors, and global leadership in green finance, we are successfully exporting goods and services around the world. For example, in 2018, 1 in every 5 battery electric cars sold in Europe was built in the UK.<sup>29</sup> This progress means there are nearly 400,000 jobs in low-carbon businesses and their supply chains, employing people in locations across the country.<sup>30</sup>

Capturing part of the global opportunity while continuing to drive down carbon emissions from our own activities provides a huge economic opportunity for the UK. By one estimate, the UK low-carbon economy could grow by an estimated 11% per year between 2015 and 2030 – 4 times faster than the rest of the economy – and could deliver between £60 billion and £170 billion of export sales of goods and services by 2030.<sup>31</sup> This means that clean growth can play a central part in our Industrial Strategy – building on our strengths to drive economic growth and boost earning power across the country.

The Department for Business, Energy and Industrial Strategy (BEIS) holds the responsibility for strategic oversight of climate and energy science and innovation across UK government, promoting and protecting the UK government's policy interests. Its Science and Innovation for Climate and Energy Directorate (SICE) provides the science and engineering evidence and data to support, constructively challenge and enable development and delivery of national energy policy.

Wider prioritisation of activity, research and innovation spending on energy is co-ordinated through the UK government's Energy Innovation Board (EIB), with SICE providing the

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<sup>27</sup> Battery Reality, Bloomberg, [www.bloomberg.com/news/articles/2019-04-03/battery-reality-there-s-nothing-better-than-lithium-ion-coming-soon](http://www.bloomberg.com/news/articles/2019-04-03/battery-reality-there-s-nothing-better-than-lithium-ion-coming-soon)

<sup>28</sup> Electricity Storage and Renewables, IRENA, [http://irena.org/-/media/Files/IRENA/Agency/Publication/2017/Oct/IRENA\\_Electricity\\_Storage\\_Costs\\_2017.pdf](http://irena.org/-/media/Files/IRENA/Agency/Publication/2017/Oct/IRENA_Electricity_Storage_Costs_2017.pdf)

<sup>29</sup> UK Office for Low Emission Vehicles, [www.gov.uk/government/news/funding-for-thousands-of-electric-car-charge-points-unused-by-councils](http://www.gov.uk/government/news/funding-for-thousands-of-electric-car-charge-points-unused-by-councils)

<sup>30</sup> ONS (2019). Low Carbon and Renewable Energy Economy Survey: 2017 Final Estimates [www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalesimates/2017](http://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalesimates/2017)

<sup>31</sup> Ricardo Energy and Environment for the Committee on Climate Change (2017) UK business opportunities of moving to a low-carbon economy (supporting data tables) [www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/](http://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/)

secretariat for this. There is currently no separate energy research and innovation strategy. Prioritisation decisions are informed by the Industrial Strategy and the CGS.

*iii Overview table with key objectives, policies and measures of the plan*

As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union. However, UK policies and measures relating to the five dimensions of the EU's Energy Union are detailed in [section 3.1.1](#).

The Climate Change Plan sets out the Scottish Government's policies and proposals to reduce emissions over the period to 2032 in line with the reduction target in the 2009 Act.

The plan for the first Welsh carbon budget, Prosperity for All: A Low-Carbon Wales, was published in March 2019 and contains 100 policies and proposals from all emissions sectors and Ministerial portfolios.<sup>32</sup> The Welsh Government's plan for meeting Wales' second carbon budget will be published in 2021.

## 1.2 Overview of current policy situation

*i National energy system and policy context of the national plan*

The strategy of the EU's Energy Union consists of five dimensions which inform the structure and content of this plan. As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union. The UK government's CGS sets out the UK's proposals to deliver increased economic growth and decreased emissions:

- Accelerating clean growth
- Improving business and industry efficiency
- Improving UK homes
- Accelerating the shift to low-carbon transport
- Delivering clean, smart, flexible power
- Enhancing the benefits and value of our natural resources
- Leading in the public sector

*ii Current energy and climate policies and measures relating to the five dimensions of the EU Energy Union*

As stated above, UK policies and measures relating to the five dimensions of the EU's Energy Union are detailed in [section 3.1.1](#).

The Climate Change Plan sets out the Scottish Government's policies and proposals to reduce emissions over the period to 2032 in line with the reduction target in the 2009 Act.

The Welsh Government's plan for meeting Wales' second carbon budget will be published in 2021.

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<sup>32</sup> Prosperity for All: A Low Carbon Wales, Welsh Government, 2019: <https://gov.wales/prosperity-all-low-carbon-wales>

*iii Key issues of cross-border relevance*

Northern Ireland and Ireland have a shared wholesale single electricity market (SEM). It was formed in November 2007 and underwent a reform programme in 2018 called the Integrated Single Electricity Market (or 'I-SEM'). The reforms introduced new and more efficient wholesale trading arrangements, closer integration with other electricity markets and a more competitive capacity mechanism. While Northern Ireland is wholly dependent on Great Britain for its natural gas supply, it has gas interconnection with Ireland and gas security of supply is considered on a national and regional basis.

The UK is part of the wider North Seas region, which has a large renewable energy potential. More information on this cooperation is set out in section 1.4(ii).

Another forum for regional cooperation is the Energy Work Sector under the British Irish Council (BIC). This provides opportunities for the governments of the UK, Ireland, Scotland, Wales, Isle of Man, Jersey and Guernsey to share information and work together on energy issues of common interest.

*iv Administrative structure of implementing national energy and climate policies*

The UK government has a legally binding climate change framework under the Climate Change Act 2008. To ensure the UK is on an appropriate emissions reduction pathway, the UK government is obliged to set legally binding five-year caps on emissions twelve years in advance (carbon budgets), informed by advice from our independent statutory adviser, the CCC. Additionally, the UK is required to publish a report setting out the policies and proposals to meet budgets after setting each carbon budget. See Table 1 for the UK's actual and projected performance against the carbon budgets.

**Table 1: Performance against carbon budgets<sup>33</sup>**

Carbon budget:	1	2	3	4	5
	(2008-12)	(2013-17)	(2018-22)	(2023-27)	(2028-32)
	Actual	Actual	No carry forward/ (with carry forward)		
	Actual	Actual	Projection	Projection	Projection
Carbon budget level: cumulative emissions	3,018	2,782	2,544 (2,632)	1,950	1,725
Average required reduction vs 1990 emissions <sup>34</sup> , %	-24%	-30%	-36%	-51%	-57%
Projected emissions, Mt	2,982 (actual)	2,398 (actual)	2,456	2,059	1,890
Result vs budget level, Mt	-36 Mt	-384 Mt	-88Mt (-176 Mt)	+109 Mt	+165 Mt
Result vs budget, %	-1%	-14%	-3% (-7%)	+6%	+10%

The Climate Change Act established the Committee on Climate Change (CCC) to advise the UK government and the Devolved Administrations on setting and meeting carbon budgets and other related matters.

The Scottish Parliament passed the Climate Change (Scotland) Act in 2009, establishing Scotland's 2050 target and the supporting framework of interim and annual targets. The Scottish Government is required to publish reports every five years setting out the policies and proposals to meet annual targets over periods of around the next fifteen years. The Climate Change (Scotland) Act also establishes Scotland specific roles for the CCC as an independent advisory body. On 25 September 2019, the Scottish Parliament approved the Climate Change (Emissions Reductions Targets) (Scotland) Act. Following advice received from the CCC, the Act sets a net zero emissions target for 2045. It also includes interim targets of a 75% reduction by 2030 and a 90% reduction by 2040 and makes provision for the establishment of a Citizens Assembly on Climate Change.

<sup>33</sup> Actual emissions (carbon budgets 1 and 2) - Source: BEIS, Final UK GHG emissions statistics 1990-2017 (table 9)

[www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017](http://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017)

Projected emissions (carbon budgets 3, 4 and 5) - Source: BEIS, Energy and Emissions Projections 2018 (web table 2.3), [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

<sup>34</sup> Base year emissions are revised each year, so the percentage reductions against carbon budgets are subject to change.

The National Assembly for Wales passed the Environment (Wales) Act in 2016<sup>35</sup>, which includes Wales's 2050 target and allows for the establishment of an advisory body. The CCC currently exercises these functions. The National Assembly passed secondary legislation in 2018 to set decadal interim targets and the first two carbon budgets. Since then, the Welsh Government has accepted the CCC's recommendation to increase Wales's 2050 target to 95% and has requested the CCC's advice on how this affects the interim targets and carbon budgets set in 2018. The Welsh Government will ask the Welsh Parliament to amend the targets and budgets legislation in 2020.

## 1.3 Consultations and involvement of national and EU entities and their outcome

### *i Involvement of the national parliament*

In accordance with the Climate Change Act, a carbon budget must be made by order, subject to affirmative resolution procedure.<sup>36</sup> Before laying a draft statutory instrument containing an order setting a carbon budget, the UK government must take into account the advice of the CCC as well as any representations made by the Devolved Administrations.

A carbon budget must be set with a view to meeting the 2050 target and complying with international obligations of the UK. The Climate Change Act sets out a number of matters that must also be taken into account when deciding the level of a carbon budget.<sup>37</sup>

In Scotland, the Climate Change (Scotland) Act 2009, requires that Scottish Ministers set annual targets, in secondary legislation, for each year from 2010 to 2050. Scottish Ministers also take advice from the CCC on the targets before these are set.

In Wales, the Welsh Ministers must lay interim targets and carbon budgets in the Welsh Parliament. Before doing so, they must obtain and have regard to advice from the CCC. The Environment (Wales) Act 2016 sets out the matters Welsh Ministers must take into account when setting a carbon budget and those the CCC must consider in its advice.<sup>38</sup>

### Reporting to Parliament

The UK government must lay before Parliament an Annual Statement of Emissions by 31 March in the second year following that to which it relates. It must also prepare and lay a Final Statement for each budgetary period by 31 May in the second year following the end of the period to which it relates, setting out, among other things, the final amount for the period of UK emissions, removals and net emissions of each greenhouse gas.

In June each year (and in July in the second year after the end of a budgetary period), the CCC must lay before Parliament a report setting out its views on progress against the carbon budgets and 2050 target, to which the UK government is required to respond by October. In

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<sup>35</sup> Environment (Wales) Act 2016, [www.legislation.gov.uk/anaw/2016/3/part/2/enacted](http://www.legislation.gov.uk/anaw/2016/3/part/2/enacted)

<sup>36</sup> More information on the affirmative resolution procedure can be found at: [www.parliament.uk/site-information/glossary/affirmative-procedure/](http://www.parliament.uk/site-information/glossary/affirmative-procedure/)

<sup>37</sup> See s10(2) of the CCA: [www.legislation.gov.uk/ukpga/2008/27/section/10](http://www.legislation.gov.uk/ukpga/2008/27/section/10)

<sup>38</sup> Environment (Wales) Act 2016, [www.legislation.gov.uk/anaw/2016/3/part/2/enacted](http://www.legislation.gov.uk/anaw/2016/3/part/2/enacted)

the second year after the end of a budgetary period the report will also set out the CCC's views on how the UK performed on meeting the last carbon budget.

In Scotland, Scottish Ministers must lay before the Scottish Parliament an annual report that states whether the annual target has been met. The CCC must lay before the Scottish Parliament an annual report setting out Scotland's progress against achieving its targets and the Scottish Government provide a response to this report.

In Wales, the Welsh Ministers must lay a statement in the Senedd no later than two years after the end of each budget outlining the final amount of net Welsh emissions and the number of offsets used. If the carbon budget has not been met, Welsh Ministers must within three months lay before the Senedd a report setting out proposals and policies to compensate for the excess emissions in later budgetary periods. Welsh Ministers must also lay a statement in the Senedd, within two years of each interim target year outlining the final amount of net Welsh emissions for the target year, the number of offsets used for the year and why the target has been met or missed.

Welsh Ministers must also lay CCC progress reports on carbon budgets and interim targets before the Senedd, and Ministers' respond to the points raised by the CCC within six months.

#### *ii Involvement of local and regional authorities*

The BEIS Local Energy Programme has now supported Local Energy Strategies for each of the 38 Local Enterprise Partnerships in England. These documents are feeding into Local Economic planning at local and regional levels. These strategies form the basis of new Local Energy Hubs, which are resourced to support the development of commercially viable low-carbon energy projects. This includes raising awareness, building partnerships with green finance as well as developing the pipeline of projects. To support the hubs, we are also building a number of tools including the SCATTER tool which will support Local Authorities to report on action and also to help prioritise actions.

Alongside the Local Energy Programme, we have launched a UK wide innovation programme, Prospering from the Energy Revolution, which is working with Local Authorities across the UK to demonstrate and design future local energy systems.

The Scottish Government has an ambition to achieve 1GW of community and locally owned renewables by 2020, and 2GW by 2030, as well as an ambition to spread the economic benefits of commercial renewables schemes through shared ownership with communities.<sup>39</sup> As of June 2017, there was an estimated minimum of 666 MW of community and locally owned renewable energy capacity operating in Scotland. Local government in Scotland is already playing a key role in delivering energy efficiency programmes, primarily for the domestic sector. The Scottish Government sees a stronger role for local government in the future. In 2017, there was a consultation on the possible introduction of a statutory duty on local authorities to develop Local Heat and Energy Efficiency Strategies (LHEES), to be delivered in consultation with local stakeholders and in collaboration with community planning partners. This would provide the link between the delivery of long-term targets and national policies, and the delivery of energy efficiency and heat decarbonisation on the ground. A position paper on Local Energy Systems in Scotland has been developed, further to a commitment made in the Energy Strategy, and is due to be published in Autumn 2020.

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<sup>39</sup> Source: Renewable and low carbon energy, Scottish Government website, [www.gov.scot/policies/renewable-and-low-carbon-energy/local-and-small-scale-renewables/](http://www.gov.scot/policies/renewable-and-low-carbon-energy/local-and-small-scale-renewables/)

The Welsh Government is supporting local authorities in the development of energy plans. There are transformative opportunities in developing local or regional energy plans, driven by network and/or national regional energy data, which will help decision-making and enable us to meet decarbonisation objectives in Wales. The Welsh Government has committed to providing support to enable regional strategic energy plans to be developed, as part of the Cardiff City Region and the Mid Wales and North Wales Growth Deals work. This will build on earlier work undertaken in the Swansea Bay City Region by the Institute of Welsh Affairs and Regen.<sup>40</sup> Using the learning from this work, the Welsh Government will explore the potential for developing more locally owned energy plans, which could lead to pipelines of energy projects and provide more clarity on the energy infrastructure required for a low-carbon energy system in Wales.

The Welsh Government has set a target to produce 70% of the electricity Wales uses from renewable sources by 2030, and for 1GW of locally owned renewable energy capacity by 2030. In 2018 Wales generated enough renewable electricity to meet 50% of its power use. At the end of 2018 there was 783MW of renewable energy in local ownership in Wales. 540MW of this capacity is renewable electricity and 243MW is renewable heat. In total there are over 64,600 locally owned renewable energy projects in Wales.<sup>41</sup>

*iii Consultations of stakeholders, including the social partners, and engagement of civil society and the general public*

The UK is committed to proper public participation and consultation and is committed to meeting its obligations under Article 7 of the Aarhus Convention, which are set out in the UK's published Consultation Principles.<sup>42</sup>

Ahead of the UK government setting a carbon budget, it is required to consider the advice of the CCC on the appropriate budget level, as well as any representations made by the Devolved Administrations. For the fifth carbon budget, the CCC published its advice in November 2015 and the budget was set in June 2016, in line with the requirements of the Climate Change Act. In preparing its advice on the level of the fifth carbon budget, the CCC ran a public call for evidence in mid-2015, to which 51 organisations responded. These organisations included representatives from the power, transport, buildings, industrial and agricultural sectors, as well as Non-Governmental Organisations (NGOs) and others. In addition, the CCC ran more than ten roundtable and workshop discussions with business stakeholders, including trade associations, and more than 200 meetings with individual stakeholders across all sectors including areas such as fuel poverty, competition and technological progress.

In the Clean Growth Strategy, the UK government stated that it welcomed views and comments on our approach to decarbonising the economy. An opportunity to provide feedback on the Strategy was provided between 12 October and 31 December 2017, and we received 132 responses from a wide range of stakeholders, including individuals, companies from different sectors, academia, trade associations, NGOs and local government.

As the policies and proposals in the Clean Growth Strategy are developed and implemented over time, they are subject to public consultation as part of the normal regulatory process.

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<sup>40</sup> Swansea Bay City Region: A Renewable Energy Future, April 2018, [www.iwa.wales/wp-content/uploads/2018/04/Regen-SBCR-A-Renewable-Future-FINAL.pdf](http://www.iwa.wales/wp-content/uploads/2018/04/Regen-SBCR-A-Renewable-Future-FINAL.pdf)

<sup>41</sup> Energy generation in Wales, Welsh Government website, <https://gov.wales/energy-generation>.

<sup>42</sup> UK Consultation Principles, July 2012, [www.gov.uk/government/publications/consultation-principles-guidance](http://www.gov.uk/government/publications/consultation-principles-guidance)

The UK government has conducted a number of public consultations on issues relating to the five dimensions of the EU's Energy Union, including on the UK Industrial Strategy Green paper.<sup>43</sup> A list of stakeholder and public consultations is set out below.

In summer 2018, the Welsh Government consulted on early ideas for meeting the Wales 2030 target across all emissions sectors.<sup>44</sup> Further policy-specific engagement and consultation will follow as appropriate.

The Scottish Energy Strategy committed the Scottish Government to publishing an Annual Energy Statement to monitor the strategy's delivery. The first of these was published on 15 May 2019 alongside a new Annual Compendium of Scottish Energy Statistics (ACSES).

The statement highlights the key developments in the sector which will have an impact upon Scotland's ability to deliver the strategy, progress made to date, and key plans for the coming year and beyond.

The Scottish Government has also consulted with the Scottish Energy Advisory Board (SEAB) on progress of the Energy Strategy and is working towards agreeing a new structure of expert advisory groups – one that is consistent with, and ensures effective coverage of, the strategic priorities set out in the strategy.

The Scottish Government's Climate Change Programme is supported by a range of engagement activities. The Big Climate Conversation included strands for the public sector, private sector and members of the public. This is an important part of shaping Scotland's response to the global climate emergency and all government portfolios are encouraged to engage with the events.

The public engagement element consisted of a series of 10 large scale, open public workshops designed to ascertain the public's awareness of the issue as a national endeavour and the appetite for particular societal changes and actions required to meet Scotland's goals. The workshops were supplemented by a programme of digital engagement through Twitter and Facebook and a free toolkit and funding were provided to enable groups to conduct their own sessions and contribute to the conversation. Over 2,500 people across Scotland participated in the Big Climate Conversation. The findings were summarised in the Big Climate Conversation Report that was published on 30 January 2020.<sup>45</sup>

With regards to public sector engagement a written consultation on the role of the public sector in tackling climate change, ran from September to December 2019. There is also a series of face-to-face engagements using existing networks such as the Scottish Leaders Forum, Convention of Highlands and Islands, and the Sustainable Scotland Network. Business engagement is happening with both multi-stakeholder and sector specific events. The Cabinet Secretaries for Finance, Economy and Fair Work will host a Business Summit in October; the Cabinet Secretary for Environment, Climate Change and Land Reform will host a climate change workshop at the Business in Parliament event in November; and other workshop events are being planned for small businesses (with FSB) and larger businesses (with CBI). In parallel, additional sector specific, portfolio-led business engagement events are being

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<sup>43</sup> Industrial Strategy consultation, 2017, [www.gov.uk/government/consultations/building-our-industrial-strategy](http://www.gov.uk/government/consultations/building-our-industrial-strategy)

<sup>44</sup> A low carbon pathway for Wales (consultation), October 2018, <https://gov.wales/low-carbon-pathway-wales>

<sup>45</sup> Big Climate Conversation Report, published January 2020: [www.gov.scot/publications/report-findings-big-climate-conversation/](http://www.gov.scot/publications/report-findings-big-climate-conversation/)

planned, including the Energy Intensive Industry roundtable and an event focusing on decarbonising transport fleets.

The Department for the Economy in Northern Ireland has been considering how to advance proposals for an energy strategy that will enable new and challenging decarbonisation targets. Following a Call for Evidence in December 2019 the department will consider the responses and plans to establish five working groups on consumers, energy efficiency, heat, power and transport. A summary report of responses will be published in June 2020. The department intends to develop an Energy Transition Model for the entire energy system which will test different scenarios and pathways to estimate the impact on energy demand. An options paper will be published by end of March 2021 with the aim of a final strategy in place by November 2021.

**Table 2: UK Consultations**

EU Dimension	Consultation	More Information
<b>Decarbonisation</b>	An emissions reduction target for the wider public and higher education sectors: A summary of responses to the call for evidence	<a href="http://www.gov.uk/government/consultations/leading-by-example-cutting-energy-bills-and-carbon-emissions-in-the-public-and-higher-education-sectors">www.gov.uk/government/consultations/leading-by-example-cutting-energy-bills-and-carbon-emissions-in-the-public-and-higher-education-sectors</a>
	E10 petrol, consumer protection and fuel pump labelling	<a href="http://www.gov.uk/government/consultations/e10-petrol-consumer-protection-and-fuel-pump-labelling">www.gov.uk/government/consultations/e10-petrol-consumer-protection-and-fuel-pump-labelling</a>
	Proposals for a new Climate Change (Scotland) Bill (2017)	<a href="https://consult.gov.scot/energy-and-climate-change-directorate/climate-change-bill/">https://consult.gov.scot/energy-and-climate-change-directorate/climate-change-bill/</a>
	The Renewable Transport Fuel Obligations Order: Proposed changes for 2017	<a href="http://www.gov.uk/government/consultations/renewable-transport-fuel-obligation-proposed-changes-for-2017">www.gov.uk/government/consultations/renewable-transport-fuel-obligation-proposed-changes-for-2017</a>
	Renewables Obligation closure consultation	<a href="http://www.gov.uk/government/consultations/transition-from-the-renewables-obligation-to-contracts-for-difference">www.gov.uk/government/consultations/transition-from-the-renewables-obligation-to-contracts-for-difference</a>
	Feed-in-Tariffs closure consultation	<a href="http://www.gov.uk/government/consultations/feed-in-tariffs-scheme">www.gov.uk/government/consultations/feed-in-tariffs-scheme</a>
	Contracts for Difference publications	<a href="http://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference">www.gov.uk/government/publications/contracts-for-difference/contract-for-difference</a>
	The Renewable Heat Incentive: A reformed and refocused scheme	<a href="http://www.gov.uk/government/consultations/transition-from-the-renewables-obligation-to-contracts-for-difference">www.gov.uk/government/consultations/transition-from-the-renewables-obligation-to-contracts-for-difference</a> <a href="http://www.gov.uk/government/consultations/renewables-obligation-ro-grace-periods">www.gov.uk/government/consultations/renewables-obligation-ro-grace-periods</a>
	The future of low-carbon heat for off gas buildings: a call for evidence	<a href="https://consult.gov.scot/better-homes-division/the-future-of-low-carbon-heat/">https://consult.gov.scot/better-homes-division/the-future-of-low-carbon-heat/</a>

EU Dimension	Consultation	More Information
	Smart Export Guarantee (SEG)	<a href="http://www.gov.uk/government/consultations/the-future-for-small-scale-low-carbon-generation">www.gov.uk/government/consultations/the-future-for-small-scale-low-carbon-generation</a>
	Wales: Achieving our low-carbon pathway to 2030	<a href="https://gov.wales/low-carbon-pathway-wales">https://gov.wales/low-carbon-pathway-wales</a>
	Wales: Locally-owned renewable energy – Call for evidence	<a href="https://gov.wales/locally-owned-renewable-energy-call-evidence">https://gov.wales/locally-owned-renewable-energy-call-evidence</a>
	Carbon Capture, Usage and Storage: Re use of oil and gas infrastructure for CCUS projects	<a href="http://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-projects-re-use-of-oil-and-gas-assets">www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-projects-re-use-of-oil-and-gas-assets</a>
	Carbon Capture, Usage and Storage: Business Models	<a href="http://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models">www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models</a>
	Regulated Asset Base (RAB) model for nuclear	<a href="http://www.gov.uk/government/consultations/regulated-asset-base-rab-model-for-nuclear">www.gov.uk/government/consultations/regulated-asset-base-rab-model-for-nuclear</a>
	New NI Energy Strategy Call for Evidence	<a href="http://www.economy-ni.gov.uk/energy-strategy-call-for-evidence">www.economy-ni.gov.uk/energy-strategy-call-for-evidence</a>
	The Future of UK Carbon Pricing	<a href="http://www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing">www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing</a>
<b>Energy efficiency</b>	Building a market for energy efficiency: Call for evidence and summary of responses	<a href="http://www.gov.uk/government/consultations/building-a-market-for-energy-efficiency-call-for-evidence">www.gov.uk/government/consultations/building-a-market-for-energy-efficiency-call-for-evidence</a>
	Energy Performance Certificates in buildings: Call for evidence	<a href="http://www.gov.uk/government/consultations/energy-performance-certificates-in-buildings-call-for-evidence">www.gov.uk/government/consultations/energy-performance-certificates-in-buildings-call-for-evidence</a>
	Call for evidence and summary of responses on the Green Deal Framework	<a href="http://www.gov.uk/government/consultations/call-for-evidence-on-the-reform-of-the-green-deal-framework">www.gov.uk/government/consultations/call-for-evidence-on-the-reform-of-the-green-deal-framework</a>
	Widening eligibility for energy intensive industries for renewable cost exemption schemes	<a href="http://www.gov.uk/government/consultations/widening-eligibility-for-renewable-electricity-cost-relief-schemes">www.gov.uk/government/consultations/widening-eligibility-for-renewable-electricity-cost-relief-schemes</a>
	Energy Company Obligation: ECO3, 2018 to 2022 ECO3: Improving Consumer Protection	<a href="http://www.gov.uk/government/consultations/energy-company-obligation-eco3-2018-to-2022">www.gov.uk/government/consultations/energy-company-obligation-eco3-2018-to-2022</a> <a href="https://www.gov.uk/government/consultations/energy-company-obligation-eco3-improving-consumer-protection">https://www.gov.uk/government/consultations/energy-company-obligation-eco3-improving-consumer-protection</a>

EU Dimension	Consultation	More Information
	Removal of 'no cost to the land' principle in domestic private rented sector energy efficiency regulations (England and Wales)	<a href="http://www.gov.uk/government/consultations/domestic-private-rented-sector-minimum-level-of-energy-efficiency">www.gov.uk/government/consultations/domestic-private-rented-sector-minimum-level-of-energy-efficiency</a>
	Energy efficiency scheme for small and medium sized businesses: call for evidence	<a href="http://www.gov.uk/government/consultations/energy-efficiency-scheme-for-small-and-medium-sized-businesses-call-for-evidence">www.gov.uk/government/consultations/energy-efficiency-scheme-for-small-and-medium-sized-businesses-call-for-evidence</a>
	Non-domestic Private Rented Sector minimum energy efficiency standards: future trajectory to 2030	<a href="http://www.gov.uk/government/consultations/non-domestic-private-rented-sector-minimum-energy-efficiency-standards-future-trajectory-to-2030">www.gov.uk/government/consultations/non-domestic-private-rented-sector-minimum-energy-efficiency-standards-future-trajectory-to-2030</a>
	Heat Networks Investment Project	<a href="http://www.gov.uk/government/consultations/consultation-on-the-heat-networks-investment-project-hnip">www.gov.uk/government/consultations/consultation-on-the-heat-networks-investment-project-hnip</a>
	Warm Home Discount	<a href="http://www.gov.uk/government/consultations/warm-home-discount-scheme-2018-to-2019">www.gov.uk/government/consultations/warm-home-discount-scheme-2018-to-2019</a>
	Energy Efficient Scotland	<a href="https://consult.gov.scot/better-homes-division/energy-efficient/">https://consult.gov.scot/better-homes-division/energy-efficient/</a>
	Future Homes Standard: 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings	<a href="http://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings">www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings</a>
<b>Energy security</b>	Capacity Market-related publications and consultations	<a href="http://www.gov.uk/government/collections/electricity-market-reform-capacity-market">www.gov.uk/government/collections/electricity-market-reform-capacity-market</a> <a href="http://www.ofgem.gov.uk/publications-and-updates/report-our-five-year-review-capacity-market-rules-and-forward-work-plan">www.ofgem.gov.uk/publications-and-updates/report-our-five-year-review-capacity-market-rules-and-forward-work-plan</a> <a href="http://www.gov.uk/government/consultations/capacity-market-carbon-dioxide-emissions-limits">www.gov.uk/government/consultations/capacity-market-carbon-dioxide-emissions-limits</a> <a href="http://www.gov.uk/government/publications/capacity-market-5-year-review-2014-to-2019">www.gov.uk/government/publications/capacity-market-5-year-review-2014-to-2019</a>
	Petroleum extraction (Welsh Government)	Petroleum extraction policy in Wales: <a href="https://gov.wales/petroleum-extraction-policy-wales">https://gov.wales/petroleum-extraction-policy-wales</a>

EU Dimension	Consultation	More Information
<b>Energy security</b>	Ofgem (Office of Gas and Electricity Markets) Developing a Framework for Assessing Whether the Conditions for Effective Competition are in Place	<a href="http://www.ofgem.gov.uk/publications-and-updates/developing-framework-assessing-whether-conditions-are-place-effective-competition-domestic-supply-contracts">www.ofgem.gov.uk/publications-and-updates/developing-framework-assessing-whether-conditions-are-place-effective-competition-domestic-supply-contracts</a>
	RIIO 2 framework Consultation	<a href="http://www.ofgem.gov.uk/publications-and-updates/riio-2-framework-consultation">www.ofgem.gov.uk/publications-and-updates/riio-2-framework-consultation</a>
	Smart systems and flexibility plan	<a href="http://www.ofgem.gov.uk/publications-and-updates/upgrading-our-energy-system-smart-systems-and-flexibility-plan">www.ofgem.gov.uk/publications-and-updates/upgrading-our-energy-system-smart-systems-and-flexibility-plan</a>
	Smart systems and flexibility plan: progress update	<a href="http://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan">www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan</a>
	Ofgem RIIO-ED2	<a href="http://www.ofgem.gov.uk/publications-and-updates/open-letter-consultation-riio-ed2-price-control">www.ofgem.gov.uk/publications-and-updates/open-letter-consultation-riio-ed2-price-control</a>
	Government response on proposals regarding the planning system for electricity storage	<a href="http://www.gov.uk/government/consultations/the-planning-system-for-electricity-storage-follow-up-consultation">www.gov.uk/government/consultations/the-planning-system-for-electricity-storage-follow-up-consultation</a>
	Electric vehicle smart charging	<a href="http://www.gov.uk/government/consultations/electric-vehicle-smart-charging">www.gov.uk/government/consultations/electric-vehicle-smart-charging</a>
	Smart appliance proposals	<a href="http://www.gov.uk/government/consultations/proposals-regarding-setting-standards-for-smart-appliances">www.gov.uk/government/consultations/proposals-regarding-setting-standards-for-smart-appliances</a>
	The most recent consultation by Ofgem on the needs case for the connection to Hinkley Point C	<a href="http://www.ofgem.gov.uk/publications-and-updates/hinkley-seabank-consultation-final-needs-case-and-potential-delivery-models">www.ofgem.gov.uk/publications-and-updates/hinkley-seabank-consultation-final-needs-case-and-potential-delivery-models</a>
	Smart meter interoperability	<a href="http://www.gov.uk/government/consultations/maximising-interoperability-for-first-generation-smets1-smart-meters">www.gov.uk/government/consultations/maximising-interoperability-for-first-generation-smets1-smart-meters</a>
	Smart meter interoperability	<a href="http://www.gov.uk/government/consultations/enrolment-of-smets1-meter-cohorts-with-the-data-communications-company">www.gov.uk/government/consultations/enrolment-of-smets1-meter-cohorts-with-the-data-communications-company</a>
	Smart meter interoperability	<a href="http://www.gov.uk/government/consultations/enrolment-of-secure-smets1-meters-in-the-data-communications-company-dcc">www.gov.uk/government/consultations/enrolment-of-secure-smets1-meters-in-the-data-communications-company-dcc</a>
	Smart metering policy framework post-2020	<a href="http://www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020">www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020</a>

The UK held a 'Green Great Britain & Northern Ireland Week' in October 2018, to showcase the opportunities clean growth offers the UK and raise understanding of how business and the public can contribute to tackling climate change. Next year, the UK will host the UN climate change conference COP26, in Glasgow with our partners, Italy. The UK is committed to working with all countries and joining forces with civil society, companies and people on the frontline of climate change to inspire action ahead of COP26.

#### *iv Consultations of EU Member States*

As of 31 January, the UK has left the EU and is no longer a Member State. While a Member State the UK worked closely with Member States party to the North Seas Energy Cooperation (NSEC). The UK also worked with Member States on various technical and policy aspects of the draft NECP during workshop sessions at the NECP Technical Working Groups meetings. UK government officials attended workshops in France, Germany and the Netherlands to share ideas and comment on their respective NECPs. UK government officials also engaged in discussions with officials from Member States on preparation of their respective NECPs during meetings of the Concerted Action on the Energy Efficiency Directive (CA-EED).

#### *v Iterative process with the Commission*

A representative from BEIS attended NECP Technical Working Group meetings in 2018 and 2019 during the development of Member States' National Energy and Climate Plan (NECPs), taking onboard Commission advice in the development of the draft and final NECP.

Following the submission of the UK's draft NECP in December 2018, the Commission published a suite of documents under the Governance Regulation assessment and recommendations process. This included 11 formal recommendations for the UK to consider in its final NECP and an assessment of the draft NECP, which underpinned the Recommendations document. The UK government has considered all of the Commission's recommendations carefully in view of the UK's departure from the EU as of 31 January 2020, and has provided a response to each at Annex A to this NECP document.

## 1.4 Regional cooperation in preparing the plan

### *i Elements subject to joint or coordinated planning*

### *ii Explanation of how regional cooperation is considered in the plan*

#### North Seas Energy Cooperation

The UK is part of the wider North Seas region, which has a large renewable energy potential.

Offshore wind generation and grid infrastructure projects may have cross-border effects on energy prices, security of supply and the environment, including availability of marine space as well as the pace of innovation. The North Seas countries therefore have benefits to gain from cooperation.

The NSEC a voluntary, market-oriented, regional cooperation initiative established in 2016.<sup>46</sup>  
The NSEC is a voluntary, market-oriented, regional cooperation initiative established in 2016.<sup>47</sup>  
It aims to coordinate and facilitate further cost-effective deployment of offshore renewable energy, in particular wind, ensuring a sustainable, secure and affordable energy supply in the North Seas countries.

### **Regional cooperation**

The UK made use of the NSEC in preparing this plan, by experts in the support groups sharing information, best practice and experiences on specific issues, for example on barriers to offshore wind and grid development and on aggregating national renewable energy trajectories for offshore wind by 2030.

The UK furthermore consulted on its NECP in the area of planned offshore wind deployment until 2030 and related grid planning aspects with the other North Seas countries, while a member.

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<sup>46</sup> The North Seas Energy Cooperation, [https://ec.europa.eu/energy/topics/infrastructure/high-level-groups/north-seas-energy-cooperation\\_en](https://ec.europa.eu/energy/topics/infrastructure/high-level-groups/north-seas-energy-cooperation_en)

<sup>47</sup> The North Seas Energy Cooperation, [https://ec.europa.eu/energy/topics/infrastructure/high-level-groups/north-seas-energy-cooperation\\_en](https://ec.europa.eu/energy/topics/infrastructure/high-level-groups/north-seas-energy-cooperation_en)

## 2. National objectives and targets

### 2.1. Decarbonisation

#### 2.1.1 Greenhouse Gas (GHG) emissions and removals

*i The elements set out in Article 4(a)(1) of Regulation (EU) 2018/1999*

*ii Where applicable, other national objectives and targets consistent with the Paris Agreement and the existing long-term strategies. Where applicable, other objectives and targets, including sector targets and adaptation goals, if available*

The Paris Agreement on climate change entered into force on 4 November 2016. It was ratified by the UK on 18 November 2016. Parties to the Paris Agreement are required to prepare, communicate and maintain successive Nationally Determined Contributions (NDCs). The UK will come forward with an enhanced NDC well ahead of the 26th UN Climate Change Conference of the Parties (COP26).

The first joint EU/Member State NDC for the period of 2021-2030 was published in 2015. This commits the EU to at least 40% reduction in greenhouse gas emissions by 2030 compared to 1990 levels. The EU has adopted a legally binding domestic framework to meet its NDC commitments in both the traded sector (covered by Directive 2003/87/EC) and the non-traded sector. The EU's non-traded sector is covered by the following legislation.

#### **Effort Sharing Regulation**

EU Member States have binding annual greenhouse gas emission targets for 2021-2030 for those sectors of the economy that fall outside the scope of the EU Emissions Trading System (EU ETS), such as transport, buildings, waste and agriculture. As a whole, the EU has committed to reduce emissions in these sectors by 30% by 2030 compared to 2005.

As of 31 January 2020, the UK has left the EU, and therefore will not contribute to EU targets or be bound by the Effort Share Regulation after the Transition Period ends. The estimated emission trajectory and the resulting annual emission limits are set out in the table below.

**Table 3: Calculated annual indicative GHG emission allocations for the UK from 2021 to 2030.**

These are calculated on the basis Global Warming Potentials from the IPCC's 4th Assessment Report.

Year	2005 (base year) <sup>48</sup>	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Annual Emission Allocation (MtCO <sub>2</sub> e) <sup>49</sup>	416	321	315	308	301	295	288	282	275	268	262

### Land use, land use change and forestry (LULUCF)<sup>50</sup>

Under further EU legislation adopted in May 2018, EU Member States agreed to ensure that greenhouse gas (GHG) accounted emissions from land use, land use change and forestry (LULUCF) are offset by at least an equivalent accounted sink for the periods from 2021-25 and from 2026-30 individually, as specified in Article 4 of the Regulation (EU) 2018/841. There are several flexible mechanisms to help Member States comply. As of 31 January 2020, the UK has left the EU, and will therefore not contribute to EU targets after the Transition Period ends.

### The UK Climate Change Act 2008, including carbon budgets

This is explained in 1.1(ii) and 1.3(i).

### Devolved Climate Change Legislation

Climate change policy is devolved to Wales, Scotland and Northern Ireland, although the UK government retains control over many policy areas that have great potential for emissions reduction.

The Environment (Wales) Act 2016<sup>51</sup> requires Welsh Ministers to reduce emissions in Wales by at least 80% in 2050. This Act also requires Welsh Ministers to set interim emissions reduction targets for the years 2020, 2030 and 2040, and establish a system of carbon budgeting that together create an emissions reduction pathway to the 2050 target. Regulations passed by the National Assembly for Wales in December 2018 set the 2020 target at 27%, the 2030 target at 45% and the 2040 target at 67%. The first two carbon budgets (2016-20 and 2021-25) were also set in legislation. Since then, the Welsh Government has accepted the CCC's recommendation to increase Wales's 2050 target to 95% and has requested the CCC's advice on how this affects the interim targets and carbon budgets set in 2018. It has also asked the CCC to explore how Wales might go beyond 95%. The Welsh Government will ask the Senedd to amend the targets and budgets legislation in early 2021.

Scotland's climate change legislation requires Scottish Ministers to reduce emissions in Scotland to net-zero by 2045, with interim targets of 56% reduction (from a 1990 baseline) by

<sup>48</sup> 2005 data from ESD dataset 2018 (data used was originally taken from ESD dataset 2019 which has since been revised) : [www.eea.europa.eu/data-and-maps/data/esd-2](http://www.eea.europa.eu/data-and-maps/data/esd-2)

<sup>49</sup> Starting point for Annual Emission Allocations calculated by taking average of 2016, 2017 and 2018 UK ESD emissions from ESD dataset 2019: [www.eea.europa.eu/data-and-maps/data/esd-2](http://www.eea.europa.eu/data-and-maps/data/esd-2)

<sup>50</sup> This analysis is based on reported emissions, not on accounted emissions following the regulation 2018/841.

<sup>51</sup> Environment (Wales) Act 2016, [www.legislation.gov.uk/anaw/2016/3/contents/enacted](http://www.legislation.gov.uk/anaw/2016/3/contents/enacted)

2020, 75% reduction by 2030, 90% reduction by 2045 and annual targets for each other year to net-zero.

The Climate Change Plan published in February 2018 sets out the Scottish Government's comprehensive package of policies and proposals for meeting emissions reduction targets under the Climate Change (Scotland) Act 2009 over the period to 2018 to 2032 – these targets have subsequently been increased (as above) through the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019. The second annual report monitoring progress towards the Plan was published in December 2019.<sup>52</sup> The Scottish Government has committed to update the Plan in December 2020 to reflect the increased ambition of the 2019 Act targets. The Climate Change (Scotland) Act 2009 required Scottish Ministers to reduce emissions in Scotland by at least 80% by 2050, with an interim target of 42% by 2020 and annual targets for each year to 2050.

## 2.1.2 Renewable energy

### *i The elements set out in point (a)(2) of Article 4 of Regulation (EU) 2018/1999*

The UK is producing record levels of renewable energy. We have performed particularly strongly with regards to renewable electricity – by the end of 2018 we had already achieved our original ambition of 31% for that sector in 2020, as set out in our 2010 National Renewable Energy Action Plan.<sup>53</sup> We continued our progress in the power sector with a record 38.9% of total electricity generation coming from renewables in the third quarter of 2019.<sup>54</sup> Offshore wind is a particular British success story, with new projects awarded contracts at record low prices creating opportunities for jobs and economic growth. Building on our achievements to date, the UK supports continued deployment of cost-effective renewable energy through the 2020s in line with our ambitious domestic decarbonisation objectives.

The EU has a target under the Renewable Energy Directive of 32% of energy coming from renewable sources in 2030, with Member States required to set their own non-binding contributions to collectively achieve the EU target. As of 31 January 2020, the UK has left the EU and will therefore not contribute to EU targets or be bound by the Renewable Energy Directive after the Transition Period ends.

However, to comply with our commitments under the Withdrawal Agreement with respect to the NECP, the UK has set out a proportion of renewables in final energy consumption in 2030 of between 22%-29%,<sup>55</sup> based on estimates of the level of renewables deployment which may be required to meet our carbon budgets and net zero target.<sup>56</sup> Future policies and strategies for encouraging deployment of renewable energy will be set out in forthcoming publications such as our Energy White Paper and Heat and Buildings Strategy.

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<sup>52</sup> Second annual report monitoring progress towards Scotland's 2018 Climate Change Plan, Dec 2019, [www.gov.scot/publications/climate-change-plan-monitoring-report-2019/](http://www.gov.scot/publications/climate-change-plan-monitoring-report-2019/)

<sup>53</sup> UK National Renewable Energy Action Plan (NREAP) 2010, available at: [www.gov.uk/government/publications/national-renewable-energy-action-plan](http://www.gov.uk/government/publications/national-renewable-energy-action-plan)

<sup>54</sup> Energy Trends: December 2019, section 6.3: [www.gov.uk/government/statistics/energy-trends-section-6-renewables](http://www.gov.uk/government/statistics/energy-trends-section-6-renewables)

<sup>55</sup> The UK will not contribute to the EU's renewable energy target. Should a point number be required for the purposes of Article 4(a)(2) of the Governance Regulation, this should be taken from the minimum bound of this range (i.e. 22%).

<sup>56</sup> Analysis does not account for impacts resulting from COVID-19.

The data in Table 4 show a trajectory to reach a 22%-29% proportion of renewable energy in 2030.

**Table 4: Illustrative trajectory for proportion of renewable energy in final energy consumption.**

Year	2020 Target	2022	2025	2027	2030
Proportion of renewables in final energy consumption	15%	16% - 18%	18% - 21%	20% - 24%	22% - 29%

*ii Estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating & cooling, and transport sector*

The UK supports cost-effective deployment of renewable and low-carbon energy to meet our domestic emissions reduction goals. It is likely that the balances between different sectors could change as we develop further policies and take additional action to decarbonise the UK energy system during the 2020s. The estimated trajectories in the electricity, heating & cooling and transport sectors shown in Table 5 and 6 below are therefore potential pathways for the purpose of complying with our commitments under the Withdrawal Agreement. They should not be taken as fixed targets for – or limits to – the UK’s ambition for renewables deployment to 2030.

**Table 5: Pathway 1, estimated trajectories for the sectoral proportion of renewable energy in final energy consumption**

Sector	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	38%	39%	45%	46%	48%	50%	49%	48%	49%	50%
Heating & Cooling	10%	10%	10%	10%	11%	11%	12%	12%	13%	13%
Transport (including multipliers) <sup>57</sup>	11%	12%	13%	13%	14%	14%	15%	15%	16%	16%

<sup>57</sup> Transport data include the double weighting of some biofuels, as permitted under the Renewable Energy Directive.

**Table 6: Pathway 2, estimated trajectories for the sectoral share of renewable energy in final energy consumption**

Sector	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	38%	39%	45%	48%	52%	58%	62%	65%	70%	75%
Heating & Cooling	10%	11%	11%	12%	13%	13%	14%	15%	16%	17%
Transport (including multipliers) <sup>58</sup>	11%	12%	13%	13%	14%	14%	15%	15%	16%	16%

Note: Individual sectoral shares may not necessarily sum to the overall renewable share

*iii Estimated trajectories by renewable energy technology to achieve the overall and sectoral trajectories for renewable energy from 2021 to 2030 including expected total gross final energy consumption per technology and sector in Mtoe and total planned installed capacity (divided by new capacity and repowering) per technology and sector in MW*

## Electricity

The UK is looking at several options and technology pathways in 2020 for expanding our deployment of renewables in the electricity sector in order to help reach net zero in 2050. This will include publication of an Energy White Paper and a range of other documents to support our climate ambitions. In light of where we are in terms of domestic policy development, we are unable to provide a breakdown for the renewable electricity technology mix at this point.

## Heat

The CGS identifies heat as the most difficult decarbonisation challenge facing the country: meeting our net zero target will require virtually all heat in buildings to be decarbonised, and heat in industry to be reduced to close to zero carbon emissions. This will involve large-scale transformation of energy systems and markets, changing the way we supply heating and cooling to over 28 million buildings – the vast majority of which (85% of households, and 70% of all heat use) currently use natural gas in our extensive gas network.

Due to the UK's natural resources and historical investment and infrastructure decisions, the UK has one of the highest dependencies globally on natural gas for heating.<sup>59</sup>

In 2018, the UK government published a review of the options for the UK to meet our legally binding emissions reduction in heat target by 2050.<sup>60</sup> This report outlined the different options for decarbonising heat – including heat networks, heat pumps, low-carbon hydrogen, and biogas – and concluded that there is no clear consensus on the best approach to decarbonising heat at scale in the UK. This makes it extremely difficult to estimate with any certainty the technology mix for renewable heat over the next ten years.

<sup>58</sup> Transport data include the double weighting of some biofuels, as permitted under the Renewable Energy Directive.

<sup>59</sup> International Comparisons of heating, cooling and heat decarbonisation policies, [www.gov.uk/government/publications/international-comparisons-of-heating-cooling-and-heat-decarbonisation-policies](http://www.gov.uk/government/publications/international-comparisons-of-heating-cooling-and-heat-decarbonisation-policies)

<sup>60</sup> UK Government evidence review, 'Clean Heat: Transforming Heating' - [www.gov.uk/government/publications/heat-decarbonisation-overview-of-current-evidence-base](http://www.gov.uk/government/publications/heat-decarbonisation-overview-of-current-evidence-base)

Following the publication of our report, we are committed to publishing a Heat and Buildings Strategy, which will set out the immediate actions we will take for reducing emissions from buildings. These actions include the deployment of additional energy efficiency measures and low-carbon heating, as part of an ambitious programme of work required to enable key strategic decisions on how we achieve the mass transition to low-carbon heat and set us on a path to decarbonising all homes and buildings. In light of where we are in terms of domestic policy development, we are unable to provide a breakdown for the renewable heat technology mix at this point.

## Transport

The UK's domestic policy for renewable transport fuels, the Renewable Transport Fuel Obligation, has set in law a biofuels volume target of 12% to 2032.<sup>61</sup> Transport has a huge role to play in the UK economy reaching net zero. The UK is developing an ambitious plan to accelerate the decarbonisation of transport. As with the heat and electricity sectors, in light of where we are in terms of domestic policy development, we are unable to provide a breakdown for the renewable transport technology mix at this point.

*iv Estimated trajectories on bioenergy demand, disaggregated between heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between domestic production and imports). For forest biomass, an assessment of its source and impact on the LULUCF sink*

## Bioenergy demand

Current biomass policy has been informed by the CCC's 2011 Bioenergy Review and the UK government's 2012 Bioenergy Strategy. The strategy recommended support for sustainably produced biomass that delivers real greenhouse gas savings, is cost effective, taking into account wider impacts across the economy and that possible key risks from biomass (such as to food security and air quality) continue to be monitored and managed. The CCC published its 2018 Bioenergy Review (Biomass in a low-carbon economy)<sup>62</sup> in November 2018.

Biomass is an important technology, helping the UK on its path to a low-carbon economy. The CGS sets out the need to lay the groundwork for setting up decisions that will be made in the first half of the next decade about the long-term future of heat; the role that bioenergy can play in this is currently being explored. The Renewable Heat Incentive, which supports solid biomass and biogas technologies for heat, and biomethane injection to the gas grid, has budget confirmed to 2021. The UK government, however, recognises that there are scenarios where bioenergy could further support the decarbonisation of heat, for example in buildings that are currently dependent on coal and oil, and for which electrification is not the most suitable option, or where high temperature dispatchable heat is required for industry.

Bioenergy for transport is expected to be used in all forms of transport including for aviation fuels. It is incentivised via the RTFO and is expected to deliver around 27 Terawatt hours (TWh) of biomass derived energy in transport in 2032.<sup>63</sup>

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<sup>61</sup> Guidance: Renewable Transport Fuel Obligation: [www.gov.uk/guidance/renewable-transport-fuels-obligation](http://www.gov.uk/guidance/renewable-transport-fuels-obligation)

<sup>62</sup> Biomass in a low carbon economy (2018): [www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy](http://www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy)

<sup>63</sup> Renewable Transport Fuel Obligations Order: government response (2017), [www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response](http://www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response)

## Biomass supply

In the UK the main biomass feedstocks are:

- a. **Biomass wastes** – sourced from food, sewage, or the biomass portion of mixed black bag waste – if not used for biomass these wastes may go to landfill and produce methane.<sup>64</sup> Use in the energy sector avoids these additional emissions and provide generators a fee for accepting the waste.<sup>65</sup>
- b. **Woody/dry biomass residues** – sourced from sustainably managed forestry residues or by-products from agriculture (such as straw) or timber production. The effects of this harvesting are reported in the UK emission inventory.<sup>66</sup> The UK also imports woody biomass from North America and Europe which is reported in accordance with the source country's inventory.
- c. **Energy crops** – domestically produced, these include fast-growing trees or grasses grown on low grade farmland that is not suitable for food production.
- d. **Other crops** – domestically and internationally produced, these include food crops such as oil seed rape and sugar beet.

The Renewable Heat Incentive scheme<sup>67</sup> has imposed restrictions on the use of energy crops, to encourage the use of at least 50% agriculture and food waste feedstocks rather than energy crops. This change came into effect on 22 May 2018.

In transport, the RTFO includes a cap on the amount of incentive available for fuels made from 'other crops'. This is set at 4% in 2018/19 and reduces to 2% in 2032.<sup>68</sup> Detailed data is available on the origin and type of biomass feedstocks used to supply biofuels in the UK market. Nearly one third of biomass is sourced domestically and the remainder is imported. In 2018, nearly 70% of renewable transport fuels supplied were made from wastes.<sup>69</sup> Information on the volumes and types of biomass expected to be used to meet the RTFO targets in the period to 2032 is available in the cost benefit analysis that accompanied the legislation.<sup>70</sup>

For electricity, biomass electricity plants supported under our incentive schemes are required to provide information on biomass use to Ofgem. The latest information can be found via Ofgem's website.<sup>71</sup>

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<sup>64</sup> For example, the Renewable energy directives provides a credit for the avoided emissions from methane when using wet wastes such as manure in anaerobic digestion (<http://publications.jrc.ec.europa.eu/repository/bitstream/JRC104759/ld1a27215enn.pdf>).

<sup>65</sup> Anaerobic digestion plants are paid between £0-65 per tonne to take source separated food waste. Energy from waste incinerators are paid between £26 and £144 per tonne to process 'refuse derived fuel'. (source: [www.wrap.org.uk/sites/files/wrap/Gate%20Fees%20report%202017\\_FINAL\\_clean.pdf](http://www.wrap.org.uk/sites/files/wrap/Gate%20Fees%20report%202017_FINAL_clean.pdf)).

<sup>66</sup> UK Emissions Inventory: [www.gov.uk/government/collections/uk-greenhouse-gas-emissions-statistics](http://www.gov.uk/government/collections/uk-greenhouse-gas-emissions-statistics)

<sup>67</sup> The Renewable Heat Incentive: A reformed Scheme (Consultation response), 2016:

[www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme](http://www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme)

<sup>68</sup> Renewable transport fuel obligations order: government response (2017),

[www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response](http://www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response)

<sup>69</sup> Biofuels statistics, published 2019, [www.gov.uk/government/collections/biofuels-statistics](http://www.gov.uk/government/collections/biofuels-statistics)

<sup>70</sup> Cost Benefit Analysis: Amendments to the RTFO, 2017,

[www.legislation.gov.uk/uksi/2018/374/pdfs/uksiod\\_20180374\\_en.pdf](http://www.legislation.gov.uk/uksi/2018/374/pdfs/uksiod_20180374_en.pdf)

<sup>71</sup> Biomass Sustainability Dataset, Ofgem, available at: [www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2017-18](http://www.ofgem.gov.uk/publications-and-updates/biomass-sustainability-dataset-2017-18)

*v Where applicable, other national trajectories and objectives, including those that are long term or sectoral (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, energy communities and self-consumers, energy recovered from the sludge acquired through the treatment of wastewater)*

Not applicable.

## 2.2 Energy efficiency

*i The elements set out in point (b) of Article 4 of Regulation 2018/1999, where the elements in point (b) are:*

*(a) An indicative contribution to the Union's energy efficiency targets of at least 32.5% in 2030 (either Primary Energy Consumption (PEC) or Final Energy Consumption (FEC))*

The EU has a headline target under the Energy Efficiency Directive to reduce energy consumption by 32.5% in 2030, with Member States required to set their own indicative contributions to the EU target. As of 31 January 2020, the UK has left the EU and will therefore not contribute to EU targets or be bound by the Energy Efficiency Directive after the Transition Period ends.

However, to comply with our commitments under the Withdrawal Agreement with respect to the NECP, the UK has set out at Table 7 a trajectory that leads to a primary energy consumption in 2030 of 151 Mtoe (Net Calorific Value (NCV)).<sup>72</sup> This is consistent with the pathway for energy efficiency policy presented in the UK's 2017 CGS.

Energy efficiency has an important role to play in helping the UK to decarbonise, and future policies and strategies to better incentivise the deployment of energy efficiency measures in line with our net zero target will be set out in domestic publications, such as our forthcoming Heat and Buildings Strategy.

Although we are ambitious in our domestic plans for energy efficiency, it is important that we maintain flexibility in the policy mix throughout the 2020s as we develop further measures and take additional action to ensure we are decarbonising in the most cost-effective way. It should also be noted that energy consumption is impacted to a large extent by external factors which are difficult to predict, such as weather conditions, oil prices and economic performance.

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<sup>72</sup> Analysis based on data up to 31 January 2020, does not account for impacts resulting from COVID-19.

**Table 7: Estimated trajectory for Primary Energy Consumption and Final Energy Consumption 2021-2030 by Net Calorific Value (NCV)**

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
<b>Primary Energy Consumption (NCV)</b>	168	165	164	162	157	156	157	155	153	154	151
<b>Final Energy Consumption (NCV)</b>	131	131	130	129	129	125	125	123	122	123	121

*(b) The cumulative end-use energy savings achieved 2021-30 due to EE obligation schemes*

EU Member States are required under Article 7 of the Energy Efficiency Directive to achieve energy savings of 0.8% as an annual average between 2021-2030 through supplier obligations and/or alternative measures. As of 31 January 2020, the UK has left the EU and will therefore not contribute to EU targets or be bound by the Energy Efficiency Directive after the Transition Period ends. However, to comply with our commitments under the Withdrawal Agreement, the UK has calculated the cumulative end-use energy savings for 2021-2030 as 719 TWh.

The UK has already introduced a wide range of policies to help households, businesses and the public sector reduce their energy use and save money, including supplier obligations, building regulations and taxation measures. Please see Annex B for the UK's Article 7 methodology and a list of these measures.

*(c) the Long-Term Renovation Strategy (LTRS) elements listed in ii) below*

See section 2.2(ii).

*(d) the total floor area to be renovated or equivalent annual energy savings to be achieved from 2021-30 under Article 5 of Directive 2012/27/EU on the exemplary role of public bodies' buildings*

Article 5 of the Energy Efficiency Directive requires EU Member States either to renovate, each year from 2021 to 2030, 3% of the floor space of their central government building stock that does not meet minimum energy performance standards in eligible buildings, or to take alternative measures to achieve equivalent energy savings by end 2030 in eligible buildings owned and occupied by central government.

As of 31 January 2020, the UK has left the EU and will not be required to achieve the energy savings envisaged under Article 5 after the Transition Period ends. However, to comply with our commitments under the Withdrawal Agreement, we have calculated the equivalent annual energy savings for 2021-2030 as 716.8 GWh.

During the period 2014-2020 the UK has been able to achieve energy savings in eligible buildings considerably in excess of the EU requirement. Moving into the 2020s and beyond, our central government buildings are expected to continue to play an exemplary role in respect of energy efficiency. Future energy savings and greenhouse gas reductions in government buildings will be in line with the wider public sector ambitions set out in the Clean Growth

Strategy. Further information will be provided in our next set of Greening Government Commitments (GGCs),<sup>73</sup> along with commitments on waste, water, transport and other sustainability priorities.

*ii The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and their contributions to the Union's energy efficiency targets as included in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, both public and private, in accordance with Article 2a of Directive 2010/31/EU*

The UK government's full Long-Term Renovation Strategy (LTRS) for the UK building stock is currently in development and is expected to be published separately in 2020, as permitted under the derogation found in Article 53 of Regulation 2018/1999. As of 31 January 2020, the UK has left the EU, and will therefore not contribute to EU targets after the Transition Period ends.

The following pages contain the advance elements of the LTRS required for the NECP in accordance with Articles 3 and 4 of Regulation (EU) 2018/1999:

- The indicative milestones for 2030, 2040 and 2050.
- The roadmap with domestically established measurable progress indicators.
- An evidence-based estimate of expected energy savings and wider benefits, and the contributions to the Union's energy efficiency targets.

This content is indicative and subject to revision upon publication of the UK's full LTRS.

The content of this advance LTRS focuses on policies and initiatives owned primarily by the UK government. A wide range of additional initiatives are being undertaken by the Devolved Administrations. These will be set out in more detail in the UK's full LTRS, following consultation with the governments of Northern Ireland, Scotland and Wales.

## Overview and indicative milestones of the UK's Long-Term Renovation Strategy

### Overview

Our homes as well as industrial and commercial buildings have become more efficient in the way they use energy, which is helping to reduce emissions and cut energy bills. Greenhouse gas emissions from the UK's housing sector (excluding electricity supply) fell by nearly 16% between 1990 and 2018<sup>74</sup>, despite an increase in the total number of homes in the UK. We have also improved the energy efficiency of non-domestic buildings since 1990, with emissions 18% lower in 2015.<sup>75</sup> However, the UK building stock continues to account for a significant proportion of the UK's greenhouse gas emissions and energy use, and further progress will be required in order to underpin the UK's legally binding 2050 net-zero target.

There are a number of possible technological pathways leading to the decarbonisation of the building stock. One illustrative pathway to meet the UK's carbon budget 5 (which covers emissions over 2028-2032) could involve emissions from business and industry falling by 30%

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<sup>73</sup> Greening Government Commitments: [www.gov.uk/government/collections/greening-government-commitments](http://www.gov.uk/government/collections/greening-government-commitments)

<sup>74</sup> Provisional UK greenhouse gas emissions national statistics, 2018: [www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2018](http://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2018)

<sup>75</sup> Clean Growth Strategy, 2017: [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

and from homes by 19% between 2017 and 2032 from 2017 levels. This could be delivered in a number of ways including significant improvements in energy efficiency, phasing out high carbon fossil fuels in off-gas grid properties, rolling out heat networks where appropriate, reducing energy use per unit of output and drastically reducing emissions from electricity generation through increased use of renewables and a smarter power grid.

### Indicative milestones

We cannot at this stage predict the exact technological changes or policy solutions that will help us deliver on our ambitions, particularly as we approach 2050. Some technologies, processes and business models will develop faster than expected, making it easier to reduce emissions. Others may develop less quickly than we hope. It is also challenging to predict exactly what the UK economy will look like in 2030, 2040 or 2050.

Given these elements of uncertainty, the UK's indicative milestones focus on our core objective of reducing greenhouse gas emissions, in line with our carbon budgets and 2050 net zero target. While the 2017 CGS forms the basis for these calculations, the UK government is expecting further advice in 2020 from its independent advisors, the CCC, on pathways to net zero in 2050. This will include advice on what level to set the sixth carbon budget (2033-2037). The below indicative milestones are provided without prejudice to that advice, which will further inform the UK government as we establish a pathway to net zero by 2050.

**Table 8: The UK's indicative milestones for 2030, 2040 and 2050<sup>76</sup>**

Milestone	2030	2040	2050
<b>1. Residential greenhouse gas emissions</b>	Around 60 (MtCO <sub>2</sub> e) <sup>77</sup>	Proportionate progress on pathway to 2050 milestone	Eliminate emissions from residential buildings by 2050.
<b>2. Non-residential: private/business greenhouse gas emissions<sup>78</sup></b>	Around 9 (MtCO <sub>2</sub> e) <sup>79</sup>	Proportionate progress on pathway to 2050 milestone	Eliminate emissions from non-domestic buildings by 2050.
<b>3. Non-residential: public greenhouse gas emissions</b>	Around 5 (MtCO <sub>2</sub> e) <sup>80</sup>	Proportionate progress on pathway to 2050 milestone	Eliminate emissions from non-residential public sector buildings by 2050.
<b>4. Total buildings emissions</b>	Around 155(MtCO <sub>2</sub> e)	Proportionate progress on pathway to 2050 milestone	Eliminate emissions from the UK building stock by 2050.

<sup>76</sup> Based primarily on the 2032 and 2050 pathways set out in the Clean Growth Strategy.

<sup>77</sup> In line with the 2032 pathway set out in the Clean Growth Strategy.

<sup>78</sup> This segment includes greenhouse gas emissions created as a result of industrial processes, which are challenging to fully disaggregate from greenhouse gas emissions created purely from building energy use. However, building energy use does constitute the majority of this combined figure.

<sup>79</sup> In line with the 2032 pathway set out in the Clean Growth Strategy.

<sup>80</sup> In line with the 2032 pathway set out in the Clean Growth Strategy.

## Outline roadmap of policies and measures including domestically established measurable progress indicators

### Outline roadmap of policies and measures

The CGS sets out the UK's strategy for achieving its legally binding emissions reductions targets, known as carbon budgets, through to 2032, and includes indicative decarbonisation pathways out to 2050, as referred to in the previous section.

The pathways set out in the CGS provide an overview of how the impacts of its policies and proposals may map out over time. They include future policy development such as publications, key decisions, reviews and consultations, which aim to unlock future carbon savings.<sup>81</sup>

Achieving net zero will mean going further, virtually eliminating emissions from the UK's building stock. Decarbonising heat is our most difficult policy and technology challenge in meeting our carbon targets. The UK government is currently developing its low-carbon heat policy for the 2020s and beyond. We are working on a Heat and Buildings Strategy, which will set out the immediate actions we will take for reducing emissions from buildings. These actions include the deployment of energy efficiency measures and low-carbon heating as part of an ambitious programme of work required to enable key strategic decisions on how we achieve the mass transition to low-carbon heat and set us on a path to decarbonising all homes and buildings. (see [section 2.1.2](#) above).

This LTRS sets out the UK's outline roadmap in accordance with the CGS and subsequent UK government documents – content is subject to revision in final version of the LTRS, expected to be published separately later in 2020.

Residential and non-residential buildings, both public and private, are dealt with in turn.

### Residential buildings

#### 2020-2032

Homes in the UK account for 15% of greenhouse gas emissions, or 22% including electricity use.<sup>82</sup> The UK has already made considerable progress in this sector with residential emissions having reduced by about 16% since 1990<sup>83</sup> despite there being over 20% more homes.<sup>84</sup>

We want to further reduce emissions while ensuring everyone has a home that is comfortable, healthy and affordable to run. Our objective is to ensure our policies will encourage people to improve their homes where it is cost effective and affordable for them to do so. Our aspiration, as set out in the CGS, is that fuel poor homes should be upgraded to an Energy Performance Certificate (EPC) rating of at least Band C by 2030, and more broadly that as many existing

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<sup>81</sup> Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>82</sup> Final UK greenhouse gas emissions national statistics: 1990-2017: [www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017](http://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017)

<sup>83</sup> BEIS(2019), BEIS, Final UK greenhouse gas emissions statistics 1990-2017:

[www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017](http://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017)

<sup>84</sup> Live tables on house building: new build dwellings, 2019: [www.gov.uk/government/statistical-data-sets/live-tables-on-house-building](http://www.gov.uk/government/statistical-data-sets/live-tables-on-house-building)

homes as possible are improved to at least EPC Band C by 2035, where practical, cost-effective and affordable.<sup>85</sup> At present, 70% of homes fall below this standard in England.

The CGS, and subsequent UK government documents, set out policies and proposals to decarbonise this sector over the coming years, including:

#### *Complete*

- Strengthening domestic Private Rented Sector regulations to require landlords to contribute up to £3,500 towards improving their property to EPC Band E;
- Supporting around £3.6 billion of investment to upgrade around one million homes through the Energy Company Obligation (ECO), and confirming extended support for home energy efficiency improvements until 2028 at the current level of ECO (£640m per year);
- Sponsoring new standards (PAS 2035:2019 & PAS 2030:2019<sup>86</sup>) covering the end-to-end delivery of energy efficiency measures;
- Supporting a new TrustMark government-endorsed quality scheme for energy efficiency improvements to ensure consumers get what they are expecting and have suitable financial protections in place;
- Incorporating TrustMark and the new PAS standards into the Energy Company Obligation;
- Launching Simple Energy Advice, a new digitally led advice service that provides tailored advice to homeowners, landlords, and tenants on how they can improve their home's energy efficiency.

#### *In progress*

- Committing to introducing a Future Homes Standard which will see new build homes future-proofed with low-carbon heating and world-leading standards of energy efficiency by 2025. We expect new homes built to the new standard to produce 75-80 per cent lower CO<sub>2</sub> emissions compared to current levels. These homes will be 'zero carbon ready', with the ability to become fully zero carbon homes over time as the electricity grid decarbonises, without the need for further costly retrofitting work.
- As a stepping-stone to the Future Homes Standard, we have consulted on a meaningful and achievable interim increase to the energy efficiency standards for new homes. The preferred option set out in consultation is a standard that should result in a 31% further reduction in emissions, compared to current standards.
- We will respond to the Future Homes Standard consultation in full in the autumn (2020). As part of this, we intend to review the roadmap to the Future Homes Standard to ensure that implementation takes place to the shortest possible timeline. To work towards ensuring that all new homes are fit for a zero-carbon future we will also explore options for the future of energy efficiency standards beyond the Future Homes Standard.

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<sup>85</sup> Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>86</sup> PAS 2035/2030:2019 is a key document in a framework of new and existing standards on how to conduct effective energy retrofits of existing buildings, developed by the British Institute of Standards (BSI): [https://shop.bsigroup.com/ProductDetail/?pid=00000000030400875&creative=366703430328&keyword=%2Bpas%20%2B2030&matchtype=b&network=g&device=c&clid=EAlalQobChMIxuu1gZaO7AIVR-btCh31pAyfEAAYASAAEgla7\\_D\\_BwE](https://shop.bsigroup.com/ProductDetail/?pid=00000000030400875&creative=366703430328&keyword=%2Bpas%20%2B2030&matchtype=b&network=g&device=c&clid=EAlalQobChMIxuu1gZaO7AIVR-btCh31pAyfEAAYASAAEgla7_D_BwE)

- A further consultation will follow in due course, proposing changes to the energy efficiency standards for new non-domestic buildings; for building work to existing homes and non-domestic buildings; and on mitigating overheating in new dwellings.
- Consulting on strengthening domestic Private Rented Sector regulations, with a longer-term aim of upgrading as many private rented homes as possible to EPC Band C by 2030, where practical, cost-effective and affordable<sup>87</sup>.
- Consulting on standards for social housing. The social housing Green Paper published in August 2018<sup>88</sup> asked, among other things, whether the energy performance of social homes should be upgraded. Government is currently considering the responses to the consultation and will publish a Social Housing White Paper for implementing social housing reform soon.
- Consulting on setting requirements for lenders to improve the energy efficiency of the homes they lend to and launching a £5m Green Home Finance Innovation Fund which will support the development and piloting of innovative green mortgages and other green home finance products.
- Launching a £10m Whole House Retrofit Innovation Competition to explore ‘at scale’ delivery of whole house energy efficiency retrofit, aiming to demonstrate the cost reduction potential of large-scale roll-out, and initiating a longer-term cost reduction trajectory.
- Testing six different approaches to delivering whole house retrofit in local areas across England that could be replicated at a broader scale, by providing support for local supply chain integration, skills training and project coordination.
- Providing funding to a number of local authorities to produce a series of feasibility studies to test means of encouraging homeowners to improve the energy efficiency of their properties through retrofit measures.
- Publishing an Action Plan to improve the EPC framework, following our public Call for Evidence. More robust EPCs will play a key role in underpinning various energy efficiency-related policies over the coming years.
- Updating the Fuel Poverty Strategy<sup>89</sup> (for England), including the mix of subsidy, regulations and incentives required to meet the fuel poverty target.
- Manifesto commitments of a £3.8bn Social Housing Decarbonation Fund to deliver transformational change in the social housing sector, and a £2.5bn Homes Upgrade Grant sector targeting fuel poor households in private housing.

## **Beyond 2032**

Reducing demand for energy will not be enough on its own to meet our ambitions for homes. By 2050, we will likely need to fully decarbonise how we heat our homes. There are several low-carbon heating technologies with the potential to support the scale of change needed, including heat pumps, low-carbon gases such as hydrogen (using the existing gas grid) and

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<sup>87</sup> Setting long-term energy performance standards for the private rented sector in England and Wales, 2019: [https://beisgovuk.citizenspace.com/home-local-energy/prs-minimum-energy-efficiency-standards/supporting\\_documents/PRS\\_workshop\\_slides.pdf](https://beisgovuk.citizenspace.com/home-local-energy/prs-minimum-energy-efficiency-standards/supporting_documents/PRS_workshop_slides.pdf)

<sup>88</sup> Social housing green paper: a ‘new deal’ for social housing, 2018: [www.gov.uk/government/news/social-housing-green-paper-a-new-deal-for-social-housing](http://www.gov.uk/government/news/social-housing-green-paper-a-new-deal-for-social-housing)

<sup>89</sup> Fuel poverty strategy for England (consultation), 2019: [www.gov.uk/government/consultations/fuel-poverty-strategy-for-england](http://www.gov.uk/government/consultations/fuel-poverty-strategy-for-england)

district heat networks. However, at present, it is not certain which approaches will work best at scale and offer the most cost-effective long-term answer.

## **Non-residential buildings - private non-domestic**

### **2020-2032**

Business and industry in the UK are responsible for around 20% of greenhouse gas emissions, or 30% including energy use.<sup>90</sup> In the CGS, the UK government set an ambition to support businesses to improve their energy efficiency by at least 20% by 2030. This could deliver up to £6 billion in cost savings by 2030 and contribute up to 22 MtCO<sub>2</sub>e of non-traded carbon savings towards the fifth carbon budget.<sup>91</sup>

The CGS committed the UK government to consult on a package of measures to support businesses to improve how productively they use energy, including actions that could be taken to improve the take up of energy efficiency measures across buildings. This would build on the significant existing measures to promote energy efficiency in business and industry such as the Climate Change Agreement (CCA) Scheme and the Energy Savings Opportunity Scheme (ESOS).

The CGS, and subsequent UK government documents, set out policies and proposals to decarbonise this sector over the coming years, including:

#### *Complete*

- Utilising environmental taxes to encourage businesses to operate in more environmentally friendly ways. There are taxes and schemes for different types and size of business.
- Requiring that from 1 April 2018, landlords of privately rented property in England or Wales ensure that their properties reach at least an Energy Performance Certificate (EPC) rating of E before granting a tenancy to new or existing tenants.
- Completing the compliance period for Phase 2 of the Energy Savings Opportunity Scheme (ESOS), which required large businesses, by 5 December 2019, to carry out audits of their energy use in buildings, processes and transport and receive recommendations on energy efficiency improvement actions they can take.
- Requiring large or quoted UK businesses to disclose their annual energy and carbon emissions in annual reports under the Streamlined Energy and Carbon Reporting (SECR) framework, which came into force in April 2019, following an earlier consultation.<sup>92</sup> This aims to simplify reporting requirements while increasing corporate transparency, further incentivising energy efficiency and reducing emissions.
- Completing the Electricity Demand Reduction Pilot which offered organisations £6m of funding for projects which could improve energy efficiency and security of supply through delivery of electricity savings at peak times. This pilot has finished, and we published the evaluation in July 2019<sup>93</sup>, alongside a call for evidence which ran to

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<sup>90</sup> Final UK greenhouse gas emissions national statistics: 1990-2017, 2019:

[www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017](http://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017)

<sup>91</sup> Helping businesses improve the way they use energy: call for evidence, 2018:

[www.gov.uk/government/consultations/helping-businesses-to-improve-the-way-they-use-energy-call-for-evidence](http://www.gov.uk/government/consultations/helping-businesses-to-improve-the-way-they-use-energy-call-for-evidence)

<sup>92</sup> Streamlined energy and carbon reporting (consultation outcome), 2018:

[www.gov.uk/government/consultations/streamlined-energy-and-carbon-reporting](http://www.gov.uk/government/consultations/streamlined-energy-and-carbon-reporting)

<sup>93</sup> Electricity Demand Reduction pilot, 2019: [www.gov.uk/guidance/electricity-demand-reduction-pilot](http://www.gov.uk/guidance/electricity-demand-reduction-pilot)

September 2019.<sup>94</sup> These initiatives will help us better understand how we can facilitate energy efficiency in the electricity system.

- Published a call for evidence on a new Small Business Energy Efficiency Scheme.<sup>95</sup>

### *In progress*

- Published a consultation on a preferred future requirement of EPC Band B by 2030 for minimum energy efficiency standards in privately rented non-domestic buildings.
- Committing to consult in 2020 on introducing mandatory in-use energy performance ratings for business buildings.
- We are initiating the demonstration phase of the 'Boosting Access for SMEs (small and medium-sized enterprises) to Energy Efficiency' (BASEE) innovation competition in March 2019. This offers up to £6m to fund the development of new, innovative scalable business models or solutions that reduce costs, simplify processes and encourage the take up of energy efficiency by SMEs at scale. We have awarded eight contracts to pilot their solutions which will complete in March 2021.
- Publishing the evaluation and post implementation review of ESOS in 2020 and expect to publish a consultation in 2021 which sets out proposals for strengthening future phases of the scheme.
- Commencing work with the British Standards Institute (BSI) to develop Publicly Available Specification (PAS) standards for the installation of energy efficiency measures in the non-domestic sector to ensure consistency in the market and provide confidence to consumers.

### **Beyond 2032**

To meet the UK's 2050 net zero target, the deep decarbonisation of industry and private sector non-domestic buildings will need to take place alongside wider measures, such as Carbon Capture, Usage and Storage (detailed in section 2.5(ii)) and the widespread decarbonisation of electricity and heat provision (as outlined in the residential roadmap and detailed in [section 2.1.2](#) of this NECP).

### **Non-residential buildings - public non-domestic**

#### **2020-2032**

The public sector in the UK is responsible for around 2% of direct greenhouse gas emissions, or 3% including indirect emissions from electricity use.<sup>96</sup> The government is taking a leading role in reducing greenhouse gas emissions through the Greening Government Commitments to reduce central government emissions by 43% by the end of 2019/20 compared to 2009/10 – having met the previous target of a 32% reduction three years early.<sup>97</sup> Good progress is being

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<sup>94</sup> Facilitating energy efficiency in the electricity system (closed consultation), 2019:

[www.gov.uk/government/consultations/facilitating-energy-efficiency-in-the-electricity-system](http://www.gov.uk/government/consultations/facilitating-energy-efficiency-in-the-electricity-system)

<sup>95</sup> Boosting access for SMEs to energy efficiency (BASEE): competition, 2019:

[www.gov.uk/government/publications/boosting-access-for-smes-to-energy-efficiency-basee-competition](http://www.gov.uk/government/publications/boosting-access-for-smes-to-energy-efficiency-basee-competition)

<sup>96</sup> Final UK greenhouse gas emissions national statistics: 1990-2017, 2019:

[www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017](http://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017)

<sup>97</sup> Greening Government Commitments, 2019: [www.gov.uk/government/collections/greening-government-commitments](http://www.gov.uk/government/collections/greening-government-commitments)

made towards our 43% reduction target, with the latest Greening Government Commitment Annual Report showing that we have delivered a 39% reduction in emissions by 2017/18<sup>98</sup>.

Our illustrative pathway to 2032 sees emissions from the public sector falling by around 50% compared to a 2017 baseline.<sup>99</sup>

The CGS, and subsequent UK government documents, set out policies and proposals to decarbonise this sector over the coming years, including:

#### *Complete*

- Continuing to enable greenhouse gas emission reductions through the Public Sector Energy Efficiency Loan Scheme. The capital pot for England stands at £312m as of the end of 2019/20 and is planned to increase to a total of £385m by 2020/21. This funding, managed by Salix Finance, has delivered over 17,000 projects, significantly improving energy performance in the public sector, with estimated emissions reductions of over 800,000 tonnes per year.
- Modern Energy Partners, an innovation programme working to develop a toolkit to reduce greenhouse gas emissions from campus-scale public sector sites. The pilot phase concluded in March 2019 and the second phase of the project commenced in April 2019.

#### *In progress*

- Committed to publish a roadmap on the next steps for reducing public sector emissions in 2020.
- A manifesto commitment of £2.9bn for a Public Sector Decarbonisation Programme.

#### **Beyond 2032**

The CGS sets out the challenge facing the public sector in meeting the UK's 2050 target, and the leadership role the public sector can play in reducing carbon emissions. Central government has already shown what is possible through its Greening Government Commitments which include a greenhouse gas reduction target.<sup>100</sup> However, to meet the UK's 2050 target, emissions from the buildings and activities of the public sector will need to be near zero. This will mean improving energy efficiency and energy management and decarbonising the heating and cooling of buildings.<sup>101</sup>

#### **Indicative progress indicators**

Given the uncertainties surrounding the exact technological changes and policy solutions that will help us deliver on our ambitious milestones, particularly as we approach 2050, it is challenging to predict exactly which progress indicators will prove the most relevant over the long term, or whether new indicators will emerge.

The proposed progress indicators may be used by government in relation to the UK's indicative milestones for 2030, 2040 and 2050, and some are published publicly on a regular basis. Though it is not possible to set how any single indicator should change over the next 30 years,

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<sup>98</sup> Greening Government Commitments, 2019: [www.gov.uk/government/collections/greening-government-commitments](http://www.gov.uk/government/collections/greening-government-commitments)

<sup>99</sup> Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>100</sup> Greening Government Commitments, 2019: [www.gov.uk/government/collections/greening-government-commitments](http://www.gov.uk/government/collections/greening-government-commitments)

<sup>101</sup> Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

it is clear that the landscape of metrics set out in the following table will need to, as a whole, display proportionate change in line with our milestones and clear, legally binding 2050 net zero target.

**Table 9: Indicative progress indicators of the LTRS**

Progress indicator (metric)	Building stock sector(s)	Link to milestones
Dwellings' EPC ratings (proportion at each EPC band)	Domestic	Buildings with better fabric and/or own renewable energy generation are likely to be responsible for fewer greenhouse gas emissions.
Energy intensity (MWh/household)	Domestic	Lower energy use (notwithstanding any rise in total no. of households) likely to lead to lower carbon emissions from sector.
Carbon intensity (tCO <sub>2</sub> e /household)	Domestic	Lower carbon energy sources and lower energy use (notwithstanding any rise in total no. of households) likely to lead to lower carbon emissions from sector.
ECO measures installed (no. installed by measure type and obligation)	Domestic	Buildings with better fabric / heating systems are likely to be responsible for fewer greenhouse gas emissions.
Greenhouse gas emissions from building stock (MtCO <sub>2</sub> e, by sector)	Domestic, non-domestic, public	Lower emissions from any one sector will contribute to the overall milestones.
Energy use per £ million output (MWh/£ million)	Non-domestic	Lower energy use (notwithstanding any rise in total output) likely to lead to lower carbon emissions from sector.
Emissions intensity energy use (tCO <sub>2</sub> e/kWh)	Non-domestic	Lower emissions intensity (notwithstanding any rise in total generation) likely to lead to lower total carbon emissions from sector.

### Expected Energy Savings and contributions to the Union's energy efficiency targets pursuant to Directive 2012/27/EU

As set out in section 2.2(i), the UK has left the EU and will therefore not contribute to EU targets after the Transition Period ends.

### Evidence-based estimates of expected energy savings and wider benefits resulting from the Long-term renovation strategy

In reaching our indicative milestones and net zero, we want to decarbonise our economy at lowest cost. Energy efficiency can play an important role in supporting this, reducing the quantity of heat required and the costs of future heat decarbonisation. It will also deliver a

range of wider economic benefits (explored in the next section) including lower energy bills, increased energy security, better air quality, and improved health. However, the optimal level of energy efficiency is subject to wider drivers, for example, our strategic choices around heat decarbonisation, future cost reductions, and technology innovation.

The above roadmap sets out numerous measures which will improve the energy efficiency of the building stock, and the CGS sets out how building energy efficiency improvements could contribute to the UK's 2032 pathway to meeting carbon budget 5:

**Table 10: Possible building energy efficiency improvements under the 2032 pathway**

	2015	2032
<b>Home energy use per household (MWh/household)</b>	17	15
<b>Non-industrial business and public energy use per £ million output (MWh/£ million)</b>	164	79

### **Wider benefits resulting from measures in the Long-Term Renovation Strategy**

The reduction in greenhouse gas emissions and improvements in energy efficiency resulting from the measures and targets outlined in this LTRS will have numerous wider benefits applying at individual, macroeconomic and societal dimensions.

The UK government explicitly recognises these benefits. HM Treasury's Green Book<sup>102</sup> is the central government document setting out a framework for the appraisal and evaluation of policies, programmes and projects. It applies to all proposals that concern public spending, taxation, changes to regulations, and changes to the use of existing public assets and resources.

The updated 2018 edition of the Green Book sees a much-increased focus on environmental factors, improving the ability of UK policymakers to factor these into decision-making. It directs government to identify the social costs from policies' carbon emissions and to evaluate wider impacts on natural capital. It provides guidance on assigning value to greenhouse gas emissions and energy efficiency in recognition of their wider societal costs. The Green Book makes clear that energy efficiency has a social value in addition to the value of a reduction in greenhouse gas emissions, given its direct impact on society.

More broadly, the measures and milestones outlined in the LTRS have the potential to, for example:

Improve health: There is a clear link between cold homes and ill-health. The Building Research Establishment (BRE) has estimated that the cost of cold and damp homes to the NHS is approximately £760m per year.<sup>103</sup> The Health Impact of Domestic Energy Efficiency Measures

<sup>102</sup> The Green Book: appraisal and evaluation in central government, 2019:

[www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government](http://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government)

<sup>103</sup> Building Research Establishment (2011) The cost of poor housing to the NHS (Building Research Establishment), 2015: [www.bre.co.uk/healthbriefings](http://www.bre.co.uk/healthbriefings)

(HIDEEM) model<sup>104</sup> was developed for government to quantify indoor environmental conditions and monetise the health impacts associated with energy efficiency changes.

Generate economic benefits: The UK low-carbon economy could grow by an estimated 11% annually between 2015 and 2030 (four times faster than the wider the economy)<sup>105</sup> and could deliver between £60bn and £170bn of export sales of goods and services by 2030<sup>106</sup>. There is significant potential for the retrofit supply chain to generate employment, driving UK manufacturing and expertise. In 2016 the domestic and non-domestic energy efficiency sectors employed 140,000 people, with turnover of £20bn.<sup>107</sup>

**Reduce costs for consumers:** Actions taken to tackle emissions and reduce energy use have already helped to reduce average energy bills - average household energy bills have fallen by 16.7% in real terms between 2013 and 2018.<sup>108</sup> The recently released Future Homes Standard consultation<sup>109</sup> outlines possible average annual bill savings of between £59 and £257 resulting from improving standards for future new build homes.

**Reduce costs for businesses and government:** Emissions from central government fell by 39% between 2009/10 and 2017/18, delivering savings to the taxpayer of an estimated £112 million in 2017/18 through reduced energy consumption.<sup>110</sup> The CGS set out our ambition to improve business and industry energy efficiency by at least 20% by 2030 compared to 2015 levels, which will reduce energy bills by up to £6 billion by 2030.<sup>111</sup>

**Reduce fuel poverty:** By reducing the heating costs of homes, energy efficiency reduces the breadth and depth of fuel poverty. The latest iteration of the Energy Company Obligation (ECO3) is a fuel poverty focused scheme which incentivises the treatment of properties which are expensive to heat.

**Increase energy security:** Delivering the 2032 pathway would result in changes in fuel consumption across the whole economy, with coal and gas use falling by an additional 38% and 23% respective over and above current plans. Reductions in fossil fuel consumption will reduce imports and in turn boost the UK's energy security.

*iii Where applicable, other national objectives, including long term targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling.*

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<sup>104</sup> The Health Impact of Domestic Energy Efficiency Measures (HIDEEM) model: [www.ucl.ac.uk/energy-models/models/hideem](http://www.ucl.ac.uk/energy-models/models/hideem)

<sup>105</sup> Ricardo Energy and Environment for the Committee on Climate Change - UK business opportunities of moving to a low carbon economy, 2017: [www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/](http://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/)

<sup>106</sup> Ricardo Energy and Environment for the Committee on Climate Change - UK business opportunities of moving to a low carbon economy, 2017 (supporting data tables): [www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/](http://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/)

<sup>107</sup> Low carbon and renewable energy economy, UK: 2017:

[www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2017](http://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2017)

<sup>108</sup> Annual domestic energy bills (BEIS dataset), 2019: [www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics](http://www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics)

<sup>109</sup> The Future Homes Standard: changes to Part L and Part F of the Building Regulations for new dwellings (consultation), 2019: [www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings](http://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings)

<sup>110</sup> Greening government commitments 2017 to 2018 annual report, 2019:

[www.gov.uk/government/publications/greening-government-commitments-2017-to-2018-annual-report](http://www.gov.uk/government/publications/greening-government-commitments-2017-to-2018-annual-report)

<sup>111</sup> Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

The UK government's ambition for decarbonising road transport and developing zero and low emission vehicles is clearly set out in recent strategies, including the Road to Zero, CGS and Industrial Strategy.

By 2040, the UK government expects the majority of new cars and vans sold to be 100% zero emission and all new cars and vans to have significant zero emission capability<sup>112</sup>. By 2030, the UK government wants to see at least 50% and as many as 70% of new car sales to be ultra-low emission, and up to 40% of new van sales.

The road freight sector has agreed a voluntary industry-wide commitment to reduce HGV CO<sub>2</sub> emissions by 15% by 2025. This was announced in the Road to Zero Strategy<sup>113</sup> in July 2018 and was welcomed by road freight trade bodies. We will work with industry to help operators contribute to this commitment by reducing their CO<sub>2</sub> emissions.

## 2.3 Energy security

### *i The elements set out in point (c) of Article 4*

The UK government's ambition for interconnector capacity is set out in the CGS, which states that project assessments to date indicate at least a further 8.1GW of interconnection by the early to mid-2020s will be in consumers' interests, in addition to the 5GW currently operational and 4.8GW that is currently under construction.

The UK government also has an objective to establish a best-in-class regulatory framework to harness the full potential of smart and flexible energy solutions such as storage and demand side response. We are working closely with Ofgem and industry to support the transition to a smarter, more flexible energy system and to deliver the actions set out in the 2017 Smart System and Flexibility Plan<sup>114</sup> and 2018 Progress Update<sup>115</sup> by 2022. This Plan is discussed in more detail in section 2.3(iv).

More information on resilience of our energy systems is set out in the Security of Supply report<sup>116</sup> Also see 2.3(ii) and (iv).

### *ii National objectives with regard to increasing the diversification of energy sources and supply from third countries for the purpose of increasing the resilience of regional and national energy systems*

BEIS works with industry, regulators, sector bodies and other stakeholders to improve and maintain the resilience of the energy infrastructure, networks and assets, to reduce vulnerabilities, and ensure an effective response to actual or potentially disruptive incidents. The UK government recognises a range of benefits that interconnection can provide. By giving access to generation beyond national borders it can improve security of supply when market prices reflect scarcity and flows across interconnectors follow prices. Interconnection can also

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<sup>113</sup> The Road to Zero Strategy, 2018: [www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy](http://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy)

<sup>114</sup> Upgrading our Energy System: Smart Systems and Flexibility Plan, July 2017, [www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan](http://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan)

<sup>115</sup> Upgrading Our Energy System: Progress Update, October 2018, [www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan](http://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan)

<sup>116</sup> Security of Supply Report, [www.gov.uk/government/collections/statutory-security-of-supply-report](http://www.gov.uk/government/collections/statutory-security-of-supply-report)

help with the integration of intermittent sources of energy and the associated system balancing. In terms of interconnection with third countries, the NorthConnect project between Great Britain and Norway has been granted a Cap and Floor regime in principle and the UK government continues to explore the potential of further projects with Norway and Iceland.

The UK's import dependency in 2018 was just under 50% and the UK benefits from a diverse range of supply sources of both piped gas and liquified natural gas (LNG). Gas interconnectors between the UK and Ireland, Belgium and the Netherlands means that this supply diversity and resilience is of benefit regionally as well as nationally. The UK currently has an import deliverability of ~56 billion cubic metres per year (bcm/y) from Norway, ~43bcm/y from continental Europe and ~49bcm/y from LNG import terminals.<sup>117</sup> This supply diversity and resilience is of benefit regionally as well as nationally.

The UK is connected to global gas markets through three LNG import terminals. The UK currently has the infrastructure capacity to import around 49bcm/y of LNG through the two terminals at Milford Haven (South Hook and Dragon, 21bcm/y and 8bcm/y respectively) and through the Isle of Grain terminal in Kent (20bcm/y).<sup>118</sup> This means the UK has the second largest LNG infrastructure in Europe in terms of capacity, after Spain.<sup>119</sup>

These terminals connect the UK to any LNG producing country, and the UK's LNG supply is becoming more diversified as a wider range of new LNG supply sources come online. In 2018 the UK received LNG from 10 different countries including Qatar, the USA, and Trinidad and Tobago, among others. Though the majority of UK LNG receipts are still from Qatar, imports from Qatar decreased from around 12.1% of total UK gas supply in 2016, to 3.6% in 2018.<sup>120</sup>

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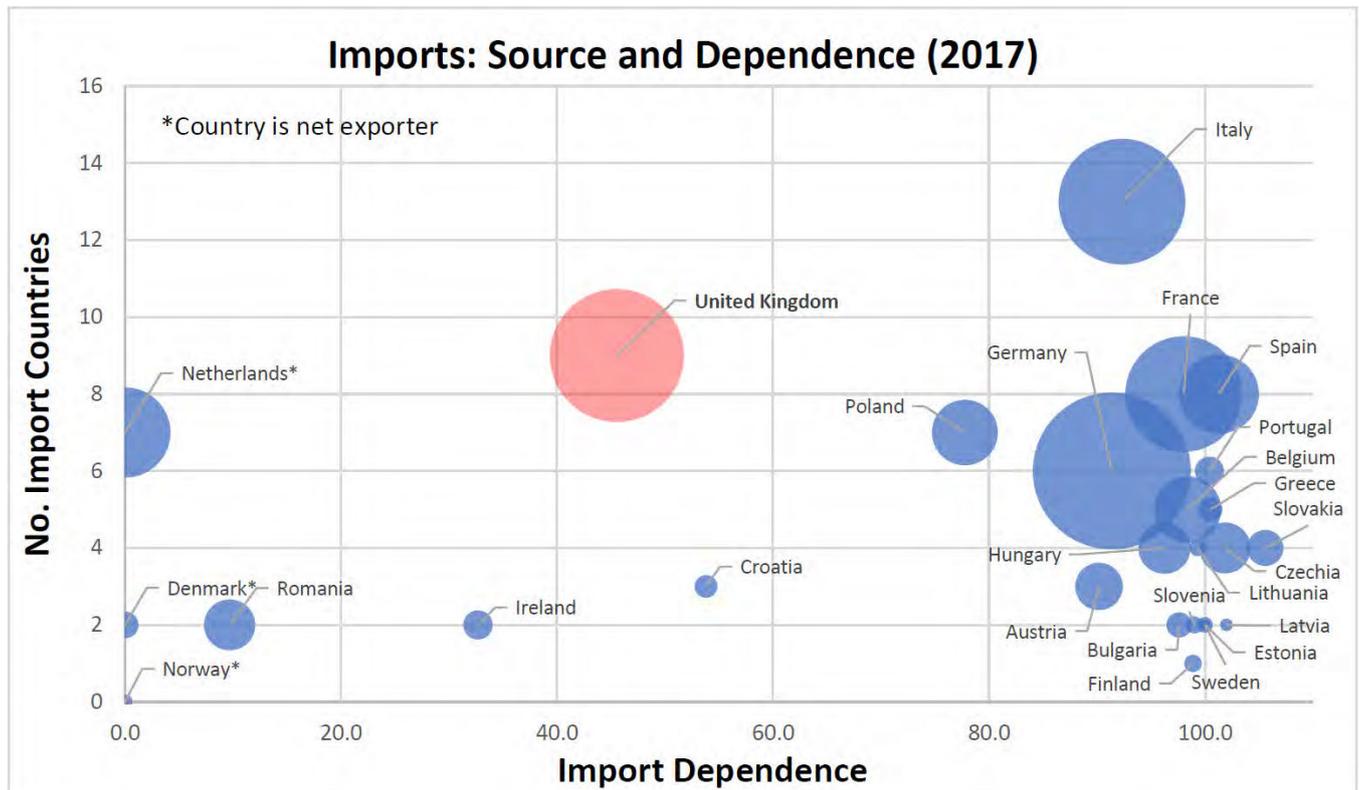
<sup>117</sup> Gas Ten Year Statement, National Grid 2018, [www.nationalgridgas.com/insight-and-innovation/gas-ten-year-statement-gtys](http://www.nationalgridgas.com/insight-and-innovation/gas-ten-year-statement-gtys)

<sup>118</sup> National Statistics Digest of UK Energy Statistics (DUKES) 2019, Table 4.4, [www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019](http://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019)

<sup>119</sup> Gas Infrastructure Europe (GIE) LNG Map, December 2016, [www.gie.eu/index.php/gie-publications/databases/lng-database](http://www.gie.eu/index.php/gie-publications/databases/lng-database)

<sup>120</sup> National Statistics Digest of UK Energy Statistics (DUKES) 2019; Chapter 4 Natural gas (Commodity Balances - DUKES 4.1 and 4.5): [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/820686/DUKES\\_4.1.xls](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820686/DUKES_4.1.xls)

**Figure 2: Gas import source and dependence, UK and EU member states<sup>121</sup>**



*iii Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems*

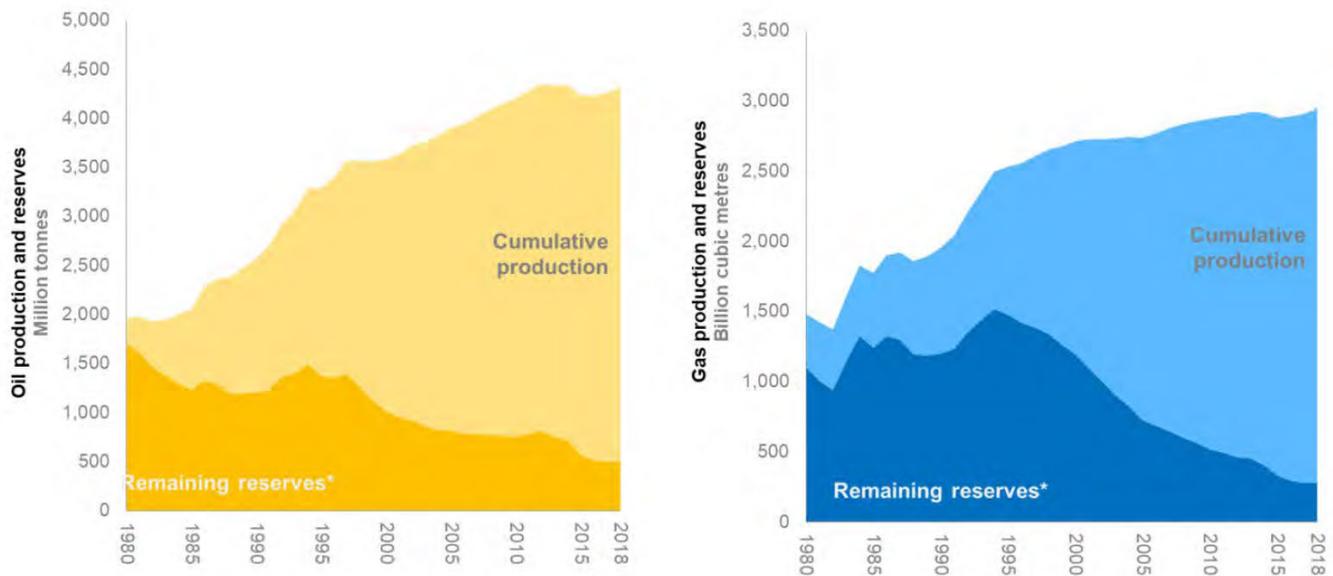
The UK set out a strategy to maximise economic recovery of petroleum from the United Kingdom Continental Shelf (UKCS), based on the UKCS Maximising Recovery Review (2014 Wood Review).<sup>122</sup> Based on the recommendations of the review, the UK government established an independent regulator, the Oil and Gas Authority (OGA, a Government Company) with new competences under the Energy Act 2016 to enable maximising economic recovery of UKCS hydrocarbons. The OGA issued the Maximising Economic Recovery UK Strategy in March 2016. Its Central Obligation states that “relevant persons must take the steps necessary to secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath UK waters.”. The Strategy is due to be reviewed in 2020 including with a view to integrating expressly into the Strategy relevant aspects where industry can assist the Secretary of State in meeting the net zero target. Assisting in achieving net zero forms a part of a proper consideration of the Maximising Economic Recovery Strategy.

The UK government introduced changes to the fiscal regime over 2 budgets including measures abolishing the Petroleum Revenue Tax and cutting the supplementary charge from 32% to 10% and has supported seismic surveys in under-explored areas of the UKCS. Operators in the UKCS will be able to transfer part of their tax history when assets change

<sup>121</sup> BEIS chart, data taken from: ACER ‘Market Monitoring Report 2017’ <https://acer.europa.eu/en/Electricity/Market%20monitoring/Pages/Current-edition.aspx>; Eurostat ‘Energy Dependence by Product’ [https://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=sdg\\_07\\_50&language=en](https://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=sdg_07_50&language=en); Eurostat ‘Final Energy Consumption by Product’ <https://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=ten00095&language=en>  
<sup>122</sup> [www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/471452/UKCS\\_Maximising\\_Recovery\\_Review\\_FINAL\\_72pp\\_locked.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/471452/UKCS_Maximising_Recovery_Review_FINAL_72pp_locked.pdf)

hands in order to facilitate the transfer of late-life oil and gas assets. This will allow new investors to benefit from tax relief when assets are eventually decommissioned and help extend field life.

**Figure 3: UK Oil and gas production and reserves, 1980-2018\*<sup>123</sup>**



\*From 2015, contingent resources have been re-categorised and removed from the probable and proven reserves category.

Exploration and appraisal drilling have been declining in the UKCS since the mid-2000s. The OGA is continuing to support exploration and appraisal drilling through licensing rounds, including making significant quantities of high quality seismic and other exploration data openly available in support of these rounds.

### Unconventional gas resources

The UK government is committed to a low-carbon and affordable future for our energy. Gas still meets over a third of our primary energy demand and we will need it for many years to come. However, it is the UK government's view that hydraulic fracturing should only take place if it is safe and environmentally appropriate to do so.

A range of measures specific to hydraulic fracturing and the nascent industry have been put in place to ensure that shale gas exploration is safe and environmentally sound. The Infrastructure Act 2015 introduced thirteen technical and legislative conditions that need to be met before a hydraulic fracturing consent will be issued; this includes an equivalent assessment of the financial resilience of the company proposing to carry out hydraulic fracturing, including its ability to fund decommissioning costs.

Following analysis of hydraulic fracturing operations in 2018, the OGA has found that it is not currently possible to accurately predict the probability or magnitude of earthquakes linked to hydraulic fracturing operations. On this basis and following the significant disturbance that has been caused to local people following seismic events in August 2019, due to further operations at Preston New Road, Lancashire, on 2 November 2019 the BEIS Secretary of State

<sup>123</sup> UK energy in brief 2019, [www.gov.uk/government/statistics/uk-energy-in-brief-2019](http://www.gov.uk/government/statistics/uk-energy-in-brief-2019)

announced a moratorium with immediate effect. On 4 November 2019, the UK government issued a Written Ministerial Statement<sup>124</sup> that sets out its position – namely that the UK government will no longer be supporting further hydraulic fracturing activities in England at this time. The statement sets out that there will be a presumption against Ministers issuing further Hydraulic Fracturing Consents, which would only be altered if compelling new evidence comes to light.

In 2018, onshore oil and gas licensing powers in Scotland and Wales were devolved to both Scottish and Welsh Ministers respectively and Wales and Scotland have adopted their own policy positions with respect to unconventional oil and gas exploration (UOG).<sup>125</sup>

Following consultation in 2018, Wales will not undertake any new petroleum licensing or support applications for hydraulic fracturing petroleum licence consents.<sup>126</sup> Fossil fuel extraction is not compatible with Wales's decarbonisation and renewable energy generation targets and is placed at the bottom of the hierarchy in Planning Policy Wales.<sup>127</sup> On 3 October 2019, the Scottish Government confirmed its finalised policy position of no support for unconventional oil and gas development in Scotland. This means development connected to the onshore exploration, appraisal or production of coal bed methane or shale oil or shale gas using unconventional oil and gas extraction techniques, including hydraulic fracturing and dewatering for coalbed methane.

## Government incentives to promote exploration and production, changes in upstream regulatory regime

The UK government announcements have included:

- The establishment of the Oil and Gas Authority to be a strong and independent regulator and supporter of the oil and gas industry;
- In its 2015 and 2016 budgets, the UK government provided a £2.3bn fiscal package to support the offshore industry. This included zero rating the Petroleum Revenue Tax and cutting the supplementary charge from 32% to 10%;
- Providing £40m (in two tranches) for seismic surveys in under-developed areas of the UK Continental Shelf and £5m to support exploration;
- A £250m Aberdeen City Region Deal in collaboration with Scottish Government, which included £180m for the new Oil and Gas Technology Centre (£90m from each government); and
- In the Autumn budget 2017, the UK government announced that operators in the UKCS will be able to transfer part of their tax history when assets change hands in order to facilitate the transfer of late-life oil and gas assets. This will allow new investors to benefit from tax relief when assets are eventually decommissioned and help extend field life.

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<sup>124</sup> Written Ministerial Statement on shale gas, November 2019, [www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2019-11-04/HCVS68/](http://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2019-11-04/HCVS68/)

<sup>125</sup> Scottish Government position statement, December 2017, [www.gov.scot/publications/unconventional-oil-and-gas-position-statement/](http://www.gov.scot/publications/unconventional-oil-and-gas-position-statement/)

<sup>126</sup> <https://gov.wales/written-statement-petroleum-extraction-policy-statement>

<sup>127</sup> Planning Policy Wales, Edition 10, December 2018, <https://gov.wales/planning-policy-wales>

*iv National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage*

National objectives about increasing flexibility of the national energy system are set out in the 'Smart Systems and Flexibility' section in 2.4.3(i).

*v) addressing constrained or interrupted supply of an energy source, for the purpose of improving the resilience of regional and national energy systems, including a timeframe for when the objectives should be met*

The UK government continually monitors and assesses the UK's gas security of supply, including the potential for disruption caused by constrained or interrupted gas supplies. UK government analysis over the past 10 years has shown that Great Britain's gas system is resilient and well-placed to respond effectively to unexpected changes in supply and demand including supply constraints. The resilience of Great Britain's gas system is based on:

- A mature and liquid gas market;
- An effective regulatory regime and dynamic pricing signals; and,
- A diversity of flexible import infrastructure and spare import capacity.

The UK government's monitoring and analysis forms part of a five-year cycle of reviews announced by the Secretary of State for Energy and Climate Change in October 2015, the most recent of which was published in October 2017.<sup>128</sup>

## 2.4 Internal energy market

As of 31 January 2020, the UK has left the EU and will not be part of the internal energy market after the Transition Period ends. The UK is open to an agreement on energy with the EU that would provide efficient cross-border electricity and gas trade, with technical cooperation between network operators and organisations in the planning and use of energy infrastructure.

### 2.4.1 Electricity interconnectivity

*i The level of electricity interconnectivity aimed for in 2030*

The UK government recognises the potential for further interconnection to contribute to energy security, affordability and decarbonisation objectives and supports projects which support these outcomes. The Great Britain electricity system is currently connected with north-west Europe via 4GW interconnector capacity – 2GW with France, 1 GW with Belgium and 1GW with the Netherlands. 1GW of interconnection also links Great Britain and the Single Electricity Market (SEM) on the island of Ireland.<sup>129</sup>

The UK provides a supportive policy environment for further interconnection projects, including through the regulatory route of the Cap and Floor regime and an exempted route for merchant

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<sup>128</sup> Gas Security of Supply: a strategic assessment, Department for Business Energy and Industrial Strategy, [www.gov.uk/government/publications/gas-security-of-supply-strategic-assessment-and-review](http://www.gov.uk/government/publications/gas-security-of-supply-strategic-assessment-and-review)

<sup>129</sup> Electricity Interconnectors, Ofgem, [www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors](http://www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors)

projects. In addition to the 5GW already operational, 4.8GW of capacity is already in construction, linking GB with Norway, France, and Denmark. A further 8.1GW is progressing through regulatory process. This is expected to increase our level of interconnection by 2030.

The UK has been involved in the North Seas Energy Cooperation (NSEC) work on concrete concepts for joint offshore projects or cluster projects. The NSEC identified a list of potential areas and projects in the region, where joint projects could be most beneficial. This showed that there is considerable potential for such projects in UK waters.

## 2.4.2 Energy transmission infrastructure

*i Key electricity and gas transmission infrastructure projects, and, where relevant, modernisation projects*

There are a number of key electricity transmission projects in the UK, such as the recently completed Western high-voltage direct current (HVDC) link which is helping to transport renewable energy from Scotland to England and Wales.<sup>130</sup>

Also, the fourth list of Projects of Common Interest published by the European Commission on 31 October 2019 included a number of UK-impacted Projects of Common Interest, which are set out in Table 11.

**Table 11: UK-impacted Projects of Common Interest<sup>131</sup>**

PCI No.	Name	Description	Size (GW)
1.14	Viking Link	Interconnection between Revsing (DK) and Bicker Fen (UK)	1.4
1.15	Nautilus	Interconnection between the Antwerp area (BE) and the vicinity of Kemsley (UK)	1.4
1.16	New GB - NL	Interconnection between Netherlands and United Kingdom	1-2
1.2	NeuConnect	Interconnection between Germany and United Kingdom	1.40
12.2	CO2-Sapling	Transportation infrastructure component of the Acorn full chain CCS project (UK, in further phases Netherlands, Norway)	N/A
1.10.1	North Sea Link	Interconnection between Blythe (UK) and Kvilldal (NO)	1.40
1.10.2	NorthConnect	Interconnection between Peterhead (UK) and Simadalen (NO)	1.40
1.12.3	CARES	3 Compressed air energy storage in Middlewich	0.50
1.12.4	Cruachan II	Hydro-pumped electricity storage at Cruachan II	0.60

<sup>130</sup> Electricity transmission networks: major projects update, 2018, [www.gov.uk/government/publications/electricity-transmission-networks-major-projects-update](http://www.gov.uk/government/publications/electricity-transmission-networks-major-projects-update)

<sup>131</sup> 4th list of Projects of Common Interest, European Commission 2019, [https://ec.europa.eu/info/news/commission-publishes-4th-list-projects-common-interest-making-energy-infrastructure-fit-energy-union-2019-oct-31\\_en](https://ec.europa.eu/info/news/commission-publishes-4th-list-projects-common-interest-making-energy-infrastructure-fit-energy-union-2019-oct-31_en)

PCI No.	Name	Description	Size (GW)
1.7.1	FAB	Interconnection between Cotentin (FR) and the vicinity of Exeter (UK)	1.40
1.7.3	ElecLink	Interconnection between Coquelles (FR) and Folkestone (UK)	1.00
1.7.5	Gridlink	Interconnection between the vicinity of Dunkerque (FR) and the vicinity of Kingsnorth (UK)	1.40
1.9.1	Greenlink	Interconnection between Wexford (IE) and Pembroke, Wales (UK)	0.50
2.13.1	North-South	Connection between Woodland (IE) and Turleenan (UK)	1.50
2.13.2	RIDP1	Interconnection between Srananagh (IE) and Turleenan (UK)	1.50

In the gas sector, the iron mains risk reduction programme which seeks to replace fractured iron mains pipe with plastic is also improving the efficiency of the gas network by reducing leaks of uncombusted gas. Ofgem intend to consult on the RII02 price control mechanism for the period from 2021.<sup>132</sup> This will help direct investment in the gas network, including expenditure on resilience and decarbonisation.

There is also investment in new natural gas infrastructure in Northern Ireland through two significant gas extension projects, which will build on existing gas networks which only commenced development since 1996.

ii Where applicable, main infrastructure projects envisaged other than Projects of Common Interest (PCIs)

In addition to the list for PCI interconnector projects, the NeuConnect interconnector project has been granted regulatory approval in principle through Ofgem's Cap and Floor regime.<sup>133</sup> Further projects, which have not yet applied for regulatory approval, are listed on the Ten Year Network Development Plan.<sup>134</sup>

The UK government requires the electricity transmission operator to submit updates on the progress of infrastructure projects on a quarterly basis. This information is published online.<sup>135</sup>

<sup>132</sup> [www.ofgem.gov.uk/regulating-energy-networks/2021-price-control-review-riio-gd2](http://www.ofgem.gov.uk/regulating-energy-networks/2021-price-control-review-riio-gd2)

<sup>133</sup> Decision on the Initial Project Assessment of the GridLink, NeuConnect and NorthConnect interconnectors, January 2018, [www.ofgem.gov.uk/publications-and-updates/decision-initial-project-assessment-gridlink-neuconnect-and-northconnect-interconnectors](http://www.ofgem.gov.uk/publications-and-updates/decision-initial-project-assessment-gridlink-neuconnect-and-northconnect-interconnectors)

<sup>134</sup> [www.entsog.eu/tyndp](http://www.entsog.eu/tyndp)

<sup>135</sup> Electricity transmission networks: major projects update, 2018, [www.gov.uk/government/publications/electricity-transmission-networks-major-projects-update](http://www.gov.uk/government/publications/electricity-transmission-networks-major-projects-update)

### 2.4.3 Market integration

*i National objectives related to other aspects such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met.*

#### **Smart Systems and Flexibility**

We are working closely with the energy regulator (Ofgem) and industry to support the transition to a smarter, more flexible energy system. Our aim is to establish a best-in-class regulatory framework to harness the full potential of smart and flexible energy solutions such as storage, demand side response and interconnection.

In July 2017, BEIS and Ofgem published the Smart Systems and Flexibility Plan.<sup>136</sup> The plan outlines the underlying principles of our approach to enable the transition to a smart and flexible system and sets out 29 actions for the UK government, Ofgem and industry to implement.

The actions are split across three core themes:

- removing barriers to smart technologies, such as electricity storage – for example, ending double payment of network and policy costs by storage providers;
- enabling the use of smart solutions, including demand side response, in homes and businesses – for example, rolling out smart meters, implementing market-wide half hourly settlement and regulating smart appliances; and
- ensuring markets fairly reward flexibility and smart solutions – for example, enabling access of aggregators to the balancing mechanism and encouraging development of new local flexibility markets.

In October 2018, BEIS and Ofgem published a Progress Update<sup>137</sup> to the Plan which announced that we have now implemented over half of the original actions in the plan. This update also identified nine new actions which continue to support the transition to a smart and more flexible energy system.

*ii Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets including a timeframe for when the objectives are to be met.*

National objectives are outlined in the ‘Smart Systems and Flexibility’ section in 2.4.3(i).

*iii Where applicable, national objectives with regard to ensuring that consumers participate in the energy system and benefit from self-generation and new technologies, including smart meters.*

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<sup>136</sup> Upgrading our Energy System: Smart Systems and Flexibility Plan, July 2017,

[www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan](http://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan)

<sup>137</sup> Upgrading Our Energy System: Progress Update, October 2018,

[www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan](http://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan)

## Self-Generation

The Feed-in Tariffs scheme supports a range of small-scale, low-carbon electricity generation projects (with capacity up to 5MW for solar PV, wind, hydropower and anaerobic digestion, and up to 2kW for combined heat and power), and was designed to be accessible to organisations, businesses, communities and individuals that have not traditionally engaged in the electricity market. Generators receive three benefits:

- Generation tariff - a payment for every kWh generated (the rate being dependent on the technology, the capacity of the installation, and the date installed);
- Export tariff - an additional payment for every kWh that is exported to the electricity network, and
- Bill savings - additional benefit from usage of electricity 'onsite' as opposed to paying the retail price for importing that energy from the grid.

Following a consultation process, the scheme closed to new applications in March 2019 – however projects that have previously qualified will continue to be supported by the scheme.

In December 2018, the UK government proposed to introduce a new market-led Smart Export Guarantee (SEG), which aims to ensure that eligible small-scale low-carbon generators who export electricity to the network can receive payment for it. This received Parliamentary approval in June 2019 and came into force on 1 January 2020. More information on the SEG is included in 3.1.2(iii).

## Smart meters

Smart meters are replacing traditional gas and electricity meters across Great Britain as part of an important national upgrade that will build a smart grid, digitise our energy system and drive innovation. In September 2019, the UK government published a consultation on a post-2020 policy framework to further drive investment and maintain momentum towards a market-wide roll out that will deliver consumer and system benefits as soon as practicable.<sup>138</sup>

Smart meters offer a range of intelligent functions and provide consumers with more accurate information on their energy usage and cost. Every domestic consumer is also offered an In-Home Display, which gives consumers easy access to their energy consumption data in pounds and pence to help them manage and reduce their energy consumption, save money and reduce emissions.

The UK government's latest Cost Benefit Analysis estimates the roll-out of smart meters in Great Britain will deliver total net benefits of around £bn, the majority of which come from consumer energy savings and industry operational cost savings.<sup>139</sup> Without the flexibility enabled by smart metering, modelling for the CCC estimates the costs of delivering net zero emissions by 2050 could be up to £16bn higher each year.<sup>140</sup>

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<sup>138</sup> Smart meter policy framework post 2020, September 2019, [www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020](http://www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020)

<sup>139</sup> Smart meter roll-out: cost-benefit analysis 2019, [www.gov.uk/government/publications/smart-meter-roll-out-cost-benefit-analysis-2019](http://www.gov.uk/government/publications/smart-meter-roll-out-cost-benefit-analysis-2019)

<sup>140</sup> Analysis of Alternative UK Heat Decarbonisation Pathways, for the Committee on Climate Change, August 2018, [www.theccc.org.uk/wp-content/uploads/2018/06/Imperial-College-2018-Analysis-of-Alternative-UK-Heat-Decarbonisation-Pathways.pdf](http://www.theccc.org.uk/wp-content/uploads/2018/06/Imperial-College-2018-Analysis-of-Alternative-UK-Heat-Decarbonisation-Pathways.pdf)

As at 30 September 2019 there were 15.6 million smart and advanced meters operating in homes and businesses across Great Britain<sup>141</sup>, allowing consumers to take control of their energy consumption, making it easier for them to switch energy supplier, paving the way towards a smart energy system,<sup>142</sup> and playing a key role on the road to decarbonisation and net zero.

The UK government has developed a comprehensive consumer engagement strategy to help consumers benefit from smart metering. Energy suppliers hold the primary consumer engagement role as the main point of contact for customers before, during and after the smart meter installation. A mandatory installation code of practice requires energy suppliers to take consumers' specific needs into account. This ensures that all consumers, particularly vulnerable consumers, can access the benefits of smart metering. In addition, Smart Energy GB, an independent body funded by energy suppliers, is delivering a national engagement programme to raise awareness and drive behaviour change. As part of this work Smart Energy GB is partnering with grassroots organisations around Great Britain to reach all types of consumers including the most vulnerable.

Millions of energy consumers are already benefitting from smart meters and the overwhelming majority are having a good experience, which is testament to the hard work, skill and dedication of all the organisations involved in delivering the rollout:

- 9 in 10 people with smart meters say they were satisfied with the installation process.<sup>143</sup>
- 8 in 10 people with smart meters say they have a better idea of their energy costs.<sup>144</sup>
- 9 in 10 smart pre-payment customers say that topping up has become easier since getting a smart meter.<sup>145</sup>

The Scottish Government is working to deliver a Smart Meter Advice Project (SMAP) delivered through Home Energy Scotland to enable customers to make the most of the energy use data provided by their smart meters. Home Energy Scotland now has a network of advisors trained to provide general smart meter information and recruit customers for SMAP. Each centre has a smart meter specialist fully trained to use the SMAP tool. Home Energy Scotland will routinely ask customers about their meter and, if they have a smart meter, ask their permission to use their data to improve the service provided.

*iv National objectives with regard to ensuring electricity system adequacy, as well as for the flexibility of the energy system with regard to renewable energy production, including a timeframe for when the objectives are to be met*

## Capacity Market

The UK government has established in law a reliability standard for system adequacy in Great Britain. This is set at 3 hours Loss of Load Expectation (LOLE), i.e. the expectation that there will be three hours per year on average where generation in the market may not meet demand,

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<sup>141</sup> Statistical release and data: Smart Meters, Great Britain, quarter 3 2019, published November 2019, [www.gov.uk/government/statistics/statistical-release-and-data-smart-meters-great-britain-quarter-3-2019](http://www.gov.uk/government/statistics/statistical-release-and-data-smart-meters-great-britain-quarter-3-2019)

<sup>142</sup> Smart meters: unlocking the future, published December 2018, [www.gov.uk/government/publications/smart-meters-unlocking-the-future](http://www.gov.uk/government/publications/smart-meters-unlocking-the-future)

<sup>143</sup> BEIS, Smart Meter Customer Experience Study: Post-installation survey, August 2017, [www.gov.uk/government/publications/smart-meter-customer-experience-study-2016-18](http://www.gov.uk/government/publications/smart-meter-customer-experience-study-2016-18)

<sup>144</sup> Smart Energy GB, Smart Energy Outlook March 2019, [www.smartenergygb.org/en/-/media/SmartEnergy/essential-documents/press-resources/Documents/Smart-energy-outlook-March-2019.ashx](http://www.smartenergygb.org/en/-/media/SmartEnergy/essential-documents/press-resources/Documents/Smart-energy-outlook-March-2019.ashx)

<sup>145</sup> BEIS, Smart Meter Customer Experience Study: Post-installation survey, August 2017, [www.gov.uk/government/publications/smart-meter-customer-experience-study-2016-18](http://www.gov.uk/government/publications/smart-meter-customer-experience-study-2016-18)

and other measures may be needed. Capacity Market (CM) auctions are held one (T-1) and four (T-4) years ahead of the delivery year with targets set at the level needed to meet this reliability standard. Existing generators compete against a range of other technologies to obtain agreements under which they commit to making their capacity available when needed, in return for guaranteed payments.

Section 3.3(i) contains information on flexibility.

*v Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector*

The UK's plans for the next 10 years include:

### **Default Tariff Cap:**

- On 1 January 2019, the Default Tariff Cap came into force in Great Britain.<sup>146</sup> This will remain in place until the end of 2020 but can be extended each year until 2023. Analysis from Ofgem (the independent GB energy market regulator) suggests that the cap will save around 11 million default tariff customers c.£75-100/year compared to if the cap was not introduced.<sup>147</sup> As of October 2019, the default tariff cap was set at £1,179/year for a typical domestic customer.<sup>148</sup>
- Ofgem implemented the measure following the passing of the Domestic Gas & Electricity (Tariff Cap) Act 2018 in July 2018.<sup>149</sup> The legislation was put in place following the Competition & Markets Authority's (CMA) Energy Market Investigation conducted in 2016, which found that in total domestic customers of the six largest energy companies were paying an average of £1.4bn a year more than they would in a truly competitive market. The Default Tariff Cap is designed as an interim measure to protect consumers on standard variable and default tariffs from overpaying for their energy.

### **Engaging consumers:**

- Ofgem are introducing a principles-based approach which allows bills to be simplified with information presented in a way that works for consumers. This approach balances the protection of consumers, with greater room for flexibility and innovation in the future.
- Ofgem are also conducting trials to discover what works to appropriately engage consumers. These trials may be scaled up and rolled out nationally if successful.

### **Future Retail:**

- The joint BEIS-Ofgem Future Retail Markets Review launched in November 2018 is looking at how the regulatory framework might need to evolve to ensure the energy market is fit for the future, so that consumers can take advantage of the increased flexibility and lower costs of a smart, low-carbon energy system. The review will seek to

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<sup>146</sup> Default Tariff Cap: [www.ofgem.gov.uk/gas/retail-market/market-review-and-reform/default-tariff-cap](http://www.ofgem.gov.uk/gas/retail-market/market-review-and-reform/default-tariff-cap)

<sup>147</sup> Figure based on typical domestic consumption values of 3100kwh electricity, 12000kwh gas. Source: Ofgem, Higher wholesale costs push up default and pre-payment price caps from April, [www.ofgem.gov.uk/publications-and-updates/higher-wholesale-costs-push-default-and-pre-payment-price-caps-april](http://www.ofgem.gov.uk/publications-and-updates/higher-wholesale-costs-push-default-and-pre-payment-price-caps-april)

<sup>148</sup> Figure based on typical domestic consumption values of 3100kwh electricity, 12000kwh gas. Source: Ofgem, default tariff cap level – Letter (1 April 2019 to 30 September 2019), [www.ofgem.gov.uk/publications-and-updates/default-tariff-cap-level-1-april-2019-30-september-2019](http://www.ofgem.gov.uk/publications-and-updates/default-tariff-cap-level-1-april-2019-30-september-2019)

<sup>149</sup> Domestic Gas and Electricity (Tariff Cap) Act 2018, [www.legislation.gov.uk/ukpga/2018/21/contents/enacted/data.htm](http://www.legislation.gov.uk/ukpga/2018/21/contents/enacted/data.htm)

ensure that consumers are appropriately protected no matter what energy related products and services they sign up to.

- In July 2019 the joint team published the consultation ‘Flexible and Responsive Energy Retail Markets’, setting out a vision for the future of the energy retail markets, including key opportunities and challenges.<sup>150</sup> The consultation closed on 16 September 2019. The team are currently analysing the responses from the wide range of stakeholders. We plan to use the responses and continue to work with stakeholders to help us shape the development of more detailed reforms over the coming months.

#### **Use of data:**

- The UK government and Ofgem are revising the Midata programme so that domestic consumers can quickly, securely and easily share their energy data with trusted third parties. This will enable services including, but not limited to, faster and more accurate tariff comparisons.
- Price comparison websites are to be granted access to the Electricity Central Online Enquiry Service and gas and electricity customers’ data to reduce errors in switching process. There will be an annual report on the development of this work.
- Smart meters are replacing traditional gas and electricity meters across Great Britain as part of an important national upgrade that will build a smart grid, digitise our energy system and drive innovation. The UK government has published a consultation on a post-2020 policy framework to further drive investment so that momentum continues that will deliver a market-wide roll out and all consumer and system benefits as soon as practicable.<sup>151</sup>
- Building on the functionality provided by smart metering, Ofgem is considering the move to market-wide half-hourly electricity settlement; and intend to reach a decision on the approach and timeframe for implementing it in Q1 2021.<sup>152</sup>

#### **Faster switching:**

- Ofgem and the UK government are moving to faster and more reliable switching for customers.

The Scottish Government published the Energy Consumer Action Plan in May 2019.<sup>153</sup> The Action Plan establishes a framework to guide devolved energy policy and influence change in areas reserved to UK government. Building on two Scottish Energy Summits held in 2016 and 2018 and delivering on a commitment in the Scottish Energy Strategy, the Energy Consumer Action Plan sets out a collaborative approach to ensuring consumers are informed, engaged and empowered as the energy system evolves.

The Scottish Government also announced in October 2017, an ambition to establish a public energy company with the aim of supporting efforts to tackle fuel poverty and helping to achieve

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<sup>150</sup> Flexible and Responsive Energy Retail Markets, [www.gov.uk/government/consultations/flexible-and-responsive-energy-retail-markets](http://www.gov.uk/government/consultations/flexible-and-responsive-energy-retail-markets)

<sup>151</sup> Smart meter policy framework post 2020, published September 2019,

[www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020](http://www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020)

<sup>152</sup> Electricity Settlement Reform, Ofgem, [www.ofgem.gov.uk/electricity/retail-market/market-review-and-reform/smarter-markets-programme/electricity-settlement-reform](http://www.ofgem.gov.uk/electricity/retail-market/market-review-and-reform/smarter-markets-programme/electricity-settlement-reform)

<sup>153</sup> Energy Consumer Action Plan, [www.gov.scot/publications/energy-consumer-action-plan-putting-consumers-heart-scotlands-energy-transition/pages/3/](http://www.gov.scot/publications/energy-consumer-action-plan-putting-consumers-heart-scotlands-energy-transition/pages/3/)

climate change targets.<sup>154</sup> It will be publicly owned and run on a not-for-profit basis. The company will offer energy at a fair price and ultimately will contribute to economic development through supporting renewable energy ambitions. An outline business case is currently being finalised and will be published once considered by Ministers and potential local authority partners.

#### 2.4.4 Energy poverty

*i Where applicable, national objectives with regard to energy poverty including a timeframe for when the objectives are to be met.*

Energy poverty, known as fuel poverty in the UK, is a devolved issue, with separate objectives to address fuel poverty in each administration which are set out below. Each administration is also able to set out specific policies to support their objective. Some of the policies implemented by the UK government extend to more than one administration, where this is the case the geographical extent is specified.

##### **England**

The Fuel Poverty (England) Regulations 2014<sup>155</sup> created an objective for improving the energy performance of as many fuel poor homes in England as is reasonably practicable to a minimum energy efficiency rating of Band C by 31 December 2030. The fuel poverty strategy for England includes interim milestones for as many fuel poor homes as is reasonably practicable to achieve a minimum energy efficiency rating of Band E by 2020 and Band D by 2025.

An annual assessment of the number of households living in fuel poverty is undertaken in England. Currently fuel poverty is measured using the Low Income High Cost indicator. In 2019 Government consulted on a proposal to update this to a new measure of fuel poverty 'Low Income Low Energy Efficiency', further details on this proposal is set out in the Consultation on the Fuel Poverty Strategy for England.<sup>156</sup> Data is collected through the English Housing Survey to produce annual fuel poverty statistics. The 2019 Report<sup>157</sup> provides the latest statistics on the number of households living in fuel poverty in England, analysis of the composition of the fuel poor group in 2017 and projections of the number of households in fuel poverty in 2018 and 2019. The proportion of households in England in fuel poverty was estimated to be 10.9% in 2017, approximately 2.53 million households.

In 2017, further progress was made towards the fuel poverty interim milestones and fuel poverty target. Table 12 highlights the percentage of fuel poor households that have an energy efficiency rating corresponding to the milestones and target and highlights the percentage change since 2010:

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<sup>154</sup> Public Energy Company, Scottish Government website, [www2.gov.scot/Topics/Business-Industry/Energy/POEC](http://www2.gov.scot/Topics/Business-Industry/Energy/POEC)

<sup>155</sup> The Fuel Poverty (England) Regulations 2014, [www.legislation.gov.uk/ukxi/2014/3220/contents/made](http://www.legislation.gov.uk/ukxi/2014/3220/contents/made)

<sup>156</sup> Consultation on the Fuel Poverty Strategy for England, [www.gov.uk/government/consultations/fuel-poverty-strategy-for-england](http://www.gov.uk/government/consultations/fuel-poverty-strategy-for-england)

<sup>157</sup> The 2019 Annual Fuel Poverty Statistics, [www.gov.uk/government/statistics/annual-fuel-poverty-statistics-report-2019](http://www.gov.uk/government/statistics/annual-fuel-poverty-statistics-report-2019)

**Table 12: Progress towards fuel poverty interim milestones and fuel poverty target in England<sup>158</sup>**

Target year	Target	2010 (%)	2017 (%)	Percentage point change
2020	E or above	81.1	92.2	+11.1
2025	D or above	32.7	65.9	+33.2
2030	C or above	1.5	10.0	+8.5

### Northern Ireland

In Northern Ireland a household is considered to be living in fuel poverty if it needs to spend more than 10% of its income on fuel to obtain a satisfactory level of heating - that is, 21°C in the living room and 18°C in other occupied rooms. Essentially fuel poverty means not being able to keep your home adequately warm at a reasonable cost. It is generally caused by a combination of three factors:

- poor household energy efficiency (this is the factor addressed by the Affordable Warmth Scheme)
- low income
- high fuel costs

The 2016 House Condition Survey estimated that approximately 22% (160,000) of households in Northern Ireland were in fuel poverty.

The Northern Ireland Executive's fuel poverty strategy is delivered mainly through the Affordable Warmth Scheme.<sup>159</sup> The 2019/20 Fuel Poverty target for the Affordable Warmth Scheme and Boiler Replacement Scheme is to deliver 3,900 energy efficiency measures to 2,600 homes through the Affordable Warmth Scheme and to deliver a further 1,300 replacement boilers to 1,300 homes through the Boiler Replacement Scheme.

### Scotland

The Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act ('the 2019 Act')<sup>160</sup> was passed by Parliament with unanimous support in June 2019 and received Royal Assent on 18 July 2019. It sets statutory targets for reducing fuel poverty, introduces a new definition which aligns fuel poverty more closely with relative income poverty and requires Scottish Ministers to produce a comprehensive strategy to show how they intend to meet the targets. This Strategy is due to be published in 2021.

<sup>158</sup> Annual fuel poverty statistics report: 2019, June 2019, [www.gov.uk/government/statistics/annual-fuel-poverty-statistics-report-2019](http://www.gov.uk/government/statistics/annual-fuel-poverty-statistics-report-2019)

<sup>159</sup> Northern Ireland Affordable Warmth Scheme, [www.nihe.gov.uk/index/benefits/affordable\\_warmth\\_scheme.htm](http://www.nihe.gov.uk/index/benefits/affordable_warmth_scheme.htm); current AWS Fuel Poverty Strategy, [www.communities-ni.gov.uk/publications/fuel-poverty-strategy](http://www.communities-ni.gov.uk/publications/fuel-poverty-strategy)

<sup>160</sup> The Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019, [www.legislation.gov.uk/asp/2019/10/enacted](http://www.legislation.gov.uk/asp/2019/10/enacted)

## Targets

The statutory targets set by the 2019 Act are that in 2040:

- no more than 5% of households should be in fuel poverty
- no more than 1% of households should be in extreme fuel poverty
- the median fuel poverty gap of households in fuel poverty is no more than £250 in 2015 prices before adding inflation

Each of these 2040 targets must be achieved not only in Scotland as a whole, but also within each of the 32 local authority areas. This is to ensure that no part of the country is left behind. There are also interim targets set for the same metrics at 2030 and 2035. However, the interim targets only need to be met at a national level.

## New definition and provisions for remote and island communities

The 2019 Act establishes a new two-part definition whereby a household is considered fuel poor if:

- more than 10% (20% for extreme fuel poverty) of their after-housing costs adjusted net income is required to pay for their reasonable fuel needs; and
- after further adjustments for childcare costs and receipt of specified benefits, their remaining adjusted net income is insufficient to maintain an acceptable standard of living, defined as being at least 90% of the UK Minimum Income Standard.

To take account of the generally higher costs of living in Scotland's remote and island communities, the legislation provides for uplifts to be applied to the Minimum Income Standard for households in these areas.

## Fuel Poverty Statistics for 2018

The latest statistics on fuel poverty were published on 21 January as part of the [Scottish House Condition Survey](#) and relate to 2018. The figures presented in the 2018 survey are a best estimate of fuel poverty under the new definition. The headline figures are:

- The level of fuel poverty was 25.0% (around 619,000 households). This is similar to the rate in 2016 and 2017 but lower than the peak of 31.7% (761,000 households) in 2013.
- The level of extreme fuel poverty was 11.3%, equivalent to around 279,000 households. Levels of extreme fuel poverty have been decreasing since the peak in 2013 of 16.0% (384,000 households).
- While fuel poverty rates for households in urban and rural areas were similar in 2018, extreme fuel poverty rates were higher in rural areas compared to urban areas; 17% compared to 10%, respectively.
- Overall rates of extreme fuel poverty were similar between the social (13%) and private sector (10%) in 2018, although levels of extreme fuel poverty in housing association households have decreased from 18% in 2017 to 11% in 2018.
- 69% of fuel poor households are also income poor, similar to 2017.
- 28% of households report owning an energy monitoring device – a nine percentage point increase on the previous year.

- Fuel poor and extreme fuel poor households are more likely to monitor energy use (62% and 65% respectively compared to 57% for non-fuel poor households) but less likely to have monitoring devices at home (23% for both compared to 29% for non-fuel poor households).

By the end of 2021, the Scottish Government will have allocated over £1bn since 2009 to tackling fuel poverty and improving energy efficiency and is on track to deliver its 2016 Programme for Scottish Government commitment to make half a billion pounds available over four years to address these issues, making people's homes warmer and cheaper to heat.

The Scottish House Condition Survey<sup>161</sup> shows that just over two-fifths (44%) of homes in 2018 were rated EPC band C or above, an increase from 35% in 2014, based on the SAP 2012 (RdSAP v9.92) methodology. In the delivery of Scotland's Energy Efficient Scotland Programme, priority will be given to improving the homes of fuel poor households. The programme sets a target for all Scottish homes to achieve an EPC band C by 2040 (where technically feasible and cost effective). To support the ambition of eradicating fuel poverty by removing poor energy efficiency as a driver the Scottish Government have consulted on setting a more ambitious target for those households in fuel poverty - for all homes with households in fuel poverty to reach EPC Band C by 2030 and EPC Band B by 2040 (where technically feasible and cost effective).

## Wales

The Warm Homes and Energy Conservation Act 2000 as amended by the Energy Act 2013, imposes a requirement on the Welsh Ministers in relation to Wales to publish and implement a strategy for reducing fuel poverty; to require the setting of targets for the implementation of that strategy, and for connected purposes.

Targets for eradicating fuel poverty in Wales were initially published in 2003, in the Welsh Assembly Government's A Fuel Poverty Commitment for Wales. The 2010 Strategy replaced the commitment, although the targets remained in place. As far as reasonably practicable, the objective is the eradication of fuel poverty:

- Amongst vulnerable households by 2010;
- In social housing by 2012; and
- By 2018, there would be no-one in Wales living in fuel poverty.

Under the Strategy, fuel poverty in Wales is measured by the number of people having to spend more than 10% of income on all household fuel used to maintain a satisfactory heating regime. Where expenditure on all household fuel exceeds 20% of income, households are defined as being in severe fuel poverty.

On 22 May 2019, new headline estimates for Fuel Poverty in Wales were published and detailed analysis was published in August.<sup>162</sup> In 2018, it is estimated:

- 155,000 households in Wales were living in fuel poverty, equivalent to 12% of households.

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<sup>161</sup> Scottish House Condition Survey, 2017, Table 18, [www.gov.scot/publications/scottish-house-condition-survey-2017-key-findings/pages/5/](http://www.gov.scot/publications/scottish-house-condition-survey-2017-key-findings/pages/5/)

<sup>162</sup> Fuel poverty estimates for Wales, 2019, <https://gov.wales/fuel-poverty-estimates-wales>

- Of these households, 32,000 households were living in severe fuel poverty<sup>163</sup>, equivalent to 2% of households.
- 130,000 vulnerable<sup>164</sup> households in Wales were living in fuel poverty, equivalent to 11% of vulnerable households.
- 19,000 vulnerable households were living in severe fuel poverty, equivalent to 2% of vulnerable households.

From October to December 2020, the Welsh Government is consulting on a new draft plan for tackling fuel poverty. The aim of the new plan is to set out the actions to be taken by the Welsh Government to support efforts to reduce the number of homes in Wales living on a lower income in 'Fuel Poverty'. It will set out a range of new targets, policy goals, objectives and activities designed to collaborate with partners towards the objective of eradicating fuel poverty for people living on a lower income where it is practicable to do so, whilst contributing to the Welsh Government's commitments to tackle climate change by reducing carbon emissions.

## 2.5 Research, innovation and competitiveness

i National objectives and funding targets for public and, where available, private research and innovation including, where appropriate, a timeframe for when the objectives are to be met.

Through our Industrial Strategy, the UK government has set a Clean Growth Grand Challenge to put the UK at the forefront of the industries of the future. The UK government will maximise the advantages for UK industry from the global shift to clean growth – through leading the world in the development, manufacture and use of low-carbon technologies, systems and services that cost less than high carbon alternatives. As part of this Grand Challenge, the UK will:

1. Develop smart systems for cheap and clean energy across power, heating and transport.
2. Transform construction techniques to dramatically improve efficiency (with up to £170m available through wave 2 of the Industrial Strategy Challenge Fund up to 2021).
3. Work with industry to make the UK's energy intensive industries competitive in the clean economy.
4. Put the UK at the forefront of the global move to high-efficiency agriculture.
5. Make the UK the global standard-setter for finance that supports clean growth.

The UK government has significantly increased its investment in low-carbon innovation. From 2015 to 2021 we expect to invest more than £2.5bn in research, development and the demonstration of low-carbon energy, transport, agriculture and waste.<sup>165</sup> This includes:

- Up to £505m from BEIS's Energy Innovation Programme, which aims to accelerate the commercialisation of innovative clean energy technologies and processes.

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<sup>163</sup> The sample sizes for severe Fuel Poverty are small and these estimates are not considered as robust as those for Fuel Poverty.

<sup>164</sup> A vulnerable household is defined as those with a person aged 60 years or over, a child or young person under the age of 16 years and/or a person who is disabled or has a long-term limiting condition.

<sup>165</sup> Energy Innovation, [www.gov.uk/guidance/energy-innovation](http://www.gov.uk/guidance/energy-innovation)

- Up to £1.2bn of funding from the combination of UK Research Councils and Innovate UK – now being brought into one organisation with the creation of UK Research and Innovation. These investments include funding for the Energy Systems Catapult and the Offshore Renewable Energy Catapult.
- Up to £246m for the Faraday Challenge, which will ensure the UK builds on its strengths and leads the world in the design, development and manufacture of electric batteries.
- Up to £620m from a range of UK government departments, including BEIS, Department for Transport (DfT), Department for International Development (DfID) and Department for Environment, Food and Rural Affairs (Defra) and additional Industrial Strategy Challenge Fund support.
- In addition to this UK government funding, in the current price control Ofgem is making £720m of regulated expenditure available to gas and electric companies in Great Britain, to support smarter, more flexible, efficient, and resilient networks.
- The UK government is also stimulating industry-academia collaboration for example through the Agri-tech catalyst, which will help improve agricultural productivity and contribute to more environmentally sustainable agricultural systems.

The UK's Office of National Statistics (ONS) publishes estimates of total private sector research and development, but this is not broken down by Energy Technology Research, Development and Innovation (ETRDI). We are not aware of any formal reporting of data broken down in this way as there is no formal record of different private sector ETRDI projects.

The UK government actively encourages private sector participation in public ETRDI Programmes, recognizing the clear economic benefits such as supporting jobs and increasing export potential.

## Co-ordination of UK energy research and innovation activity

The Energy Innovation Board was formed in November 2016 and replaces and builds on the work of the former Low Carbon Innovation Coordination Group (LCICG), as the strategic body aligning low-carbon innovation investments across the UK government and regulated bodies (Ofgem). It plays a strategic role in aligning domestic and international clean tech investments across the UK government.

The Board is currently chaired by the UK Government Chief Scientific Advisor and is attended by senior civil servants across BEIS, Innovate UK, Research Councils, Ministry of Housing, Communities and Local Government, Department for International Development, Department for Transport, Ofgem, and with the Treasury as observers. The Board is internal to the UK government but is seeking external members with industry insights to provide external challenge. The Board meets on a regular basis to discuss a range of clean technology innovation topics.

## Prioritisation of UK energy research and innovation activity

The Energy Innovation Needs Assessment (EINA) project is a two-phased effort to develop a set of reports to provide evidence for the innovation needs of a range of clean energy technologies, and the systems and processes in which they are utilised. These reports build on the evidence developed as part of the Technology Innovation Needs Assessment (TINA) project, conducted during the 2010-2015 Parliament. The objectives of the EINAs are:

- To create a methodology for conducting assessments of future innovation needs in a way that will produce comparable outputs across different technologies.
- To facilitate efforts across government to identify strategic energy innovation areas for investment.
- To analyse the role of technologies in the energy system.
- To quantify the scale of the opportunity to UK and regions of:
  - reducing technology costs
  - expanding economic growth
- To help understand the uncertainty associated with the above estimates.

The EINAs assess themes such as power generation including bioenergy, carbon capture and storage, hydrogen, demand and supply of heating and transport.

The methodology has been tested through a small-scale pilot of heating technologies to test the effectiveness of the methodology. The EINAs were published in November 2019 and will be used as a key information resource for planning spending towards delivering the UK's international and net zero commitments.

In Scotland, the Energy Strategy emphasised the importance of attracting, retaining and developing low-carbon innovators who will shape the future. Alongside the publication of the Scottish Energy Strategy in December 2017, the Scottish Government announced the creation of a £20m Energy Investment Fund, building on the success of the Renewable Energy Investment Fund, and a £60m Low Carbon Innovation Fund, to provide support for renewable and low-carbon infrastructure over and above wider interventions to support innovation.<sup>166</sup> The programme aims to stimulate commercial interest and investment, maximising Scotland's vast potential in the low-carbon sector, building on the success of the Low Carbon Infrastructure Transition Programme (LCITP) which has allocated around £40m to 16 low-carbon capital projects since 2015. The invitation for the LCITP Low Carbon Innovation Fund launched in January 2018, seeking applications in three priority areas: Low Carbon Heat, Integrated Energy Systems and Ultra Low Emission Vehicle Infrastructure: 14 projects have received offers of development support.

The energy sector in Wales has benefited considerably from European structural funds. The funding awarded includes building research capacity at Welsh universities, enabling collaborative research, development and demonstrators, and investment in renewables and marine energy development. During the period 2014-2018 over £60m has been invested. In addition, the Smart Living Programme works with local authorities and other key stakeholders

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<sup>166</sup> Low Carbon Infrastructure Transition Programme, [www.gov.scot/policies/renewable-and-low-carbon-energy/low-carbon-infrastructure-transition-programme/](http://www.gov.scot/policies/renewable-and-low-carbon-energy/low-carbon-infrastructure-transition-programme/)

to develop innovative demonstrators in Smart Living.<sup>167</sup> Examples of projects which have received EU funding include:

- **FLEXIS<sup>168</sup>**: World-leading energy research scheme, involving collaborations with industry and research organisations in Wales, Europe and around the world. FLEXIS investigates how multiple energy sources can be supplied to consumers through more flexible and efficient systems that integrate traditional and renewable energy sources.
- **Active Building Centre<sup>169</sup>**: Developing and delivering the first examples of buildings as power stations which are able to generate, store and release their own energy both thermal and electrical.
- **Caerau Local Heat Scheme**: Using underground mine-water to warm 150 homes in Caerau Bridgend. Water in the underground mine workings of the former Caerau colliery has been naturally heated by the earth and will be harnessed using heat pump technology and a network of pipes as a geothermal source of energy.
- **WaveSub**: Enabling the design, manufacture and testing of a prototype Wave Energy Converter within the Haven Waterway Enterprise Zone.

*ii Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives including long term targets (2050) for deployment of low-carbon technologies, including for decarbonising energy- and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure*

Our future research and innovation activities will be designed to achieve our legally binding domestic carbon budgets and our new commitment to achieve net zero greenhouse gas emissions from the UK by 2050. Our research and innovation priorities and related spending to deliver these targets are in the process of being considered and agreed, but in the meantime, our intention is to remain closely engaged in international research and innovation activities to meet these world leading commitments. We have an overall target of spending an amount equal to 2.4% of GDP on UK research and innovation more generally, with energy research and innovation a part of this.

In the meantime, the CGS, published in 2017, included three illustrative pathways to meeting what was then our long-term target of reducing emissions by at least 80% relative to 1990 levels by 2050. These did not represent the most likely or preferred pathways to meeting the previous 2050 target, but showed that the 2032 pathway would leave open a wide range of options for 2050 - different pathways within this range, and beyond this range, were also possible. The pathways explored were:

- An Electricity pathway - where all cars and vans are electric, four in five buildings use electric heating, electricity is the main low-carbon energy source for the industry sector and around one in five buildings uses a largely low-carbon district heat network.
- A Hydrogen pathway- where all cars and vans are fuelled by hydrogen, the majority of buildings use hydrogen for heat, with CCUS capturing and storing the emissions during Hydrogen production.

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<sup>167</sup> Smart Living, Welsh Government website, July 2018, <https://gov.wales/low-carbon-living-smart-living-annual-review-2018-2019>

<sup>168</sup> Meeting the energy demands of the future, [www.flexis.wales/](http://www.flexis.wales/)

<sup>169</sup> Active Buildings website, <http://specific.eu.com/>

- A Negative Emissions pathway- where negative emissions in the electricity sector create 'headroom' for other sectors such as transport, buildings and agriculture to decarbonise more slowly.

## Scotland

The Scottish Energy Strategy sets two ambitious targets for 2030:

- The equivalent of 50% of Scotland's heat, transport and electricity consumption to be met from renewable sources, and
- An increase of 30% in the productivity of our energy use across the Scottish economy.

The Scottish Government has also set interim targets for 100% of Scotland's electricity and for 11% of Scotland's non-electrical heat demand to come from renewable sources by 2020. As well as a 12% reduction in energy consumption by 2020.

Like the CGS, the Scottish Energy Strategy is not prescriptive in setting out the pathway by which decarbonisation will ultimately be delivered – instead it offers two illustrative examples, a Hydrogen Future and an Electric Future, both of which are consistent with Scotland's Climate Change targets. These are designed to aid the consideration of developments in the near-term, and the influence they may have on the eventual shape of the system.

In terms of low-carbon and renewable transport, the Scottish Government have committed to phasing out the need for new petrol and diesel cars and vans by 2032, through expanding the electric charging infrastructure in Scotland, accelerating the procurement of ultra-low emission vehicles (ULEV) in the public and private sectors, and introducing large scale pilots to remove barriers to and encourage private motorists to use ULEVs.

### *iii Where applicable, national objectives with regard to competitiveness*

Public investment in economic infrastructure will have doubled over the decade leading up to 2022-2023. This investment will be delivered through a strengthened institutional framework, with longer-term budgets, the advice of the National Infrastructure Commission, an increased focus on the effective delivery of projects in departments, and five-year capital investment programmes for road, rail, water and flooding.

The UK government will take a more strategic approach to our investment in the design of relevant markets, focusing on three principles. We will:

- Invest in ways that support all the objectives of the Industrial Strategy: increasing innovation, developing skills, growing business, and driving productivity and earning power in urban and rural locations across the UK.
- Take greater account of disparities in productivity and economic opportunity between different parts of the UK, ensuring our investments drive growth across all regions of the UK.
- Invest to increase UK competitiveness in relation to long-term global economic changes, such as the shift to clean growth. These will be positive choices that enable the UK economy to flourish in the context of these transformational changes.

Innovation in clean growth will be important for low-cost, low-carbon infrastructure systems, as well as for realising industrial opportunities. We will increase support for clean growth innovation by making this a strategic priority for the Industrial Strategy Challenge Fund.

This will build on the UK government investment in low-carbon innovation set out in the CGS, which has grown to more than £3bn between 2015 and 2021.<sup>170</sup> In addition to the Faraday Challenge for battery technology, the UK government has announced three new Industrial Strategy programmes in Clean Growth across energy, construction and agriculture. We will continue to build our international partnerships in clean growth research and innovation: the UK is a proud member of Mission Innovation – a global initiative that aims to reinvigorate and accelerate the global clean energy revolution. We will strengthen support to commercialise new clean technologies through our investments in patent capital, beginning with a new equity fund for which we will provide up to £2m.

We will use all the UK government tools available to support innovation in a low-carbon economy including market design, taxation and regulation. We will also aim to accelerate private investment and promote market growth.

We will promote overseas investment in the UK's clean economy and strengthen our support for UK exporters through better identification of overseas opportunities, industry briefings, overseas missions, pavilions at key international events and campaigns for sectors and industries that are delivering clean growth. We will also promote the UK's exceptional expertise through the Green is GREAT campaign to amplify the UK's global reputation for excellence in this area.<sup>171</sup>

In Scotland, the Energy Strategy highlights the huge economic opportunity that the transition to a low-carbon economy presents. Scotland has a well-established oil and gas sector, a proud engineering heritage and enviable natural resources, which has provided the platform for the recent growth in renewable energy deployment. Building on these strengths will help the UK as a whole to create a modern, integrated, low-carbon energy system, and support the delivery of the ambitions and priorities set out in Scotland's Economic Strategy. Scotland's rich energy history and expertise will support greater internationalisation by strengthening renewable supply chains and research dissemination. The Scottish Government is committed to building on Scotland's international reputation for excellence in energy, and to forging partnerships between the UK and other countries.

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<sup>170</sup> Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>171</sup> Industrial Strategy, 2017, [www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future](http://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future)

## 3. Policies and measures

### 3.1 Decarbonisation

#### 3.1.1 GHG emissions and removals

*i Policies and measures as referred in section 2.1.1 and covering all key emitting sectors and sectors for the enhancement of removals, with an outlook to the long-term vision and goal to become a low emission economy and achieving a balance between emissions and removals in accordance with the Paris Agreement*

The UK has a significant package of policies and measures to meet its targets. Many of the policies described cross different sectors and involve a number of delivery mechanisms.

Table 13 below was published in the UK's 7th National Communication in December 2017<sup>172</sup> and summarises these policies, some of which have been updated. Not all of these policies apply across all of the Devolved Administrations.

In Scotland, the policies and proposals for meeting statutory emissions reduction targets are set out in the Scottish Government's Climate Change Plan<sup>173</sup> published in February 2018, and the Energy Strategy<sup>174</sup> published December 2017. The specific policies and proposals that apply to Scotland are therefore not listed below but can be accessed through these documents.

Prosperity for All: A Low Carbon Wales was published in March 2019 and sets out the policies and proposals for meeting the first Welsh carbon budget (2016-2020).<sup>175</sup> The plan for the second carbon budget will be published in 2021.

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<sup>172</sup> Seventh National Communication – Annex I, <https://unfccc.int/node/28527>

<sup>173</sup> Climate Change Plan: third report on proposals and policies 2018-2032 (RPP3):

[www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/](http://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/)

<sup>174</sup> Scottish Energy Strategy: The Future of Energy in Scotland, 2017, [www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/](http://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/)

<sup>175</sup> <https://gov.wales/prosperity-all-low-carbon-wales>

**Table 13: Summary of the UK's policies updated from the UK's 7th National Communication**  
**Energy supply**

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Climate Change Levy (CCL)	2001 (Implemented)	Economic, Regulatory, Fiscal	System of carbon pricing, ESR
<p>The Climate Change Levy (CCL) was introduced in 2001. It is levied on the supply of energy to business and public sector consumers. Each of the four main groups of taxable commodities (electricity, gas, solid fuels, and liquefied petroleum gas [LPG]) has its own main rate per unit of energy. The main rates of the CCL are intended to incentivise businesses to reduce their energy consumption. Eligible energy-intensive industries may pay reduced main rates of CCL through CCAs, or be exempt from the CCL for mineralogical/metallurgical processes.</p>			
Renewables Obligation (RO)	2002-2019 (Implemented)	Regulatory, Economic	System of carbon pricing, ESR
<p>Sets an annual obligation on electricity suppliers to source a proportion of their generation from renewable sources. The RO was introduced in 2002 in Great Britain, and in 2005 in Northern Ireland. It closed to most new applicants on 31 March 2017. Limited grace periods extended the deadline for certain projects up to 31 January 2019 in Great Britain, and to 31 March 2019 in Northern Ireland. Stations receive support for up to 20 or 25 years until final closure of the scheme on 31 March 2037.</p>			
Carbon Pricing	2005 (Implemented)	Economic	System of carbon pricing, ESR
<p>Until the end of 2020 the UK will continue to participate in the EU ETS, which sets a limit (cap) on industrial and power sector emissions, which reduces year-on-year, on the total number of greenhouse gas emissions that can be emitted by scheme participants. Emitters must acquire and surrender enough allowances to cover their emissions each year.</p> <p>In May 2019 the UK consulted on The Future of Carbon Pricing outlining proposals for future carbon pricing policy in the UK.</p>			
Large Combustion Plant Directive	2007 (Expired)	Regulatory	System of carbon pricing, ESR
<p>The Large Combustion Plant Directive (LCPD, 2001/80/EC) sets limits on emissions of sulphur dioxide, nitrogen oxides, and dust from combustion plants with a thermal capacity of 50 MW or greater. Has now been replaced by the Industrial Emissions Directive.</p>			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Additional renewables in generation (Renewable Energy Strategy)	2009 (Implemented)	Regulatory, Economic	System of carbon pricing, ESR
Increases Renewable Obligation (RO) targets in electricity supply so as meet the UK's overall renewables target for 2020 as set out in the Renewables Directive (RED, 2009/28/EC).			
Feed in Tariffs (FIT) (GB only)	2010-2019 (Implemented)	Regulatory, Economic	System of carbon pricing, ESR
Feed-in Tariffs (FIT) support organisations, businesses, communities and individuals to generate low-carbon electricity using small-scale (5 MW or less total installed capacity) systems. Electricity suppliers are obliged to pay the regulated tariffs to eligible generators. The FIT scheme closed to new applications on March 31st, 2019.			
Carbon Price Support	2013 (Implemented)	Economic	System of carbon pricing, ESR
The Carbon Price Floor (CPF) is designed to further reduce the use of emission-intensive fossil fuels and increase the proportion of electricity generation and supply from low-carbon sources.			
Contract for Difference (CfD) (2014-2020) (GB only)	2014-2020 (Implemented)	Economic	System of carbon pricing, ESR
Offers Contracts for Difference (CfDs) in the electricity generation market for low-carbon and renewable sources. CfDs replaced the Renewables Obligation which closed to most new applications in 2017 (with extensions to 2019 for certain projects). Current policy offers CfDs for new capacity through competitive auctions.			
Industrial Emissions Directive (as it applies to Large Combustion Plant)	2016 (Implemented)	Regulatory	System of carbon pricing, ESR
As transposed into UK law, the IED replaced the LCPD from 1 January 2016 with similar although more stringent provisions set out in chapter III of the Industrial Emissions Directive (2010/75/EU) (IED). Those provisions already apply in respect to any plant newly permitted since 7 January 2013. Three compliance routes were available to generating plants; to abate emissions and comply with more stringent limits by 2020; to comply with less stringent limits but face a 1,500 hour per year load factor constrain; or to close by 2023.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Capacity Mechanism	2014 (Implemented)	Economic	System of carbon pricing, ESR
Part of the UK Government's Electricity Market Reform package, the Capacity Market ensures that sufficient capacity is available to meet peak demand, encouraging construction and use of a wide variety of new low-carbon generation capacity.			
CCL Budget 2016 Changes	2019 (Adopted)	Economic, Regulatory	System of carbon pricing, ESR
Budget 2016 announced that CCL rates will increase from April 2019, moving to an electricity-to-gas ratio of 2.5:1 compared to the previous 2.9:1 ratio. In the longer term, the UK Government intends to rebalance the rates further, reaching a ratio of 1:1 by 2025. The changes in CCL between 2019 and 2021 were announced in the Budget 2018, but the rates from 2021 onwards, have not yet been announced.			
Contract for Difference (CfD) (2021-2035)	2021-2035 (Planned)	Economic	System of carbon pricing, ESR
Planned continuation of Contracts for Difference (CfDs) for new low-carbon capacity after 2020.			
Smart Export Guarantee (from 2020)	From 2020	Economic	System of carbon pricing, ESR
In July 2019 legislation was passed requiring most (larger) suppliers to offer at least one tariff for exported electricity, to eligible small-scale low-carbon electricity generation projects, that meets Smart Export Guarantee requirements. This came into force on 1 January 2020.			

## Energy consumption across homes, business & public sector

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Carbon Trust measures	2002-2012 (Expired)	Information, Education	System of carbon pricing, ESR
The Carbon Trust provides a range of measures from general advice to in-depth consultancy and accreditation, to reduce emissions and save energy and money to businesses and public sector organisations of all sizes.			
England & Wales - Building Regulations Part L (2002+2005/6)	2002 (Implemented)	Regulatory	System of carbon pricing, ESR
Scotland - Building Regulations 2007 (section 6)	2002 & 2007 (Implemented)	Regulatory	System of carbon pricing, ESR
Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled 'building work' to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.			
Small and Medium Enterprises (SME) Loans	2004-2012 (Expired)	Economic	System of carbon pricing, ESR
The Carbon Trust provided interest free loans of £3,000 - £400,000 for small and medium sized businesses to invest in energy efficiency equipment and renewable technologies. These loans were designed so that in most cases the forecast reduction in energy costs would be similar to the total repayment amount.			
Energy Performance of Buildings Directive (EPBD) 2002/91/EC	2007 (Implemented)	Regulatory, Information	System of carbon pricing, ESR
The Directive sought to improve the energy performance of domestic and non-domestic buildings which required energy certificates and the inspection of air conditioning systems. Energy Performance Certificates (EPCs) give information on a building's energy efficiency expressed on a scale of A+ to G (or A to G in the case a building that is a dwelling) with G representing the least energy efficient rating.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
CRC Energy Efficiency Scheme	2010 (Implemented)	Economic, Information	System of carbon pricing, ESR
<p>The CRC Energy Efficiency Scheme is a mandatory UK-wide emissions trading scheme (launched in 2010). It encourages the uptake of energy efficiency measures in large non-energy intensive private and public sector organisations that use energy not covered by the EU ETS or Climate Change Agreements. It covers around 5000 medium and large users of energy across the business and public sector. The scheme is split into phases. Phase 1 ran from 1 April 2010 until 31 March 2014. Phase 2 covers emissions from 1 April 2014 until 31 March 2019. In the 2016 Spring Budget, the Chancellor announced there would be no further sales of CRC allowances after Phase 2 (i.e. following the 2018/19 compliance year) and legislation was laid in July 2018 to close the scheme after Phase 2. From April 2019, the CCL was increased to recover the revenue forgone from CRC allowances and a new streamlined energy and carbon reporting framework for quoted companies of all sizes and large unquoted companies and large Limited Liability Partnerships will come into force UJ-wide.</p>			
Building Regulations 2010 Part L	2010 (Implemented)	Regulatory	System of carbon pricing, ESR
<p>Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled 'building work' to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.</p>			
Renewable Heat Incentive	2011 non-domestic GB, 2014 domestic GB (Implemented)	Economic	System of carbon pricing, ESR
<p>The Non-Domestic Renewable Heat Incentive (RHI) is a Great Britain (GB) wide scheme which provides financial incentives to increase the uptake of renewable heat by businesses, the public sector and non-profit organisations. Eligible installations receive quarterly payments for 20 years based on the amount of heat generated.</p> <p>The Domestic RHI is a GB wide scheme which provides financial incentives to promote the use of renewable heat in domestic properties. Eligible installations receive quarterly payments for seven years based on either the estimated amount of renewable heat generated, or their metered heat use.</p> <p>In Northern Ireland, separate Renewable Heat Incentive schemes operated before being suspended on 29 February 2016.</p>			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Smart Metering	2012-2020 (Implemented)	Information/regulatory	System of carbon pricing, ESR
<p>The Smart Metering Implementation Programme aims to replace up to 53 million meters with smart electricity and gas meters in all domestic properties, and smart or advanced meters in smaller non domestic sites in Great Britain. Smart meters will provide consumers with near-real time information on their energy consumption to help them control energy use, and avoid wasting energy and money. They will provide energy networks with better information upon which to manage and plan current activities. Smart meters will also assist the move towards smart grids which support sustainable energy supply and will help reduce the total energy needed in the system. As at 30 September 2019 there were 15.6 million smart and advanced meters operating across Great Britain, and the UK Government published a consultation in September 2019 on a post-2020 policy framework to maintain roll out momentum.</p>			
Climate change agreements (CCA)	2013-2023 (Implemented)	Economic, Voluntary Agreement/negotiated agreement	System of carbon pricing, ESR
<p>Climate Change Agreements offer participating energy-intensive industries a discount from the Climate Change Levy (CCL) in return for meeting targets for energy reductions. From 2013 these are a 90% discount for electricity and a 65% discount for other fuels. From April 2019 this will increase to a 93% discount for electricity and 78% discount for other fuels to reflect changes to the CCL from this date. The UK Government due to evaluate the effectiveness of the current CCA Scheme in April 2020, which provides CCL discounts to March 2023.</p>			
England - Building Regulations 2013 Part L	2013 (Implemented)	Regulatory	System of carbon pricing, ESR
<p>Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled 'building work' to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.</p>			
Scotland - Building Regulations 2015 (section 6)	2015 (Implemented)	Regulatory	System of carbon pricing, ESR
<p>Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled 'building work' to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.</p>			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Energy Savings Opportunity Scheme (ESOS)	2014 (Implemented)	Regulatory/ Information	System of carbon pricing, ESR
<p>A mandatory energy assessment scheme for all large undertakings (non-SMEs) in response to requirements contained Article 8 of the EU Energy Efficiency Directive (2012/27/EU). Organisations in scope must measure their total energy consumption and carry out audits of the energy used by their buildings, industrial processes and transport to identify cost-effective energy saving measures or comply with the alternative routes to compliance, by 5 December 2015 and every four years thereafter. It is estimated that around 10,000 organisations are participating in the scheme.</p>			
Private Rented Sector (PRS) Energy Efficiency Regulations	2016, 2018 (Implemented)	Regulatory, Information	System of carbon pricing, ESR
<p>'There are two distinct parts to the Private Rented Sector Energy Efficiency Regulations. The first part represents the 'Tenants' energy efficiency improvements' provisions, which came into force in 2016. The second part represents the 'Minimum level of energy efficiency' provisions which were implemented in 2018. This implies a requirement for any properties rented out in the private rented sector to have a minimum energy performance rating of E on an Energy Performance Certificate (EPC), unless the property meets the conditions for an exemption, and that exemption has been registered on the PRS Exemptions Register. The regulations came into force for new lets and renewals of tenancies in England and Wales with effect from 1 April 2018 and for all longer-term tenancies on 1 April 2020 (1 April 2023 for non-domestic properties). In April 2019 these regulations were further strengthened with respect to the domestic sector only, to require a contribution of up to £3,500 from landlords towards the cost of improving their property towards EPC Band E (previously landlords of domestic properties were only required to take action where third party funding was available to meet the improvement costs). It will be unlawful to rent a property which breaches the requirement for a minimum E rating, unless one of the limited number of exemptions applies.</p> <p>There is no minimum requirement for private rented sector properties in Northern Ireland currently.</p>			
Energy Performance of Buildings Directive (EPBD) 2017 Cost Optimal Review and Nearly Zero Energy Buildings (NZEB) (2018 and 2020)	2018 (Delivered)	Regulatory, Information	System of carbon pricing, ESR
<p>In July 2018 the UK Government submitted the second cost optimal assessment of energy performance requirements for the United Kingdom (UK) as required by the Energy Performance of Buildings Directive. Gibraltar submitted its own standalone report later in 2018.</p> <p>Cost-optimal energy performance means that the lifetime cost-benefit analysis is positive. Minimum energy performance requirements must be compared against calculated cost-optimal levels using the Comparative Methodology Framework.</p>			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Products Policy	2008 and 2017 (Adopted)	Regulatory	System of carbon pricing, ESR
<p>The EU Ecodesign Directive and the Energy Labelling Framework Regulation operate by setting minimum energy performance and information requirements for energy-related products placed to take the least efficient products off the market and to give consumers clear information to make informed purchasing decisions. This is implemented domestically through product specific EU regulations.</p>			
Amendments to Heat Networks Metering & Billing Regulations (2014)	2017 (Planned)	Regulatory	System of carbon pricing, ESR
<p>UK legislation requiring heat network operators to submit data on networks and to install heat meters/heat cost allocators in buildings on networks unless it is not cost-effective to do so. The amendments will revise the cost-effectiveness methodology and address ambiguities in the existing legislation.</p>			
Public Sector Energy Efficiency Loans Scheme	2004-2021 (Implemented)	Economic	System of carbon pricing, ESR
<p>The Public Sector Energy Efficiency Loans Scheme, managed by Salix Finance Ltd, provides interest-free loans in England, Scotland and Wales to public sector organisations for energy efficiency schemes. These loans are intended to provide the capital cost of energy efficiency retrofit work and other measures to be installed. These loans have a payback period of five years (eight for schools) during which the repayments are met with the energy bill savings from the energy efficiency measures. Thus, once the loan has been paid off, the organisations continue to benefit from energy savings for the lifetime of these measures. This funding is then recycled once it has been returned to the Scheme and once again loaned out. BEIS provides the most amount of funding to the Scheme but there is also some funding from the Scottish Government, the Welsh Government and the Department for Education. Wales will have invested approximately £80 million in public sector energy efficiency and renewable energy projects by 2020. The loans are further supported by the provision of expert technical, commercial and financial expertise through the Welsh Government Energy Service. The service has enabled £55 million of zero-interest loans across the public sector in Wales between 2016 and 2018 and also supported the delivery of a further £27.5 million of energy and energy efficiency projects, where finance was secured from alternative routes. The projects supported will realise savings of £183 million for the public sector over the life of the installed technologies and also reduce carbon emissions by 820,000 tonnes<sup>176</sup>.</p>			

<sup>176</sup> Written Statement - Increasing the Scale and Rate of Residential Energy Efficiency Retrofit in Wales, November 2017, <https://gov.wales/about/cabinet/cabinetstatements/2017/energyretrofits/?lang=en>.

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Energy Performance of Buildings Directive (EPBD) Recast 2010	2013 (Transposed)	Regulatory, Information	System of carbon pricing, ESR
Recast of the EPBD 92010/31/EU) in July 2013, the principal regulations extended DEC's to public buildings over 500 square metres. This size threshold was on 9 July 2015 to include buildings over 250 square metres.			
Warm Front	2000-2013 (Expired)	Economic	System of carbon pricing, ESR
Warm Front installed heating and insulation measures to make homes warmer and more energy efficient for private sector households in England vulnerable to fuel poverty. The scheme offered a package of heating and insulation measures of up to £3,500 (or £6,000 where oil central heating or other alternative technologies are recommended).			
EEC1, EEC2 (2002-2008) & Baseline Carbon Emissions Reductions Target (CERT) (2008-2010)	2002-2009 (Expired)	Regulatory	System of carbon pricing, ESR
Energy Efficiency Commitment I (EEC I): GB wide regulation that required all electricity and gas suppliers with 15,000 or more domestic customers to achieve a combined energy saving of 62 TWh by 2005 by incentivising their customers to install energy-efficiency measures in homes.  EEC II - energy suppliers with more than 50,000 domestic customers required to deliver a total of 130 TWh lifetime energy use reductions in GB households, primarily through the promotion of energy efficiency measures. Carbon Emission Reduction Target (CERT) – GB regulation that required all domestic energy suppliers with a customer base in excess of 50,000 domestic customers to make savings in the amount of CO2 emitted by householders.			
Community Energy Saving Programme (CESP)	2009-2012 (Expired)	Regulatory	System of carbon pricing, ESR
Community Energy Saving Programme (CESP) - area based regulation that targeted households across Great Britain, in areas of low income, to improve energy efficiency standards, and reduce fuel bills. CESP was funded by an obligation on larger energy suppliers and also the larger, electricity generators.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Carbon Emissions Reduction Target (CERT) Uplift and Extension (2010-2012)	2010-2012 (Expired)	Regulatory	System of carbon pricing, ESR
<p>CERT extension - increased the targets originally set under CERT by 20% and required domestic energy suppliers with a customer base in excess of 50,000 (later increased to 250,000) to make savings in the amount of CO<sub>2</sub> emitted by householders. The extension also refocused subsidy towards insulation measures and away from electricity saving measures such as low energy lighting - and introduced a super priority group (households in receipt of certain means-tested benefits) to make energy reductions in low income and vulnerable households.</p>			
Energy Company Obligation 1 and 2	2013-2017 (Expired)	Economic, Regulatory	System of carbon pricing, ESR
<p>The Energy Company Obligation (ECO) is a statutory obligation on energy suppliers with over 250,000 domestic customers and delivering over a certain amount of electricity or gas to make reductions in carbon emissions or achieve heating cost savings in domestic households. ECO focuses on insulation measures, and also heating improvements to low income and vulnerable households. It ran until March 2017. ECO initially ran to March 2015 (also known as 'ECO1') and was extended in April 2014 to March 2017 ('ECO2').</p>			
Heat Networks Investment Project	2017-2021 (Implemented)	Economic	System of carbon pricing, ESR
<p>The Heat Networks Investment Project (HNIP) is a capital funding scheme across England and Wales to encourage the development of heat networks. The HNIP is expected to support up to 200 projects by 2022 through grants and loans and other mechanisms and to lever in up to wider investment, reducing bills, cutting carbon and forming a key part of wider urban regeneration in many locations. The scheme will be open for applications from heat networks for up to three years and allocate commercialisation and construction funding through a competitive process. The key objective of the project is to build a sustainable market for heat networks to support the decarbonisation of heat in buildings, helping the UK reach the carbon budget targets.</p>			
Energy Company Obligation 2 Extension	2017-2018 (Expired)	Economic, Regulatory	System of carbon pricing, ESR
<p>The 2015 Spending Review announced that ECO will be replaced with a new, lower cost scheme that will run for 5 years (April 2017 to March 2022) and will tackle the root causes of fuel poverty. The 5-year extension will take place in two phases, with the ECO 2 Extension (April 2017 - September 2018) acting as a bridge between the expired ECO scheme and the new fuel poverty focused scheme, ECO 3, which will run from autumn 2018 to March 2022.</p> <p>The Local Authority Flexible Eligible mechanism was introduced under ECO2 Extension, enabling LAs to determine eligibility and refer households to obligated suppliers. Up to 10% of Affordable Warmth could be delivered through this route.</p>			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Energy Company Obligation 3	2018 -2022 (Implemented)	Regulatory	ESR
The reformed scheme (ECO 3) will run from autumn 2018 to March 2022. The scheme focusses completely on low income and vulnerable households. Supplier thresholds were lowered to 200,000 domestic customers from 2019, and 150,000 domestic customers from 2020. A new 'Innovation' element was introduced to incentivise new better performing measures and cost-effective delivery techniques (up to 10% of scheme), and up to a further 10% of scheme for a monitoring regime to better understand measure performance. The LA Flexible Eligibility mechanism was increased to up to 25% of the scheme.			
Building Regulations 2020 Part L	2020 (Planned)	Regulatory	System of carbon pricing, ESR
Building Regulations set minimum energy performance standards for new buildings and when people carry out controlled 'building work' to existing properties including extensions, conversions and certain categories of renovation and replacement windows and boilers.			
Boiler Plus (standards for domestic boiler installations)	2018 (Implemented)	Regulatory	System of carbon pricing, ESR
The policy objectives of Boiler Plus are to deliver additional energy and carbon savings from the domestic heating sector in England by lowering overall gas demand from domestic properties. It aims to do this by increasing the deployment of devices which increase the efficiency of domestic heating systems, through controls and measures to make gas boilers heat homes more efficiently. The policy instrument is a technical standard set through statutory guidance under the Building Regulations framework. This requires existing households in England to install an additional energy saving measure from a choice list at the point of installing a new or replacement combi gas boiler in an existing dwelling.			
Streamlined energy and carbon reporting framework for business (SECR)	2019 (Implemented)	Information, Regulatory	System of carbon pricing, ESR
SECR is a reporting framework which obligates all large (as defined by the Companies Act 2006) UK registered companies to report their energy use and associated emissions relating to electricity, gas and transport in their annual reports. Companies will also be required to provide an intensity metric and disclose any energy efficiency actions undertaken during the reporting period. Quoted companies will in addition be required to report their global energy use and GHG emissions.			

## Transport

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
PSV Fuel Efficiency Policies	2006/07-2019 (Implemented)	Regulatory, Information, Voluntary Agreement	ESR
<p>The Green Bus Fund (GBF) allowed bus companies and local authorities in England to compete for funds to help them buy new low-carbon emission buses. The four rounds of the fund, which ran from 2009- 2014, added around 1250 Low Carbon Emission Buses onto England's roads. The GBF was replaced in 2015 by the Low Emission Bus Fund (LEBS) which offered £30m for bus operators and local authorities across England and Wales to bid for low emission buses and supporting infrastructure. This scheme funding was open from 2016-2019 and the successful bidders were announced in July 2016, adding more than 300 extra low emission buses to fleets. In Autumn 2016, a further £100m was announced to increase the amount of low emission buses on the road. £11.1m was used to fund those who narrowly missed out on LEBS funding, and £48m formed the Ultra- Low Emission Bus Scheme which was launched in March 2018. Winners of this scheme were announced in February 2019. The remaining funding formed the Clean Bus Technology Fund, which was used to fund retrofitting solutions for existing bus fleets to a minimum Euro VI standard, and the winners of this fund was announced in February 2018. This was in addition to the previous £27m of Clean Bus Technology Fund rounds in 2013 and 2015. There was also a £5m Clean Vehicle Technology Fund in 2014. These funding schemes have contributed to an extra 5000 low emission buses on the road.<sup>177</sup></p>			
Renewable Transport Fuel Obligation, (RTFO)	2007 - 2032 (Implemented)	Regulatory	ESR
<p>The RTFO sets phased targets for renewable fuel use by diesel and petrol suppliers to be achieved by 2020 and on to 2032. Targets are by volume rather than by energy. This implements the EU Renewable Energy Directive (2009/28/EC) and ILUC Directive (EU) 2015/1513.</p>			
Advanced Biofuel Demonstration Competition	2014-2018 (Expired)	Economic	ESR
<p>The Advanced Biofuel Demonstration Competition made available £25 million to enable the construction of two demonstration-scale advanced biofuel plants.</p>			

<sup>177</sup> Renewable transport fuel obligations order: government response (2017), [www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response](http://www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response)

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Local Sustainable Transport Fund	2011-2016 (Expired)	Regulatory	ESR
<p>£600m of capital and revenue funding between 2011 and 2015 to support sustainable travel investments by local government. The projects include promoting public transport, encouraging uptake of cycling and walking, and raising awareness of the alternative transport modes available to commuters and residents awards were made through competitive bidding processes.</p> <p>Since then central government has made an additional Local Sustainable Transport Fund revenue funding of £65m (2015/16) and Access Fund £20m (p.a. 2016/17 to 2019/20) available for similar schemes.<sup>178</sup></p>			
Car Fuel Efficiency Policies	2012 (Implemented) 2019 (Adopted)	Regulatory, Information, Voluntary Agreement	System of carbon pricing, ESR
<p>EC Regulation 443/2009 sets fuel efficiency targets for new cars to be achieved by 2015 and 2020. The regulation translates a fleet average CO<sub>2</sub> tailpipe emissions target for new vehicles sold into the EU market into specific targets for individual manufacturers according to the mass of their fleet. Heavy fines are imposed for non-compliance. The 2021 target is for a fleet average of 95g CO<sub>2</sub>/km across the single market, with a Transition Period where 95% of a manufacturer's fleet must meet the 95g target by 2020.</p> <p>New stretching CO<sub>2</sub> reduction targets (EU Regulation 2019/631) have been introduced for 2025 and 2030 based on the 2021 Worldwide Harmonised Light Vehicle Test Procedure (WLTP) measurements. As a result, the new passenger cars and light duty vehicles CO<sub>2</sub> regulation came into force in January 2020. The Road Vehicle Emission Performance Standards (Cars and Vans) (EU Exit) (Amendment) Regulations 2019 in March 2019 ensure the UK's existing ambition and targets out to 2024 still apply after the end of the Transition Period.</p> <p>Complementary measures are a collection of technologies that could improve 'real world' fuel efficiency of cars which would not be fully captured in new car CO<sub>2</sub> target and could improve fuel efficiency within the existing fleet. These include gear shift indicators, tyre pressure monitoring systems, more efficient mobile air-conditioning and low rolling resistance tyres. EC Regulation 661/2009 sets minimum requirements and introduces labelling for the rolling resistance, wet grip and external rolling noise of tyres.</p> <p>Measures to support the uptake of ultra-low emission vehicles include the Plug-in Grant funding for ultra-low emission vehicle (ULEV) cars, vans, motorcycles and taxis as well as various tax incentives including lower rates for Vehicle Excise Duty and Company Car Tax. Electric vehicle (EV) infrastructure is directly supported through the Workplace Charging Scheme grants for EV charge points for employees and fleets, the Electric Vehicle Homecharge Scheme grants towards home EV charge points, the On-street Residential Chargepoint Scheme and the public-private £400 million Charging Infrastructure Investment Fund, launched in September 2019. Highways England have committed £15 million to ensure that 95% of the Strategic Road Network will be within 20 miles (32.2km) of a charging point.</p>			

<sup>178</sup> Government response to call for evidence: Cycling and walking Investment Strategy (Safety Review), [www.gov.uk/government/consultations/cycling-and-walking-investment-strategy-cwis-safety-review](http://www.gov.uk/government/consultations/cycling-and-walking-investment-strategy-cwis-safety-review)

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Van Fuel Efficiency Policies	2012 (Implemented) 2019 (Adopted)	Regulatory, Information, Voluntary Agreement	ESR
<p>EC Regulation 510/2011 sets fuel efficiency targets for new Light Commercial Vehicles (LCV) to be achieved by 2017 and 2020. EC Regulation 661/2009 sets minimum requirements and introduces labelling for the rolling resistance, wet grip and external rolling noise of tyres. The regulation translates a fleet average CO<sub>2</sub> tailpipe emissions target for new vehicles sold into the EU market into specific targets for individual manufacturers according to the mass of their fleet. Heavy fines are imposed for non-compliance. The 2020 target is for a fleet average of 147g CO<sub>2</sub> /km and represents a reduction of 19% from the 2012 average.</p> <p>New stretching CO<sub>2</sub> reduction targets (EU Regulation 2019/631) have been introduced for 2025 and 2030 based on the 2021 Worldwide Harmonised Light Vehicle Test Procedure (WLTP) measurements. As a result, the new passenger cars and light duty vehicles CO<sub>2</sub> regulation came into force in January 2020. The Road Vehicle Emission Performance Standards (Cars and Vans) (EU Exit) (Amendment) Regulations 2019 in March 2019 ensure the UK's existing ambition and targets out to 2024 still apply after the end of the Transition Period.</p> <p>To help address payload penalty issues and encourage uptake of cleaner vans, a derogation from the European Union third Driving Licence Directive (2006/126/EC) has been introduced to allow Category B (car) licence holders to operate alternatively fuelled vehicles up to a maximum authorised mass of 4.25 (rather than 3.5) tonnes.</p> <p>Complementary measures to support the uptake of ultra-low emission vans include the Plug-in Van Grant and various tax incentives; for instance zero emission vans only pay a small proportion of the van benefit charge and are not subject to the van fuel benefit charge. Electric vehicle (EV) infrastructure is directly supported through the Workplace Charging Scheme grants for EV charge points for employees and fleets, the Electric Vehicle Homecharge Scheme grants towards home EV charge points, the On-street Residential Chargepoint Scheme and the public-private £400 million Charging Infrastructure Investment Fund, launched in September 2019. Highways England have committed £15 million to ensure that 95% of the Strategic Road Network will be within 20 miles (32.2km) of a charging point.</p>			
HGV Fuel Efficiency Policies	2012 (Implemented)	Regulatory, Information, Voluntary Agreement	ESR
<p>EC Regulation 661/2009 sets minimum requirements and introduces labelling for the rolling resistance, wet grip and external rolling noise of tyres. Industry and government are taking a range of actions to reduce freight emissions, including the Freight Transport Association's Logistics Carbon Reduction Scheme, which encourages members to record, report and reduce emissions from freight.</p> <p>The Mode Shift Revenue Support scheme encourages modal shift from road to rail or inland waterway where the costs are higher than road, and where there are environmental benefits to be gained. It currently helps to remove around 800,000 lorry journeys a year from Britain's roads. A similar scheme, Waterborne Freight Grant, can provide assistance with the operating costs associated with coastal or short sea shipping.</p> <p>A voluntary, industry-supported commitment to reduce HGV greenhouse gas emissions by 15% by 2025, from 2015 levels, was introduced in 2018.</p>			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
HGV natural gas policy	2012 (Implemented)	Economic, Research	ESR
<p>The UK government has implemented measures to encourage alternatively fuelled HGVs including through reduced fuel duty rates for road fuel gases and increasing rewards for renewable gaseous fuels under the Renewable Transport Fuel Obligation.</p> <p>The UK government has helped operators establish and run fleets of alternatively fuelled HGVs through the Low Carbon Truck Trial. £11.3 million funding has been provided, via competition, to part fund and test around 370 commercial vehicles, with most using a gas or dual fuel system (diesel and gas), and to develop refuelling infrastructure.</p> <p>Savings for this policy are captured within HGV fuel efficiency policies.</p>			
Rail Electrification	2013-2019 (Implemented)	Economic	System of carbon pricing, ESR
<p>Programme of rail electrification underway to replace older diesel trains with modern, low-emission electric or bi-mode trains.<sup>179</sup> Network Rail is leading a strategy that will inform the scale and pace of rail decarbonisation.</p> <p>This means that operators are contractually obliged to meet emissions levels based on running modern electric rather than diesel traction. Trans Pennine Express (TPE) and Northern are examples where 11% and 17% reductions in CO<sub>2</sub>e emissions per vehicle km respectively were contracted based on electrification schemes. Reducing costs: electric trains tend to be cheaper to buy, operate and maintain than diesels. They are also lighter so do less damage to the track. So whilst there is clearly a large capital cost associated with installing new electrification infrastructure, this can be compensated over time by the lower operational costs of electric trains. Increasing capacity and reliability and reducing journey times: electric trains tend to outperform equivalent diesels in terms of reliability, acceleration and carrying capacity. Reducing environmental impacts: electric trains are quieter and more carbon efficient than diesels and zero emission at point of use which helps with local air quality.</p>			
Future Fuels for Flight and Freight Competition	2018-2021 (Adopted)	Economic	ESR
<p>The Future Fuels for Flight and Freight Competition makes £22 million of funding available to projects that will produce low-carbon waste-based fuels to be used in aviation and freight. In December 2019, KEW Projects and Rika Biogas were awarded a share of £6.5 million to build plants which aim to provide fuel for heavy goods vehicles.<sup>180</sup></p>			

<sup>179</sup> DfT Rolling Stock Perspective, Third Edition (2017). Section 6.5 Sustainable Development Principles.

<sup>180</sup> [www.gov.uk/government/news/orange-peel-rubbish-and-fatbergs-the-fuels-behind-the-future-of-green-transport](http://www.gov.uk/government/news/orange-peel-rubbish-and-fatbergs-the-fuels-behind-the-future-of-green-transport)

**Industrial processes**

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Ozone Depleting Substances Regulation	2001 and 2009 (Implemented)	Regulatory	ESR
This regulation implements obligations under the Montreal Protocol and EU Regulations (2037/2000/EC and 1005/2009/EC) on ozone depleting substances. With the exemption of some critical use exemptions, CFCs and halon use is banned and HCFC use was banned from 2015. Most ozone depleting substances are potent greenhouse gases, so reductions in their use both protects the ozone layer and provides some GHG emissions mitigation.			
Fluorinated GHG Regulation	2007 (Implemented)	Regulatory	System of carbon pricing, ESR
Control (containment, prevention and reduction) of F-gas emissions through recovery, leak reduction and repair and some very limited use bans. Mandatory certification requirements to work with F gases.			
F-gas regulation 2014	2015 (Implemented)	Regulatory	ESR
Introduced a 79% phase down in the quantities of hydrofluorocarbons (HFCs), the main group of F gases, that can be placed on the EU market delivered via a gradually reducing quota system; a number of bans on the use of certain F gases in some new equipment; a ban on the use of very high GWP HFCs for the servicing of certain types of refrigeration equipment; some strengthening of obligations in 2006 Regulation related to leak checking, repairs, F gas recovery and technician training.  In November 2017 the UK ratified the Kigali Amendment to the Montreal Protocol, committing to an 85% reduction in the UKs consumption of HFCs, from a 2011-2013 baseline level, by 2036. A UK led review of the F-gas Regulation, to be completed by the end of 2022 at latest, will be used to assess what further reductions can be made.			
Industrial Heat Recovery Support (IHRS) Programme	2018 (Implemented)	Information, Economic	System of carbon pricing, ESR
The policy aims to increase industry confidence to invest in the technology potential to recover heat from industrial processes and increase the deployment of such technologies across manufacturing and data centres in England and Wales. It establishes a fund for feasibility studies that examine the potential for industrial businesses to adopt heat recovery technologies and a fund to subsidise the deployment of heat recovery technologies.			

## Waste, Agriculture, Land Use and Forestry

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Waste measures	Various (earliest 1996) (Implemented)	Fiscal, regulatory	ESR
<p>There are a number of waste measures with the aim of increasing recycling/reuse and reduce harmful disposal.</p> <p>The Waste Framework Directive (2008/98/EC) is the general framework of waste management requirements and sets rules governing the separate collection of waste.</p> <p>The Landfill Directive (1999/31/EC) sets rules governing the disposal of waste to landfill.</p> <p>The UK Landfill Tax escalates tax on waste sent to landfill, including biodegradable waste.</p> <p>There are other waste measures targeting other waste streams, such as the Industrial Emissions Directive (2010/75/EU). The overall effect is reducing environmental impacts of waste, such as landfilling biodegradable waste and its associated CH4 emissions.</p>			
Environmental Stewardship (Entry Level Schemes and Higher Level Stewardship)	2005 (Implemented)	Economic	ESR
<p>Provides income foregone support under Pillar 2 of the Common Agricultural Policy (CAP) for farmers to undertake management options that benefit biodiversity, resource protection and water quality.</p>			
Catchment Sensitive Farming	2006 (Implemented)	Economic, information	ESR
<p>Delivers practical solutions and targeted support to enable farmers and land managers to take voluntary action to reduce diffuse water pollution from agriculture to protect water bodies and the environment.</p>			
Soils For Profit	2009-2013 (Expired)	Education	ESR
<p>Provides on farm reviews and training on soils manures and nutrients. The programme closed in 2013.</p>			
Agricultural Action Plan	2010-2022 (Implemented)	Voluntary Agreement, Information, Education	ESR
<p>The Agricultural Action Plan covers a range of resource-efficiency and land management measures to reduce emissions to meet UK carbon budgets.</p>			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Nitrates Action Plan	2013 (Implemented)	Regulatory, Information	ESR
This ensures improved compliance with the Nitrate Directive (91/676/EEC). Designated revised 'Nitrate Vulnerable Zones' (NVC) established a range of mandatory measures to reduce nitrate pollution to water in each NVC. It includes also code of good practice for areas outside NVZs.			
Agri- Tech Strategy	2014 (Implemented)	Economic	ESR
Co-funded by industry and addressing industry priorities. Funding is split between projects – 'the Agri-Tech Catalyst' – and new Centres of Agricultural Innovation. These technologies can contribute to agricultural efficiency and reduce GHG emissions.			
CAP Cross Compliance	2015 (Implemented)	Regulatory	LULUCF
<ul style="list-style-type: none"> <li>• Good Agricultural and Environmental Conditions in place to ensure minimum soil cover, to maintain soil organic matter and to minimise erosion.</li> <li>• Implementation of the Nitrates Directive.</li> <li>• Retention of permanent pasture (up to 2014 – now under Greening measures).</li> </ul>			
Common Agricultural Policy (CAP) Greening	2015 (Implemented)	Regulatory	LULUCF
<ul style="list-style-type: none"> <li>• Obtain consent before improving grassland that has not been cultivated for 15 years or more (Environmental Impact Assessment/EIA).</li> <li>• Select a range of Ecological Focus Area (EFA) measures to meet new standards: relevant actions include enhanced buffer strips, cover crops and growing N-fixing crops.</li> <li>• In Wales consent must be obtained to improve grassland that has less than 25% rye grass.</li> <li>• In Northern Ireland, under CAP Greening, farmers can select a number of relevant EFA measures including, landscape features, fallow land, agro-forestry, short rotational coppice and nitrogen fixing crops.</li> </ul>			
Forestry Act, Felling Licence Regulations and Environmental Impact (Forestry) regulations	1999 (Implemented)	Regulatory	LULUCF
Strong regulatory framework that controls felling, only allows deforestation for purposes of nature conservation and prevents afforestation of deep peat. Legislation updated 1999.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Rural Development Programme	2007-2020 (Implemented)	Economic	LULUCF
Woodland creation grants provided through EU co-financed Rural Development Programmes in all four countries of the UK.			
Woodland Carbon Code	2011 (Implemented)	Voluntary Agreement, Information	LULUCF
Voluntary Code and associated carbon registry (2013) for UK domestic woodland carbon schemes to encourage private sector funding for woodland creation projects. Recognised as component of net GHG emissions reporting for businesses in Government's Environmental Reporting Guidelines.			
Wood fuel Implementation Plan	2011-2014 (Expired)	Information, Education, Economic	LULUCF
Initiative to develop supply chains, including through support for harvesting/processing and woodland access, to increase wood fuel supply from existing woodland.			
Grown in Britain	2013 (Implemented)	Voluntary Agreement, Information, Education	LULUCF
Industry-led action plan announced in the UK government's Forestry and Woodlands Policy Statement (2013) which aspires to encourage businesses to invest in woodland creation and sustainable forest management practice.			
Woodland Creation Planning Grant	2015 (Implemented)	Information, Education, Economic	LULUCF
Grant to support the planning of large-scale productive woodlands, compliant with the UK Forestry Standard.			
Woodland Carbon Fund	2016 (Implemented)	Voluntary Agreement, Information	LULUCF
The Woodland Carbon Fund is an exchequer-funded grant to support the creation of large-scale productive woodlands which also enhance natural capital.			
Revised UK Forestry Standard	2017 (Implemented)	Regulatory, Information	LULUCF
Revised (2017) national standard for sustainable forest management including a new guideline on climate change (2011), covering both adaptation and mitigation.			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Forestry Investment Zone	2018 (Implemented)	Voluntary Agreement, Information	LULUCF
A pilot Forestry Investment Zone has been opened in Cumbria, North West England. A FIZ will establish the conditions necessary to create a more favourable investment environment for forestry, conducive to large scale tree planting, and create a supportive framework with local stakeholders to promote this.			
Northern Forest	2018 (Implemented)	Voluntary Agreement	LULUCF
'Kickstart' funding for a new forest covering a 150-mile-wide stretch of northern England.			
Natural England's Strategic Approach to the Restoration of Blanket Bog	2015 (Implemented)	Information	LULUCF
Natural England published the Strategy for the Restoration of Blanket Bog in England in 2015. The approach sets out the extent, nature and importance of the blanket bog resource across England and what is currently being done to conserve it, as well as setting out the required management and timeframe for delivery to achieve an improvement in site condition across the resource at a strategic level.			
Natural Environment White Paper (NEWP) targets on horticultural peat	2011 (Implemented)	Information, Other	LULUCF
The Sustainable Growing Media Taskforce was set up to look at ways in which the barriers to the use of peat alternatives could be overcome. The UK government published its response to the Task Force's report and draft roadmap in 2013 which set out where our resources will be focused. A policy review was published in 2017 assessing the delivery of the roadmap and identifying further actions necessary to achieve a transition to sustainable growing media and reduced peat use.			
Peat Restoration Northern Ireland	2018 (Implemented)	Voluntary	LULUCF
Northern Ireland (NI) will include peatland restoration measures within the new agri-environment scheme, the Environmental Farming Scheme (EFS), as part of its Northern Ireland Rural Development Programme 2014-2020.			
Peatland Area Designations	2004 (Implemented)	Regulatory	LULUCF
3 out of 12 Nature Improvement Areas (NIA, 2012) are focused on peatland restoration. 47% England's wetlands are protected by Sites of Special Scientific Interest (SSSIs).			

Policy name	Status	Type of measure	Impacting traded or non-traded sectors
Peatland Code	2011 (Implemented)	Economic, Information, Voluntary	LULUCF
A UK Voluntary Code to encourage and support private sector funding for peatland restoration projects. Provides standards and robust science to give business supporters confidence that their financial contribution is making a measurable and verifiable difference.			

*ii Where relevant, regional cooperation in this area*

The Powering Past Coal Alliance (PPCA) was launched by the United Kingdom (UK) and Canada at COP23 in 2017 and has since grown to 91 members. The aim of the PPCA is to accelerate the global transition from unabated coal fired power generation by international leadership through sustaining and growing an Alliance of progressive members. The UK works closely with European members to achieve this aim.

The UK is a founding member of the Green Growth Group (GGG), a group of ambitious European countries established in 2013 whose membership currently comprises 17 EU Member States and Norway. The GGG provides a forum for progressive ministers and officials to meet to discuss contemporary issues concerning climate ambition and identify opportunities for driving forward greater climate action.

*iii Without prejudice to the applicability of state aid rules, financing measures, including Union support and the use of Union funds, in this area at national level, where applicable*

Not applicable.

### 3.1.2 Renewable energy

*i Policies and measures for renewable energy and trajectories as referred to in point (a)(2) Article 4, and, where applicable or available, the elements referred to in section 2.1.2, including sector- and technology-specific measures*

#### Electricity

The UK already has a world-leading offshore wind sector and is well placed to benefit from further investment in renewables innovation to accelerate cost reduction. The Offshore Wind Sector Deal, published on 7 March 2019, builds on this global leadership, setting out a pathway for up to 30 GW<sup>181</sup> of generating capacity by 2030 whilst creating thousands of high-quality jobs, a strong supply chain and a fivefold increase in exports. This will help the UK to maintain itself as the anchor market in Europe and support economic growth across the UK, particularly in coastal communities.

The UK government expects to invest around £900 million of public funds between 2015 and 2021 in research and innovation in the power sector, including around £177 million in partnership with the Research Councils and Innovate UK to further reduce the cost of

<sup>181</sup> The recent manifesto commitment seeks to increase this ambition to 40 GW of offshore wind capacity by 2030.

renewables. Innovation opportunities are likely to arise in a number of areas, including floating offshore wind platforms and advanced solar PV technologies.<sup>182</sup>

The UK government is working to improve the route to market for renewable technologies. The 2019 Contracts for Difference allocation round saw 5.8GW of projects offered contracts, including offshore wind, Remote Island wind and Advanced Conversion Technologies, with offshore wind clearing prices 30% lower than the 2017 allocation round.<sup>183</sup> The UK government intends to run subsequent auctions around every 2 years.<sup>184</sup>

The UK government is also working to support small scale electricity generation as the cost of these technologies approach market competitiveness, by introducing the Smart Export Guarantee. This ensures that the owners of various low-carbon technology projects can access the electricity market and receive payment for any electricity they export. This is a market-led approach with no set prices and is designed to be compatible with smart meters that are being rolled-out across Great Britain (see [section 2.4.3](#)) and the growth of small-scale electricity storage.

## Heat

In 2018, 7.3% of UK energy for heating and cooling came from renewable sources.<sup>185</sup> Through the Renewable Heat Incentive (RHI), the UK government has committed to spend £4.5 billion between 2016 and 2021 to support innovative low-carbon heat technologies in homes and businesses, such as heat pumps, biomass boilers and solar water heaters.<sup>186</sup> The government has also announced its intention to extend the Domestic RHI for 12 months to provide further support for the deployment of building level technologies, so it will remain open to new applicants until 31 March 2022, with funding committed until March 2024. Following the RHI, in April 2022, we propose to launch a new £100 million Clean Heat Grant scheme, providing targeted support to consumers and small businesses for heat pumps and some limited biomass. This scheme will be open for two years.

Beyond the RHI and Clean Heat Grant, our ambition is to phase out the installation of high carbon fossil fuel heating in new and existing off gas grid buildings during the 2020s, starting with new homes as these lend themselves more readily to other forms of low-carbon heating.<sup>187</sup>

In May 2018, the UK government launched the Buildings Mission<sup>188</sup>, the first mission under the Clean Growth Grand Challenge, which aims to at least halve the energy use of new buildings by 2030, reduce the cost of retrofitting efficiency measures in existing buildings, and ensure homes and businesses are heated by clean energy sources. The Mission was backed by £170 million of public money through the Transforming Construction Industrial Strategy Challenge

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<sup>182</sup> Clean Growth Strategy, 2017: [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>183</sup> Press release September 2019, UK Government website, [www.gov.uk/government/news/clean-energy-to-power-over-seven-million-homes-by-2025-at-record-low-prices](http://www.gov.uk/government/news/clean-energy-to-power-over-seven-million-homes-by-2025-at-record-low-prices)

<sup>184</sup> Press release July 2018, UK Government website, [www.gov.uk/government/news/a-boost-for-north-east-innovation-to-promote-high-quality-jobs-and-growth](http://www.gov.uk/government/news/a-boost-for-north-east-innovation-to-promote-high-quality-jobs-and-growth)

<sup>185</sup> Digest of UK Energy Statistics (DUKES) 2019, Table 6.7, [www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes](http://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes)

<sup>186</sup> Domestic RHI, [www.gov.uk/government/publications/domestic-rhi-mechanism-for-budget-management-estimated-commitments](http://www.gov.uk/government/publications/domestic-rhi-mechanism-for-budget-management-estimated-commitments); Non-Domestic RHI, [www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments](http://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments)

<sup>187</sup> Clean Growth Strategy, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>188</sup> The Grand Challenge Missions, [www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions](http://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions)

Fund.<sup>189</sup> We expect this will be matched by £250 million of private sector investment, meaning over £400 million will be invested in new construction products, technologies and techniques.

In Spring 2019, the UK Chancellor announced that we will introduce a Future Home Standard by 2025 to ensure that all new build homes are future-proofed with low-carbon heating and world-leading levels of energy efficiency. We are consulting on amendments to Part L of the Building Regulations for England to deliver this policy.<sup>190</sup> The Future Homes Standard could pull through a significant amount of low-carbon heating, particularly heat pumps and heat networks, delivering up to nearly 9MtCO<sub>2</sub>e of emissions savings by the end of the fifth carbon budget.

The RHI also currently supports the injection of biomethane into the gas grid. The RHI has supported the injection of an estimated 9.3 TWh of biomethane (as of October 2019), of which 3 TWh was produced in the last 12 months. In 2019, we announced that we would seek to accelerate the decarbonisation of our gas supplies by increasing the amount of 'green gas' in the grid, and to consult on an appropriate mechanism to achieve this.

Heat networks form an important part of our plan to reduce carbon and cut heating bills for customers (domestic and commercial). The Heat Networks Investment Project is delivering £320 million<sup>191</sup> of capital investment support to increase the volume of heat networks built, deliver carbon savings for carbon budgets, and help create the conditions for a sustainable market that can operate without direct government subsidy.<sup>192</sup> Delivering continued market growth beyond the lifetime of HNIP will require the establishment of a long-term policy framework. In December 2018, the UK government published 'Heat Networks: ensuring sustained investment and protecting consumers' which sets out the priorities for the market framework, and we have consulted on that framework. We will use the consultation responses we have received to help us refine our policy proposals, and we will continue to discuss emerging issues with stakeholders. We will consult further in 2020 or 2021 on any significant changes to our proposals or new issues if required and we will publish a government response to our first consultation in late 2020.

The Northern Ireland RHI Scheme commenced in 2012, based on the RHI Scheme introduced in the rest of the UK but with differences in tariffs and tariff structures.<sup>193</sup> The Northern Ireland RHI schemes were suspended for new applicants on 29 February 2016.

In Scotland, the Scottish Government has established the District Heating Loan Fund (DHFLF) which offers low rate, unsecured capital loans to overcome a range of technical and financial barriers. Since 2011, the DHFLF has offered over £15m to 50 different projects across Scotland. Additionally, the Low Carbon Infrastructure Transition Programme (LCITP) can offer support for the development of investment grade business cases to help projects secure public and private capital finance and can provide financial support for capital.

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<sup>189</sup> UKRI, Transforming Construction, [www.ukri.org/innovation/industrial-strategy-challenge-fund/transforming-construction/](http://www.ukri.org/innovation/industrial-strategy-challenge-fund/transforming-construction/)

<sup>190</sup> The Future Homes Standard: changes to Part L and Part F of the Building Regulations for new dwellings, [www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings](http://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings)

<sup>191</sup> Press release April 2018, Heat Networks Investment Project, [www.gov.uk/government/news/governments-ground-breaking-heat-networks-investment-project-to-launch-in-the-autumn](http://www.gov.uk/government/news/governments-ground-breaking-heat-networks-investment-project-to-launch-in-the-autumn)

<sup>192</sup> Heat Networks Guidance, GOV.UK, [www.gov.uk/guidance/heat-networks-overview](http://www.gov.uk/guidance/heat-networks-overview); Heat Networks Investment Project (HNIP), [www.gov.uk/government/publications/heat-networks-investment-project-hnip](http://www.gov.uk/government/publications/heat-networks-investment-project-hnip)

<sup>193</sup> Northern Ireland RHI, [www.economy-ni.gov.uk/articles/renewable-heat-incentive-rhi](http://www.economy-ni.gov.uk/articles/renewable-heat-incentive-rhi)

## Transport

See section 3.1.3(iii).

*ii Where relevant, specific measures for regional cooperation*

Not relevant.

*iii Specific measures on financial support for the promotion of the production and use of energy from renewable sources in electricity, heating and cooling, and transport*

## Renewables Obligation

The Renewables Obligation (RO) (enacted through the ROS and NIRO in Scotland and Northern Ireland respectively) was introduced to England, Wales and Scotland in 2002, and to Northern Ireland in 2005. The scheme was previously the main financial mechanism to incentivise the deployment of renewable electricity generation in the UK.<sup>194</sup> It closed to new applications on 31 March 2017, but limited grace periods extended the deadline for certain projects up to 31 March 2019. Early projects receive support for 25 years. Since 2008, new projects are supported for 20 years or until final closure of the scheme on 31 March 2037, whichever is earlier.

The scheme operates by putting an obligation on UK electricity suppliers to present a certain number of Renewables Obligation Certificates (ROCs) to Ofgem in respect of each MWh of electricity supplied during an obligation year. Suppliers buy these ROCs from renewable generators (or traders). Generators obtain them free of charge from Ofgem in relation to the renewable electricity they generate. The scheme is paid for by consumers through their energy bills and the UK government is committed to keeping these bills as low as possible. By the end of March 2018, 26,422 stations had been accredited, with a renewable energy capacity of 32.7GW. In 2017/18, 75.2TWh of renewable electricity was generated at a scheme cost of £5.3 billion.<sup>195</sup> The RO has now been replaced by the Contracts for Difference scheme in GB.

## The Feed-in-Tariffs Scheme

The Feed-in Tariffs (FIT) scheme was introduced to England, Wales and Scotland on 1 April 2010, under powers in the Energy Act 2008. The intention was to encourage deployment of micro-scale and small-scale low-carbon electricity generation (up to 5MW), particularly by organisations, businesses, communities and individuals that have not traditionally engaged in the electricity market.<sup>196</sup>

The technologies supported under the scheme are solar PV, onshore wind, hydropower, anaerobic digestion (AD), and micro (<2kW) combined heat and power (micro-CHP).

Under the scheme, generators receive three sources of income/savings:

- Generation tariff - a payment for every kWh generated, dependent on the technology and capacity of the installation, and date installed
- Export tariff - an additional payment for every kWh exported to the local electricity network

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<sup>194</sup> About the RO, OFGEM, [www.ofgem.gov.uk/environmental-programmes/ro/about-ro](http://www.ofgem.gov.uk/environmental-programmes/ro/about-ro)

<sup>195</sup> Renewables Obligation (RO) Annual Report 2017-18, [www.ofgem.gov.uk/publications-and-updates/renewables-obligation-ro-annual-report-2017-18](http://www.ofgem.gov.uk/publications-and-updates/renewables-obligation-ro-annual-report-2017-18)

<sup>196</sup> About the FIT Scheme, OFGEM, [www.ofgem.gov.uk/environmental-programmes/fit/about-fit-scheme](http://www.ofgem.gov.uk/environmental-programmes/fit/about-fit-scheme)

- Bill savings - additional benefit from usage of electricity 'on-site' as opposed to paying the retail price for importing that energy from the grid

Tariffs are calculated to give rates of return that encourage investment but prevent overcompensation. Payments to generators are made quarterly by electricity suppliers and then passed on to consumers through electricity bills.

Since its introduction, the FIT scheme has supported over 850,000 installations, or 6GW of capacity. 99% of installations are solar, which consist of 80% of overall capacity<sup>197</sup>.

A periodic review of the scheme was conducted in the second half of 2015, as required by the EU State Aid approval. The purpose of the review was to ensure tariff levels provided sufficient incentive to potential generators whilst not over-compensating them. Following the review, the UK government also introduced a capping mechanism to bring costs under control to protect households and businesses. Our measures sought to put the scheme on a more sustainable footing which would maintain a viable small-scale renewables industry which could continue to reduce its costs and move towards subsidy free deployment. The closure of the generation tariff after March 2019 was also announced.

Growth in the small-scale low-carbon generation sector must be sustainable; driven by competition and innovation, not direct subsidies. The UK government therefore published a consultation on 19 July 2018 proposing to close the current FIT flat rate export tariff alongside the generation tariff from 31 March 2019, which reflects our desire to move towards fairer, cost reflective pricing and the continued drive to minimise support costs on consumers as set out in the Control for Low Carbon Levies.

On the same day, a call for evidence was also published to further understand the challenges and opportunities for small-scale low-carbon generation, including rooftop solar.

The call for evidence sought to identify:

- The challenges to, and opportunities for, small-scale low-carbon electricity generation in contributing to the UK government's objectives for clean, affordable, secure and flexible power; and
- The role for the UK government and the private sector in overcoming these challenges and realising these opportunities.

Legislation was introduced to close the FIT scheme in full to all new applications after 31 March 2019 subject to a number of time-limited extensions and a grace period. Existing generators will continue to receive generation and export tariff payments for the duration of their support under the scheme.

The importance of maintaining a route to market for small-scale low-carbon renewable generation after 31 March 2019 was stressed by many stakeholders and the UK government subsequently published a consultation on specific proposals for a Smart Export Guarantee in January 2019.

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<sup>197</sup> Monthly feed-in tariff commissioned installations, 2014, [www.gov.uk/government/statistics/monthly-small-scale-renewable-deployment](http://www.gov.uk/government/statistics/monthly-small-scale-renewable-deployment)

## **The Smart Export Guarantee (SEG)**

In June 2019, following two public consultations, the UK government introduced legislation to implement the 'Smart Export Guarantee', which came into force on 1 January 2020. This enables anaerobic digestion, hydro, onshore wind, and solar photovoltaic generators with up to 5MW capacity, as well as micro-combined heat and power with up to 50kW capacity, to receive payment for electricity they export to the grid. It was introduced in the context of falling costs for low-carbon technologies, and a concern that due to their small size some of these small generators may otherwise find it difficult to access a competitive market for the electricity they produce.

Licensed electricity suppliers with 150,000 and over domestic customers will be required to provide at least one tariff offer for exported power (and they are free to offer more than one tariff); other suppliers may participate on a voluntary basis.

The SEG is very much a market-led policy. To provide space for the small-scale export market to develop, there will not be any specified minimum tariff rate, other than that suppliers must provide payment greater than zero at all times of export. To provide space for innovative approaches suppliers will be free to choose the form of the tariff they offer – provided they meet the requirements of the SEG. This will allow for relatively simple tariff offers to be implemented quickly, with an expectation that with time increasingly smart approaches will be implemented.

Exported power must be metered, with a meter capable of measuring export at half-hourly intervals, and meters must also be registered for settlement (though the SEG design is flexible and does not necessarily require half-hourly readings).

Recognising that smart systems may take various forms, the SEG therefore provides suppliers with the flexibility to purchase power from more complex systems including small-scale storage, and other forms of generation, if they choose to do so (provided they are co-located with a SEG installation). To benefit from the SEG, installations should be certified to suitable standards, and installations using anaerobic digestion meet sustainability criteria and feedstock requirements.

## **Contracts for Difference (CfD) Scheme**

The Contracts for Difference (CfD) scheme was introduced in GB in 2014 and is the UK government's main mechanism for supporting new low-carbon electricity generation projects.<sup>198</sup> The scheme has been a success, delivering substantial new investment and helping deliver significant reductions in the costs of some renewable technologies.

A CfD is a 15-year private law contract between a low-carbon electricity generator and the Low Carbon Contracts Company (LCCC), a UK government-owned company. On top of market revenues generators are paid the difference between the strike price and the reference price for the electricity they generate. The cost of any top up is met by consumers via a levy on electricity suppliers. When the reference price is above the strike price then generator must 'pay back' the difference.

Contracts are awarded in a series of competitive 'pay as clear' auctions, with the lowest price bids being successful, which drives efficiency and cost reduction. The clearing price for new

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<sup>198</sup> Electricity Market Reform: Contracts for Difference, [www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference](http://www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference)

offshore wind projects, for example, fell from £114.39 per MWh<sup>199</sup> (2012 prices) in the first auction in 2015 to £39.65 per MWh<sup>200</sup> (2012 prices) in the third auction in 2019.

The CfD scheme<sup>201</sup> has awarded contracts to 58 renewable electricity projects<sup>202</sup> across a range of technologies, totalling around 16GW of renewable electricity capacity. The combined estimated budget spend for all three allocation rounds at the time of contract award is £491 million (2012 prices).<sup>203</sup>

Below is the capacity per technology offered contracts:

- Advanced Conversion Technologies – 159.91MW;
- Biomass Conversion – 1,065MW;
- Dedicated Biomass with Combined Heat and Power – 384.64MW;
- Energy from Waste with Combined Heat and Power - 94.75MW;
- Offshore Wind – 13,008MW;
- Onshore Wind - 748.55MW;
- Remote Island Wind – 275.22MW;
- Solar PV - 71.55MW.

The CGS announced up to £557 million of annual support for further CfDs, providing developers with the confidence they need to invest in bringing forward new projects.<sup>204</sup>

The third CfD allocation round saw 5.8GW of projects offered contracts, including offshore wind, Remote Island Wind and Advanced Conversion Technologies, with offshore wind clearing prices 30% lower than the 2017 allocation round.<sup>205</sup> The UK government plans to hold another allocation round in 2021 and further auctions around every two years after that.

*iv Where applicable, the assessment of the support for electricity from renewable sources pursuant to Article 6(4) of Directive (EU) 2018/...*

Not applicable.

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<sup>199</sup> CfD First Round allocation results,

[www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/407059/Contracts\\_for\\_Difference\\_-\\_Auction\\_Results\\_-\\_Official\\_Statistics.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/407059/Contracts_for_Difference_-_Auction_Results_-_Official_Statistics.pdf)

<sup>200</sup> CfD Third Round allocation results, [www.gov.uk/government/publications/contracts-for-difference-cfd-allocation-round-3-results/contracts-for-difference-cfd-allocation-round-3-results](http://www.gov.uk/government/publications/contracts-for-difference-cfd-allocation-round-3-results/contracts-for-difference-cfd-allocation-round-3-results)

<sup>201</sup> In addition to the three auctions held between 2015 and 2019, early contracts were also awarded through the Final Investment Decision Enabling for Renewables (FIDER) scheme, which was put in place to help developers of low carbon electricity projects make final investment decisions ahead of the Contract for Difference scheme being introduced as part of Electricity Market Reform.

<sup>202</sup> Including projects that did not sign or failed their milestone requirements.

<sup>203</sup> The estimated budget impact did not increase after the AR3 results because due to all strike prices being below the reference prices forecast at the time of the auction, the estimated budget impact in the valuation years considered was zero.

<sup>204</sup> Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>205</sup> Press release July 2018, UK Government website, [www.gov.uk/government/news/a-boost-for-north-east-innovation-to-promote-high-quality-jobs-and-growth](http://www.gov.uk/government/news/a-boost-for-north-east-innovation-to-promote-high-quality-jobs-and-growth)

*v Specific measures to introduce one or more contact points, streamline administrative procedures, provide information and training, and facilitate the uptake of power purchase agreements*

*Summary of the policies and measures to promote and facilitate the development of renewable self-consumption and renewable energy communities*

The UK has a relatively healthy short-term PPA market for renewables which a number of our policies have facilitated, however there has been limited growth in the long-term PPA market. The design of the Renewables Obligation encouraged suppliers to sign PPAs as a way of securing the corresponding certificates (ROCs). Similarly, the Contracts for Difference scheme, being based on wholesale market price, prompts PPAs to be signed which will provide revenues corresponding to market reference price for the CfD. Additionally, the SEG will allow small scale generators to secure some of the route-to-market benefits of a PPA-type agreement. We now see an established and liquid market for short-term PPAs, predominantly signed between generators and utilities. Single sites or portfolio projects regularly retender in a competitive field of over 40 offtakers. Value retention is therefore relatively high for generators.

The UK has recently seen a rise in the number of corporate offtakers signing PPAs with low-carbon generators. This is providing a route to market for some renewables projects. However, volumes remain small at present as there is a relatively limited amount of corporates that are able to enter into long-term agreements with generators.

A summary of the policies and measures to promote and facilitate the development of renewable self-consumption and renewable energy communities are outlined in 2.4.3(iii).

*vi Assessment of the necessity to build new infrastructure for district heating and cooling produced from renewable sources*

In 2014 the UK carried out the first comprehensive assessment of the investment picture and pipeline in the UK energy sector.<sup>206</sup> The assessment identified an enormous investment opportunity for new and renewable forms of heating, including heat networks. In the right circumstances, particularly where there is high heat demand, a high proportion of non-domestic consumers, new buildings and/or proximity to low-cost large-scale heat sources, heat networks are a highly cost effective and non-disruptive way to reduce carbon emissions.

The UK government is committed to significantly expanding the district heating sector. The CGS makes clear that heat networks have the potential to play a significant role in the decarbonisation of heat. In each of the Strategy's three illustrative pathways to 2050, heat networks are projected to meet 17% of heat demand in homes and up to 24% of heat demand in the non-industrial business and public sector buildings. There are currently over 14,000 heat networks in the UK. Of these, approximately 12,000 are communal heat networks (serving only one building) and 2,000 are district heat networks (serving multiple buildings). District heat networks currently supply around 10TWh of annual heat demand.<sup>207</sup>

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<sup>206</sup> Delivering UK Energy Investment, July 2014, [www.gov.uk/government/publications/delivering-uk-energy-investment-2014](http://www.gov.uk/government/publications/delivering-uk-energy-investment-2014)

<sup>207</sup> Energy Trends: March 2018, Experimental statistics on heat networks: [www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks](http://www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks)

A study<sup>208</sup> commissioned by the CCC in 2015 developed three core scenarios for deployment of district heating to 2050. Under the central scenario analysis, this study estimates that 18% of buildings' heat will need to be supplied by heat networks by 2050 if the UK is to meet its carbon budgets cost effectively. While the majority of schemes in the UK are currently based on Gas CHP, this study expects gas CHP to play a limited role in the longer term and forecasts the use of a wide range of heat supply technologies by 2050 (primarily heat pumps, biomass and waste heat) reflecting the variety in locally-available secondary heat sources. In 2015 the UK also published its national comprehensive assessment of the potential for district heating and cooling in the UK.<sup>209</sup>

The UK government plans to publish further details on the approach to delivering a future market framework that will enable sustained investment in heat networks, strengthen consumer protections and move towards low-carbon heat sources.

The regulation of heat is devolved to Scotland. The Scottish Government has also set out its ambitions for a growth in heat networks<sup>210</sup> and in March 2018 there were over 800 district and communal heating networks in Scotland supplying over 25,000 final customers.<sup>211</sup>

The Scottish Government is currently preparing legislation that would introduce a regulatory framework and licensing system which aims to provide certainty to the sector and investors, reduce the risk premium on the cost of capital faced by projects by setting clear standards and providing the kind of rights that other utility companies receive, as well as raising consumer acceptance and awareness. In 2015 the Scottish Government published a Heat Policy Statement setting out how low-carbon heat can reach more householders, businesses and communities and a clear framework for investment in the future of heat in Scotland. The ambition is to achieve 1.5TWh of Scotland's heat demand to be delivered by district or communal heating and to have 40,000 homes connected by 2020.<sup>212</sup> The Scottish Government is in the process of developing a Heat Decarbonisation Policy Statement and Action Plan, to be published later in 2020. The Scottish Government's Climate Change Plan, published in 2018, sets out a pathway for low-carbon heat that will see around 45% of buildings' heat met by low-carbon sources by 2032. To support this, the Scottish Government is developing the Energy Efficient Scotland programme, and as part of this, in 2017 and 2018 consulted on the development of a policy and regulatory system to develop heat networks in a strategic manner, and provide appropriate conditions on the ground to accelerate the delivery of heat networks and to grow this market.

Northern Ireland is currently developing a long-term energy strategy, looking to 2030 and beyond, which will include considerations around heat policy. The future Energy Strategy will set out a pathway and timeline for decarbonising heat, and the most effective way to measure

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<sup>208</sup> Research on district heating and local approaches to heat decarbonisation: A study for the CCC, 2015, <https://www.theccc.org.uk/wp-content/uploads/2015/11/Element-Energy-for-CCC-Research-on-district-heating-and-local-approaches-to-heat-decarbonisation.pdf>

<sup>209</sup> National Comprehensive Assessment of the Potential for Combined Heat and power and District Heating and Cooling in the UK, 2015, [www.gov.uk/government/publications/the-national-comprehensive-assessment-of-the-potential-for-combined-heat-and-power-and-district-heating-and-cooling-in-the-uk](http://www.gov.uk/government/publications/the-national-comprehensive-assessment-of-the-potential-for-combined-heat-and-power-and-district-heating-and-cooling-in-the-uk)

<sup>210</sup> Heat Policy Statement Towards Decarbonising Heat: Maximising the Opportunities for Scotland, the Scottish Government, 2015, [www.gov.scot/publications/heat-policy-statement-towards-decarbonising-heat-maximising-opportunities-scotland/](http://www.gov.scot/publications/heat-policy-statement-towards-decarbonising-heat-maximising-opportunities-scotland/)

<sup>211</sup> Energy Trends: March 2018, Experimental statistics on heat networks, [www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks](http://www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks)

<sup>212</sup> Heat Policy Statement, Scottish Government 2015, <https://beta.gov.scot/publications/heat-policy-statement-towards-decarbonising-heat-maximising-opportunities-scotland/>

progress between now and 2030, and subsequently to 2050. The future policy options for decarbonising heat are being considered by taking a holistic view of energy in terms of energy efficiency, power, heat and transport, whilst also considering the impact on society as a whole, and consumers individually.

### **Policy initiatives to support district heating**

In 2013, the UK government set up the Heat Network Delivery Unit (HNDU) to support local authorities in England and Wales through the early stages of heat network project development. Through HNDU support the UK government has invested over £17 million in grant funding to more than 200 projects across 140 local authorities.<sup>213</sup>

The UK government is investing £320 million in efficient heat network projects through the Heat Networks Investment Project (HNIP). The funding will be allocated from April 2019 for up to three years, with £18.5 million of funding already allocated to eight pilot projects.<sup>214</sup>

The GB Renewable Heat Incentive scheme (RHI) supports the deployment of heat networks by incentivising the take up of those technologies that will play a strategic role in the long-term decarbonisation of the UK; for example, large biomass and heat pumps. Heat network projects can become accredited to the non-domestic RHI to secure a tariff guarantee, so long as their heat generation plant meets the scheme criteria. The Northern Ireland RHI schemes were suspended for new applicants on 29 February 2016.

In Scotland, the Heat Network Partnership was set up in 2015 to support the development of heat networks and low-carbon heat projects.<sup>215</sup> Support includes provision of the Scotland Heat Map<sup>216</sup>, and the District Heating Loan Fund, which offers loans to support the development of district heating networks. Since 2011, more than £15 million has been lent to 50 different projects across Scotland.<sup>217</sup> Additionally, since its launch in 2015, the Low Carbon Infrastructure Transition Programme (LCITP) has awarded over £50 million of funding to low-carbon demonstration projects that encourage replication and wider uptake of innovative renewable technology across Scotland, which includes committing over £25 million of grant funding to low-carbon heat network projects across Scotland that encourage the replication and wider uptake of innovative renewable technology. LCITP is a collaborative partnership led by the Scottish Government, working with Scottish Enterprise, Highlands and Islands Enterprise, Scottish Futures Trust and Resource Efficient Scotland.

Heat policy is not devolved to Wales, though Welsh Government received some powers under the Wales Act 2017. The UK government supports development of heat networks in Wales with revenue grants through the Heat Network Development Unit and capital through the Heat Network Investment Programme.

The Welsh Government Energy Service (WGES) is carrying out regional energy planning for power, heat and transport, which will feed into growth deals in Wales and help regions in developing the energy system of the future. Mapping has also been used to shape of the Welsh Government's spatial policy, with Priority Areas for District Heat Networks being identified in the draft National Development Framework. The heat map data has also been

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<sup>213</sup> Heat Networks Delivery Unit, [www.gov.uk/guidance/heat-networks-delivery-unit](http://www.gov.uk/guidance/heat-networks-delivery-unit)

<sup>214</sup> Heat Networks Investment Project (HNIP), [www.gov.uk/government/publications/heat-networks-investment-project-hnip-scheme-overview](http://www.gov.uk/government/publications/heat-networks-investment-project-hnip-scheme-overview)

<sup>215</sup> Heat Network Partnership, [www.districtheatingscotland.com/](http://www.districtheatingscotland.com/)

<sup>216</sup> Scotland Heat Map, <http://heatmap.scotland.gov.uk/>

<sup>217</sup> District Heating Loan, Energy Savings Trust, [www.energysavingtrust.org.uk/scotland/grants-loans/district-heating-loan](http://www.energysavingtrust.org.uk/scotland/grants-loans/district-heating-loan)

incorporated into Lle, the Welsh Government digital resource. This will make it available to support regional and local energy planning activity, which we are supporting through the WGES.

*vii Where applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation taking into account:*

- biomass availability, including sustainable biomass: both domestic potential and imports from third countries*
- other biomass uses by other sectors (agriculture and forest-based sectors); as well as measures for the sustainability of biomass production and use*

### **Promotion of the use of energy from biomass**

In 2018, biomass made up 21.4% of renewable electricity generation.<sup>218</sup> The UK has mandatory sustainability criteria for heat and power generation, which include criteria focusing on the land from which the biomass is sourced and greenhouse gas criteria which account for the life cycle emissions of the biomass.

Biomass is incentivised for electricity through the schemes outlined in section 3.1.2(iii) and generators only receive subsidies for the electricity output which complies with our sustainability criteria.

The Scottish Government is currently developing a Bioenergy Policy Update, which will set out its direction of travel to gather further evidence on how bioenergy can support meeting its net zero targets. This will help to develop a Bioenergy Action Plan going forward. Research was commissioned to assess the potential contribution that bioenergy can make towards meeting Scottish energy demand, considering scale, local restrictions and bioenergy resources. It concluded that there is potential for bioenergy to deliver another source of renewable energy; one that is low in cost and will help to tackle fuel poverty in Scotland.<sup>219</sup>

### **Renewable Heat Incentive (RHI)**

The non-domestic RHI was introduced in 2011, with the domestic RHI following in 2014. The schemes are designed to help bridge the gap between the costs of fossil fuel heating technologies and low-carbon alternatives. Participants receive a tariff, set in pence per kilowatt hour of heat used, for either seven (domestic RHI) or 20 years (non-domestic RHI), which is set at a level to cover the additional costs of the low-carbon heating installation. Both RHI schemes cover a range of technologies, including solid biomass heating, and for the non-domestic scheme, biogas heating and biomethane injection to the gas grid.

The UK government has confirmed funding for new applications for the non-domestic RHI scheme until the end of March 2021, and the end of March 2022 for the domestic scheme. In December 2016, a series of wide-ranging reforms to the domestic and non-domestic RHI schemes were announced. The first tranche of reforms was implemented in September 2017, and the second tranche was implemented in 2018.

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<sup>218</sup> Digest of UK Energy Statistics (DUKES) 2019, Table 6.4, available at:

[www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes](http://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes)

<sup>219</sup> The potential contribution of bioenergy to Scotland's energy system, published May 2019:

[www.climatexchange.org.uk/research/projects/the-potential-contribution-of-bioenergy-to-scotland-s-energy-system/](http://www.climatexchange.org.uk/research/projects/the-potential-contribution-of-bioenergy-to-scotland-s-energy-system/)

These reforms were designed to refocus the RHI to ensure that it:

- Focusses on long-term decarbonisation
- Offers better value for money and protects consumers
- Supports supply chain growth and challenges the market to deliver

First introduced in May 2018, Tariff Guarantees offer investment certainty to large scale renewable heat generation projects which contribute towards the UK government's commitment to meeting our legally binding carbon targets. Under the initial round of Tariff Guarantees, applicants were required to commission projects in line with industry standards by 31 January 2020. On 31 May 2019, the Department for Business, Energy and Industrial Strategy announced its intention to extend the allocation of Tariff Guarantee applications on the Renewable Heat Incentive to 31 January 2021. The legislation extending the period for Tariff Guarantee applications came into force on 17 July 2019.

This change further supports the transition to low-carbon heating in Great Britain, helping generate renewable heat for homes and businesses across the country. Since the scheme's implementation, as of October 2019, the UK government has granted 47 tariff guarantees for large scale projects, the majority of which produce biomethane for injection to the gas grid.

### **Renewable Transport Fuel Obligation (RTFO)**

Introduced in 2008 under the Energy Act, the RTFO scheme is the main mechanism to ensure the deployment of sustainable renewable fuels in transport.

The RTFO requires fuel suppliers to ensure that a specified proportion of their overall fuel supply into the UK market is from a renewable source. Suppliers can choose to meet their obligation by:

- Supplying fuel that meets the relevant sustainability criteria
- Buying RTF certificates from others who have supplied fuel that meets the criteria
- Paying a 'buy-out' in respect of each litre of shortfall in meeting their obligation.

The RTFO has developed over time, introducing mandatory sustainability criteria to implement the Renewable Energy Directive and more recently to introduce restrictions on the use of food crops to address concerns around indirect land use change. The latest changes were introduced in April 2018. These include:

- Setting a target trajectory for low-carbon fuels to 2032 (rising from ~3% of transport energy today to ~7% by 2032)
- Establishing a sub target for advanced fuels from wastes
- Extending eligibility to low-carbon aviation fuels
- Limiting the contribution of crops from a maximum of 4% in 2020, declining to a maximum of 2% in 2032

### 3.1.3 Other elements of decarbonisation

*i Where applicable, national policies and measures affecting the EU ETS sector and assessment of the complementarity and impacts on the EU ETS*

Until the end of 2020 the UK will continue to participate in the EU ETS. UK government and Devolved Administrations are firmly committed to carbon pricing as an effective tool for achieving carbon emissions reductions and a consultation on The Future of UK Carbon Pricing was carried out from May to July in 2019, to seek stakeholder views on policy proposals after the UK's exit from the EU. Emissions from installations in the EU ETS are falling as intended (decreasing by 4% between 2017 and 2018).<sup>220</sup> The 2020 target is a 21% ETS reduction below 2005 levels.<sup>221</sup>

In Scotland, the EU ETS has helped to drive reductions in actual Scottish emissions. Emissions from energy supply are down 70% from the baseline and those from business and industrial processes are down 32% and 72% respectively.<sup>222</sup> In Wales, the majority of emissions come from heavy industry and electricity generation, referred to as the 'traded sector' under the EU ETS.<sup>223</sup>

#### **The Carbon Price Support**

In Great Britain, the Total Carbon Price (TCP) for energy generation is made up of the EU Emissions Trading System price and the Carbon Price Support (CPS) rate. CPS is an HMT-led policy that was introduced to strengthen the then weak price signal provided by EU ETS prior to EU ETS reforms. The EU ETS price and the 'top-up' CPS tax sum to a total carbon price. The CPS has played a key role in incentivising the rapid reduction in UK coal fired power generation, supporting our commitment to phase out unabated coal generation by 2025. The CPS rate does not apply to energy generators in Northern Ireland.

HM Treasury confirms CPS rates in advance of delivery at Budget, and all revenue from the CPS is retained by the Treasury.

#### **Past rates**

The CPS rate was introduced in April 2013. At Budget 2014<sup>224</sup>, the UK government announced that the CPS rate would be capped at £18/tCO<sub>2</sub> from 2016-17 to 2019-20 to limit the competitive disadvantage faced by business and reduce energy bills for consumers. At Budget 2016, the cap was maintained at £18/tCO<sub>2</sub> from 2016-17 to 2019-20.<sup>225</sup> At Budget 2019, the UK government announced that CPS rates will be frozen at £18/CO<sub>2</sub> in 2021-22 following the rise in the EU ETS price.

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<sup>220</sup> EU Emissions Trading (EU ETS): [https://ec.europa.eu/clima/policies/ets\\_en](https://ec.europa.eu/clima/policies/ets_en)

<sup>221</sup> Trends and projections in the EU ETS 2017, [www.eea.europa.eu/publications/trends-and-projections-EU-ETS-2017/at\\_download/file](http://www.eea.europa.eu/publications/trends-and-projections-EU-ETS-2017/at_download/file)

<sup>222</sup> Scottish greenhouse gas emissions 2018, [www.gov.scot/publications/scottish-greenhouse-gas-emissions-2018/](http://www.gov.scot/publications/scottish-greenhouse-gas-emissions-2018/)

<sup>223</sup> National Atmospheric Emissions Inventory: [http://naei.beis.gov.uk/reports/reports?report\\_id=958](http://naei.beis.gov.uk/reports/reports?report_id=958)

<sup>224</sup> 2014 UK Budget, [www.gov.uk/government/publications/budget-2014-documents](http://www.gov.uk/government/publications/budget-2014-documents)

<sup>225</sup> 2016 UK Budget, [www.gov.uk/government/publications/budget-2016-documents](http://www.gov.uk/government/publications/budget-2016-documents)

## Small Emitters and Hospital Opt-Out Scheme

The UK's Small Emitter and Hospital Opt-Out Scheme (Article 27 of the EU Emissions Trading Scheme Directive<sup>226</sup>) provisions recognise the fact that lower emitters on average face a much higher cost of compliance per tonnes of CO<sub>2</sub> equivalent (tCO<sub>2</sub>eq) than larger emitters. This means that administration costs are significantly higher for smaller emitters, with larger emitters taking advantage of economies of scale to keep costs down.

An assessment of the administrative costs faced by UK operators during Phases I (2005-2007) and II (2008-2012) of the ETS found that smaller emitters accounting for 2% of emissions, incurred approximately 20% of the total administrative burden (across the 60% of all installations covered by the assessment). The largest 8% of emitters were responsible for 60% of emissions and incurred 45% of the administrative burden.

The UK government continues to pursue its 'better regulation' agenda<sup>227</sup>, which aims to reduce regulatory burdens on business, thereby helping to boost economic growth. In climate change policy terms, this translates into a commitment to ensuring that regulatory effort is focused on those areas of greatest risk to achieving our climate emission reduction goals and that the administrative costs of delivering these goals are minimised. Therefore, all effort should be made to reduce the compliance burden on small emitters.

The UK's Small Emitter and Hospital Opt-Out Scheme (Article 27) allowed eligible installations to face a reduced administrative burden during Phase 3 (2013 to 2020) of the EU ETS. The scheme was approved by the European Commission.

The current UK opt-out scheme was designed in consultation with industry and aims to offer a simple, deregulatory alternative to the EU ETS whilst maintaining the incentives for emission reductions. The opt-out scheme offers deregulatory savings through:

- an option for risk-based auditing of emissions instead of third-party verification
- no requirement to hold an active registry operator holding account
- the replacement of the requirement to surrender allowances with an installation emission reduction target
- a less burdensome procedure for adjusting targets to take into account changes in capacity

As part of the consultation on the Future of UK Carbon Pricing, the UK government and Devolved Administrations have consulted on proposals for continuing to offer a Small Emitter and Hospital Opt-Out. In addition the Consultation sought views on proposals to also offer an Ultra-Small Emitter exemption, which is a feature of Phase IV of the EU ETS and would allow for installations with emissions less than 2,500 tonnes of carbon dioxide equivalent, excluding emissions from biomass, to be exempted from the UK ETS.

For more details please visit the Future of UK Carbon Pricing consultation<sup>228</sup>, which outlines the proposals in more detail.

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<sup>226</sup> EU Emissions Trading Scheme Directive: <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576083587727&uri=CELEX:02003L0087-20180408>

<sup>227</sup> EU Emissions Trading System: Assessing the cost of compliance, 2010, available at: [www.gov.uk/government/publications/eu-emissions-trading-system-assessing-the-cost-of-compliance](http://www.gov.uk/government/publications/eu-emissions-trading-system-assessing-the-cost-of-compliance)

<sup>228</sup> The Future of Carbon Pricing consultation, published 2019: [www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing](http://www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing)

## Indirect compensation payments

Article 10a (6) of the revised EU Emissions Trading Scheme Directive, which took effect on 8 April 2018, requires Member States to publish annually, from 2018, the amount of compensation paid to sectors exposed to “genuine risk of carbon leakage due to significant indirect costs that are actually incurred from greenhouse gas emission costs passed on in electricity prices”. While a Member State in 2018, the UK published a report detailing the amount of EU ETS Indirect Cost Compensation awarded in 2017:

**Table 14: 2017 indirect cost compensation report<sup>229</sup>**

Sector	No. of Businesses	EU ETS compensation (£)
Iron & Steel	10	19.2 million
Chemicals	12	17.3 million
Paper	30	12.8 million
Non-ferrous metals	6	1.00 million
Other	3	0.6

The UK government’s current commitment is to provide compensation until 2020.

*ii Policies and measures to achieve other national targets, where applicable*

Not applicable.

*iii Policies and measures to achieve low emission mobility (including electrification of transport)*

## Transport

The UK government recognises that transport is one of the key areas where we must step up the pace of progress in reducing emissions. Our main focus is road transport, which accounts for over 80% of transport greenhouse gas emissions and a significant proportion of air pollutant emissions.<sup>230</sup> The UK government is also taking action to support modal shift, enabling people to choose the most sustainable mode of travel for their journey. We are investing in public transport and walking and cycling, as well as driving down emissions from aviation and shipping.<sup>231</sup>

### Cars, vans, motorcycles and taxis

In the Road to Zero strategy, published in 2018, the UK government reaffirmed that it will end the sale of new conventional petrol and diesel cars and vans by 2040. The 2040 target was conceived as ambitious but achievable. The government’s aim is to put the UK at the forefront of the design and manufacturing of zero emission vehicles, and for all new cars and vans to be

<sup>229</sup> The Future of Carbon Pricing consultation, published 2019: [www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing](http://www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing)

<sup>230</sup> Department for Transport (2019), Statistical data set, Energy and environment: data tables (ENV) [www.gov.uk/government/statistical-data-sets/tsqb03](http://www.gov.uk/government/statistical-data-sets/tsqb03)

<sup>231</sup> BEIS (2018) Final UK greenhouse gas emissions national statistics: 1990 – 2016 (online): [www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissionsnational-statistics-1990-2016](http://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissionsnational-statistics-1990-2016)

effectively zero emission by 2040. Going beyond this, we will now consult on the earliest date we can phase out the sale of new conventional petrol and diesel cars and vans, while minimising the impact on drivers and businesses. By 2050 we want almost every car and van in the UK to be zero emission.

The public sector is leading the switch to ultra low emission vehicles by example, by ensuring 25% of the central government car fleet is ultra low emission by 2022, and that all new car purchases are ultra low emission by default, ensuring 100% of the central government car fleet to be ultra low emission by 2030.

The UK government offers a range of incentives to help consumers make the shift to cleaner vehicles, including through the tax system, direct grants for vehicles and charging infrastructure and other financial support. To achieve our ambitions, we are investing nearly £1.5 billion between April 2015 and March 2021.

As part of this, the UK government will continue to offer grants for plug-in cars, vans, taxis and motorcycles until at least 2020, with consumer incentives in some form continuing beyond that date. To accelerate the shift to zero emission vehicles, all zero emission models will pay no company car tax in 2020-21, 1% in 2021-22 before returning to the planned 2% rate in 2022-23 – a significant tax saving for employees and employers.

Thanks to UK government leadership, a growing private sector and continuous local authority engagement, the UK now has over 17,000 devices providing over 24,000 public chargepoints. At least 2,400 are rapid devices; one of the largest networks in Europe. Since 2013, the UK government has supported the installation of over 120,000 domestic chargepoints and 5,000 workplace sockets through grant support schemes. 54 local authorities have successfully been awarded funding through the On-street Residential Chargepoint Scheme since 2017, which has allocated £8.5 million in grant funding towards the cost of installing on-street chargepoints through to 2020. The UK has also invested over £20 million across 27 local authorities to deliver over 900 chargepoints dedicated to taxis and private hire vehicles. The eight cities funded through the £40m Go Ultra Low Cities Scheme continue to deliver a range of pioneering local initiatives and charging infrastructure projects – including the UK's first 350kW enabled electric vehicle charging station, in Sunderland. These grant schemes and the £400-million public-private Charging Infrastructure Investment Fund will see thousands more electric vehicle chargepoints installed across the UK.

The UK government has also taken new powers through the Automated and Electric Vehicles Act 2018 to ensure that chargepoints can be easily accessed and used across the UK, and that they are smart ready. Consultations on electric vehicle smart charging and proposals for chargepoints to be installed with all newly built homes in England, where appropriate, closed in October 2019.<sup>232</sup>

## **HGVs and road freight**

The UK government's long-term goal for HGVs is the development and deployment of zero emission technologies. As solutions emerge, it remains essential to scale up and expand efficiency measures that can reduce emissions now. The UK government is supporting this by:

- Working with industry to develop an Ultra-Low Emission Truck standard to provide clarity on its emission reduction expectations.

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<sup>232</sup> The Road to Zero, 2018: [www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strate](http://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strate)

- Working at a European level to implement the new ambitious CO2 performance standards for new trucks.
- A new industry-wide voluntary target for reducing HGV greenhouse gas emissions by 15% by 2025, from 2015 levels.
- Maintaining the small and medium-sized enterprise HGV fleet review scheme, which advises companies on ways to reduce carbon dioxide emissions.
- Extending the Longer Semi-Trailer trial to further demonstrate the efficiencies gained through more effective use of the road network.
- Extending the plug-in van grant to cover all HGVs weighing more than 3.5 tonnes – the Plug in Van Grant provides 20% of the price of a qualifying vehicle to a maximum grant amount of £8,000, or £20,000 for the first 200 large vans (3.5 tonnes plus) or trucks.
- OLEV and Innovate UK awarding £20 million of grant funding to 20 projects under the Low Emissions Freight and Logistics Trial<sup>233</sup> and £18 million R&D funding focused solely on innovative low emission HGV technologies.
- Progressing planning for trials of HGV platoons, which could bring significant fuel and emissions savings, with real-world trials in 2020.

## Rail freight

Rail freight offers benefits to the environment, helps reduce road congestion and is important to UK businesses. Rail is one of the most carbon efficient ways of moving goods over long distances. Carbon emissions per freight tonne fell by 4.1% in 2018/2019 (ORR: Rail Emissions 2018-19). Rail freight is estimated to remove 7.2 million HGV journeys and 1.5 billion HGV kilometres from the roads annually (ORR: 2018-19 Q4).

The main way to achieve rail freight decarbonisation is to stop using diesel traction, through direct government intervention to roll out further electrification. Network Rail is leading the Traction Decarbonisation Network Strategy (TDNS), which will inform decisions about the scale and pace of decarbonisation between now and 2050. The challenge for rail freight is that current alternatives to overhead electrification, such as hydrogen and battery, do not have sufficient power to pull heavy freight trains. There is potential for bi-modes to reduce emissions. We have recently funded, through Innovate UK and RSSB, competitions that provided over £4 million for projects to drive decarbonisation across passenger and freight.

Government recognises the economic and environmental benefits of rail freight; the sector plays an essential part of the UK economy. Government has invested £235m in the Strategic Freight Network over CP5 (2014-2019) to improve the capacity and capability of the rail network for freight. Government is also providing freight grant schemes to support the carriage of freight by rail and water on routes where road haulage has a financial advantage. The scheme is providing up to £15.6 million in 2019/20 and helps to remove around 900,000 lorry journeys a year from Britain's roads.

## Rail

Rail is currently a relatively green mode of transport – making up 10% of GB kilometres travelled but only 2% of UK transport GHG emissions (about 0.5% of economy-wide emissions). Rail's carbon emissions are also going down: CO2 emissions per passenger km in 2018-19 were 10.3% lower than in 2017-18, a continuation of a general trend of falling

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<sup>233</sup> TRL, Low Emissions Freight and Logistics Trial, <https://left.trl.co.uk/>

emissions per passenger km. In recent years this trend has mostly been due to grid decarbonisation, but still illustrates that rail remains a low-carbon travel option.

Nevertheless, if the UK is to meet its net zero target across the economy by 2050, the Government believes that the rail sector must play its part in decarbonising transport. To reduce carbon emissions from trains we will need to both reduce use of diesel trains and take advantage of grid decarbonisation. As the organisation responsible for railway infrastructure, Network Rail (NR) are developing a Traction Decarbonisation Network Study (TDNS), which will inform the scale and pace of rail decarbonisation. The strategy outcomes will identify the areas of the network likely to need electrification, and which would be better suited to novel technologies such as hydrogen and battery in order to decarbonise the railway. The Government has recently invested over £4.5 million innovation projects through RSSB and Innovate UK, which will help novel low-carbon technologies such as hydrogen-powered trains reach maturity.

## Buses

As for other road vehicles, the UK government ultimately wants to see all buses become zero emission. The UK government has built on previous investments with the Ultra-Low Emission Bus Scheme, providing £48 million to accelerate the uptake of these buses and related infrastructure in England and Wales.<sup>234</sup> The UK government has also announced £220 million funding in September 2019 to transform bus services and promote the development of an all-electric bus town or city.<sup>235</sup>

The UK government also works to increase bus usage. The £220 million Clean Air Fund is available for investment in a range of measures, including bus priority measures, which improve reliability and reduce journey times.<sup>236</sup> The £2.45 billion Transforming Cities Fund is also providing support for public transport in some of England's largest cities.<sup>237</sup>

The Bus Services Act 2017 gives local authorities new powers to work with operators to improve passengers' experience of bus travel. It introduces new bus franchising powers for local authorities, and powers to allow local authorities and bus operators to work in partnership, among other tools. Regulations made under the new open data provisions and new ticketing powers will make it easier for passengers in England (outside London) to use buses, move between different modes of transport and, from 2020, to access timetables, routes, fares, tickets, real time information and the actual location of bus services. To facilitate the improvement of information available to bus passengers, and ease their travel decisions based on complete, accurate and timely data, the UK government is developing a new digital platform to support the development of bus travel apps.

More generally, the UK government already provides around £2 billion to bus operators and local authorities to support bus services, and £250 million is provided via the Bus Service Operators Grant, with £43 million of this directly devolved to local authorities to support bus services that are not commercially viable.<sup>238</sup> The UK government also supports free off-peak

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<sup>234</sup> Ultra-low emission bus scheme, March 2015: [www.gov.uk/government/publications/low-emission-bus-scheme](http://www.gov.uk/government/publications/low-emission-bus-scheme)

<sup>235</sup> Press release, September 2019: [www.gov.uk/government/publications/a-better-deal-for-bus-users/a-better-deal-for-bus-users](http://www.gov.uk/government/publications/a-better-deal-for-bus-users/a-better-deal-for-bus-users)

<sup>236</sup> Press release, March 2018: [www.gov.uk/government/news/260-million-of-clean-air-funding-launched-by-government](http://www.gov.uk/government/news/260-million-of-clean-air-funding-launched-by-government)

<sup>237</sup> UK Government website, news article published March 2018: [www.gov.uk/government/news/transport-secretary-welcomes-next-step-in-17-billion-fund-to-transform-local-journeys](http://www.gov.uk/government/news/transport-secretary-welcomes-next-step-in-17-billion-fund-to-transform-local-journeys)

<sup>238</sup> Bus service: Grants and funding, published May 2015: [www.gov.uk/government/collections/bus-services-grants-and-funding](http://www.gov.uk/government/collections/bus-services-grants-and-funding)

travel for older and disabled persons through the English National Concessionary Travel Pass.<sup>239</sup>

### **Low carbon fuels**

The UK government introduced legislation in April 2018 to almost double the use of low-carbon fuels in transport, increasing the obligation level under the Renewable Transport Fuels Obligation to 9.75% by volume in 2020, and rising to 12.4% by volume in 2032.<sup>240</sup> The UK government has also launched the £22 million Future Fuels for Flight and Freight Competition to develop proposals for advanced fuels production plants. In December 2019, two projects were awarded a share of £6.5 million to build plants, which aim to provide fuel for heavy goods vehicles.<sup>241</sup>

### **Walking and cycling**

The UK government is now implementing the Cycling and Walking Investment Strategy (CWIS), which was published in April 2017<sup>242</sup>, supported nearly £1.2 billion to promote cycling and walking out to 2020/2021. The ambition for England by 2040 is to make cycling and walking the natural choices for shorter journeys, or as part of a longer journey. The CWIS also sets out some nearer term aims and targets for 2025, including an aim to double cycling to 1.6 billion stages by 2025. Since the strategy's publication, local councils and metro mayors have been greatly attracted by the benefits of cycling and walking, and they have allocated an additional £700 million to safe infrastructure and other Active Travel projects. The result is that almost £2 billion is being invested in this area over this Parliament. This represents an expected uplift of nearly 60% on the investment levels projected in 2017, reflecting the growing importance of this agenda.

Further investment in cycling and walking is being provided as part of the £2.45 billion Transforming Cities Fund, the £5.5 billion Housing Infrastructure Fund, the £1 billion Sport England Strategy, the £220 million Clear Air Fund and through the HS2 road safety fund. The £675 million High Streets fund and expanded £3.6 billion Stronger Towns fund is also expected to provide further funding opportunities. Our response to the CWIS Safety Review, published in November 2018, contained 50 commitments to make roads safer for those who cycle and walk.

### **Aviation and shipping**

The UK government is continuing to decarbonise its aviation and shipping sectors, both through international action, such as standards and offsetting schemes, and domestically; for example, by working with industry to develop sustainable alternative fuels, improved design efficiency and new propulsion technologies. We have published our Maritime 2050 strategy, our Clean Maritime Plan and our Green Paper 'Aviation 2050 - The future of UK aviation'. The CCC provided the UK government with specific advice on international aviation and shipping emissions on 24 September 2019. It is critical that aviation plays its part in delivering the UK's

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<sup>239</sup> Free bus passes for older and disabled people protected for the future, published April 2018:

[www.gov.uk/government/news/free-bus-passes-for-older-and-disabled-people-protected-for-the-future](http://www.gov.uk/government/news/free-bus-passes-for-older-and-disabled-people-protected-for-the-future)

<sup>240</sup> Renewable Transport Fuel Obligation Order, Government Response to the consultation on amendments, 2017: [www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response](http://www.gov.uk/government/publications/renewable-transport-fuel-obligations-order-government-response)

<sup>241</sup> Press notice, December 2019: [www.gov.uk/government/news/orange-peel-rubbish-and-fatbergs-the-fuels-behind-the-future-of-green-transport](http://www.gov.uk/government/news/orange-peel-rubbish-and-fatbergs-the-fuels-behind-the-future-of-green-transport)

<sup>242</sup> Department for Transport, Cycling and Walking Investment Strategy (2017): [www.gov.uk/guidance/renewable-transport-fuels-obligation](http://www.gov.uk/guidance/renewable-transport-fuels-obligation)

net zero ambitions and the Government is still planning to consult on our position on aviation and climate change later this year followed by our ambitious Aviation Strategy.

In developing these and future strategies, we have considered, and we will continue to consider the implications of our net zero target for 2050 while developing a robust and comprehensive approach to tackling aviation and shipping greenhouse gas emissions.

The Aviation Strategy will put in place a framework for tackling carbon emissions from UK aviation out to 2050. The UK government will consider all cost-effective measures to ensure that the sector contributes to the UK's emissions reduction obligations. Industry and the UK government have made a joint £3.9 billion commitment between 2013 and 2026 to the development of new aircraft technology with the Aerospace Technology Institute. The Renewable Transport Fuel Obligation has also been extended to include incentives to use renewable fuels in aviation. The UK government played an instrumental role in the International Civil Aviation Organisation (ICAO) agreeing the first worldwide scheme to tackle CO2 emissions in any single sector - the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) - in October 2016. The UK is now negotiating for ICAO to agree a long-term emissions reduction goal for international aviation by its 41st Assembly in 2022.

In 2019 the UK government and the Devolved Administrations consulted on options to replace the EU Emissions Trading System (EU ETS) when it leaves the EU ETS at the end of the Transition Period, which included proposals for the aviation sector.

On domestic shipping, the Clean Maritime Plan identifies ways to tackle air pollutants and GHG emissions while securing clean growth opportunities for the UK. It delivers on the Industrial Strategy by placing the UK at the forefront of the global transition to clean maritime technologies.

Implementation of the Clean Maritime Plan is an essential component of the Government efforts to meet the legislative target of net zero emissions by 2050 across the UK economy.

By 2025 we expect that:

- All new vessels ordered for UK waters are being designed with zero emission propulsion capability, that all vessels operating in UK waters are maximising the use of energy efficiency options, and that zero emission commercial vessels are in operation in UK waters.
- The UK is building clean maritime clusters focused on innovation and infrastructure associated with zero emission propulsion technologies, including bunkering of low or zero emission fuel.

By 2035 we expect that:

- The UK is home to a world-leading zero emissions maritime sector, with a strong UK export industry, cutting-edge R&D activities, and the global centre for maritime services related to clean maritime growth.
- The UK has built a number of clean maritime clusters, which combine infrastructure and innovation for the use of zero emission technologies. Low or zero emission bunkering options are readily available across the UK.

Good progress was made in 2019 on delivering the commitments in the Clean Maritime Plan, including by launching a ‘Greening Finance/Financing Green’ for Maritime initiative at London International Shipping Week. We provided seed funding to contribute to the establishment of MarRI-UK, ensuring strong collaboration between Government, industry and academia in the field of clean maritime innovation, funding two competitions for innovation grant funding in clean maritime. The first was through the Department for Transport’s Transport Technology Research and Innovation Grants (T-TRIG). The second is the Clean Maritime Call, in which MarRI-UK is administering a £1.5m provided by Government. Both initiatives will provide funding to early stage innovation projects in the field of maritime emissions reduction.

On international shipping, the UK was instrumental in reaching a global deal at the International Maritime Organization (IMO) in April 2018 that will see these greenhouse gas emissions reduced by at least 50% by 2050, against a 2008 baseline, while pursuing efforts to phase out these emissions entirely as soon as possible. Domestically, the UK government is working with ship owners and ports to identify the barriers faced in supplying and using sustainable alternative fuels and cleaner emissions technologies, to explore possible solutions. In addition, operational improvements are expected to play a role, including better use of ship capacity. In July 2019, the UK government published a Clean Maritime Plan, the environmental route map of the Maritime 2050 strategy, which addresses the challenge of tackling the maritime sector’s emissions of greenhouse gases and air pollutants and sets out our ambition for all new ships for UK waters ordered from 2025 to be designed with zero-emission capable technologies. The plan also includes a £1 million competition to find innovative ways to reduce maritime emissions and is published alongside a call for evidence to reduce emissions on UK waterways and domestic vessels, which closed in January 2020.<sup>243</sup>

*iv Where applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels*

The UK has support schemes for renewables, which are described in 2.3(iii) and 3.1.2 and listed in Table 15 below:

**Table 15: List of UK energy subsidies**

Energy Subsidy	Details
Renewables Obligation (RO)	Replaced by the competitive Contracts for Difference support scheme
Contracts for Difference (CfD)	<p>The Contracts for Difference (CfD) scheme was introduced in GB in 2014 and is the UK government’s main mechanism for supporting new low-carbon electricity generation projects.<sup>244</sup></p> <p>A CfD is a 15-year private law contract between a low-carbon electricity generator and the Low Carbon Contracts Company (LCCC), a UK government-owned company. Planned continuation of CfDs for new low-carbon capacity after 2020 until 2035. A generator is paid for the electricity they generate, the difference between the strike price and the reference price. The cost is met by consumers via a levy on electricity suppliers.</p>

<sup>243</sup> Domestic shipping air pollution: call for evidence: [www.gov.uk/government/consultations/domestic-shipping-air-pollution-call-for-evidence](http://www.gov.uk/government/consultations/domestic-shipping-air-pollution-call-for-evidence)

<sup>244</sup> Electricity Market Reform: Contracts for Difference: [www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference](http://www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference)

Energy Subsidy	Details
Feed in Tariffs Scheme (FIT)	<p>The Feed-in Tariffs (FIT) scheme was introduced to England, Wales and Scotland on 1 April 2010, under powers in the Energy Act 2008. The intention was to encourage deployment of micro-scale and small-scale low-carbon electricity generation (up to 5MW), particularly by organisations, businesses, communities and individuals that have not traditionally engaged in the electricity market.<sup>245</sup></p> <p>Closed to new applications from 31 March 2019.</p>
Great Britain Renewable Heat Incentive (RHI)	<p>The non-domestic RHI was introduced in 2011, with the domestic RHI following in 2014. The RHI scheme has confirmed funding for new applications until 1 April 2021 in the non-domestic scheme and 1 April 2022 in the domestic scheme.</p> <p>The UK government is currently developing its low-carbon heat policy for the 2020s and beyond. We are working on a Heat Policy Roadmap which will set out key steps required to make key strategic decisions in the first half of the 2020s on how we achieve mass transition to low-carbon heating. We aim to publish this roadmap in mid-2020.</p>
Renewable Transport Fuel Obligation (RTFO)	<p>The RTFO scheme was introduced in 2008 and is the main mechanism to ensure the deployment of sustainable renewable fuels in transport.</p> <p>The RTFO requires fuel suppliers to ensure that a specified proportion of their overall fuel supply into the UK market is from a renewable source.</p>

The Feed-Tariff scheme was closed to new installations on the 31st March 2019. The Renewables Obligation has closed to new applicants (but will continue to provide support to accredited generators for a fixed period). Its successor, the CfD, largely allocates support through a competitive auction. The competitive nature of these auctions drives cost reductions and value for money for consumers. In future we expect generators for some technologies to bid close to the market price for power, and it is possible that some of these contracts may end up paying back to the consumer over the length of the scheme.

The UK uses the definition of fossil fuel subsidies developed with other G20 Member States to respond to the G20 commitment to phase out such subsidies. The definition, based on the approach of the International Energy Agency, is –

*A fossil-fuel subsidy is any government measure or program with the objective or direct consequence of reducing below world-market prices, including all costs of transport, refining and distribution, the effective cost for fossil fuels paid by final consumers, or of reducing the costs or increasing the revenues of fossil-fuel producing companies.*

Using this definition, the UK has no fossil fuel subsidies.

<sup>245</sup> About the FIT Scheme, Ofgem, [www.ofgem.gov.uk/environmental-programmes/fit/about-fit-scheme](http://www.ofgem.gov.uk/environmental-programmes/fit/about-fit-scheme)

## 3.2 Energy efficiency

Planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in [section 2.2](#), including planned measures and instruments (also of a financial nature) to promote the energy performance of buildings, in particular with regard to the following:

*i Energy efficiency obligation schemes and alternative policy measures under Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU and to be prepared in accordance with Annex III to this Regulation*

See Annex B.

The Energy Company Obligation (ECO) is a statutory scheme that places an obligation on energy suppliers to deliver energy efficiency (for example; solid wall insulation, loft insulation) and heating measures to domestic households in Great Britain.

ECO has been in place since April 2013. As of July 2019, it had delivered 2.5 million measures to approximately 2 million homes. The 2015 Spending Review committed £640 million per annum from April 2017 to March 2022. The CGS announced that domestic energy efficiency would be funded to at least this level until 2028.

The new ECO scheme came into force on 3 December 2018 and will run until March 2022. The new scheme focusses support to low income, vulnerable and fuel poor households.<sup>246</sup>

*ii Long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private<sup>247</sup>, including policies, measures and actions to stimulate cost-effective deep renovation and policies and actions to target the worst performing segments of the national building stock, in accordance with Article 2a of Directive 2010/31/EU*

The UK government's full Long-Term Renovation Strategy (LTRS) for the UK building stock is currently in development and is expected to be published separately in 2020. The requirement to submit the LTRS will be fulfilled through the publication of a Heat and Buildings Strategy. This will build on existing analysis from the Clean Growth Strategy in order to set out the UK government's long-term vision of how it will improve the energy performance of both residential and non-residential properties in support of the delivery of its legally-binding emissions and fuel poverty targets.

The required advance elements of the LTRS have been included in [section 2.2](#). This content is indicative and subject to revision upon publication of the UK's full Strategy.

*iii Description of policy and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models<sup>248</sup>*

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<sup>246</sup> ECO Scheme, [www.ofgem.gov.uk/environmental-programmes/eco](http://www.ofgem.gov.uk/environmental-programmes/eco)

<sup>247</sup> In accordance with Article 2a of Directive 2010/31/EU.

<sup>248</sup> In accordance with Article 18 of Directive 2012/27/EU.

The UK government has made available a model Energy Performance Contract,<sup>249</sup> which includes guidance notes and a guide to best practices for the public sector, and a list of registered energy service providers.<sup>250</sup>

In the business sector, BEIS has previously published research that it had commissioned to understand the potential size of the energy services market and the drivers and barriers to further growth.<sup>251</sup> The UK government also published a call for evidence to seek views on how the UK government could help businesses improve the way they use energy, including whether the UK government could stimulate the energy services market for businesses.

*iv Other planned policies, measures and programmes to achieve the objectives referred to in section 2.2 (for example measures to promote the exemplary role of public buildings and energy-efficient public procurement, measures to promote energy audits and energy management systems<sup>252</sup>, consumer information and training measures<sup>253</sup>, and other measures to promote energy efficiency<sup>254</sup>)*

Further information on these are set out in 3.2(viii) and 5.1(iii).

*v Where applicable, a description of policies and measures to promote the role of local energy communities in contributing to the implementation of policies and measures in sections i, ii, iii and iv*

The UK government recognises that local delivery is critical to achieve objectives set out in the national Industrial Strategy and CGS. In 2017 BEIS launched a Local Energy Programme<sup>255</sup> which has committed almost £20 million funding to local areas to date. This has funded all Local Enterprise Partnerships (LEPs) in England to develop their own local energy strategy; five Local Energy Hubs across England to increase the capacity of LEPs and local authorities to identify and deliver local energy projects and undertake the initial stages of project development to help attract investment; and a range of good practice guidance and toolkits.

As part of the Local Energy Programme, the Rural Community Energy Fund (RCEF) re-opened in May 2019 offering £10 million to support rural communities in England to develop renewable energy projects. RCEF offers grants for feasibility studies and pre-development of the project up to the point where there is an investable business case, and it is being delivered by the five Local Energy Hubs.

As highlighted in the CGS, the UK government is also committed to supporting local leadership and has already given additional powers and responsibilities through the Cities and Local Government Devolution Act 2016. A number of Local Devolution deals have been agreed between the UK government and local areas including Greater Manchester, West Midlands, West of England, Cornwall, Greater Peterborough and Greater Cambridgeshire, Sheffield, Liverpool City Region, Tees Valley, North of Tyne. Many of these deals incorporate energy

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<sup>249</sup> Model Energy Performance Contract, 2015, [www.gov.uk/government/publications/energy-performance-contract-epc](http://www.gov.uk/government/publications/energy-performance-contract-epc)

<sup>250</sup> Registered energy service providers, published 2014: [www.gov.uk/government/publications/registered-energy-service-providers](http://www.gov.uk/government/publications/registered-energy-service-providers)

<sup>251</sup> The Non Domestic Energy Efficiency Services Market, May 2018: [www.gov.uk/government/publications/non-domestic-energy-efficiency-services-market](http://www.gov.uk/government/publications/non-domestic-energy-efficiency-services-market)

<sup>252</sup> In accordance with Article 8 of Directive 2012/27/EU.

<sup>253</sup> In accordance with Articles 12 and 17 of Directive 2012/27/EU.

<sup>254</sup> In accordance with Article 19 of Directive 2012/27/EU.

<sup>255</sup> Clean Growth Strategy, 2017, October 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

commitments, including support for home energy efficiency, deep geothermal, tidal power and community energy initiatives.

## Scotland

Scotland has a legacy of strong community engagement in local renewable generation, often led by remote rural and island communities. The Scottish Government is defining a distinctive approach to Scotland's future energy provision, including:

- Putting communities at the heart of decisions about their local energy system
- Empowering them to take an economic stake in new developments

The Scottish Government is committed to continuing to empower Scottish communities, supporting the development of innovative and integrated local energy systems and networks. There is already a flagship scheme in place to support the growth of community and local energy throughout Scotland; the Community and Renewable Energy Scheme (CARES). This scheme, which is delivered locally by Development Officers based throughout Scotland, is a one stop shop offering free independent advice and funding options to support communities in taking forward projects or taking a stake in commercial schemes.

Up to £4.5 million is available to applicants through CARES in 2020/21. This support includes:

- Enablement grants of up to £25,000
- Development loans and grants of up to £150,000
- Capital grants of up to £150,000

Since its inception CARES has supported approximately 600 renewable energy projects across Scotland.

Furthermore, in the 2017 Scottish Energy Strategy, Innovative Local Energy was highlighted as one of our strategic priorities and, as such, the Scottish Government has set the following targets:

- 1 GW of community and locally-owned renewable energy capacity by 2020
- 2 GW of community and locally-owned renewable energy capacity by 2030
- Half of newly consented renewable energy projects to have an element of shared ownership by 2020

Scotland has made considerable progress in achieving these ambitious targets: As of March 2019, almost 0.7 GW of capacity was operational – with a further 0.6 GW in the pipeline.

Welsh Government has set targets around local ownership to ensure the benefits are captured for Wales from new energy developments. There is an expectation for all new energy projects in Wales to include at least an element of local ownership, in order to retain wealth within Wales and provide real benefit to communities.

The Welsh Government Energy Service provides support to public sector organisations and communities to help them develop energy efficiency and renewable energy schemes which generate benefit for Wales from the transition to a low-carbon energy economy. Building on

experience and learning over recent years, the service offers a wide range of technical, commercial, strategic and project management skills.

Local Authorities are supported through the Welsh Government Energy Service with 0% loans to support the delivery of new projects which support decarbonisation. The Welsh Government Local Energy Loan Fund supports community-led renewable energy projects and enable groups to buy into projects. The Welsh Government Energy Service is also supporting regional energy mapping, which will feed into growth deals and help regions in developing the energy system of the future, identifying greater regional benefits than the current system delivers for Wales. This will include power, heat and transport.

*vi Description of measures to develop measures to utilise energy efficiency potentials of gas and electricity infrastructure<sup>256</sup>*

The Ofgem assessment of the energy efficiency potential of Great Britain's gas and electricity infrastructure was published in 2015, in line with the Energy Efficiency Directive. The report assessed the energy efficiency potential of gas and electricity infrastructure and described measures in place and their expected benefits alongside potential measures that could improve energy efficiency in future.<sup>257</sup> These measures continue to be progressed under the mechanisms described in 3.4 below.

*vii Regional cooperation in this area, where applicable*

BEIS participates in a number of international fora aimed at promoting product energy efficiency policies globally. The Super-efficient Equipment and Appliances Deployment Initiative is made up of 18 member governments including Chile, the European Commission, Canada, India, South Africa and Germany, and its primary aim is to support energy efficiency policies in developing economies. The Energy Efficient End-use Equipment (4E) initiative is a Technology Collaboration Programme under the aegis of the IEA and CEM with 15 member governments including the Netherlands, Sweden, France, US, Japan, Australia and New Zealand, it aims to promote the sharing of policy best practice and conduct research studies on energy efficiency.

*viii Financing measures in the area at national level*

The CGS set out an aspiration for as many homes as possible to be EPC B and C by 2035, where practical, cost-effective and affordable. To achieve this aspiration, the UK government will:

1. Support around £3.6 billion of investment to upgrade around a million homes through the Energy Company Obligation (ECO), and extending support for home energy efficiency improvements until 2028 at the current level of ECO funding (i.e. £640 million per annum).
2. Build a market for energy efficiency by making it as easy as possible for people to pay for and make home energy efficiency improvements. Alongside the CGS, the UK government published a Call for Evidence on Building a Market for Energy efficiency that sought views on additional measures to encourage home energy performance

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<sup>256</sup> In accordance with Article 15(2) of Directive 2012/27/EU.

<sup>257</sup> Energy Efficiency Directive: An assessment of the energy efficiency potential of Great Britain's gas and electricity infrastructure, 2015: [www.ofgem.gov.uk/publications-and-updates/energy-efficiency-directive-assessment-energy-efficiency-potential-great-britain-s-gas-and-electricity-infrastructure](http://www.ofgem.gov.uk/publications-and-updates/energy-efficiency-directive-assessment-energy-efficiency-potential-great-britain-s-gas-and-electricity-infrastructure)

improvements.<sup>258</sup> Following an analysis of the responses, the UK government outlined several of its resulting actions in the July 2019 Green Finance Strategy and published the summary of responses, to the call for evidence, alongside the strategy.

3. Review the Green Deal Framework to improve and simplify this. Launched in 2013, the Green Deal enables consumers to take out loans to pay for energy efficiency improvements in their properties, with repayments made through their energy bill. The UK government intends to improve the Framework, so that it can best support future use of 'pay as you save', as well as simplify and reduce costs, whilst providing adequate protection for consumers. A Call for Evidence was published late in 2017 and the summary of responses to the Call for Evidence was published in July 2018. A consultation will follow on any proposed changes.
4. Consult on a long-term trajectory for energy performance standards in the Private Rented Sector (PRS) in England and Wales, with the aim of as many private rented homes as possible being upgraded to EPC Band C by 2030, where practical, cost-effective and affordable. We have been working with stakeholders to develop policy design options for the trajectory during the summer of 2019 and we plan to consult on this in the Autumn.

The UK government has made strong progress since the publication of the CGS. As part of its long-term PRS trajectory, for example, on 1st April 2018 it introduced the PRS Minimum standard regulations, which require landlords to bring their properties to EPC Band E or above or register an exemption if one applies. These regulations were further strengthened in April 2019 to require a contribution of up to £3,500 from landlords towards the cost of improvements. The UK government is also taking action in the social rented sector. The Social Housing Green Paper published in August 2018<sup>259</sup> asked, among other things, whether the energy performance of social housing should be upgraded. Government is currently considering the responses and will publish a Social Housing White Paper for implementing social housing reform in due course.

Measures have also been introduced to improve the supply of energy efficiency measures and stimulate demand. For example, the UK government currently makes available a reduced rate of VAT of 5% for the installation of certain energy saving materials in residential properties, including insulation, draught stripping for windows and doors and heating controls. As set out in [section 2.2](#), the UK government has also made the following finance available for demonstration projects:

- £2.5 million to improve retrofit supply chain integration and coordination across England;
- £5 million to support the development of innovative green finance products through the Green Finance Home Innovation Fund;
- And £10 million to fund projects demonstrating a cost reduction trajectory for whole house retrofit.

There is also potential for the energy services market to deliver more investment in energy efficiency to businesses. The CGS sets out the UK government's ambition to reduce business energy use by 20% by 2030. Achieving this ambition will require action across all businesses. The UK government's modelling suggests that the majority of improvements could come from

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<sup>258</sup> Building a market for energy efficiency: call for evidence, 2017:

[www.gov.uk/government/consultations/building-a-market-for-energy-efficiency-call-for-evidence](http://www.gov.uk/government/consultations/building-a-market-for-energy-efficiency-call-for-evidence)

<sup>259</sup> [www.gov.uk/government/news/social-housing-green-paper-a-new-deal-for-social-housing](http://www.gov.uk/government/news/social-housing-green-paper-a-new-deal-for-social-housing)

improving the efficiency of how energy is used in commercial and industrial buildings, in both the private rented sector and owner-occupied sectors.

The Scottish Government is committed to improving energy and resource efficiency while reducing carbon output across business and public sector and to continuing sustainable economic growth for Scotland. The Resource Efficient Scotland (RES) programme funded by the Scottish Government offers free independent, specialist advice and support to businesses, third sector and public sector organisations to implement energy, material resource and water efficiency measures that will translate into cost savings, increased economic competitiveness and reduced emissions. RES provides a degree of assistance to businesses of all sizes, but SMEs have a particular focus.

The Resource Efficient Scotland SME Loan scheme provides interest free loans up to £100,000 to small and medium sized Scotland based businesses for the installation of resource efficiency measures and renewable energy technologies. The scheme is currently offering, subject to availability, cashback funding of 15% of the total loan value (up to a maximum of £10,000) and is payable after the measures have been installed by the business. Available cashback has resulted in a higher uptake of the loan scheme over the past year (2018 – 2019).

The UK government is working with business and finance stakeholders to improve the market for energy services, building confidence across commercial and industrial customers. Delivering our ambition will present opportunities for green finance.

The CGS also set out the challenge facing the public sector in meeting the UK's 2050 target. The pathway set out to 2032 sees emissions from the public sector falling by around 50% compared to 2017. This will require UK government to go further with longer term emissions reduction targets across the public sector, addressing the barriers to energy efficiency and low-carbon investment, and making the case for action internally.

The UK government has already shown what is possible through the Greening Government Commitments which include a greenhouse gas emissions reduction target and has recently set a new, higher target of a 43% reduction by 2020 from a 2009-10 baseline across the central government estate. The UK government has also introduced a voluntary target - the Emissions Reduction Pledge - for the wider public sector and higher education sector, of a 30% reduction in greenhouse gas emissions by 2020 from a 2009-10 baseline, and will explore the possibility of moving to a more ambitious target during the 2020s.

A call for evidence was launched in October 2017: Leading by example: cutting energy bills and carbon emissions in the public and higher education sectors. A summary of responses was published in July 2018 and further analysis will feed into a review of carbon reduction policies across the public sector. The UK government has committed to publishing a roadmap on the next steps to take us towards delivering the ambition set out in the Clean Growth Strategy for the public sector to reduce greenhouse gas emissions.

We continue to enable greenhouse gas emission reductions through the Public Sector Energy Efficiency Loan Scheme. The capital pot for England stands at £312m as of the end of 2019/20 and is planned to increase each year to a total of £385 million by 2020/21. This funding, managed by Salix Finance, has delivered over 17,000 projects, significantly improving energy performance in the public sector. This revolving loan scheme will continue to be recycled to at least 2025. The UK government is also supporting development of the energy services market, helping public bodies access energy services procurement frameworks.

## 3.3 Energy security

### *i Policies and measures related to the elements set out in section 2.3*

A greater number of electricity generation technologies provide increased diversity and enhanced energy security. In addition, we believe that low-carbon ‘firm’ (i.e. always available) power will be required in order to ensure a low-cost, stable, reliable, low-carbon system in 2050. Nuclear is one of the technologies currently available to provide this large-scale firm, low-carbon power and we should continue to support the development of new nuclear plant in this regard.

The UK has successfully maintained for many years, and intends to continue to maintain, a secure long-term supply of nuclear fuel through the use and implementation of risk-assessed security of supply policies for each utility. These policies apply both separately and holistically across each and all of the individual components of the fuel cycle (uranium supply, conversion, enrichment, fabrication, and finished fuel stocks). The policies are enabled and supported by the maintenance of market expertise and engagement such that genuine intelligent customer status is, and will be, retained in the utilities to assess and monitor security of supply risks (near and long term). Through the creation of alternatives and flexibilities in supply arrangements and the avoidance of exclusivity, there is recognition of, and proactive action and mitigation in response to, market evolution and shocks.

The approach includes consideration, as a minimum, of the following aspects:

- That there are multiple facilities and contracting entities to diversify risk against technical failure, accident, environmental events, commercial issues, geopolitical intervention/constraint (such as sanctions or counter sanctions), and regulatory impact
- That a number of those facilities are located in politically stable countries with which the UK has good relations and appropriate legislative arrangements, such as nuclear co-operation agreements, to allow the supply of material subject to nuclear proliferation safeguards
- That no market cartelisation through excessive concentration of facility ownership – whether horizontally or vertically integrated – has a dominant influence on security of supply
- That the potential for disruption of transport – whether environmental, regulatory, commercial or physical – is minimised and mitigated
- That physical stock holdings are matched to risks, predicted dispute/recovery times, processing durations and operating patterns
- That due consideration is given to the nuclear liability regimes in place in supplying countries, together with the implications for the financial and legal risk to the utility, so that a secure fuel supply does not introduce significant other risk
- That consideration is also given to the credit risk of counterparties and their risk of default (elective or non-elective) should market conditions change
- The ultimate source of material/service supplied and the ability of any intermediary (e.g. broker or trader) to guarantee future deliveries especially at times of market stress
- The sustainability credentials (environmental, economic, and social) of any entity or material introduced into the supply chain

- The quality implications of the choice of source, service provider, storage duration and conditions and/or material state on any physical stock holdings
- The development and maintenance of supply routes and the readiness to use (on a temporary or long-term basis and in both a regulatory and commercial context) alternatives to conventional mined natural uranium based supplies through the likes of ‘underfed’ enrichment output/tails re-enrichment, reprocessed uranium, down-blended highly enriched uranium, and mixed oxide fuels

Policies and measures related to system flexibility are outlined in 3.4.3 (ii).

*ii Regional cooperation in this area*

## Gas security of supply

The United Kingdom is a member of both the United Kingdom and Norway Risk Groups for the purposes of implementing the EU Regulation on Gas Security of Supply (2017/1938). Common Risk Assessments, submitted to the European Commission in 2018, by both risk groups detail the regional cooperation measures undertaken by the United Kingdom and the other risk group member states for the purposes of gas security of supply.

In addition, there are a number of existing and planned agreements and protocols which govern gas security of supply arrangements between the United Kingdom and Ireland, including:

- Intergovernmental agreements, including solidarity arrangements that are currently in development
- Transportation arrangements between UK and Irish TSOs
- Load shedding protocols
- The undertaking of a joint risk assessment for the purposes of Ireland meeting the N-1 infrastructure standard – see the UK Risk Group Common Risk Assessment
- Regional communication fora

## Intergovernmental Agreements

### 1993 and 2004 Intergovernmental Agreements

In 1993, the Irish and UK government signed an Intergovernmental Agreement regarding the transmission of natural gas by pipeline between the UK and Ireland. Specifically, the purpose of the Intergovernmental Agreement was to facilitate the construction and operation of a pipeline between Moffat in Scotland and Loughshinny in Ireland for the transmission of natural gas. Additionally, in 2004, the Irish and UK government signed a second Intergovernmental Agreement to facilitate the construction and operation of a second interconnector.

The Intergovernmental Agreements contain provisions regarding pipeline consents, ownership, operation, safety, security arrangements and co-operation in the event of disruption of supply. With reference to providing gas supply to Northern Ireland and the Isle of Man, the Intergovernmental Agreements state that a portion of gas capacities shall be allocated to Northern Ireland and the Isle of Man.

## **Solidarity Arrangements**

Pursuant to Article 13 of Regulation 2017/1938, the United Kingdom and Ireland are currently in the process of developing arrangements for Solidarity measures. These measures are designed to facilitate the sharing of gas in the event of an emergency situation where the UK or Ireland request solidarity.

## **Transportation Arrangements**

### **Connected Systems Agreement (GB-Ireland Interconnectors)**

The Connected Systems Agreement (CSA) between NGG and BGE (UK) for GB-Ireland gas interconnectors came into effect on the 1st of October 1998. Under the CSA, it was agreed that BGE shall be entitled to have the BGE gas system connected to National Grid's gas system at the Connected System Points (CSPs). It was agreed and that the CSA shall not be amended, except by agreement between NGG and BGE. The provisions within the CSA address issues such as compatibility of connection facilities, operating procedures, provision of information, site maintenance and emergency co-operation.

### **Transportation Agreement between BGE (UK) and PTL**

The Transportation Agreement was signed on the 21st August 1996. The Transportation Agreement involves Premier Transmission Ltd (PTL) and BGE (UK), and relates to provision of capacity from Moffat to Twynholm. The provisions within the Transportation Agreement address issues such as pipeline capacity, obligations of delivery and transportation, operation and maintenance, third party carriage, information and access, pipeline and facilities costs, pressure, pressure facilities and emergency arrangements. The Agreement ends in 2020 and discussions are ongoing between PTL and GNI (UK) on a replacement agreement.

## **Load Shedding Protocols**

The NGG and GNI (UK) Joint Protocol for Load Shedding outlines the load shedding arrangements in place between NGG and GNI (UK) in the event of a Gas Deficit Emergency affecting either operator's gas transportation network. Specifically, these protocols address the scenarios of a:

- Network gas supply emergency in Great Britain
- Gas emergencies downstream of Moffat (e.g emergency on SWSOS, ICs, SNIP and SNP), which can affect gas supplies to Ireland, Northern Ireland and the Isle of Man

In the context of a gas supply emergency in GB that could affect the availability of gas to the Moffat network exit point, the overriding principle that is applied is one of proportionality. In a Network Gas Supply Emergency, any reduction of flows through the Moffat interconnector will be proportionate with actions being enacted on the GB network, unless specific geographical circumstances occur which require proportionally higher or lower load reduction in the north of GB.

In this way, domestic consumers in Ireland, Northern Ireland and the Isle of Man would be given the same priority as domestic consumers in GB unless there were geographical circumstances that required proportionally higher or lower load reduction in the north of the UK.

## Regional Communication Fora

Co-operation between the UK and Ireland on issues pertaining to gas security of supply are facilitated through the UK and Ireland Emergency Planning Group, and previously the All-Island Emergency Planning Group.

The UK and Ireland Emergency Planning Group comprises the three government departments (BEIS, DCCAE and DfE), the three regulators (Ofgem, CRU and UREGNI), and the gas and electricity TSOs. Meetings take place every six months. As part of its work, the group is working towards applying a regional approach to risk analysis, preventative measures and emergency response. This includes the establishment of protocols between the gas TSOs to link emergency plans of each jurisdiction. Emergency exercises are also carried out by the TSOs in GB, Northern Ireland and Ireland on an annual basis and plans are refined based on the learning from the exercises. Additionally, the forum is used to discuss the implementation of the Regulation and the plans and assessments carried out by each jurisdiction in compliance with the Regulation.

## Capacity Market

The Capacity Market (CM) is at the heart of the UK government's plans for a secure and reliable electricity system. It ensures sufficient investment in the overall level of reliable capacity (both supply and demand sides) needed to provide secure electricity supplies. The CM's design is consistent with the EU principle of technology neutrality, which requires State aid approved electricity resource adequacy schemes (like the CM) to enable participation by all technologies capable of the required technical performance. The CM is a technology neutral mechanism to achieve security of supply, however, to implement requirements of the EU Electricity Regulation, amendments were made to the Capacity Market Rules in July 2019 to introduce CO<sub>2</sub> emissions limits requirements applying to all auctions held in 2020 onwards. New build plants that exceed the limit have been excluded from competing in auctions from 2020 and existing plants that exceed the limit will be excluded from being awarded agreements or receiving payments from 1 July 2025 at the latest.

A Call for Evidence as part of the Five-year Review of the CM<sup>260</sup> found that the CM has been important in ensuring security of supply. Capacity agreements have been awarded to a diverse mix of energy technologies, including significant amounts of flexible and smart technologies, such as Demand Side Response, batteries and reciprocating engines. This has been positive in facilitating the transition to a smarter, more flexible electricity system. Three capacity auctions scheduled to take place in early 2020 will secure the majority of Great Britain's capacity needs out to 2023/24.

## Electricity security of supply

The UK is in the process of taking the action needed in order to comply with Regulation (EU) 2019/941 on risk preparedness in the electricity sector. This includes the identification of regional electricity crisis scenarios for our region which will form the basis of our risk-preparedness plans covering national, regional and, possibly, bilateral measures. We will work together with Ireland in the preparation of these plans and the underlying regional crisis scenarios. We will cooperate with Ireland in a spirit of solidarity in order to prevent and manage electricity crises and offer assistance where possible.

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<sup>260</sup> Capacity Market: Five-year Review (2014 to 2019), [www.gov.uk/government/publications/capacity-market-5-year-review-2014-to-2019](http://www.gov.uk/government/publications/capacity-market-5-year-review-2014-to-2019)

## Oil stocks

Ireland is bound by the same IEA and EU rules. The obligations enable member countries to co-operate on and respond collectively to major disruptions to the global oil market.

*iii Where applicable, financing measures in this area at national level*

Not applicable.

## 3.4 Internal energy market

### 3.4.1 Electricity infrastructure

*i Policies and measures to achieve the targeted level of interconnectivity as set out in point (d) of Article 4*

These are outlined in section 2.4.

*ii Regional cooperation in this area<sup>261</sup>*

This is outlined in section 1.4.

*iii Where applicable, financing measures in this area at national level*

Several interconnectors between the UK and EU have received European Investment Bank financing. This includes €150 million for the BritNed electricity interconnector (2009) connecting it with the Netherlands<sup>262</sup> and €425 million for the UK-Belgium gas interconnector (1996),<sup>263</sup> and €300 million for the Eirgrid East-West electricity interconnector between Ireland and Wales (2009).<sup>264</sup>

A number of UK projects have received grant funding from the Connecting Europe Facility. As of 31 January 2020, this provided grant funding of over €70 million for electricity transmission projects in the UK and over €30 million for gas transmission projects in the UK bringing a cross border benefit.<sup>265</sup>

### 3.4.2 Energy transmission infrastructure

*i Policies and measures related to the elements set out in section 2.4.2, including, where applicable, specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infrastructure projects*

Energy network companies in England, Scotland and Wales are regulated by Ofgem, the independent energy regulator, via a price control process called RII. This process ensures that energy network companies maintain a safe and secure network and invest in new infrastructure where needed whilst ensuring value for money for consumers.

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<sup>261</sup> Other than the PCI Regional Groups established under Regulation (EU) No 347/2013.

<sup>262</sup> [www.eib.org/en/projects/loan/loan/20070229](http://www.eib.org/en/projects/loan/loan/20070229)

<sup>263</sup> [www.eib.org/en/projects/loan/loan/19941152](http://www.eib.org/en/projects/loan/loan/19941152)

<sup>264</sup> [www.eib.org/en/projects/loan/loan/20080326](http://www.eib.org/en/projects/loan/loan/20080326)

<sup>265</sup> <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/cef-energy-projects-and-actions>

Ofgem introduced a 'Cap and Floor' regulatory regime for interconnection in 2014.<sup>266</sup> The 'Cap and Floor' regime has reduced risks and unlocked substantial investment in interconnection, reflected in the number of new interconnectors under construction from Great Britain and those that have received regulatory approval for projects.

Electricity interconnectors developed under this regime can earn revenue from the allocation of capacity to users who want to flow electricity between GB and its neighbours. The floor is the minimum amount of revenue that an interconnector can earn, which means that if an interconnector does not receive enough revenue from its operations, its revenue will be 'topped up' to the floor level. These funds are transferred from National Grid, which will in turn recover the sum from transmission charges applied to all users of the national electricity transmission system. The cap is the maximum amount of revenue an interconnector can earn; if an interconnector's revenue exceeds the cap, it will transfer the excess revenue to National Grid, which will in turn reduce transmission charges. For consumers, the cap on revenues provides benefits in return for their exposure in underwriting the floor.

As an alternative to the cap and floor, interconnector developers can seek an exemption from the regulatory regime. Exempt interconnectors would usually apply for exemptions from European legislation to facilitate this route. Under this exemption, an interconnector developer would face greater upside and downside risks on their investment.

*ii Regional cooperation in this area<sup>267</sup>*

This is outlined in section 1.4.

*iii Where applicable, financing measures in this area at national level*

Energy network companies are regulated by Ofgem in Great Britain, the independent energy regulator through a price control process called RIIO.<sup>268</sup> GB energy network investment is funded by bill payers through network charges and the companies are financed via a combination of debt and equity investment. All equity investment is made by private sector investors, mostly through private ownership but in some cases via the purchase of shares on the stock exchange (i.e. for publicly listed companies). Most debt finance is raised in the capital markets via the issuing of bonds, or otherwise via commercial banks loans. Some network companies in the GB have also received lending from the European Investment Bank (EIB). EIB loans typically have lower interest rates than commercial bank debt, all else being equal.

### 3.4.3 Market integration

*i Policies and measures related to the elements set out in section 2.4.3*

Policies and measures related to system flexibility are set out in section 3.4.3 ii.

*ii Measures to increase the flexibility of the energy system with regard to renewable energy production such as smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, real-time price signals, including the roll-out of intraday market coupling and cross-border balancing markets*

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<sup>266</sup> Electricity interconnectors: [www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors](http://www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors)

<sup>267</sup> Other than the PCI Regional Groups established under Regulation (EU) No 347/2013.

<sup>268</sup> Network regulation – the 'RIIO' Model: [www.ofgem.gov.uk/network-regulation-riio-model](http://www.ofgem.gov.uk/network-regulation-riio-model)

## Smart Systems and Flexibility

In July 2017, the UK government and Ofgem jointly published the Smart Systems and Flexibility Plan.<sup>269</sup> The Plan outlines 29 actions for UK government, Ofgem and industry to implement by 2022 in order to realise the transition to a more flexible system and remove barriers to smart technologies, such as storage and DSR, so that they can compete fairly alongside other new or established energy solutions. In October 2018, BEIS and Ofgem published a Progress Update<sup>270</sup> to the Plan, which identified 9 new actions beyond those set out in the original Plan. We have now implemented over half of the actions in the plan and progress update. Analysis undertaken on behalf of the UK government estimates that a smart and more flexible energy system can save £17-40 billion by 2050.<sup>271</sup>

Actions in the Smart Systems and Flexibility Plan and Progress Update are split across three core themes:

### 1) Removing barriers to smart technologies, such as electricity storage

The Smart Systems and Flexibility Plan and Progress Update set out key measures that the UK government, Ofgem and/or industry will take to remove policy and regulatory barriers to storage, with the aim of creating a best in class regulatory framework. For example, clarifying the regulatory status of storage within the electricity system including a modified generation licence for storage and reviewing its treatment within the planning system.

Important actions focused on storage also include reforming network charges and policy costs faced by storage to ensure they are proportionate and ensuring the network connections process for storage is appropriate and does not present any undue burdens.

### 2) Enabling the use of smart solutions in homes and businesses

The Smart Systems and Flexibility Plan and Progress Update include a number of actions for UK government, Ofgem and industry to enable and develop DSR, including:

- Rolling out smart meters to households and small businesses across Great Britain as part of a national infrastructure upgrade that will help make our energy system cheaper, cleaner and more efficient.
- Moving to half-hourly electricity settlement on a market-wide basis to enable smart tariffs and other innovative products and services. Ofgem plan to make a decision and publish a full business case in Q1 2021.
- Setting standards for smart appliances, in order to stimulate the market and increase consumer demand. The UK government has now consulted on smart appliances and committed to taking powers to set regulatory requirements for a certain cohort of these appliances. In tandem, we are working with industry to develop standards.

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<sup>269</sup> Upgrading our Energy System: Smart systems and Flexibility Plan, July 2017, [www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan](http://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan)

<sup>270</sup> Upgrading Our Energy System: Progress Update, October 2018, [www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan](http://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan)

<sup>271</sup> See: [www.carbontrust.com/news/2016/12/capturing-the-benefit-of-a-smart-flexible-energy-system/](http://www.carbontrust.com/news/2016/12/capturing-the-benefit-of-a-smart-flexible-energy-system/)

### 3) Ensuring markets provide the right incentives for flexibility and smart solutions

The Smart Systems and Flexibility Plan sets out the need for markets which reflect the true value of flexibility to the system and allow flexibility providers to stack revenues across multiple markets. Actions include:

- National Grid ESO opening up access to existing balancing services markets to a wider range of flexible technologies. Ongoing reforms will rationalise these services into a smaller number of more competitive, technology neutral products whilst increasing transparency and accessibility.
- Simplification of metering requirements for those offering DSR and enabling DSR component reallocation<sup>272</sup> in the Capacity Market; and allowing the stacking of revenues between the Capacity Market and ancillary services.<sup>273</sup>
- Distribution Network Operators (DNOs) opening up network requirements to competition with flexibility services<sup>274,275</sup>, creating new markets for flexibility at the distribution level and improving co-ordination across transmission and distribution to deliver whole system approaches. Industry is leading on the delivery of these changes through the Energy Networks Association's Open Networks Project. In July 2019, UK government and Ofgem jointly published a letter setting out their views on the progress of the ENA's work, and their expectations for this work going forwards.<sup>276</sup>

Launching an Energy Data Taskforce to deliver recommendations to reduce costs and facilitate competition and innovation in the energy sector, through improving data availability and transparency. The Taskforce published their report in June 2019, which includes specific recommendations for the UK government, Ofgem and industry as part of a strategy for a modern and digitalised energy system. The UK government and Ofgem are now considering how we can realise the vision set out in this report.

*iii Where applicable, measures to ensure the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets*

See section 3.4.3 (ii).

*iv Policies and measures to protect consumers, especially vulnerable and, where applicable, energy poor consumers, and to improve the competitiveness and contestability of the retail energy market*

There are around 60 energy suppliers in the domestic retail energy market<sup>277</sup>. Evidence shows competition continues to benefit household consumers who are able and willing to shop

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<sup>272</sup> Ofgem, Decision on the statutory consultation on amendments to the Capacity Market Rules, July 2019, [www.ofgem.gov.uk/publications-and-updates/decision-statutory-consultation-amendments-capacity-market-rules-2](http://www.ofgem.gov.uk/publications-and-updates/decision-statutory-consultation-amendments-capacity-market-rules-2)

<sup>273</sup> Ofgem, Publication of the consolidated Capacity Market Rules, July 2017, [www.ofgem.gov.uk/publications-and-updates/publication-consolidated-capacity-market-rules](http://www.ofgem.gov.uk/publications-and-updates/publication-consolidated-capacity-market-rules)

<sup>274</sup> Energy Networks Association. (2018). Energy Networks Association's Flexibility Commitment. Available at: [www.energynetworks.org/assets/files/ENA%20Flex%20Commitment.pdf](http://www.energynetworks.org/assets/files/ENA%20Flex%20Commitment.pdf)

<sup>275</sup> Energy Networks Association. (2019). Our six steps for delivering flexibility services. Available at: [www.energynetworks.org/assets/files/ENA%20Flexibility%20Commitment%20Our%20Six%20Steps%20for%20Delivering%20Flexibility%20Services.pdf](http://www.energynetworks.org/assets/files/ENA%20Flexibility%20Commitment%20Our%20Six%20Steps%20for%20Delivering%20Flexibility%20Services.pdf)

<sup>276</sup> UK Government & Ofgem. (2019). Letter from BEIS/Ofgem to Energy Networks Association, July 2019. Available at: [www.gov.uk/government/publications/open-networks-project-letter-from-beis-and-ofgem-to-the-energy-networks-association-ena](http://www.gov.uk/government/publications/open-networks-project-letter-from-beis-and-ofgem-to-the-energy-networks-association-ena)

<sup>277</sup> Ofgem, Data Portal - Retail Energy Indicators [www.ofgem.gov.uk/data-portal/retail-market-indicators](http://www.ofgem.gov.uk/data-portal/retail-market-indicators)

around, meaning they can usually get a good deal. However, competition is not working well for consumers who are less active. 53% of non-prepayment consumers are on a default tariff, such as a Standard Variable Tariff, which are around £260 more expensive each year than the cheapest fixed-term deals for a typical consumer.<sup>278</sup>

To achieve an innovative and competitive market, the UK government and Ofgem have introduced measures including:

- rolling out smart meters to households and small businesses across Great Britain
- moving to faster and more reliable switching for customers
- Ofgem trials including writing letters to disengaged customers offering cheaper market deals

To protect disengaged consumers who are on poor value tariffs, the UK government has introduced the temporary Tariff Cap, which will be in place until 2020, when Ofgem must report on the conditions for effective competition in the market and recommend to the UK government whether it should be extended. The cap can be extended annually for a year at a time up to the end of 2023 at the very latest.

See section 2.4.4(i).

*v Description of measures to enable and develop demand response including those addressing tariffs to support dynamic pricing<sup>279</sup>*

See section 3.4.3(ii).

### 3.4.4 Energy poverty

*i Where applicable, policies and measures to achieve the objectives set out in section 2.4.4*

There are specific initiatives introduced by the UK government that seek to address fuel poverty, which are summarised below.

The Energy Company Obligation (ECO) is a requirement on larger energy suppliers to deliver energy efficiency measures to domestic premises in **England, Scotland and Wales**. The scheme has delivered over 2.6 million measures since it was introduced in 2013. In 2018, the UK government reformed the scheme so that support is entirely focused on low income and vulnerable households. The scheme provides support worth up to £640m per year and will run to 2022. The 2017 Clean Growth Strategy committed to funding for home energy efficiency to continue to 2028 at least at the current level of ECO and that the scheme would be reviewed beyond 2022.

The Minimum Energy Efficiency Standards for landlords (found in The Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015) focus on the least energy-efficient private rental properties in **England and Wales** – those rated EPC Band F or G. Around 40% of households in such properties live in fuel poverty. The Minimum Energy Efficiency Standards require private landlords to improve their properties to at least EPC Band E, and, if they cannot source sufficient external funding, are required to make a financial

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<sup>278</sup> Ofgem, State of the energy market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2018](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2018)

<sup>279</sup> In accordance with Article 15(8) of Directive 2012/27/EU.

contribution of up to £3,500 including VAT. This establishes the principle that landlords are expected to play an important role in funding improvements to the properties they own.

In addition to support to improve home energy efficiency, over 2 million low income and vulnerable households in **England, Scotland and Wales** receive a £140 rebate off their winter energy bill through the Warm Home Discount scheme and 11 million households are protected from poor value standard variable and default tariffs through the energy price cap. The Warm Home Discount scheme has been extended until at least 2021. The price cap will be in place until the end of 2020 and may be extended by a year at a time until the end of 2023 at the latest. The decision to lift the price cap will be informed by a review into whether the conditions for effective competition are in place.<sup>280</sup> In addition, the Winter Fuel Payment provides support worth up to £300 to help ensure pension aged households can afford to heat their homes over the winter and additional payments are made to low income and vulnerable households during periods of cold weather through the Cold Weather Payments.

## England

The Warm Homes and Energy Conservation Act 2000 as amended by the Energy Act 2013 requires the Secretary of State to publish and implement a strategy in relation to England that sets out a comprehensive package of measures for achieving the 2030 fuel poverty target. The current fuel poverty strategy for England was published in 2015<sup>281</sup> and in July 2019 the UK government published a consultation on proposals to update the fuel poverty strategy for England.<sup>282</sup> One proposal in the consultation is to introduce a sustainability principle to align Government strategy on fuel poverty, decarbonisation and air quality to ensure that the fuel poor are not left behind in the energy transition and that action to meet the fuel poverty targets is consistent with wider objectives.

## Northern Ireland

The Northern Ireland Executive's fuel poverty strategy is delivered mainly through the Affordable Warmth Scheme.<sup>283</sup> The Scheme identifies and assists those low-income households most at risk of fuel poverty. Since its inception in September 2014 the Affordable Warmth Scheme has invested more than £66 million improving the energy efficiency of more than 16,000 low income households.

## Scotland

By the end of 2021, the Scottish Government will have invested over £1 billion in energy efficiency programmes that help make homes warmer and cheaper to heat. National and local action ensures that delivery meets the needs of a wide range of communities, as well as supporting individual households.

The Home Energy Scotland service provides free and impartial expert advice to people on how to make homes cheaper and easier to heat, support on switching energy supplier and a referral service for benefit maximisation.

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<sup>280</sup> Ofgem (2019) [www.ofgem.gov.uk/publications-and-updates/developing-framework-assessing-whether-conditions-are-place-effective-competition-domestic-supply-contracts](http://www.ofgem.gov.uk/publications-and-updates/developing-framework-assessing-whether-conditions-are-place-effective-competition-domestic-supply-contracts)

<sup>281</sup> [www.gov.uk/government/publications/cutting-the-cost-of-keeping-warm](http://www.gov.uk/government/publications/cutting-the-cost-of-keeping-warm)

<sup>282</sup> [www.gov.uk/government/consultations/fuel-poverty-strategy-for-england](http://www.gov.uk/government/consultations/fuel-poverty-strategy-for-england)

<sup>283</sup> Northern Ireland Affordable Warmth Scheme, [www.nihe.gov.uk/index/benefits/affordable\\_warmth\\_scheme.htm](http://www.nihe.gov.uk/index/benefits/affordable_warmth_scheme.htm); current AWS Fuel Poverty Strategy, [www.communities-ni.gov.uk/publications/fuel-poverty-strategy](http://www.communities-ni.gov.uk/publications/fuel-poverty-strategy)

The Scottish Government's national fuel poverty scheme Warmer Homes Scotland is delivered on a regional basis, including a separate islands region, to ensure those households who are living in or at risk of living in fuel poverty in the more remote parts of the country get the same level of service as those living in urban areas.

Warmer Homes Scotland has a strong focus on heating and insulation measures, to improve the energy efficiency, warmth and comfort of fuel poor households. Q-Bot robotic underfloor insulation and new renewable measures have been added to the suite of measures already available for eligible households, including ground source heat pumps, micro-hydro, micro wind and micro-CHP.

These measures provide opportunities for greener, more innovative solutions, that may be of particular benefits to those households in remote and rural areas that are not served by the gas grid. It also provides the Scottish Government with the building blocks for using innovative technologies and tackling fuel poverty in the future through providing opportunities to build up the skills and accreditations of contractors to undertake new types of work in the renewables sector.

In addition, new enabling measures such as asbestos removal and the replacement of existing unsafe oil storage tanks have been added to the Scheme. This will help those households who are most in need of help to gain access to the scheme where financial constraints would previously have prevented them from doing so, allowing more fuel poor homes to benefit from Warmer Homes Scotland.

Since 2013, the Scottish Government has invested over £373 million through its Area Based Schemes supporting over 85,000 households and helping hundreds of local communities to tackle fuel poverty. Every council in Scotland has been enabled to design and deliver energy efficiency programmes targeting fuel poor areas. The design and delivery of these projects draws upon local knowledge and housing strategies, as well as reflecting the additional costs of delivery in remote rural and island communities.

Home Energy Scotland loans of up to £38,500 per home are also available to owner occupiers and eligible registered private sector landlords in Scotland. This covers a range of energy efficiency improvements, including up to £17,500 for home renewables systems or connections to an approved district heating scheme powered by a renewable energy source. The HEEPS Equity loan pilot scheme was extended in June 2018 from Glasgow, Perth & Kinross and Argyll and Bute areas to cover additional areas Inverclyde, Renfrewshire, Stirling, Dundee and Western Isles.

## **Wales**

In Wales, investment through the Welsh Government's Warm Homes Programme, including European, UK and Welsh Government funding has reached more than £327m delivering the demand-led Nest Scheme and Arbed area based on Scheme since 2009, which has improved the energy efficiency of more than 55,000 homes in Wales. By the current funding period in March 2021, Welsh Government investment will have reached more than £344m in the Warm Homes Programme. Funding that will have benefitted more than 75,000 homes. More than 129,506 people have received energy efficiency advice through the Warm Homes Programme since 2011.

In Prosperity for All: A Low Carbon Wales, the Welsh Government recognised the need for greater understanding of the economic, environmental social and cultural impacts associated

with decarbonisation. It has committed to creating a Climate Just Advisory Group to advise Welsh Ministers on the transition from a fossil fuel economy.

## 3.5 Research, innovation and competitiveness

### *i Policies and measures related to the elements set out in section 2.5*

Our future research and innovation activities will be designed to achieve our legally binding domestic carbon budgets and our new commitment to achieve net zero greenhouse gas emissions from the UK by 2050. Our research and innovation priorities and related spending to deliver these targets are in the process of being considered and agreed, but in the meantime, our intention is to remain closely engaged with EU and international research and innovation activities to meet these world leading commitments. We have an overall target of spending an amount equal to 2.4% of GDP on UK R&I more generally, with energy R&I a part of this.

The UK government has set out a Clean Growth Grand Challenge to put the UK at the forefront of the industries of the future. This is set out in section 2.5(i). Some specific examples of activity included in what now amounts to more than £3 billion of UK spending are included below for illustrative purposes.<sup>284</sup>

### BEIS Energy Innovation Programme

BEIS has a £505 million Energy Innovation Programme which aims to accelerate the commercialisation of innovative clean energy technologies and processes into the 2020s and 2030s.<sup>285</sup> As set out in the CGS, the BEIS Energy Innovation Programme<sup>286</sup> will invest around:

- £70 million in smart systems
- £90 million in the built environment (energy efficiency and heating)
- £100 million in industrial decarbonisation and carbon capture, use and storage (CCUS)
- £180 million in nuclear innovation (fission)
- £15 million in renewables innovation
- £50 million in support for energy entrepreneurs and green financing

From the BEIS Energy Innovation Programme, the UK is progressing well in terms of contractually committing funding to projects and will be adding to this list over the duration of the programme. These include:

### Renewable Innovation

- The UK is working with other countries to develop shared solutions to reduce the cost of renewable energy technologies. This includes UK investments through the European Research Area Network (ERANet) of around £700,000 in bioenergy demonstration projects and up to £8 million in the 'DemoWind' programme to reduce the cost of offshore wind technologies.

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<sup>284</sup> Energy Innovation, [www.gov.uk/guidance/energy-innovation](http://www.gov.uk/guidance/energy-innovation)

<sup>285</sup> Energy Innovation, [www.gov.uk/guidance/energy-innovation](http://www.gov.uk/guidance/energy-innovation)

<sup>286</sup> Clean Growth Strategy, 2017: [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

- Up to £1.3 million in an Offshore Renewable Innovation Hub, which is led by the Offshore Renewable Energy Catapult and Knowledge Transfer Network to bring the offshore wind industry together to solve common innovation challenges.

### **Smart Systems Innovation**

- Up to £9 million to reduce the cost of energy storage technologies (including electricity storage, thermal storage, and power-to-gas technologies).
- Up to £600,000 on feasibility studies for a potential first of a kind large-scale future energy storage demonstrator. Up to £20 million to fund innovative large-scale, long-duration storage projects that can provide an alternative to conventional commercial storage technologies.
- Up to £7.6 million for innovative demonstrations of energy DSR technologies in UK businesses or public sector organisations to reduce their energy use in peak times and provide flexibility to the energy system.
- Up to £30 million (£18 million from the BEIS Energy Innovation Programme, £12 million from the Office for Low Emission Vehicles) for an electric vehicle-to-grid programme to invest in demonstrators and feasibility studies.
- Up to £600,000 to fund flexible market feasibility studies, as part of the Upgrading our Energy System: Smart Systems and Flexibility Plan.
- Up to £4 million to fund the development of Flexibility Exchanges. Flexibility Exchanges are online market platforms for flexibility providers to view and bid for flexibility requirements across multiple markets. This funding followed on from the earlier work on flexibility market feasibility studies.
- Up to £9.78 million from 2018-2021 to support innovative domestic applications of DSR technologies and business models.
- Up to £8.8 million to develop innovative approaches to energy management using smart meter data, tailored to the needs of smaller non-domestic sites in three priority sectors (retail, hospitality and schools).

### **Nuclear Innovation**

- Up to £20 million over 2016-2018 to support innovation in the civil nuclear sector.
- Up to £7 million to ensure UK regulators are able to build the capability and capacity required to support the development of advanced technologies.

### **Industrial Innovation**

- Up to £9.2 million over the next 4 years on an industrial energy efficiency accelerator to seek industry-specific solutions which are close to commercialisation, by leveraging private sector investment and strengthening UK supply chains to reduce energy costs for UK industry.
- Up to £20 million to design and construct carbon capture and utilisation (CCU) demonstration projects.
- Up to £20 million to stimulate early investment in fuel switching processes and technologies, so that a range of technologies are available by 2030 and beyond.

## **Energy Entrepreneurs and Green Financing**

- Up to £13 million for phase 5 and up to £11 million for phase 6 of the BEIS Energy Entrepreneurs Fund, which seeks the best ideas from the public and private sector, particularly aimed at small and medium-sized enterprises, and supports the demonstration of state-of-the-art energy technologies.
- Up to £20 million of new investment to support clean technology early stage funding.

## **Built Environment Innovation**

- Up to £9.8 million for the second phase of work led by the Energy Systems Catapult on the 'Smart Systems and Heat' programme. The programme will help develop local energy plans alongside Local Authorities and support the development of low-carbon heating projects across the UK.
- Up to £25 million to investigate the potential uses of hydrogen gas for heating and testing the possibility of domestic gas pipes and appliances.
- Up to £10 million to develop technologies that reduce the carbon emissions associated with providing heat and hot water to UK buildings.
- Up to £10 million to develop technologies and approaches to improving the energy efficiency of existing UK buildings.
- We are partnering internationally, to accelerate the development of innovative, clean energy technologies, driving forward our own transition to a low-carbon economy and positioning the UK as a world leader in these areas.

## **Carbon capture, usage and storage**

Carbon capture, usage and storage (CCUS) is likely to play a vital role in meeting our target to reach net zero greenhouse gas emissions by 2050 and supporting our Industrial Strategy. CCUS can add value to the economy and help tackle hard to decarbonise sectors of the economy, creating new high value jobs and export opportunities whilst reducing emissions.

Since 2011, the UK government has invested significantly to develop CCUS in the UK. The UK government is continuing this support by committing to spend up to £100 million from BEIS's Energy Innovation Programme to support industry and CCUS innovation and deployment in the UK with over £50 million of innovation funding announced in 2018, to drive down the cost of CCUS and support the development of the technology. This funding includes:

- A £20 million CCU Demonstration Programme to fund design and construction of CCU demonstration plants in the UK, including £4.2 million to support a CCU plant at Tata Chemicals in North West England.
- A £15 million CCUS Call for Innovation, supporting a new CCUS international testing centre near Rotherham and supporting engineering studies and planning for projects in Scotland, Yorkshire, Merseyside and Teesside.
- £6.5 million of UK funding to the second international call of the Accelerating Carbon Technologies research programme, a €30 million fund supporting CCUS research across 11 countries that can lead to safe and cost-effective development of CCUS technology.

The UK government is also committed to maintaining a leading position in global collaboration and capacity building on CCUS and to work internationally to drive down the cost and

accelerate deployment of CCUS. In May 2018, the UK took on leadership (with Saudi Arabia and Mexico) of the Carbon Capture Challenge under Mission Innovation.

The UK continues to support developing countries and emerging economies to develop their technical and institutional knowledge of CCUS through our £70m international CCUS programme, which uses Official Development Assistance (ODA)

Furthermore, to help industry decarbonise, we have launched an Industrial Energy Transformation Fund, worth up to £315m. This will provide funding for transformative decarbonisation investments, potentially including fuel switching and carbon capture.

## Hydrogen

Hydrogen is an energy carrier with potential to support the UK's efforts to transform and decarbonise the energy system in line with our 2050 net zero target. We are committed to exploring the option of hydrogen as a strategic decarbonised energy carrier, alongside electricity and other decarbonised gases.

The UK government is currently investing up to £121m in a range of innovation programmes to explore and develop the potential of low-carbon hydrogen across the value chain from production through to end use:

- Up to £121m in a range of innovation programmes to explore and develop the potential of hydrogen.
- £33m in a Hydrogen Supply programme to reduce the costs of bulk low-carbon hydrogen production.
- £20m in a Fuel Switching Competition to support the switch to lower carbon fuels in industry, including hydrogen.
- £20m in a Storage at scale competition to demonstrate large scale energy storage, including power-to-gas.
- £23m in a Hydrogen for Transport programme to support deployment of hydrogen vehicles and growth of refuelling infrastructure.
- £25m in the Hy4Heat programme to ensure the safe use of 100% hydrogen in buildings.

We are also exploring the development of sustainable policy and market frameworks for hydrogen. In July 2019, we published a hydrogen chapter of the CCUS business models consultation, which explored the main challenges a hydrogen business model needs to address.

## Scotland

Scotland's energy sector has benefited from EU funding for energy infrastructure projects and research and development, particularly in the pursuit of new, low-carbon technologies and enabling infrastructure, such as offshore wind, marine renewables and integrated hydrogen solutions. For example:

- Orkney is home to what was the UK's first smart grid, connecting renewable generation to Orkney's distribution network at a considerably lower cost than conventional network connection. The 'Surf 'n' Turf' project demonstrates a fully integrated energy model, with hydrogen produced using electricity from tidal and onshore wind turbines. This is stored in a fuel cell, and used to provide low-carbon heat, power and transport. A European-

funded project called 'BIG HIT' will build on the Surf 'n' Turf project in Orkney by producing hydrogen from renewable sources for transport and heating.<sup>287</sup>

- The Scottish Government launched the Low Carbon Infrastructure Transition Programme (LCITP) in March 2015, in partnership with Scottish Enterprise, Highlands and Islands Enterprise, Scottish Futures Trust and sector specialists. It is a Strategic Intervention supported by the European Structural and Investment Funds, and European match funding for the LCITP is guaranteed up until Autumn 2021.<sup>288</sup>

## Wales

Through its Smart Living Initiative<sup>289</sup>, the Welsh Government has been encouraging a portfolio of innovative pilots/demonstrators to help learning and shaping of future energy solutions. As a catalyst the initiative is facilitating the development of place-based and themed based concepts and feasible solutions from zero carbon areas, smart intelligent towns to hydrogen themed initiatives.

*ii Where applicable, cooperation with EU Member States in this area, including, where appropriate, information on how the SET Plan objectives and policies are being translated to a national context*

Whilst a Member State, the UK was a very active contributor to the ongoing work of the EU's Strategic Energy Technology (SET) Plan, providing the Chair for two of its governance bodies (SET Plan Bureau and Joint Actions Working Group). The UK participated in ten (out of fifteen) temporary working groups for the implementation of the integrated SET Plan, co-leading the one on nuclear safety. In addition, the UK has participated in 6 ERA-NETs launched under H2020 (CCS, Bioenergy, Wind, Smart grids, Ocean energy and Solar Energy). Regarding Horizon 2020, the UK has historically been involved in almost half of all successful H2020 Energy project proposals enabling UK organisations to benefit from the results.

For Horizon 2020, the UK was involved in almost half of all successful H2020 Energy project proposals, providing evidence of the significant strengths and engagement from the UK's energy research and innovation community towards delivering SET Plan objectives. SET Plan delivery continues to form a major driver of the priorities and spending under H2020's energy theme.

SET Plan objectives and policies in the energy technology areas relevant to the UK, already align well with our existing activities and we are actively looking for opportunities to increase bilateral and multilateral collaboration in these areas through the SET Plan's governance structures.

UK International Energy Innovation activity can be split into 4 main areas:

- UK government funding for R&D collaboration with developed countries
- UK government funding for R&D collaboration with, in or targeting developing countries (usually classified as Overseas Development Assistance or ODA)
- European funding for UK organisations

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<sup>287</sup> Building Innovative Green Hydrogen Systems in Isolated Territories: [www.bighit.eu/](http://www.bighit.eu/)

<sup>288</sup> Renewable and low carbon energy, Scottish Government website: [www.gov.scot/policies/renewable-and-low-carbon-energy/low-carbon-infrastructure-transition-programme/](http://www.gov.scot/policies/renewable-and-low-carbon-energy/low-carbon-infrastructure-transition-programme/)

<sup>289</sup> Smart Living review: <https://gov.wales/low-carbon-living-smart-living-annual-review-2018-2019>

- UK membership of multilateral organisations and fora

The UK government funding in this area is delivered by different organisations, pursuing slightly different objectives. For example, UKRI typically focusses on excellent science and academic collaboration, whereas BEIS Energy Innovation focuses on industrial collaborations.

The UK's Energy Innovation Board has an International Working Group (sub-Group to the EIB) tasked with developing cross-government co-operation opportunities and knowledge sharing related to international research and innovation collaboration. As part of its work, it has been developing an International Strategic Framework. Pooling a wide range of inputs from government funding organisations and stakeholders, the Framework identifies international objectives, key technology development needs, which countries have strengths in these areas and existing co-operation initiatives. The objective is to arrive at a menu of opportunities for international collaboration that can then be prioritised and pursued.

### Examples of existing cross-Government activity

1. **Energy Catalyst:** Since 2013, BEIS, UKRI and DfID (since 2016) have provided funding enabling the Energy Catalyst programme to invest almost £100 million in grant funding across more than 750 organisations and 250 projects, via six rounds of open competition. Since DFID joined in round four, the programme has included international Overseas Development Assistance (ODA) alongside the original UK focus.
2. **International Climate Fund / Energy Innovation:** The BEIS portion of the International Climate Fund, jointly administered with DFID and DEFRA, includes a commitment to invest £40 million on Energy Innovation projects. Officials are currently designing this in close consultation with other departments.

### Steel

A vibrant steel sector is of vital importance to the UK economy. Steel is a fundamental material input to a variety of industries and the sector makes a significant contribution to local economic growth and prosperity. However, the UK steel sector is also a significant source of emissions and faces a significant decarbonisation challenge, with specific barriers, including varying technology readiness, long lead in and pay back periods and the need to align with long term equipment replacement cycles. Consequently, we believe the time is right to provide dedicated support to our steel industry, to help put it on a pathway to decarbonisation in line with our net zero commitments. As a signal of that support, on 29th August, the UK government announced a £250 million Clean Steel Fund:

- To help set the UK steel sector on a pathway to decarbonisation that is consistent with the UK's net zero target under the Climate Change Act
- To maximise longevity and resilience in the UK steel sector by building on longstanding expertise and skills and harnessing clean growth opportunities

Recognising that availability of low-carbon hydrogen at scale is a constraint to large industrial users considering fuel switching, the UK government also announced a new £100 million Low Carbon Hydrogen Production Fund alongside the Clean Steel Fund. The Low Carbon Hydrogen Production Fund aims to:

- Deploy low-carbon hydrogen production capacity to enable greater use of hydrogen as a decarbonisation option across the energy system

- Encourage future private sector investment in low-carbon hydrogen to support scale up and market development that aligns with the UK's clean growth objectives

## UK government funding for R&D collaboration with developed countries

Across the UK government, we expect to launch R&D collaborations with developed countries including the US, Canada and South Korea. UKRI (both Research Councils and Innovate UK) have run several competitions with these countries in the current spending review period. As part of future collaborations, BEIS and UKRI will discuss the possibility of co-funding calls.

The draft International Research and Innovation Strategy has recognised the issue of a relative lack of funding for collaboration with developed countries within the broader international research context and is proposing a new non-ODA fund to support such collaboration.

## UK government funding for R&D collaboration with, in or targeting developing countries (usually classified as ODA)

As part of the UK's Overseas Development Aid (ODA) funding, the UK government has a substantial activity of R&D collaboration in developing countries, part of a wider set of ODA activities which span the full spectrum from R&D to technical assistance, and supporting innovation in market design and regulatory frameworks.

UK ODA funding for international energy innovation is delivered through many programmes and organisations, namely: BEIS (Newton Fund, Global Challenge Research Fund, and International Climate Fund); UKRI (Newton Fund, Global Challenge Research Fund); and DfID.

## European funding for UK organisations

EU funding for energy innovation is largely delivered through two programmes: Horizon 2020 (the EU's main R&D programme) & Euratom, and the European Regional Development Fund (ERDF).

For further information, see section 3.4(ii).

The UK is a member of several multilateral organisations which aim to share information on energy innovation activity including:

- Mission Innovation
- Clean Energy Ministerial
- International Energy Agency (the UK is active in IEA Governance structures including providing a Vice-Chair to the CERT. The UK is also active in the Energy Technology Network's Technology Collaboration Programmes - UK organisations participate in c22 of these)
- International Renewable Energy Agency
- World Bank Group, particularly the Energy Sector Management Assistance Programme (ESMAP)

## Areas of potential interest identified for UK international energy activity

1. Efficient, resilient, smart networks (including: off-grid access, mini-grids and embedded mini-grids; storage and system balancing, and vehicle charging)
2. Electricity Supply – low-cost renewables (also nuclear, CCS)
3. Heating and Cooling in Buildings
4. Industrial Energy Efficiency
5. Energy for Mobility
6. Land use and land waste (Including land-use for bioenergy)
7. Hydrogen
8. Supporting potentially disruptive technologies, systems and materials
9. Skills and capacity to support the energy transition
10. Increased Global Access to Affordable, Reliable Energy
11. Common Financial and Non-Financial Barriers
12. Supporting new supply chains, business models and customer value propositions

## Mission Innovation

There is strong momentum behind Mission Innovation.<sup>290</sup> Since Mission Innovation (MI) launched in 2015, MI estimates that members have committed in excess of US\$31 billion to accelerate innovation in clean energy, three new members have joined Mission Innovation, it has brought together over 3,000 technical experts and innovators and more than 20 new international partnerships in clean energy between MI members have been announced.

The UK has a considerable leadership role in the initiative and as part of our involvement has pledged to double central government funding for energy innovation, to in excess of £400 million in 2020/21. The UK took over as Head of the Secretariat from the US on 1 October 2017. We are Vice-Chair of the Steering Committee and a member of all Innovation Challenges. The UK led the development of seven Innovation Challenges to deepen collaboration and information sharing between members. We are a member of all seven and co-lead the Affordable Heating and Cooling in Buildings Innovation Challenge with the UAE and EC.

The key Mission Innovation and UK priorities through to 2021 are:

- Deliver a substantial boost in public-sector investment in clean energy R&D
- Increase private sector engagement and investment in energy innovation
- Build new or strengthened international networks and partnerships in energy innovation
- Increase awareness of the transformational potential of energy innovation, the progress being made, and the remaining gaps and opportunities

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<sup>290</sup> Mission Innovation, <http://mission-innovation.net/>

As part of Mission Innovation, the UK is working with both the Breakthrough Energy Coalition (BEC) and the World Economic forum (WEF). At the One Planet Summit in Paris (December 2017), Breakthrough Energy founder Bill Gates announced public-private collaborations with five Mission Innovation members: Canada, European Commission, France, Mexico, and the United Kingdom. By combining government expertise and the Coalition's convening power the partnership aims to focus on ensuring that the UK is one of the most attractive places in the world to invest in clean energy innovation and more rapidly bring breakthroughs from the lab to market.

We are building on the WEF's System Initiative on Shaping the Future of Energy to explore whether the outcomes of that project are relevant to the UK context.

*iii Where applicable, financing measures in this area at national level*

Our vision for a knowledge-led economy is underpinned by world-leading research, world-class facilities and international collaborations that push scientific frontiers and attract the brightest talents, from Nobel Prize winners to ambitious graduate students. 'Innovation clusters' will form and grow around our universities and research organisations, bringing together world-class research, business expertise and entrepreneurial drive. These clusters can create thousands of skilled jobs in R&D, innovation and wider sectors, driven by the growth in science, technology, engineering and maths (STEM) skills led by new teachers and more doctorates.

We will work with industry in the coming months to develop a roadmap for meeting this target. This will provide a framework to drive business investment in R&D and focus on key sectors, technologies and clusters, including by optimising government investment to drive private investment in R&D and considering further opportunities to improve the business environment, including access to finance, regulatory frameworks, and intellectual property. This will maximise the impact of public investment in science and innovation to support businesses to invest more and drive outputs to realise our commitment to invest 2.4% of GDP in R&D.

Increasing investment in R&D to 2.4% of GDP in a decade is ambitious and will require concerted effort by the UK government and business. As a first step we will invest an additional £2.3 billion over what was previously planned in 2021/22, raising total public investment in R&D to approximately £12.5 billion in that year alone. This investment will see public R&D spending increase as a share of GDP every year. It means that we will have raised public investment in R&D from around £9.5 billion in 2016/17 to around £12.5 billion in 2021/22.

This is an extra £7 billion over five years – the biggest ever increase in public funding of R&D. The UK government will invest strategically in technologies and ideas closer to market to drive UK competitiveness, while also continuing to fund the curiosity-driven research that is fundamental to the quality of our work and ensures our place as a world-leading knowledge economy.

## Section B: Analytical basis

# 4. Current situation and projections with existing policies and measures<sup>291</sup>

In this section we provide historical context for energy use and emissions and then show how we expect these to change in the future. We cover macroeconomic and price forecasts in the later section on projections.

## 4.1 Projected changes in the main outside factors that influence the UK's energy system and its GHG emissions

### 4.1.i Macroeconomic forecasts (GDP and population growth)

Table 16 presents the short to medium-term GDP growth projections that are provided in the OBR's Economic and Fiscal outlook report, published in March 2019. This report is usually published twice a year alongside the Budget and Spring Statement.

**Table 16: OBR's Short to Medium-term GDP Growth Projections - Per cent<sup>292</sup>**

Projections, released March 2019.

	2019	2020	2021	2022	2023
GDP Growth – Per cent	1.2	1.4	1.6	1.6	1.6

Table 17 provides the OBR's long-term GDP growth projections, which were released in their Fiscal Sustainability report in July 2018. This report is released every other year, presenting long term projections for public spending and tax revenue and setting out summary indicators of the long-term sustainability of public finances.

**Table 17: OBR's Long-term GDP Growth Projections - Per cent<sup>293</sup>**

Projections, released July 2018.

	2017-18 to 2027-28	2027-28 to 2037-38	2037-38 to 2047-48	2047-48 to 2057-58	2057-58 to 2067-68
GDP Growth – Per cent	1.6	2.2	2.2	2.2	2.2

<sup>291</sup> Analysis based on latest available data up to 31 January 2020, does not account from impacts resulting from COVID-19. Some statistics may have been updated in publications released after 31 January 2020.

<sup>292</sup> OBR's Economic Fiscal Outlook, March 2019, <https://obr.uk/efo/economic-fiscal-outlook-march-2019/>

<sup>293</sup> OBR's Fiscal Sustainability Report, July 2018, <https://obr.uk/fsr/fiscal-sustainability-report-july-2018/>

**Table 18: ONS's Projected Population of the UK, mid-2018 to mid-2043 - Millions<sup>294</sup>**

Projections, released October 2019.

	2018	2023	2028	2033	2038	2043
UK Population - Million	66.4	68.1	69.4	70.5	71.4	72.4

#### 4.1.ii Sectoral changes with impacts on the energy system and GHG emissions

Projections of energy demand in manufacturing industries and construction and in the commercial sector are calculated using projections of sectorial economic growth. Growth projections are calculated using historical relationships with GDP.

These are set out in [section 4.2.1](#).

#### 4.1.iii. Global energy trends, international fossil fuel prices, EU ETS carbon price

### Fossil fuel prices, carbon prices and exchange rates

BEIS updates fossil fuel price projections<sup>295</sup> and carbon price projections<sup>296</sup> annually. Table 19 sets out key fossil fuel and carbon price values and Table 20 gives exchange rates.

**Table 19: Central Fossil Fuel and Carbon Prices, 2018 prices**

Projections.

2018 prices	2018	2020	2025	2030	2035
Crude oil (Brent 1 month), \$/bbl	73.7	71.7	77.7	84.7	84.7
Gas (NBP), p/therm	57.0	48.0	56.0	63.0	63.0
Coal (CIF ARA), \$/tonne	89.7	85.7	85.7	86.7	86.7
EU ETS short-term traded carbon values for modelling purposes, £/tCO <sub>2</sub> *	12.8	13.8	17.7	42.7	42.7

\*Following the end of the Transition Period, the UK will no longer continue to be part of the EU ETS. The UK government is committed to carbon pricing policy and the future approach will be as least as ambitious as the EU ETS.

<sup>294</sup> ONS's Population Projections, October 2019,

[www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2018based](http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2018based)

<sup>295</sup> Fossil Fuel Price Assumptions, 2018, [www.gov.uk/government/publications/fossil-fuel-price-assumptions-2018](http://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2018)

<sup>296</sup> Carbon valuation, April 2019, [www.gov.uk/government/collections/carbon-valuation--2](http://www.gov.uk/government/collections/carbon-valuation--2)

**Table 20: Exchange Rates, Against Sterling**

2018 prices	2018	2020	2025	2030	2035
Euros (€ per £)	1.1	1.1	1.1	1.1	1.1
US Dollars (\$ per £)	1.4	1.4	1.4	63.0	63.0

Making assumptions about fossil fuel prices far into the future is very challenging, as they depend on many unknowns (e.g. future economic growth rates across the world, development of new technologies, global climate change policies, technological developments and strategies of resource holders). BEIS produces a set of fossil fuel price assumptions based on available evidence around fundamentals and their potential development over time to yield a plausible range for future prices. We need these assumptions for long-term modelling of the UK energy system and economic appraisal. They are not forecasts of future energy prices.

We combine scenarios of high supply with low demand and low supply with high demand to construct the long term low and high price assumptions for each fuel. This yields long term price assumptions that span a wide range of possible outcomes. While the long-term demand projections and supply outlooks are from different sources, we consider that these combinations are plausible for each fuel.

## The Carbon Price

Carbon pricing provides a cost-effective and technology-neutral way of reducing carbon emissions and mobilising the private sector. In the UK, the EU Emissions Trading System (EU ETS) and the Carbon Price Support (CPS) in GB, have already helped to drive a switch from coal to gas generation in the power sector.

Until the end of 2020 the UK will continue to participate in the EU ETS. UK government and Devolved Administrations are firmly committed to carbon pricing as an effective tool for achieving carbon emissions reductions and a consultation on The Future of UK Carbon Pricing, was carried out from May to July in 2019, to seek views on policy proposals after the UK's exit from the EU. The UK future approach will be at least as ambitious as the current EU ETS, will provide a smooth transition for relevant sectors and will form part of the UK's pathway to its net zero target to end its contribution to global warming by 2050.

BEIS' short-term traded carbon values for modelling purposes, under current arrangements, are used to demonstrate the financial cost of purchasing allowances under the EU ETS. Its counterpart, the short-term traded carbon values for UK public policy appraisal are produced for the period up to 2020 under all three scenarios (central, high and low), and are linearly extended beyond 2020 to reach BEIS's long-term carbon values for the period from 2030 onward. BEIS's latest short-term traded values can be found in the Updated Short-Term Traded Carbon Values publication.<sup>297</sup>

### 4.1.iv Technology cost developments

Electricity generation costs are a fundamental part of energy market analysis, and a good understanding of these costs is important when analysing and designing policy.

<sup>297</sup> Carbon valuation, April 2019, [www.gov.uk/government/collections/carbon-valuation--2](http://www.gov.uk/government/collections/carbon-valuation--2)

BEIS regularly produces updated estimates of the costs and technical specifications for different generation technologies.

Costs in the report are presented as levelised costs, which is a measure of the average cost per MWh generated over the full lifetime of a plant including planning costs, construction costs, operating costs, and carbon costs. It reflects the cost of building, operating and decommissioning a generic plant for each technology. Potential revenue streams are not considered.

BEIS's most recent assessment of electricity generation costs can be found in the Electricity Generation Cost Report<sup>298</sup> which covers both renewable and non-renewable technologies; Table 21 (below) gives the most recent levelised cost estimates for key technologies in a range of commissioning years from this report.

**Table 21: Levelised Cost Estimates for NOAK Projects Commissioning in 2025**

Technology-specific Hurdle rates, £/MWh, 2018 prices	CCGT H Class	OCGT 600MW (500hrs)	Offshore Wind	Large Scale Solar PV	Onshore Wind
Pre-Development Costs	0	5	3	3	3
Construction Costs	7	63	31	30	27
Fixed O&M	2	18	19	10	10
Variable O&M	4	4	3	0	6
Fuel Costs	40	61	0	0	0
Carbon Costs	31	48	0	0	0
Decommissioning and Waste	0	0	1	0	0
<b>Total</b>	<b>84</b>	<b>197</b>	<b>57</b>	<b>44</b>	<b>46</b>

<sup>298</sup> Electricity Generation Cost Report, 2019, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/566567/BEIS\\_Electricity\\_Generation\\_Cost\\_Report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/566567/BEIS_Electricity_Generation_Cost_Report.pdf)

## 4.2 Decarbonisation

### 4.2.1 GHG emissions and removals

#### *i Trends in current GHG emissions and removals in the EU ETS, effort sharing and LULUCF sectors and different energy sectors*

In this section we first examine historic trends of GHG emissions in the UK as well as historical development in emissions by sector. Projections of future emission trends in the UK are then discussed, which are based on the 2018 GHG inventory.<sup>299</sup>

#### **Historical emissions trends**

This section references statistics from the UK's latest Greenhouse Gas Emissions Inventory (1990-2017).<sup>300</sup> The UK GHGI is an inventory tool that provides insight into the sources and magnitudes of greenhouse gas emissions in the UK. The UK GHGI is compiled in line with international guidance from the International Panel on Climate Change (IPCC) and contains the UK's official estimates of greenhouse gas emissions from 1990 to the latest available year of reporting, currently 2017. Note that the latest projected emissions referenced in the next section (Energy and Emissions Projections 2018284) are based on a slightly older inventory (1990-2016).<sup>301</sup> Any other datasets are referenced throughout.

UK net GHG emissions decreased by 42% between 1990 and 2017 as shown by Figure 4.<sup>302</sup> This has been driven by several factors such as restructuring in the energy supply industry (concerted move away from coal towards the use of gas and renewables), energy efficiency, pollution control measures in the industrial processes sector and other policies that reduced emissions of non-CO<sub>2</sub> GHGs, most notably the increase in landfill methane capture and oxidation. Between 1990 and 2017, UK net CO<sub>2</sub> emissions decreased by 37%. In 2017, net CO<sub>2</sub> emissions made up approximately 81% of all net GHG emissions. More details can be found in the UK's annual GHG emissions inventory.

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<sup>299</sup> Updated UK energy and emissions projections: 2018 [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

<sup>300</sup> Final Greenhouse Gas Emissions Statistics: 1990-2017, BEIS, [www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017](http://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017)

<sup>301</sup> Final UK greenhouse gas emissions national statistics 1990-2016 [www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2016](http://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2016)

<sup>302</sup> Covers total UK emissions excluding the impact of Gibraltar.

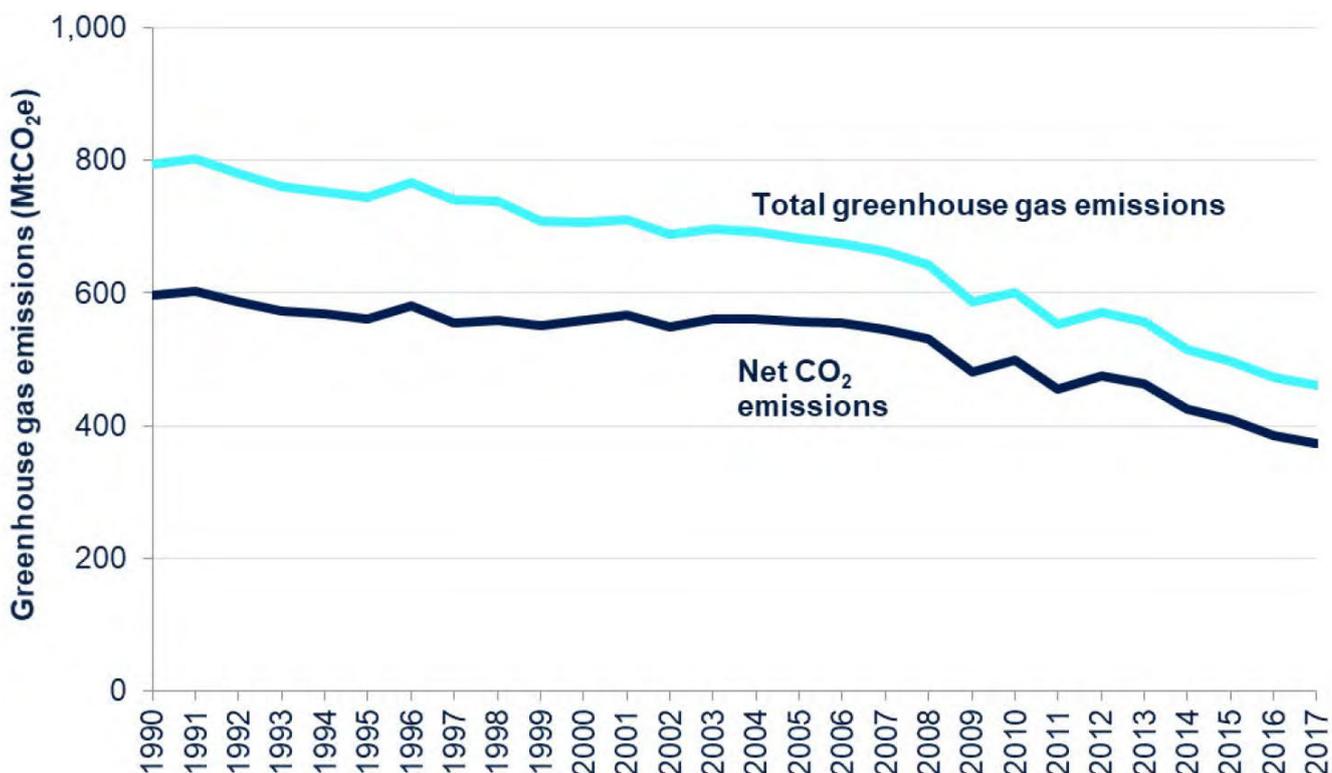
**Figure 4: UK net GHG emissions, UK only, 1990–2017, MtCO<sub>2</sub>e**


Table 22 below summarises the UK’s historical GHG emissions by National Communications source sector.

**Table 22: Net UK GHG emissions by national communications source sector, UK only, 1990-2017, MtCO<sub>2</sub>e**

Source sector	1990	1995	2000	2005	2010	2015	2016	2017
Transport	128.1	129.7	133.3	136.0	124.5	123.5	125.9	125.9
Energy supply	277.9	238.0	221.6	231.5	207.4	145.3	121.8	112.6
Business	114.0	111.8	115.4	108.9	94.1	85.1	81.4	80.1
Residential	80.1	81.6	88.7	85.7	87.5	67.4	69.8	66.9
Agriculture	54.0	52.9	50.3	47.9	44.6	45.1	45.2	45.6
Waste management	66.6	69.1	62.9	49.0	29.7	20.6	20.0	20.3
Industrial processes	59.9	50.8	27.1	20.6	12.6	12.7	10.6	10.8
Public	13.5	13.3	12.1	11.2	9.5	8.0	8.2	7.8
LULUCF	0.3	-1.7	-3.9	-7.1	-9.1	-9.7	-9.8	-9.9
Total	794.4	745.6	707.5	683.7	600.9	498.0	473.1	460.2

The emissions in Figure 4 and Table 22 above have been reported on the same basis as the UK Climate Change Act, covering the UK only and excluding Gibraltar.

## Historical developments by sector

### Transport

The transport sector consists of emissions from road transport, railways, domestic aviation, shipping, fishing and aircraft support vehicles. Transport accounted for just over a quarter (27%) of UK GHG emissions in 2017. Since 1990 emissions in this sector have reduced by around 2%. These emissions are predominantly from road transport, and the volume of road traffic increased over this period.<sup>303</sup> However, this was largely offset by lower petrol consumption outweighing an increase in diesel consumption<sup>304</sup> and, more recently, improvements in fuel efficiency of both petrol and diesel cars.<sup>305</sup> The number of registered vehicles increasing over the same period from 24.7 million to 37.7 million.<sup>306</sup>

### Energy supply

The energy supply sector consists of emissions from fuel combustion for electricity generation and other energy production sources. In 2018, CO<sub>2</sub> emissions from power stations accounted for nearly 18% of the UK's total CO<sub>2</sub> emissions.<sup>307</sup> However, overall emissions per GWh of electricity generated have been decreasing as the mix of fuels used has changed. There have been large reductions in coal use and big increases in renewables, with biomass conversions also playing an important transitional role. This is also coupled with general improvements in the efficiency of our economy.

For context, in 2018, nearly 53% of our electricity came from low-carbon sources, with the rest mainly coming from gas.<sup>308</sup> Coal use fell to record low levels in 2017; on 21 April 2017, Great Britain did not use any coal for a 24-hour period for the first time since 1882.<sup>309</sup> Further, in May 2019, the UK went a record 18 days without using coal.<sup>310</sup> The UK government has also committed to ending all unabated coal generation from 2025, while at the same time ensuring a secure supply of electricity.

### Business

The business sector includes emissions from combustion in industrial/commercial sectors, industrial off-road machinery, and refrigeration and air conditioning. In 2017, emissions from this sector were estimated to be 30% below 1990 levels and represented an estimated 17% of

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<sup>303</sup> DfT (2017) Road traffic estimates in Great Britain: 2017 [www.gov.uk/government/statistics/road-traffic-estimates-in-great-britain-2017](http://www.gov.uk/government/statistics/road-traffic-estimates-in-great-britain-2017) Measured in 'vehicle miles' which combines the number of vehicles on the road and how far they drive.

<sup>304</sup> Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0301 (ENV0101) Petroleum consumption by transport mode and fuel type: United Kingdom from 2000: [www.gov.uk/government/statistical-data-sets/tsqb03](http://www.gov.uk/government/statistical-data-sets/tsqb03)

<sup>305</sup> Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0303 (ENV0103) Average new car fuel consumption: Great Britain from 1997, [www.gov.uk/government/statistical-data-sets/tsqb03](http://www.gov.uk/government/statistical-data-sets/tsqb03)

<sup>306</sup> DfT (2017) Licensed vehicles and new registration tables, [www.gov.uk/government/statistical-data-sets/all-vehicles-veh01](http://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01)

<sup>307</sup> Digest of UK Energy Statistics (DUKES) 2019, Chapter 5 [www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes](http://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes)

<sup>308</sup> Digest of UK Energy Statistics (DUKES) 2019, Chapter 5 [www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes](http://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes)

<sup>309</sup> Financial Times (2017) Britain passes historic milestone with first days of coal-free power [www.ft.com/content/fc2c8d12-191d-11e6-bb7d-ee563a5a1cc1](http://www.ft.com/content/fc2c8d12-191d-11e6-bb7d-ee563a5a1cc1) BEIS (2017) Energy Trends June 2017 [www.gov.uk/government/collections/energy-trends](http://www.gov.uk/government/collections/energy-trends)

<sup>310</sup> <https://environmentjournal.online/articles/uks-longest-ever-coal-free-run-comes-to-an-end/>

total emissions. Several factors contributed to this decrease; primarily due to a reduction in emissions from industrial combustion, including iron and steel, which has led to a 41% reduction in CO<sub>2</sub> emissions since 1990. Each tonne of steel produced in the UK requires 40% less energy to produce than 40 years ago.<sup>311</sup>

## **Residential**

Emissions in the residential sector arise from fuel combustion for heating, cooking, garden machinery, and fluorinated gases released from aerosols and metered dose inhalers (such as those used for asthma sufferers). In 2017 residential sector emissions made up 15% of the UK total, estimated as 67 MtCO<sub>2</sub>e, compared to 1990 emissions of 80 MtCO<sub>2</sub>e, a reduction of 16%. A number of factors have had a major influence on emissions from homes, including a growth in demand for underlying energy services (such as warmer homes and hot water) and background improvement in energy efficiency.

## **Agriculture**

The agriculture sector consists of emissions from livestock and agricultural soils, stationary combustion sources and off-road machinery (e.g. tractors). There are also small amounts of emissions of CO<sub>2</sub> from the breakdown of pesticides. It is estimated to have been responsible for 10% of UK greenhouse gas emissions in 2017. In 1990, GHG emissions from agriculture were estimated to be 54 MtCO<sub>2</sub>e or 7% of total UK GHG emissions. Emissions from this sector have fallen by an estimated 16% between 1990 and 2017. This was driven by a fall in animal numbers over the period, together with a decrease in synthetic fertiliser use.

## **Waste management**

The waste management sector includes emissions from waste disposed to landfill sites, waste incineration, and the treatment of waste water. It is estimated to have been responsible for 4% of UK greenhouse gas emissions in 2017. The vast majority of these emissions are from landfill sites. Emissions from disposal of waste have decreased by 69% since 1990. This was due to a combination of factors, including improvements in the standards of landfilling, changes to the types of waste going to landfill (such as reducing the amount of biodegradable waste), and an increase in the amount of landfill gas being used for energy.

## **Industrial processes**

The industrial processes sector consists of emissions from industry except for those associated with fuel combustion. It is estimated to have been responsible for 2% of UK greenhouse gas emissions in 2017. The largest source of emissions was cement production, with other processes such as sinter, lime, and iron and steel production also contributing significantly. Industrial process emissions have decreased by an estimated 82% since 1990. This was most notably due to a large reduction in emissions from adipic acid production and halocarbon production between 1998 and 1999 (combined emissions from which are now almost zero).

## **Public sector**

The public sector consists of emissions from combustion of fuel in public sector buildings. It is estimated to have been responsible for less than 2% of UK greenhouse gas emissions in 2017. The main source of emissions from this sector is the use of natural gas for heating public

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<sup>311</sup> WSP and Parsons Brinckerhoff & DNV GL (2015) Report prepared for DECC & BIS: Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050 [www.theccc.org.uk/2015/03/27/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050/](http://www.theccc.org.uk/2015/03/27/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050/)

buildings. Public sector emissions fell from an estimated 13 MtCO<sub>2</sub>e in 1990 to 8 MtCO<sub>2</sub>e in 2017, a reduction of 42%.<sup>312</sup>

### Land use, land use change and forestry (LULUCF)

The LULUCF sector consists of emissions and removals from forest land, cropland, grassland, settlements and harvested wood products. In the UK the LULUCF sector is estimated to have gone from a small net emitter of greenhouse gases in 1990 (0.3 MtCO<sub>2</sub>e) to a net sink in every year from 1991-2017, with the estimated size of the sink in 2017 being 9.9 MtCO<sub>2</sub>e. This has been driven by a reduction in emissions from land being converted to cropland and an increase in the sink provided by forest land. There has also been some reduction in emissions since 1990 due to less intensive agricultural practices.

### EU Effort Sharing Decision

Under the ESD, the United Kingdom has a target of reducing its total emissions to 16% below the 2005 level by 2020 for non-ETS sectors.

In November 2018 the European Commission confirmed for each Member State their performance against ESD for 2016.<sup>313</sup> UK greenhouse gas emissions for 2016 under the ESD were confirmed to be 333.9 MtCO<sub>2</sub>e, 11.3 MtCO<sub>2</sub>e below the UK's annual limit for 2016 of 345.2 MtCO<sub>2</sub>e, meaning that the UK met its fourth annual target in the period. Provisional estimates indicate that greenhouse gas emissions for 2017 under the Effort Sharing Decision will also be below the annual emissions limit, by around 29 MtCO<sub>2</sub>e.

**Table 23: Progress towards the EU Effort Sharing Decision, UK and Gibraltar, 2013-2017, MtCO<sub>2</sub>e**

	2013	2014	2015	2016	2017
Total greenhouse gas emissions excl. LULUCF and NF3 (A)	566.5	524.0	503.5	482.8	470.5
Total verified emissions from stationary installations under the EU ETS (B)	225.3	197.9	175.9	147.4	137.0
CO <sub>2</sub> emissions from civil aviation (C)	1.7	1.6	1.6	1.5	1.6
Total ESD emissions (D = A - B - C)	339.5	324.4	326.0	333.9	331.9
Annual emissions allocation (E)	358.7	354.2	349.7	345.2	360.4
<b>Difference (E - D)</b>	<b>19.3</b>	<b>29.8</b>	<b>23.7</b>	<b>11.3</b>	<b>28.5</b>

### EU Emissions Trading System

Until the end of 2020 the UK will continue to participate in the EU ETS. UK government and Devolved Administrations are firmly committed to carbon pricing as an effective tool for achieving carbon emissions reductions and a consultation on The Future of UK Carbon Pricing

<sup>313</sup> Greenhouse Gas Emissions under the Effort Sharing Decision 2018 dataset, European Environment Agency: [www.eea.europa.eu/data-and-maps/data/esd-1](http://www.eea.europa.eu/data-and-maps/data/esd-1)

was carried out from May to July in 2019, to seek stakeholder views on policy proposals after the UK's exit from the EU.

Phase II of the EU ETS coincided with the first Kyoto Commitment Period (2008-12). During this period each Member State held a specific quantity of allowances based on their EU-approved National Allocation Plan (NAP). This then resulted in net 'sales' or 'purchases' of emissions allowances reported from UK installations depending on whether total emissions were below or above the UK's Phase II allocation.<sup>314</sup>

The third phase of the EU ETS (2013-20) builds upon the previous two phases and has been significantly revised to make a greater contribution to tackling climate change. Amongst other changes to the operating rules, the system shifted away from NAPs in favour of an EU-wide cap on the number of available allowances across Member States. In the absence of a UK-specific allocation plan, a notional cap has been estimated for the purpose of calculating carbon budget performance. Further details of this methodology are laid out in the UK's Annual Statement of Emissions.<sup>315</sup>

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<sup>314</sup> A negative net value indicates that the reported emissions from UK installations in the EU ETS were below the cap, i.e. there was a net selling or withholding of units by UK installations. This means that emissions are either emitted elsewhere or emitted at a later stage, so they may not be used to offset UK emissions. The opposite occurs when reported emissions from EU ETS installations exceed the cap.

<sup>315</sup> UK Annual Statement of emissions for 2017: [www.gov.uk/government/publications/annual-statement-of-emissions-for-2017](http://www.gov.uk/government/publications/annual-statement-of-emissions-for-2017).

**Table 24: EU ETS net trading position as reported for carbon budgets performance, UK, 2008-2017, MtCO<sub>2</sub>e<sup>316,317</sup>**

	Phase 1					Phase 2				
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Net purchases/(sales) by UK installations	19.3	(13.5)	(7.6)	(24.9)	(14.5)	44.2	59.1	29.1	1.3	(27.6)
Net cancelled unallocated allowances/(sales) by UK government	0.9	0.9	0.9	0.9	0.9	-	-	-	-	-
Net UK domestic aviation emissions against aviation cap	-	-	-	-	-	(0.1)	(0.3)	(0.2)	(0.3)	(0.3)
Net UK purchases/(sales)	20.2	(12.6)	(6.7)	(24.0)	(13.6)	44.1	58.8	28.9	1.0	(27.9)

## Emission projections

The 2018 Energy and Emissions Projections<sup>318</sup> underpin the discussion of future trends below. In them, our estimates of future energy demand and greenhouse gas emissions extend to 2035. They incorporate information from the 2018 Inventory (latest actuals 2016). This means that the figures underlying the projections we discuss are slightly different to those in the section on historical trends, which uses data from the 2019 Inventory. However, the broad patterns we present are unlikely to change much when we incorporate the new data.<sup>319</sup> The UK updates its national emissions projections for CO<sub>2</sub> and the other GHGs annually to take account of new data. These include revisions to policy savings estimates, fossil fuel prices, carbon price projections, growth projections, and cost estimates for the power sector. We also regularly review and improve the underlying energy and emissions projection models. Projections presented here are from the 'with existing measures' scenario in contrast to the national emissions projections report which refers to 'with additional measures' (also called the reference scenario).

<sup>316</sup> At the end of Phase II of the EU ETS, the UK was required to cancel all allowances which have not been either issued or auctioned by that point. Consequently, allowances totalling 4.5 MtCO<sub>2</sub>e were cancelled in 2012. This had the effect of reducing the overall cap for the whole of Phase II. For presentational purposes, this amount has been distributed evenly over the five years 2008-2012, effectively reducing the cap by 0.9 MtCO<sub>2</sub>e each year, [www.gov.uk/government/statistics/final-statement-for-the-first-carbon-budget-period](http://www.gov.uk/government/statistics/final-statement-for-the-first-carbon-budget-period). Domestic aviation emissions are included in carbon budgets accounting from 2013. From 2013, the EU ETS entered its third phase, which will end in 2020. Changes to the operating rules in this period mean that Member States no longer receive a national cap as the ETS operates at installation level. Therefore a 'notional' cap is estimated for the purpose of carbon budgets accounting.

<sup>317</sup> At the end of Phase II of the EU ETS, the UK was required to cancel all allowances which have not been either issued or auctioned by that point. Consequently, allowances totalling 4.5 MtCO<sub>2</sub>e were cancelled in 2012. This had the effect of reducing the overall cap for the whole of Phase II. For presentational purposes, this amount has been distributed evenly over the five years 2008-2012, effectively reducing the cap by 0.9 MtCO<sub>2</sub>e each year. Domestic aviation emissions are included in carbon budgets accounting from 2013.

From 2013, the EU ETS entered its third phase, which will end in 2020. Projections of sectoral developments with existing national and Union policies and measures at least until 2040 (including for the year 2030).

<sup>318</sup> Updated EEP 2018, [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

<sup>319</sup> This statistical release explains how the Inventory has changed:

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/776085/2017\\_Final\\_emissions\\_statistics\\_-\\_report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/776085/2017_Final_emissions_statistics_-_report.pdf)

We use a set of key assumptions about future UK economic growth, demographic changes and fuel price trajectories to underpin the projections. These mainly come from the forecasts made by the UK's Office for Budget Responsibility and the Office for National Statistics (BEIS produces the fuel prices). We publish all the main assumptions we use with the projections.<sup>320</sup>

The UK produces energy and emissions projections to 2035. The development required to produce projections to 2040 is ongoing and we will publish projections to 2040 under our national reporting framework from 2020 onwards.

## **The Carbon Price**

Putting a price on emissions provides a cost-effective and technology-neutral way of reducing carbon emissions and mobilising the private sector. In the UK, pricing policies like Carbon Price Support (CPS), and the EU Emissions Trading System (EU ETS) have already helped to drive a switch from coal to gas generation in the power sector.

## **The Carbon Price Support rate**

In Great Britain, the Total Carbon Price (TCP) for energy generation is made up of the EU Emissions Trading System price and the Carbon Price Support (CPS) rate. The CPS was implemented to support the EU ETS and underpins the price of carbon at a level that drives low-carbon investment and taxes fossil fuels used to generate electricity. The CPS rate does not apply to energy generators in Northern Ireland.

HM Treasury confirms CPS rates in advance of delivery at Budget, and all revenue from the CPS is retained by the Treasury.

## **Past rates**

The CPS rate was introduced in April 2013. At Budget 2014, the UK government announced that the CPS rate would be capped at £18/tCO<sub>2</sub> from 2016-17 to 2019-20 to limit the competitive disadvantage faced by business and reduce energy bills for consumers. At Budget 2016, the cap was maintained at £18/tCO<sub>2</sub> from 2016-17 to 2019-20. At Budget 2018, the UK government announced that CPS rates will be frozen at £18/CO<sub>2</sub> in 2020-21 following the rise in the EU ETS price. From 2021-22, the UK government will seek to reduce CPS rates if the TCP remains.

The UK considers that long-term certainty on carbon pricing is crucial for businesses, and, as set out in the CGS, is committed to a robust carbon price. The UK remains firmly committed to carbon pricing as an emissions reduction tool, whilst ensuring energy and trade intensive businesses are appropriately protected from any detrimental impacts on competitiveness.

BEIS' short-term traded carbon values for modelling purposes are used to demonstrate the financial cost of purchasing allowances under the EU ETS. The short-term traded carbon values for UK public policy appraisal are produced for the period up to 2020 under all three scenarios (central, high and low), and are linearly extended beyond 2020 to reach BEIS's long-term carbon values for the period beyond 2030. These long-term carbon values reflect the costs required to limit global temperature increases to 2 degrees centigrade above pre-

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<sup>320</sup> See also:

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/802478/Annex-m-price-growth-assumption\\_16-May-2019.ods](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/802478/Annex-m-price-growth-assumption_16-May-2019.ods)

industrial levels. BEIS's latest short-term traded values can be found in the Updated Short-Term Traded Carbon Values publication.<sup>321</sup>

*4.2.1. ii Projections of sectoral developments with existing national policies and measures at least until 2040 (including for the year 2030)*

### **Emissions projections by sector**

In this section, we present values from the 'With Existing Measures' projection scenario. These include those policies which have been implemented or adopted: they exclude planned measures. These data are taken from the 2018 Energy and Emissions Projections (EEP).<sup>322</sup> The primary purpose of the EEP is to provide an indication of the UK's performance against carbon budgets. The last carbon budget set, carbon budget 5, ends in 2032, and the UK has not yet produced a projection out to 2040. The development required to produce projections to 2040 is ongoing and we will publish projections to 2040 under our national reporting framework from 2020 onwards.

We project that UK GHG emissions including LULUCF will be around 399 MtCO<sub>2</sub>e, (about 50% below the 1990 level) by 2020 and roughly 365 MtCO<sub>2</sub>e by 2030 (54% below the 1990 level).<sup>323</sup> The percentages are very similar if we exclude LULUCF. Table 25 shows our projections of emissions by sector.

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<sup>321</sup> Carbon valuation, January 2018, [www.gov.uk/government/collections/carbon-valuation--2](http://www.gov.uk/government/collections/carbon-valuation--2)

<sup>322</sup> Energy and Emissions Projections 2018, [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

<sup>323</sup> See

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/802475/Annex-a-greenhouse-gas-emissions-by-source\\_16-May-2019\\_.ods](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/802475/Annex-a-greenhouse-gas-emissions-by-source_16-May-2019_.ods)

**Table 25: Projected greenhouse gas emissions by sector, MtCO<sub>2</sub>e (with existing measures, UK coverage)**

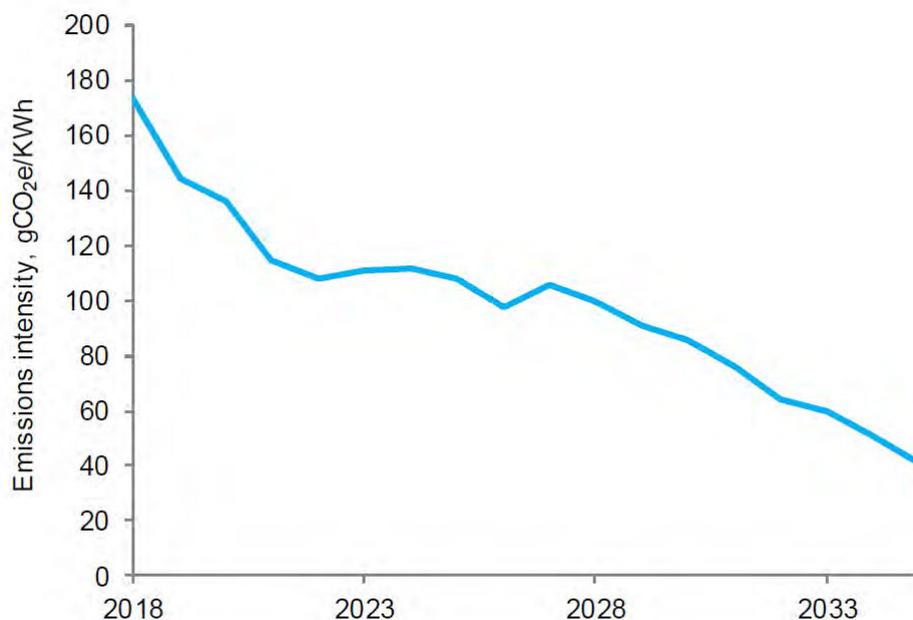
Sector	Projections, MtCO <sub>2</sub> e				
	2018	2020	2025	2030	2035
Transport	120	116	109	105	102
Energy supply	82	70	59	56	45
Business	89	83	73	69	69
Residential	71	68	70	73	77
Agriculture	46	44	42	41	41
Waste management	18	16	15	14	13
Industrial processes	11	11	10	9	9
Public	7	7	7	7	8
LULUCF	-16	-16	-14	-11	-8
<b>Total</b>	<b>428</b>	<b>399</b>	<b>370</b>	<b>365</b>	<b>356</b>
<i>Change from 1990 (%)</i>	<i>-46</i>	<i>-50</i>	<i>-53</i>	<i>-54</i>	<i>-55</i>

## Transport

We project transport emissions will be around 10% lower than 1990 levels by 2020 and 18% lower by 2030. We also project that the underlying growth in road transport use will resume following the interruption of the recession in 2008. However, we expect that measures to improve vehicle efficiency or to directly reduce emissions (such as mandating greater use of biofuels and providing incentives to encourage the adoption of electric vehicles), will reduce annual emissions between now and 2030.

Energy Supply By 2020, we project energy supply emissions will be 75% lower than 1990 levels and 80% lower by 2030. Following recent sharp falls in coal-fired generation, we project a further gradual decline in fossil fuel-based generation out to 2035: it is displaced by more renewables and (eventually) nuclear generation in the 2030s. As a consequence, we project emissions from electricity production will fall steadily over the full period to 2035. Figure 5 shows this.

**Figure 5: Emissions intensity of electricity supply (UK coverage, with additional measures), gCO<sub>2</sub>e/KWh**



### Business

We project that emissions in this area will be 28% lower than 1990 levels by 2020, and 40% lower by 2030. We can attribute improvements over time to the impact of policies that encourage energy efficiency, such as building regulations and minimum energy efficiency standards for new products, together with economic measures such as the Carbon Reduction Commitment and the Renewable Heat Incentive.

### Residential

The principal long-term driver of emissions from UK households is household numbers themselves. We project these will increase over the whole period due both to population growth in the UK and to a continuing trend for households to be smaller. Up to 2020, the impact of increases in population and housing are offset by the impact of existing energy and emission reduction policies through (for example) improved insulation of homes. The overall impact of these factors is projected to increase domestic emissions by 7 MtCO<sub>2</sub>e (9%) by 2035 compared with 2018.

### Agriculture

Our projections suggest that emissions from this sector will decline by around 7% between 2020 and 2030. The CGS set out further proposals for the agricultural sector: we want low emission, highly productive land while ensuring we pass the environment on to the next generation in a better state than we received it.

### Waste management

Waste emissions from landfill have fallen since 1990 because more waste is being preferentially disposed of in alternative ways (incineration, biological waste treatment (BWT) and recycling). This is largely due to introduction of the Landfill Tax in 1996 and small improvements in landfill efficiency. Emissions are expected to continue to fall due to government measures, including actions outlined in the Resources and Waste Strategy for England, incentivising material to be managed higher up the waste hierarchy. These include

introduction of consistency in recycling collections, extended producer responsibility for packaging and a deposit return scheme for drinks containers for which we will consult on our final proposals in 2021. Targets to recycle 65% of municipal waste (by weight) by 2035 and reduce municipal waste sent to landfill to 10% or less by 2035 are also set to reduce the tonnage of material sent to landfill and the resulting GHG emissions.

### **Industrial processes**

By 2020, we project that emissions from industrial processes will fall to 82% below 1990 levels and 84% below by 2030.

### **Public**

We project emissions from public services will remain broadly constant until the mid-2020s before rising slightly in the late 2020s and 2030s.

### **Land Use, Land Use Change and Forestry**

The UK tracks progress by annually projecting removals and emissions in the land use, land use change and forestry (LULUCF) inventory sector, based on the most recent emission inventory. Projections in Table 25 above show that the sector is expected to remain a net sink but of smaller magnitude over the coming decade.

The UK has domestic carbon targets which are to deliver a reduction of 57% in 2028 to 2032 compared to 1990 on a reported basis. To assist with meeting these targets there are a number of recent policy initiatives that will further reduce emissions and strengthen removals in the sector.

- The UK Clean Growth Strategy puts land in a central role in delivering climate mitigation. We are committed to; accelerating tree planting, having a stronger and more effective domestic carbon offsetting market, unlocking private sector investment through forestry investment zones, restoring peatlands and encouraging the use of wood in construction. We will seek to overcome the decline in soil health and support innovation in the forestry sector.
- The 25 Year Environment Plan provides a strategy to protect and enhance the natural environment. The Plan provides targets for a range of environmental outcomes which include cutting greenhouse gas emissions including from land use, land use change, the agriculture sectors.
- Forest development will be supported through rural development programmes, the woodland creation planning grant helps enable projects to develop and the Forestry Investment Zones.
- The Woodland Carbon Fund announced in 2016, supports the planting of large productive woodland in England.
- The Woodland Carbon Guarantee, announced during the Autumn 2018 Budget Statement, will support the price of woodland carbon credits. The scheme is intended to provide up to £50m of support over its lifetime and helps to meet our commitment in the 25 Year Environment Plan and Clean Growth Strategy to strengthen the market for domestic offsets.
- In the 2018 Autumn Budget Statement, £10m of funding for up to 130,000 urban trees was announced leading to the Urban Tree Challenge competition.

- The UK government have provided grants to encourage the restoration of English peatlands for example in 2018 they provided £10m for 4 landscape scale projects seeking to restore 6,850 hectares.
- In Northern Ireland, Scotland and Wales responsibility sits with the relevant Devolved Administration who have funded a number of landscape carbon mitigation initiatives. For example; the Scottish Government has committed £11m to restore 20,000 hectares of peatland by 2020 and 250,000 by 2030. The Welsh Government is seeking to restore 66,000 ha of seminatural bog to good condition.

## 4.2.2 Renewable energy

*i Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors*

All tables used in this section are 2018 outturn data, taken from Digest of UK Energy Statistics 2019, Tables 6.6 and 6.7.<sup>324</sup> Tables 26 to 29 use data from Table 6.7 which is measured using net calorific values; it also normalises wind and hydro generation and includes only heat pumps with a seasonal performance factor above 2.5. In contrast, Tables 30 to 33 use data from Table 6.6 which uses gross calorific values and includes all heat pumps.

Table 26 shows that renewable energy makes up 11% of capped gross final energy consumption. Of all final consumption of renewable energy, electricity generation makes up over 60%, heating and cooling almost 30% and transport biofuels less than 10%.

**Table 26: Overall renewables**

Sector	Thousand tonnes of oil equivalent (measured using net calorific values)
Electricity generation	9,395
Heating and cooling	4,073
Transport biofuels (restricted to those meeting sustainability criteria from 2011)	1,270
Total Final Consumption of Renewable Energy	14,738
Capped Gross Final Energy Consumption (CGFEC)	134,230
Share of renewable energy in gross final energy consumption (headline 2009 Renewable Energy Directive percentage) <sup>325</sup>	11.0%

<sup>324</sup> Digest of UK Energy Statistics 2019, [www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019](http://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019)

<sup>325</sup> Includes adjustments for losses, and generation own use of electricity, combined with the capping mechanism for air transport as specified in the Directive.

Table 27 shows the renewable make up of the electricity generation component; over 30% of all electricity came from renewable sources. This component has the highest renewable share, versus heating and cooling and transport. Half of all renewable electricity came from wind generation.

**Table 27: Electricity generation component**

Component	Thousand tonnes of oil equivalent (measured using net calorific values)
Total renewable generation from all compliant sources <sup>326</sup>	9,395
Total Gross Electricity Consumption <sup>327</sup>	30,237
Percentage of electricity from renewable sources	31.1%

Table 28 shows the renewable make-up of the heating component; around 7% of all heating and cooling came from renewable sources.

**Table 28: Heat component**

Component	Thousand tonnes of oil equivalent (measured using net calorific values)
Renewable energy for heating and cooling	4,073
Total Gross energy consumption for heating and cooling	56,042
Percentage of heating and cooling energy from renewable sources	7.3%

Table 29 shows the renewable make-up of the transport component. DUKES (2019)<sup>328</sup> states that around 6% of all energy used for transport came from renewable sources. This is largely made up of renewable electricity and compliant biofuels. However, this is an estimate; see DUKES (2018)<sup>329</sup> data for the most recent published actuals.

<sup>326</sup> The electricity figure under overall directive target excludes the renewable electricity component of transport to prevent double counting – this is the cause of the 4 ktoe discrepancy between renewable energy used for electricity generation and total renewable generation from all compliant sources.

<sup>327</sup> Excludes generation from pumped storage.

<sup>328</sup> See page 110 for transport component, DUKES 2019, [www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019](http://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019)

<sup>329</sup> DUKES 2018, dataset for main report, [www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2018-main-report](http://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2018-main-report)

**Table 29: Transport component (excluding air transport)**

Component <sup>330</sup>	Thousand tonnes of oil equivalent (measured using net calorific values)
Total transport component numerator (including weighted components)	1,270
Total transport component denominator (including weighted components)	41,620
Percentage of transport energy from renewable sources	6.2%

Table 30 shows the renewable sources used to generate electricity. Bioenergy makes up the largest proportion of this (58%), with plant biomass being the largest contributor within this. Onshore wind and offshore wind make up the next largest proportion of this; 17% and 15% respectively.

**Table 30: Renewable sources used to generate electricity**

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Onshore Wind	2,958	17%
Offshore Wind	2,295	15%
Marine energy <sup>1</sup>	1	0%
Solar photovoltaics	1,106	7%
Small scale hydro	111	1%
Large scale hydro <sup>2</sup>	361	2%
Bioenergy:	8,956	58%
of which Landfill gas	1,284	8%
of which Sewage gas	325	2%
of which Biodegradable energy from waste	1,405	9%
of which Co-firing with fossil fuels	0	0%
of which Animal biomass <sup>3</sup>	219	1%
of which Anaerobic digestion	879	6%

<sup>330</sup> Some sustainable biofuels are double weighted in the numerator of this calculation, as specified by the Directive.

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
of which Plant biomass <sup>4</sup>	4,843	31%
Total	15,428	100%
Non-biodegradable wastes <sup>5</sup>	1,411	-

<sup>1</sup> Wave and tidal stream, including EMEC test facility

<sup>2</sup> Excluding pumped storage stations.

<sup>3</sup> Includes heat from farm waste digestion, and meat and bone combustion.

<sup>4</sup> Includes heat from straw, energy crops, paper and packaging.

<sup>5</sup> Non-biodegradable part of municipal solid waste plus waste tyres, hospital waste, and general industrial waste.

Note: For wind, solar PV and hydro, the figures represent the energy content of the electricity supplied but for bioenergy the figures represent the energy content of the fuel used.

Table 31 shows the renewable sources used to generate heat. Similar to electricity, bioenergy makes up by far the largest proportion (81%), of which wood is the largest contributor (41% of total).

**Table 31: Renewable sources used to generate heat**

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Active solar heating	53	1%
Bioenergy:	4,412	81%
of which Landfill gas	14	0%
of which Sewage gas	83	2%
of which wood	2,239	41%
of which waste wood	321	6%
of which Animal biomass <sup>331</sup>	26	0%
of which Anaerobic digestion	394	7%
of which Plant biomass <sup>332</sup>	1,245	23%
of which Biodegradable energy from waste	91	2%
Deep geothermal	1	0%

<sup>331</sup> Includes heat from farm waste digestion, and meat and bone combustion.

<sup>332</sup> Includes heat from straw, energy crops, paper and packaging.

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Heat Pumps	979	18%
Total	5,445	100%
Non-biodegradable wastes <sup>333</sup>	165	-

Table 32 shows the renewable sources used as transport fuels. Biodiesel makes up the largest proportion, at 69%, while bioethanol makes up 31%.

**Table 32: Renewable sources used as transport fuels**

Fuel	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Bioethanol	429	31%
Biodiesel	935	69%
Total	1,364	100%

Table 33 shows the renewable sources used for total renewable energy. Bioenergy is the largest proportion, at over 60%, followed by onshore wind (12%) and offshore wind (10%).

**Table 33: Total use of renewable sources and wastes**

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Solar heating and photovoltaics	1,158	5%
Onshore wind	2,598	12%
Offshore wind	2,295	10%
Marine energy (wave and tidal stream)	1	0%
Hydro	472	2%
Bioenergy	13,369	60%

<sup>333</sup> Non-biodegradable part of municipal solid waste plus waste tyres, hospital waste, and general industrial waste.

Source	Energy values, thousand tonnes of oil equivalent (measured using gross calorific values)	Share of total
Deep geothermal	1	0%
Heat Pumps	979	4%
Transport biofuels	1,364	6%
Total	22,236	100%
Non-biodegradable wastes <sup>334</sup>	1,364	-

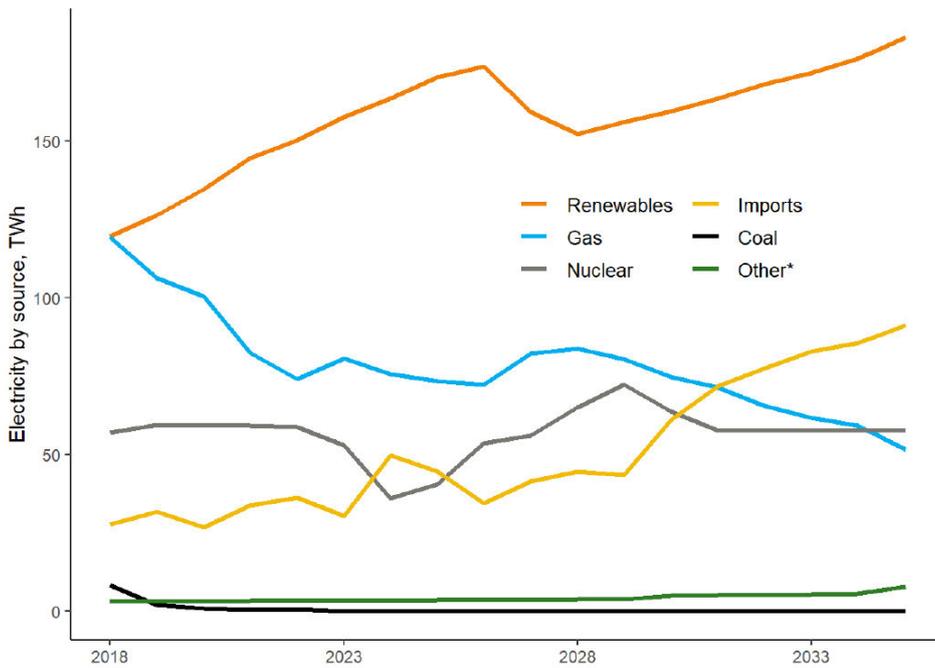
*ii Indicative projections of development with existing policies for the year 2030 (with an outlook to the year 2040)*

Under existing policies, EEP 2018 projects 159 TWh of renewable electricity generation by 2030. This is likely to be just over 50% of total electricity capacity. If we include planned policies, there could be 185 TWh of renewable electricity generation by then. This would be about 60% of all electricity generation. Note that up to 2020, this scenario reflects current power sector policies. After that year, it includes some assumptions that go beyond existing UK government policy and is therefore illustrative: the results do not indicate a preferred outcome.

We expect that renewables deployment will be sensitive to fossil fuel prices: if these are high, there could be as much as 209 TWh of renewable generation (65%) by 2030. Figure 6, below, shows the projections of generation by technology for all power producers to 2035.

<sup>334</sup> Non-biodegradable part of municipal solid waste plus waste tyres, hospital waste, and general industrial waste.

**Figure 6: UK electricity by source technology, TWh (with existing measures)**



\* Other includes generation from coal/gas Carbon Capture and Storage (CCS), oil, and from other thermal plants as well as electricity storage

Under the RTFO, renewable transport energy is expected to be 16% of total generation when including multipliers in 2030. This is expected to rise to 17% by 2032 which is where current projections finish. Forecasts show that there will be 33 TWh of renewable transport generation (excluding multipliers) in 2030, rising to 33.5 TWh by 2032.

Due to uncertainty on heat policy, please see section 2.1.2(ii) for indicative trajectories out to 2030.

## 4.3 Energy efficiency

*i Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)*

**Table 34: Primary and Final Energy Consumption<sup>335</sup>**

Energy consumption	2007	2015	2016	2017	2018	Unit
primary energy consumption	212.1	183.0	179.6	177.7	177.3	Mtoe (ncv)
total final energy consumption	145.2	131.0	132.8	132.6	134.0	Mtoe (ncv)
of which;						
industry	28.9	23.0	21.2	21.4	21.4	Mtoe (ncv)
transport (passenger)	42.2	38.1	38.4	39.2	39.2	Mtoe (ncv)
transport (freight)	14.4	13.9	14.5	14.7	14.6	Mtoe (ncv)
household	41.7	37.2	38.0	36.8	38.1	Mtoe (ncv)
services (excl agriculture)	17.2	17.8	19.2	19.0	19.2	Mtoe (ncv)
agriculture	0.9	1.0	1.5	1.5	1.5	Mtoe (ncv)

*ii Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling<sup>336</sup>*

### Cogeneration & district heating

In 2016, the Department of Energy & Climate Change published the national comprehensive assessment of the potential for combined heat and power (CHP) and district heating and cooling in the UK<sup>337</sup>, which laid out the technical and socially cost-effective potential for CHP (referred to as high-efficiency cogeneration in Member States) and efficient district heating and cooling in the UK, up to 2030. Table 35 sets out the conclusions of cost and benefit analysis to determine the social cost-effectiveness under three potential scenarios:

1. A scenario where there is no government policy around de-risking investments in infrastructure, and with IAG 2014 central scenario carbon prices ('full financing costs').
2. A scenario where the cost of securing the necessary finance is set at zero; in other words, a totally de-risked capital-raising scenario and with IAG central scenario carbon prices ('zero financing costs').

<sup>335</sup> Digest of UK Energy Statistics 2019, [www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019](http://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019)

<sup>336</sup> In accordance with Article 14(1) of Directive 2012/27/EU.

<sup>337</sup> Ricardo Energy & Environment (2015) Report for DECC: National Comprehensive Assessment of the Potential for Combined Heat and Power and District Heating and Cooling in the UK, [www.gov.uk/government/publications/the-national-comprehensive-assessment-of-the-potential-for-combined-heat-and-power-and-district-heating-and-cooling-in-the-uk](http://www.gov.uk/government/publications/the-national-comprehensive-assessment-of-the-potential-for-combined-heat-and-power-and-district-heating-and-cooling-in-the-uk)

3. A scenario with a very high carbon price of £500/tCO<sub>2</sub> for all years and the same assumption as 1 for cost of capital ('extreme carbon price').

**Table 35: Summary of UK cost-effective potential of high-efficiency solutions by scenario, TWh of heat output pa**

Solution	i) Full financing costs TWh pa	ii) Zero financing costs TWh pa	iii) Extreme carbon price TWh pa
High-efficiency, total	131	314	358
Individual	116	128	200
District heating	15	186	158
Conventional, total	334	168	120
Total heat output	465	481	477

**Table 36: Summary of the recent development of CHP<sup>338</sup>**

	Unit	2014	2015	2016	2017	2018
Number of schemes		2,071	2,130	2,224	2,409	2,473
Net No. of schemes added during year		47	59	94	185	64
Electrical capacity	MWe	5,888	5,708	5,625	5,919	5,985
Net capacity added during year	MWe	-32	-179	-83	293	66
Capacity added in percentage terms	%	-0.5	-3.0	-1.5	5.2	1.1
Heat capacity	MWh	22,223	20,091	19,975	20,586	20,722
Heat to power ratio		2.13	2.06	1.99	1.95	1.85
Fuel input	GWh	86,184	82,576	85,123	91,315	92,523
Electricity generation (CHP)	GWh	19,690	19,534	20,405	21,785	22,867
Heat generation (CHP)	GWh	41,950	40,234	40,671	42,521	42,416
Overall efficiency	%	71.5	72.4	71.7	70.4	70.6
Load factor (CHPQA)	%	38.2	39.1	41.4	42.0	43.6
Load factor (Actual)	%	52.3	51.0	60.0	56.4	57.2

<sup>338</sup> DUKES 2019, [www.gov.uk/government/statistics/combined-heat-and-power-chapter-7-digest-of-united-kingdom-energy-statistics-dukes](http://www.gov.uk/government/statistics/combined-heat-and-power-chapter-7-digest-of-united-kingdom-energy-statistics-dukes)

In the UK, Good Quality CHP denotes schemes that have been certified as being highly efficient through the UK's CHP Quality Assurance (CHPQA) programme. The criteria used are in line with the requirements for high efficiency CHP set down in the Energy Efficiency Directive (2012/27/EU). Table 36 shows the change in installed CHP capacity since 2001, when the CHPQA programme began. Installed capacity is now at 5,985 MWe, with 68 new schemes between 2017 and 2018.

In March 2018 BEIS published the first Experimental statistics on heat networks<sup>339</sup>, based on data collected under the Heat Network (Metering and Billing) Regulations. According to these, there are 2,087 heat networks in the UK, which supply 10,074 GWh of heating and hot water and 202 GWh of cooling.

*iii Projections considering existing energy efficiency policies, measures and programmes as described in section 1.2.(ii) for primary and final energy consumption for each sector at least until 2040 (including for the year 2030)<sup>340</sup>*

The UK's 2032 pathway, as set out by the CGS<sup>341</sup>, would result in changes in fuel consumption across the whole economy, with estimated impacts set out in Table 37 below. In total, the 2032 pathway would reduce final consumption by around 14% in 2032 relative to projected energy consumption under existing policies outlined in the 2016 EEP. This is as a result of further improvements in fuel efficiency. The reduction in fossil fuel consumption will help improve energy security but the pathway is also characterised by a shift from end-user fossil fuel consumption towards biomass and electricity.

**Table 37: Change in Annual Final Energy Consumption in 2032, Relative to the Existing Policies Scenario<sup>342</sup>**

	Potential saving (-) or additional consumption (+) in 2032 (TWh/year)	Percentage impact relative to existing policies
Electricity	+14	+4%
Gas	-124	-23%
Coal	-6	-38%
Oil	-126	-25%
Bioenergy	+28	+29%
<b>Total</b>	<b>-215</b>	<b>-14%</b>

<sup>339</sup> Experimental statistics on heat networks, March 2018 [www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks](http://www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-experimental-statistics-on-heat-networks)

<sup>340</sup> This reference business as usual projection shall be the basis for the 2030 final and primary energy consumption target which is described in 2.3 and conversion factors.

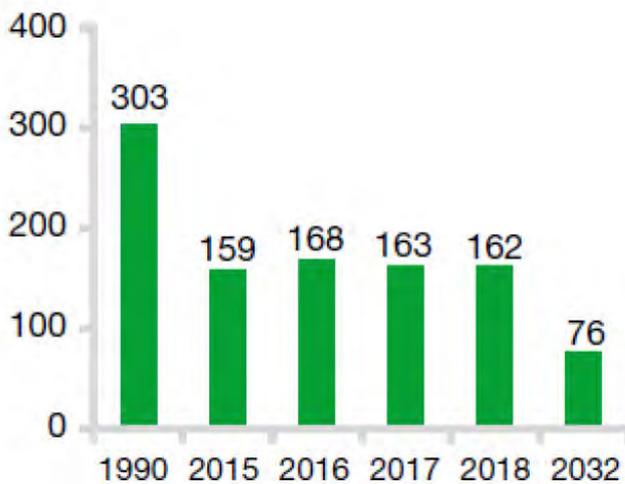
<sup>341</sup> Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>342</sup> Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

**Figure 7: Final Home Energy Use Per Household (MWh/household)<sup>343</sup>**



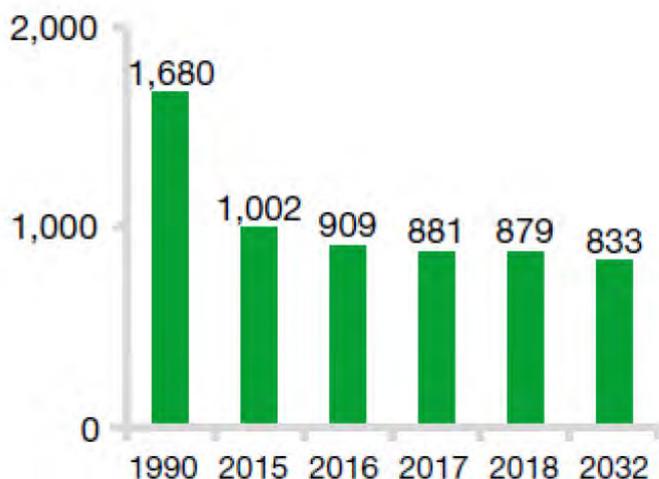
**Figure 8: Final Energy Use per £million Output for Non-Industrial Business and Public Sectors (MWh/£million)<sup>344</sup>**



<sup>343</sup> Committee on Climate Change's 2019 Progress Report: Government Response, [www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses](http://www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses)

<sup>344</sup> Committee on Climate Change's 2019 Progress Report: Government Response, [www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses](http://www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses)

**Figure 9: Final Energy Use per £million Output for Industrial Business (MWh/£million)<sup>345</sup>**



*iv Cost-optimal levels of minimum energy performance requirements resulting from national calculations, in accordance with Article 5 of Directive 2010/31/EU*

The UK has submitted a report to the European Commission that contains this information.<sup>346</sup>

## 4.4 Energy security

*i Current energy mix, domestic energy resources, import dependency, including relevant risks*

In 2018, the share of primary energy consumption from fossil fuels decreased further to a record low of 79.4% whilst that from low-carbon sources increased from 18.3% to a record 19% share.

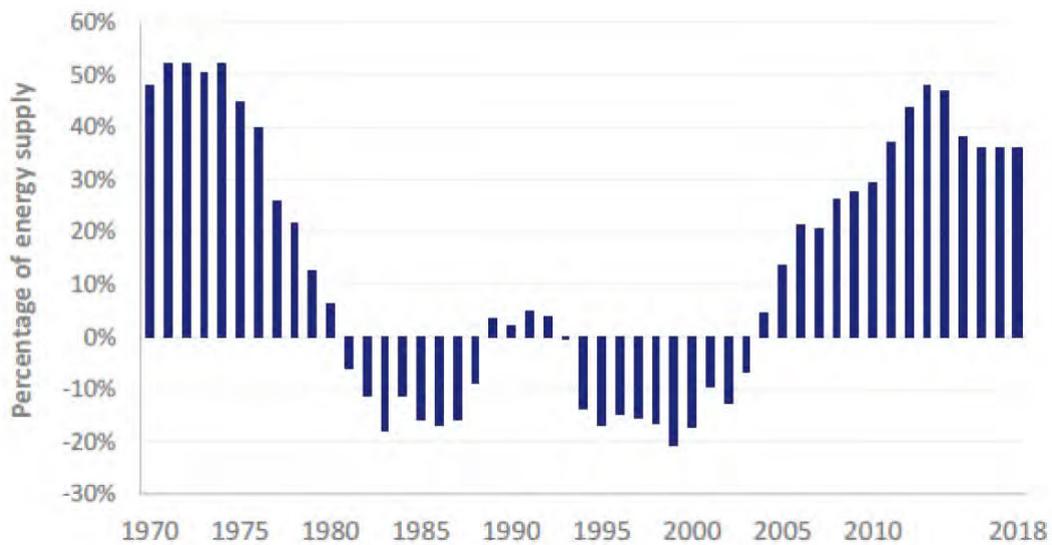
The UK's net import dependency has fallen 2.2% since 2015 but still accounts for 36% of energy supplies. Figure 10 below shows that the UK's net import dependency has fluctuated since 1970.<sup>347</sup>

<sup>345</sup> Committee on Climate Change's 2019 Progress Report: Government Response, [www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses](http://www.gov.uk/government/publications/committee-on-climate-changes-2019-progress-reports-government-responses)

<sup>346</sup> The Energy Performance of Buildings Directive, MHCLG, available at: [www.gov.uk/government/publications/energy-performance-of-buildings-directive-second-cost-optimal-assessment](http://www.gov.uk/government/publications/energy-performance-of-buildings-directive-second-cost-optimal-assessment)

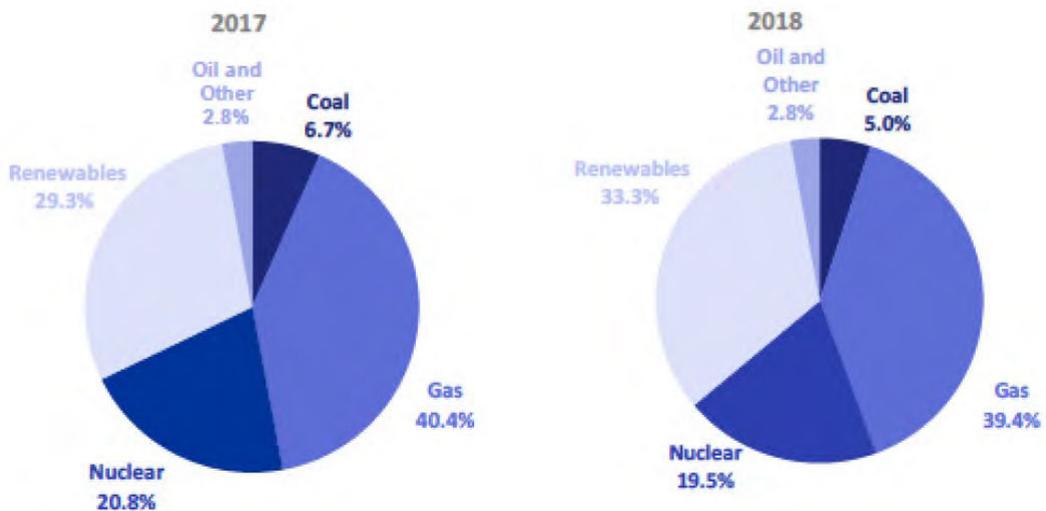
<sup>347</sup> DUKES 2019, Main Chapter and Annexes, available at: [www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019](http://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019)

**Figure 10: The UK's net import dependency since 1970**



The UK's sources of electricity generation can be seen in Figure 11 below. This shows the shift in fuel mix away from coal and a rise in low-carbon generation including renewables, which now account for 33.3% of UK's electricity supply. The UK remained a net importer of electricity in 2018, accounting for 5.4% of total supply, up from 4.2% of supply in 2017.<sup>348</sup>

**Figure 11: UK electricity generation by fuel type**



<sup>348</sup> DUKES 2019, Chapter 5 available at: [www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes](http://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes)

## Gas

Domestic UKCS production (also referred to as North Sea gas) is a key source of gas for the UK. In 2018, UKCS production was equivalent to approximately 51%<sup>349</sup> of UK gas supply, however, by 2035, it is estimated that UKCS production will fall to the equivalent of just 28% of gas demand. The 'Projections of UK Oil and Gas Production and Expenditure Report' published in March 2019, estimates that UK oil and gas production over the period 2016–2050 is projected to be 3.9 billion barrels of oil equivalent (boe) higher than projections four years ago (in March 2015). The UK remains, along with the Netherlands, one of the two major gas-producing nations within the EU.

Natural gas plays a key role in the UK economy, powering industry, heating homes (85% of the households (in the UK) currently use gas for heating, and 56% for cooking) and supporting a flexible and resilient electricity system. The reliability and flexibility afforded by gas-fired electricity generation also enables ever greater levels of intermittent renewables to come forward. The UK has a diverse range of sources of gas supply, including domestic production, pipeline imports from Norway and mainland Europe, LNG from global markets, and storage (which is not strictly speaking a 'source' of gas but is an important source of system flexibility).

Currently, the UK has an import capacity<sup>350</sup> of ~56 bcm/y from Norway, ~43 bcm/y from capacity connected to the Continent, and ~49 bcm/y from LNG import terminals<sup>351</sup>. As UKCS production declines, imports will play an increasing role in meeting UK gas demand.

## Oil

The Oil and Gas Authority estimates that there are 507 million tonnes of proven and probable (2P) oil reserves at the end of 2018, of which 360 million tonnes are proven reserves.<sup>352</sup>

### Crude Oil

The UK is a net importer of crude oils, although there are large volumes of crude oil exports depending on the prevailing market conditions. Gross crude oil exports increased by nearly one-fifth in 2018 to reach over 40 million tonnes – the highest level since 2009. - This is due mainly to the new North Sea projects that opened in late 2017, which were exported. Crude oil was principally exported to the Netherlands, Germany, Korea and China, which together comprised 80% of total crude exports in 2018.<sup>353</sup>

The UK's own production of crude oil would have been sufficient to meet roughly 90% of UK refinery demand in 2018, but an increase in the diversity of sources coming into the UK has reduced the impact of a disruption to any one source of supply on the UK. In 2018, 12% of UK crude oil production was used by UK refineries.

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<sup>349</sup> National Statistics Digest of UK Energy Statistics (DUKES) 2019 Chapter 4 Natural gas (Commodity Balances - DUKES 4.1: using net import figures)

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/820686/DUKES\\_4.1.xls](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820686/DUKES_4.1.xls)

<sup>350</sup> Nameplate capacity figures may differ from actual operational deliverability.

<sup>351</sup> Gas Ten Year Statement 2018, [www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas-Ten-Year-Statement/](http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas-Ten-Year-Statement/). Nameplate deliverability figures may differ from actual operational deliverability.

<sup>352</sup> UK Oil and Gas Reserves and Resources Report: 2018, [www.ogauthority.co.uk/news-publications/publications/2019/uk-oil-and-gas-reserves-and-resources-report-as-at-end-2018/](http://www.ogauthority.co.uk/news-publications/publications/2019/uk-oil-and-gas-reserves-and-resources-report-as-at-end-2018/)

<sup>353</sup> Statutory security of supply report: 2018, [www.gov.uk/government/publications/statutory-security-of-supply-report-2018](http://www.gov.uk/government/publications/statutory-security-of-supply-report-2018)

## Refined product

In 2018, UK refinery production was around 30% petrol, 20% diesel and 9% aviation fuel, with the remaining volumes primarily being other light and heavy distillates. This is significantly different from the demand pattern. To balance demand, the UK trades widely and is one of the largest importers of jet fuel and road diesel in the OECD and one of the largest exporters of petrol.<sup>354</sup>

Approximately 40% of fuel produced by UK refineries in 2018 was exported, of which nearly half was petrol.

Imports of diesel road fuel and jet fuel to the UK are increasing. In 2013, the UK became a net importer of petroleum products for the first time since 1984. In 2018, the UK was a net importer by 13.0 million tonnes, up 14% on 2017.

### *ii Projections of development with existing policies and measures at least until 2040 (including for the year 2030)*

Each year National Grid publishes its Future Energy Scenarios.<sup>355</sup> This publication sets out a range of credible projected scenarios for Great Britain's energy landscape to 2050. These four scenarios are based on the speed of decarbonisation (driven by policy, economics and consumer attitudes) and the level of decentralisation (proximity of production and management of energy to the end consumer). This is not a UK government publication, however the scenarios can be used as an illustration of the potential development of the UK's energy mix. The 2019 scenarios were developed prior to the introduction of the UK government's net zero target. National Grid included a sensitivity to provide an indication about the potential implications of this increase in government policy ambition.

## Scenarios:

1. **Consumer Renewables:** sets out what Great Britain's energy system could look like if the 2050 decarbonisation target is met and there is a more decentralised energy landscape.

- Achieves the 2050 decarbonisation target.
- Decentralised pathway.

In Community Renewables, local energy schemes flourish, consumers are engaged

and improving energy efficiency is a priority. UK homes and businesses transition to mostly electric heat. Consumers opt for electric transport early and simple digital solutions help them easily manage their energy demand. Policy supports onshore generation and storage technology development, bringing new schemes which provide a platform for other green energy innovation to meet local needs.

2. **Two Degrees:** explores how the 2050 decarbonisation target can be achieved using large, centralised technologies.

- Achieves the 2050 decarbonisation target.

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<sup>354</sup> Statutory security of supply report: 2018, [www.gov.uk/government/publications/statutory-security-of-supply-report-2018](http://www.gov.uk/government/publications/statutory-security-of-supply-report-2018)

<sup>355</sup> National Grid, Future Energy Scenarios 2019, <http://fes.nationalgrid.com/fes-document/>

- Large-scale centralised solutions.

In Two Degrees, large-scale solutions are delivered and consumers are supported to choose alternative heat and transport options to meet the 2050 target. UK homes and businesses transition to hydrogen and electric technologies for heat. Consumers choose electric personal vehicles and hydrogen is widely used for commercial transport. Increasing renewable capacity, improving energy efficiency and accelerating new technologies such as carbon capture, usage and storage are policy priorities.

3. **Steady Progression:** predicts a scenario in which Great Britain makes progress towards but does not meet the 2050 decarbonisation target using centralised technologies.

- 2050 decarbonisation target not met.
- Large-scale centralised solutions.

In Steady Progression, the pace of the low-carbon transition continues at a similar rate to today but then slows towards 2050. Consumers are slower to adopt electric vehicles and take up of low-carbon alternatives for heat is limited by costs, lack of information and access to suitable alternatives. Although hydrogen blending into existing gas networks begins, limited policy support means that new technologies such as carbon capture, usage and storage and battery storage develop slowly.

4. **Consumer Evolution:** a more decentralised scenario which makes progress towards the decarbonisation target but fails to achieve 80% carbon emissions reduction by 2050.

- 2050 decarbonisation target not met.
- Decentralised landscape.

In Consumer Evolution, there is a shift towards local generation and increased consumer engagement, largely from the 2040s. In the interim, alternative heat solutions are taken up mostly where it is practical and affordable, e.g. due to local availability. Consumers choose electric vehicles and energy efficiency measures. Cost-effective local schemes are supported but a lack of strong policy direction means technology is slow to develop, e.g. for improved battery storage.

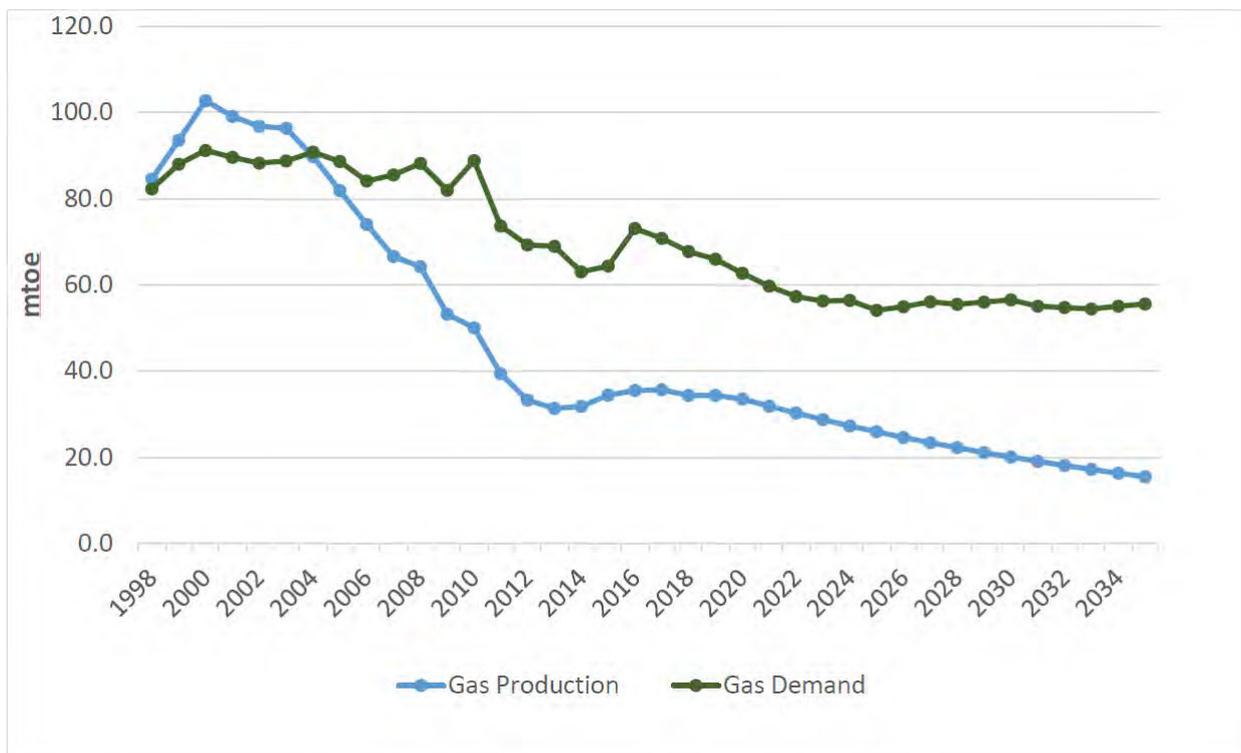
## Gas

The UK imports a large portion of its supply – in 2018 49% of total gas supply came from imports<sup>356</sup>- and this is expected to increase, even if we assume the most ambitious domestic production projections alongside reductions in natural gas demand (see Figure 12).

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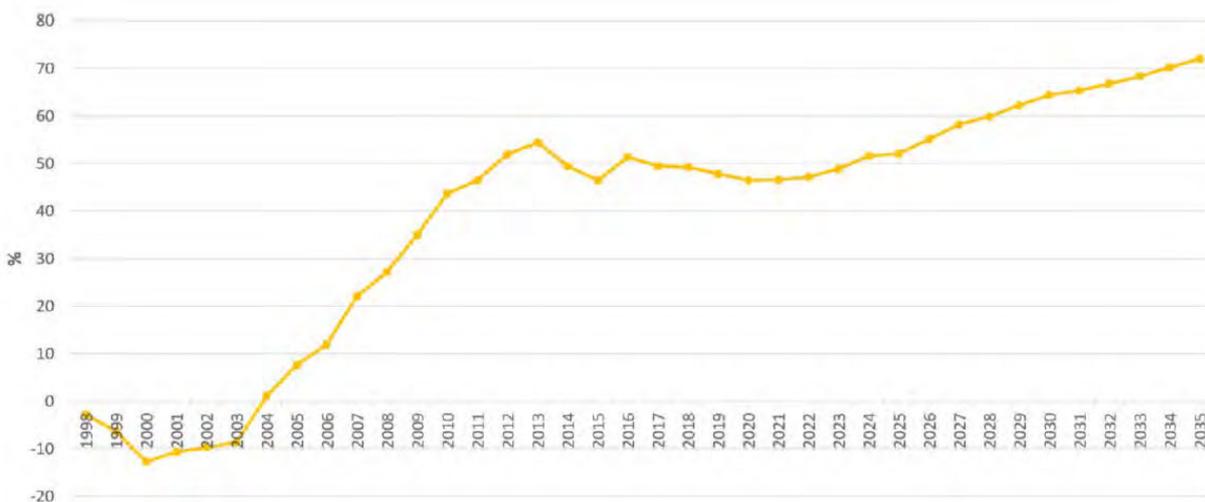
<sup>356</sup> National Statistics Digest of UK Energy Statistics (DUKES) 2019 Chapter 4 Natural gas (Commodity Balances - DUKES 4.1: using net import figures), [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/820686/DUKES\\_4.1.xls](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820686/DUKES_4.1.xls)

**Figure 12: UK gas production and demand projections<sup>357</sup>**



The long-term decline in UK production means that imports will play an increasing role in meeting UK gas demand (see Figure 13 below).

**Figure 13: Gas import dependency projection to 2035<sup>358</sup>**



The UK is well placed to adapt to the changing profile of supply sources due to the significant investment in additional gas supply and flexibility which has been delivered by the market since GB became a net importer of gas in 2004, including direct connections with Norway, the Netherlands and Belgium, and LNG terminals including Europe’s largest in terms of LNG storage capacity.

<sup>357</sup> OGA Projections of UK Oil and Gas Production and Expenditure March 2019, page 12.

<sup>358</sup> OGA Projections of UK Oil and Gas Production and Expenditure March 2019, page 12.

As is currently the case across Europe, in the future there will be competition between traditional piped gas suppliers and liquified natural gas (LNG), and how this will play out in the future remains uncertain. However, the UK consistently has one of the largest and most liquid gas markets in Europe, supported by an effective regulatory regime and dynamic pricing signals. This ensures that the UK is well-placed to attract gas supplies, and to respond to future changes in supply sources.

## 4.5 Internal energy market

### 4.5.1 Electricity interconnectivity

#### *i Current interconnection level and main interconnectors<sup>359</sup>*

The GB electricity system is connected with north-west Europe via 4GW interconnector capacity; 2GW with France (IFA), 1GW with the Netherlands (BritNed) and 1GW with Belgium (Nemo). 1GW of interconnection also links GB and the Single Electricity Market (SEM) on the island of Ireland (Moyle 500MW and East-West Interconnector 500MW). An overview of existing and future interconnector projects can be found on Ofgem's website.<sup>360</sup>

#### *ii Projections of interconnector expansion requirements (including for the year 2030)*

The UK government will work to ensure significant private investment in new electricity interconnectors, which will help reduce prices for consumers, ensure a more secure grid and help integrate clean generation. In addition to the 5GW already operational, 4.8GW of capacity is already in construction, and a further 8.1GW is progressing through regulatory process. This is expected to increase our level of interconnection by 2030.<sup>361</sup>

### 4.5.2 Energy transmission infrastructure

#### *i Key characteristics of the existing transmission infrastructure for electricity and gas<sup>362</sup>*

This is set out in 2.4.2(i).

#### *ii Projections of network expansion requirements at least until 2040 (including for the year 2030)<sup>363</sup>*

The system operator for Great Britain, National Grid Electricity System Operator, publishes two main reports each year which consider the future needs of the electricity system. The first is the Network Options Assessment<sup>364</sup>, which describes the major projects considered to meet the needs of GB's electricity transmission system as described by the Electricity Ten Year

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<sup>359</sup> Overviews of operational interconnector capacity can be found at the following websites: EWIC [www.eirgridgroup.com/customer-and-industry/interconnection/](http://www.eirgridgroup.com/customer-and-industry/interconnection/), Moyle [www.mutual-energy.com/](http://www.mutual-energy.com/), NemoLink [www.nemolink.co.uk/](http://www.nemolink.co.uk/), BritNed [www.britned.com/](http://www.britned.com/), IFA <http://ifa1interconnector.com/>

<sup>360</sup> Source, Electricity interconnectors, Ofgem website, [www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors](http://www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors)

<sup>361</sup> Source: Clean Growth Strategy, 2017, page 100, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>362</sup> With reference to overviews of existing transmission infrastructure by TSOs.

<sup>363</sup> With reference to national network development plans and regional investment plans of TSOs.

<sup>364</sup> [www.nationalgrid.com/sites/default/files/documents/Network-Options-Assessment-2017-18.pdf](http://www.nationalgrid.com/sites/default/files/documents/Network-Options-Assessment-2017-18.pdf)

Statement.<sup>365</sup> The second is the Future Energy Scenarios document, which identifies long term demand options where scenarios are unconstrained by network issues.<sup>366</sup>

### 4.5.3 Electricity and gas markets, energy prices

#### *i Current situation of electricity and gas markets, including energy prices*

#### **Wholesale**

The GB wholesale electricity market is where generators and suppliers trade electricity products ahead of final delivery to the consumer.

Energy companies are legally required to be licensed by the Office of Gas and Electricity Markets (Ofgem) to operate in the market. Trading occurs within GB, but also with European partners over electricity interconnectors. British electricity generation comes from diversified sources comprising nuclear, natural gas, coal, and varied renewable sources including wind, solar, and biomass. The GB wholesale electricity market is well connected with neighbouring countries, including France, Ireland, Belgium and the Netherlands, with substantial capacity of further interconnection planned. Most electricity is generated at large power stations connected to the national transmission network, but it can also be generated in smaller scale power stations that are connected to the regional distribution networks, or even generated off-grid.

The Single Electricity Market (known as the 'SEM') is a single, shared wholesale electricity market between Ireland and Northern Ireland. Following reforms, the new market is designed to put downward pressure on consumer electricity prices, facilitate the integration of renewables and continue to provide security of supply. The SEM one-year ahead auction in December 2018 secured just under 2GW of capacity, which ensures that there will be sufficient capacity to meet demand in Northern Ireland during winter 2019/20.

The four-year ahead capacity auction on 28 March 2019 secured 1.9GW of capacity for Northern Ireland with an auction clearing price of £43,030 per MW per year, which ensures sufficient capacity to meet expected demand for the year 2022-2023.

The SEM was established following the signing of a Memorandum of Understanding (MoU) by the UK and Irish Governments in 2006 and required parallel legislation to be enacted in Northern Ireland (NI) and Ireland (IE).

The SEM is operated by the SEM Operator (SEMO), which is a joint venture between EirGrid (the Ireland System Operator) and SONI (the System Operator of Northern Ireland). Both SONI and SEMO are part of the EirGrid Group.

The SEM Committee is the decision-making forum for SEM regulatory matters. The SEM Committee is formed of the separate committees of the Ireland regulator: the Commission for Regulation of Utilities (CRU), and the Northern Ireland Utility Regulator (UR) and is made up of representatives of each regulator and an independent and a deputy independent member.

The UK has one of the largest and most liquid gas markets in Europe. High levels of liquidity on the UK's natural gas trading hub, the National Balancing Point (NBP), are evidenced by the

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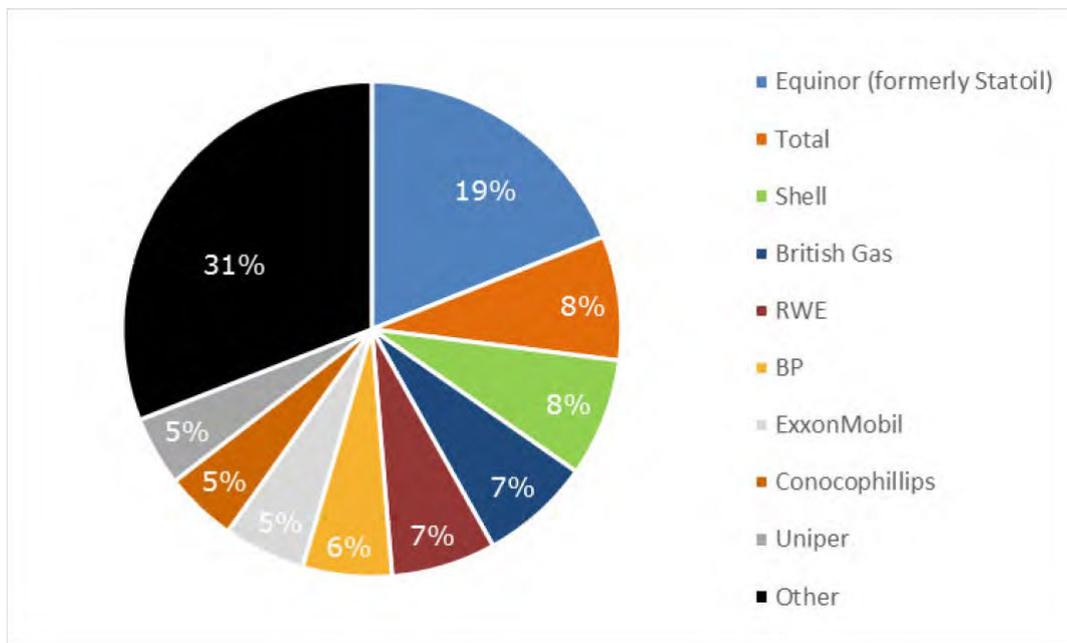
<sup>365</sup> [www.nationalgrid.com/sites/default/files/documents/ETYS%202017.pdf](http://www.nationalgrid.com/sites/default/files/documents/ETYS%202017.pdf)

<sup>366</sup> <http://fes.nationalgrid.com/media/1363/fes-interactive-version-final.pdf>

level of trades there: alongside the Netherlands the UK dominates gas trade in Europe.<sup>367</sup> In 2018, there were 158 licensed entities trading in the NBP market.<sup>368</sup>

There is a low level of concentration in the wholesale gas market, and this is reflected in the large number and diversity of gas producers. The six largest gas suppliers accounted for 55% of the market in 2018/19 (see Figure 14 below) compared to 58% in 2016-17. The level of concentration in the wholesale gas market, as measured by the HHI, remained relatively low at 1329 in 2018<sup>369</sup>, the lowest in the EU (see Figure 15 below). This level of HHI is below the threshold of 2,000, above which the CMA generally considers the market to be highly concentrated. This suggests that gas suppliers are unlikely to be able to exercise unilateral market power to increase the price of wholesale gas.

**Figure 14: Share of UK gas supply 2018/2019<sup>370</sup>**



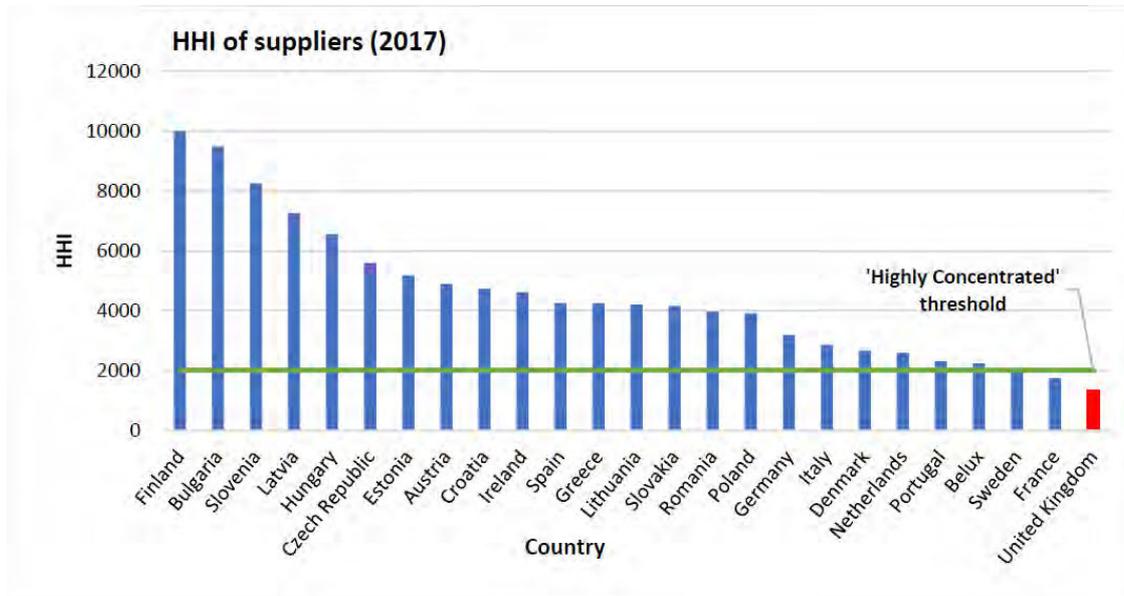
<sup>367</sup> European Commission, Quarterly Reports on European Gas Markets, <https://ec.europa.eu/energy/en/data-analysis/market-analysis>

<sup>368</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

<sup>369</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

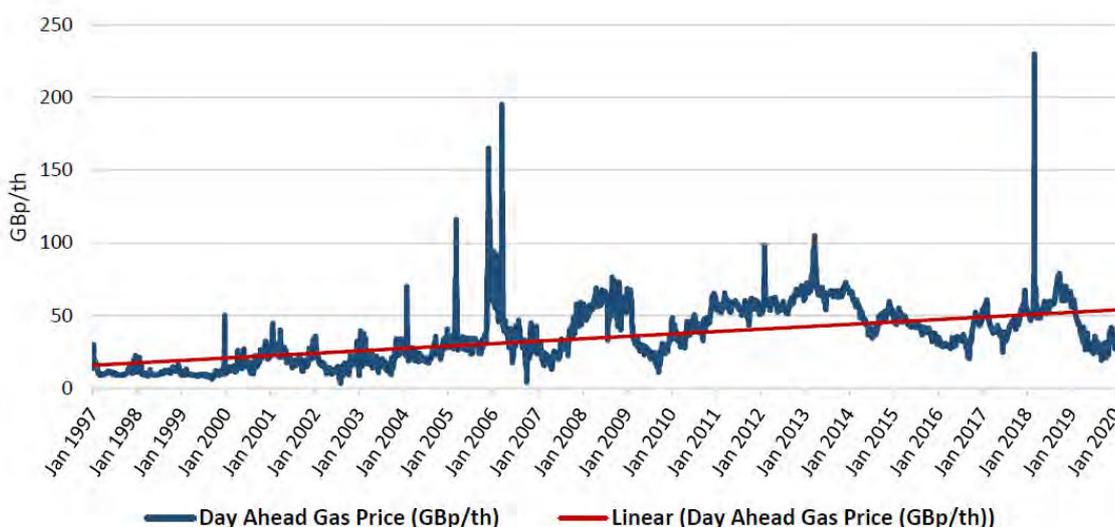
<sup>370</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

**Figure 15: The Herfindahl-Hirschman Index (HHI) of Suppliers, EU excluding Malta and Cyprus (2017)<sup>371</sup>**



GB wholesale gas prices correlate with global conditions since imports make up a large portion of GB gas supply. Wholesale prices have been increasing since the early 2000's as a result of decreased GB production and upwards pressure on European prices, and throughout most of 2018 prices traded higher than in previous years. The average day ahead trading price in September and October 2018 was 73.5p/therm and 67.0p/therm (see Figure 16 below).<sup>372</sup> Since 2019 gas prices have notably fallen as an LNG supply glut led to an oversupplied global market, causing gas prices to fall around the globe. The global market is expected to rebalance in the coming years, with gas prices forecasted to increase in the long term.

**Figure 16: Wholesale gas prices: day ahead contracts, GB<sup>373</sup>**



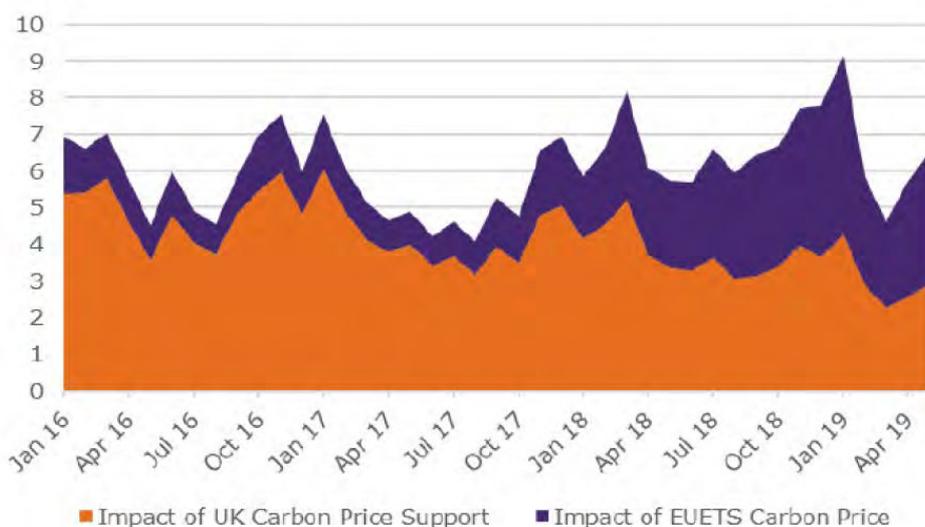
<sup>371</sup> ACER, Market Monitoring Report, Gas Wholesale Markets Volume 2017 Underlying Dataset, <https://acer.europa.eu/en/Electricity/Market%20monitoring/Pages/Current-edition.aspx>

<sup>372</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-201](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-201)

<sup>373</sup> ICIS HEREN National Balancing Point Day Ahead Contract Prices.

Electricity prices have generally been increasing as well in the long run, in large part because of the importance of gas in electricity generation in the UK.<sup>374</sup> The correlation coefficient between day ahead gas and electricity prices in the year up to April 2019 was 0.90.<sup>375</sup> Coal prices play a decreasing role in determining electricity prices, reflecting the declining importance of coal in electricity generation. Carbon costs have also driven up the price in recent years, particularly with the implementation of the Carbon Price Support (CPS). Divergence between this and the EU Emissions Trading System (ETS) has contributed to differences in electricity prices between GB and other European countries, even as increased interconnection capacity has worked to align international prices. The increase in ETS price in recent years has meant a greater share of price impacts comes from the ETS relative to the CPS (see Figure 17 below).<sup>376</sup>

**Figure 17: Carbon price impact on wholesale electricity price (£/MWh, nominal)<sup>377</sup>**



## Retail

On 1 January 2019, the Default Tariff Cap came into force in Great Britain. This will remain in place until the end of 2020 but can be extended each year until 2023. Analysis from Ofgem (the independent regulator) suggests that the cap will save around 11 million default tariff customers c.£75-100/year compared to if the cap was not introduced.<sup>378</sup> From October 2019, the default tariff cap was set at £1,179/year for a typical domestic customer, with the level updated by the regulator every six months based on changes in underlying costs.<sup>379</sup> This sits

<sup>374</sup> GOV.UK, Quarterly Energy Prices, [www.gov.uk/government/statistics/quarterly-energy-prices-september-2019](http://www.gov.uk/government/statistics/quarterly-energy-prices-september-2019)

<sup>375</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

<sup>376</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

<sup>377</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

<sup>378</sup> Figure based on typical domestic consumption values of 3100kwh electricity, 12000kwh gas. Source: Ofgem, Higher wholesale costs push up default and pre-payment price caps from April, [www.ofgem.gov.uk/publications-and-updates/higher-wholesale-costs-push-default-and-pre-payment-price-caps-april](http://www.ofgem.gov.uk/publications-and-updates/higher-wholesale-costs-push-default-and-pre-payment-price-caps-april)

<sup>379</sup> Figure based on typical domestic consumption values of 3100kwh electricity, 12000kwh gas. Source: Ofgem, default tariff cap level – Letter (1 April 2019 to 30 September 2019). [www.ofgem.gov.uk/publications-and-updates/default-tariff-cap-level-1-april-2019-30-september-2019](http://www.ofgem.gov.uk/publications-and-updates/default-tariff-cap-level-1-april-2019-30-september-2019)

alongside a prepayment meter price cap introduced in April 2017, which continues to protect the c.4 million households with prepayment meters.<sup>380</sup>

In the second quarter of 2019, there were 56 suppliers offering both gas and electricity in the GB domestic retail market, in addition to five gas-only, and three electricity-only suppliers. The six largest suppliers serve just over 70% of domestic gas and electricity customers. These suppliers together lost around six percentage points of gas and five percentage points of electricity market share between the second quarter of 2018 and the second quarter of 2019. British Gas, owned by parent company Centrica, is the largest supplier, covering 28% of the gas market and 19% of the electricity market.<sup>381</sup>

As of June 2019, there were 23.5 million gas meter points and 28.5 million electricity meter points in the domestic market, accounting for 60% (309 TWh) and 35% (105 TWh) of total (domestic and non-domestic) gas and electricity demand respectively and spending around £30 billion per year.<sup>382</sup>

Concentration of the domestic energy market is declining due to sustained new entry and expansion of new suppliers. This follows the trend of recent years, as shown in Figure 18 below. In June 2019, the Herfindahl-Hirschman Index (HHI) of concentration was around 1,224 in gas and around 987 in electricity. Typically, the Competition and Markets Authority (CMA) regards markets with an HHI below 1,000 as un-concentrated, markets with HHI between 1,000 and 2,000 as concentrated, and markets with an HHI above 2,000 as highly concentrated.<sup>383</sup>

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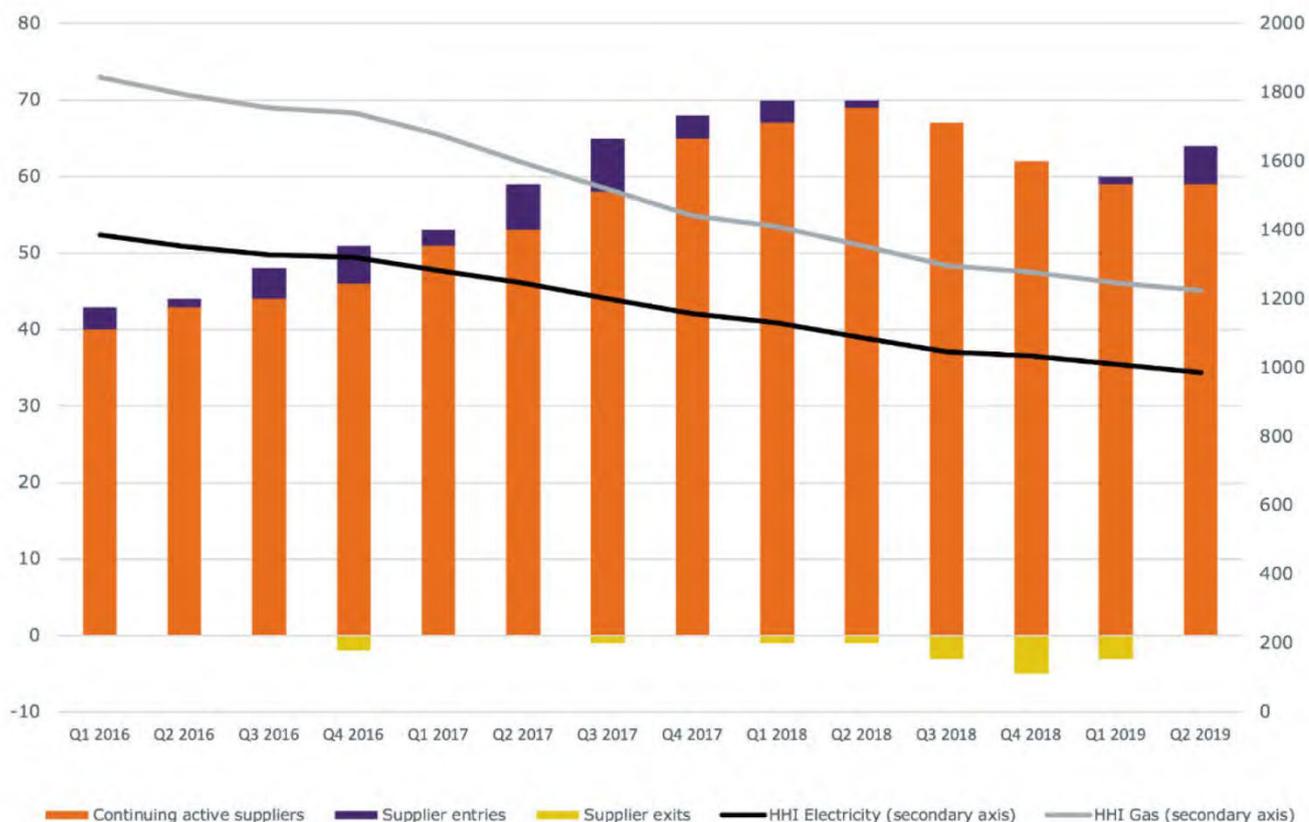
<sup>380</sup> Ofgem, 'Energy price caps to fall this winter due to lower wholesale costs', [www.ofgem.gov.uk/publications-and-updates/energy-caps-fall-winter-due-lower-wholesale-costs](http://www.ofgem.gov.uk/publications-and-updates/energy-caps-fall-winter-due-lower-wholesale-costs)

<sup>381</sup> Ofgem, Data Portal (updated frequently, accessed on 04/11/2019), [www.ofgem.gov.uk/data-portal/retail-market-indicators](http://www.ofgem.gov.uk/data-portal/retail-market-indicators)

<sup>382</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

<sup>383</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

**Figure 18: Evolution of concentration and number of active licensed suppliers<sup>384</sup>**



In Northern Ireland, there are five active domestic electricity suppliers, and nine industrial and commercial suppliers. Analysis using figures for Q3 2019 highlights how, at 56.1%, a significant number of customers remain with the previously incumbent supplier Power NI, whose retail prices are currently subject to a price control for domestic consumers. However, the 43.9% of customers with a non-incumbent supplier marks an increase from 42.8% in Q3 2018.<sup>385</sup>

### Prices

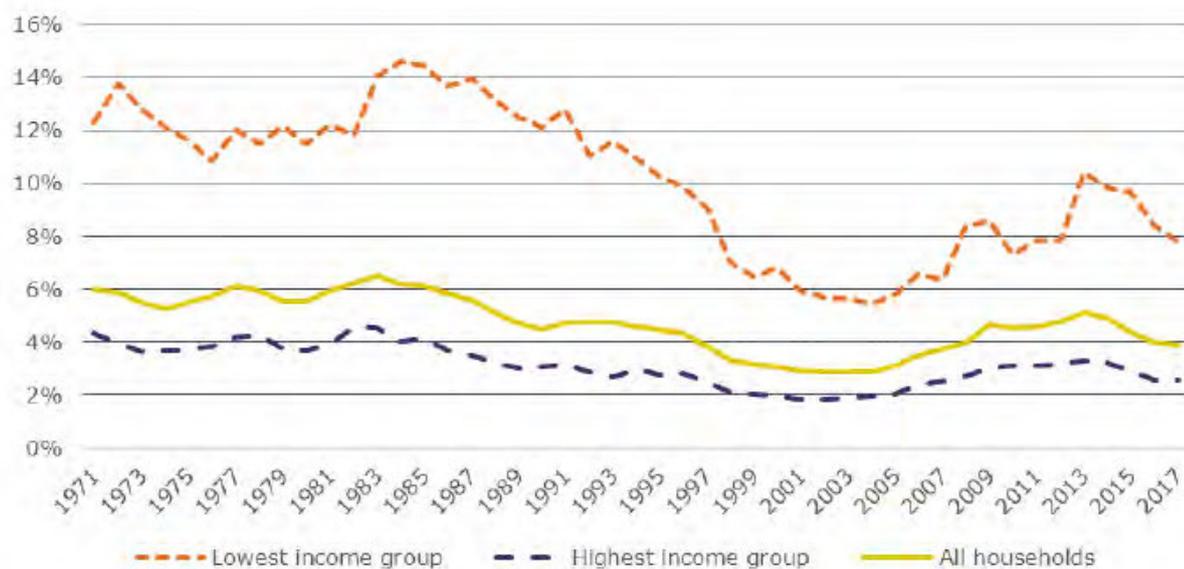
The average dual-fuel energy bill for a consumer in Great Britain with one of the large energy suppliers was £1,184 in 2018. This was an increase of 4% in real terms relative to the previous year. As a proportion of household spending, energy accounted for 3.9% (7.8%) of average income (low-income) households in the financial year 2017/18. This is below the high in 2013 (see Figure 19 below).<sup>386</sup>

<sup>384</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

<sup>385</sup> Northern Ireland Utility Regulator Retail market monitoring: Quarterly transparency report July to September 2019, [www.uregni.gov.uk/sites/uregni/files/media-files/2019-11-14%20Transparency%20Report%20Q3%202019%20FINAL.pdf](http://www.uregni.gov.uk/sites/uregni/files/media-files/2019-11-14%20Transparency%20Report%20Q3%202019%20FINAL.pdf)

<sup>386</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

**Figure 19: Energy costs as a proportion of total household expenditure<sup>387</sup>**



*ii Projections of development with existing policies and measures at least until 2040 (including for the year 2030)*

### Long term price projections

Retail gas prices across domestic, industrial and commercial sectors are forecast to increase throughout the 2020s and up to 2030. The same is also true for retail electricity prices, although to a much lesser extent (see Table 38 below). However, UK government-published statistics show retail gas and electricity prices flatlining beyond 2030.<sup>388</sup> This is because uncertainty in many of the drivers of energy prices is considered too great to form a meaningful judgement on long-term future price trends. For instance, macroeconomic indicators, such as GDP, income and population levels, and long-term climate conditions are particularly important here since uncertainty compounds over time.<sup>389</sup> Additionally, factors such as the possibility of technological breakthroughs or changes in strategic behaviour of major resource holders are highly difficult to predict and are key drivers for fossil fuel prices, including gas, which in turn drive the electricity price.<sup>390</sup>

Uncertainty with current energy policies on prices in the future is small compared to that of wider economic and climate conditions.<sup>391</sup> Beyond 2030, however, it is speculative to predict what policies will be in place as new energy policies develop in response to external factors, both economic and environmental. Generally, the low-carbon transition suggests that carbon

<sup>387</sup> Ofgem, State of the Energy Market 2019, [www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019](http://www.ofgem.gov.uk/publications-and-updates/state-energy-market-2019)

<sup>388</sup> GOV.UK, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. Updated 11 April 2019. [www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal](http://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal)

<sup>389</sup> GOV.UK, Updated energy and emissions projections: 2018. Updated 16 April 2019. [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

<sup>390</sup> GOV.UK, Fossil Fuel Price Assumptions: December 2018. [www.gov.uk/government/publications/fossil-fuel-price-assumptions-2018](http://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2018)

<sup>391</sup> GOV.UK, Updated energy and emissions projections: 2018. Updated 16 April 2019. [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

costs would increase, and fossil fuel prices would decrease as demand falls<sup>392</sup>, but the implication for electricity prices is unclear.

**Table 38: Long-term retail gas and electricity prices<sup>393</sup>**

Retail Electricity prices (2018 p/kWh)				Retail Gas prices (2018 p/kWh)		
Year	Domestic	Commercial /Public	Industrial	Domestic	Commercial /Public	Industrial
<b>2020</b>	18.5	13.7	12.3	4.58	2.87	2.23
<b>2025</b>	18.7	14.5	12.8	4.48	3.52	2.69
<b>2030</b>	18.6	14.5	12.6	4.77	3.83	2.98
<b>2035</b>	18.6	14.5	12.6	4.77	3.83	2.98
<b>2040</b>	18.6	14.5	12.6	4.77	3.83	2.98

<sup>392</sup> GOV.UK, Fossil Fuel Price Assumptions: December 2018. [www.gov.uk/government/publications/fossil-fuel-price-assumptions-2018](http://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2018) and GOV.UK, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. Updated 11 April 2019. [www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal](http://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal)

<sup>393</sup> GOV.UK, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. Updated 11 April 2019. [www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal](http://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal)

## 4.6 Research, innovation and competitiveness

Consumers are at the heart of our development of the system, which can give them choice and control over how they use electricity, including any that they generate themselves. Our approach is firmly rooted in enabling competition and markets to deliver on price, quality and choice, and we want flexible solutions to compete with each other and with more traditional solutions.

*i Current situation of the low-carbon-technologies sector and, to the extent possible, its position on the global market (that analysis is to be carried out at Union or global level)*

In 2018, nearly 53% of the UK's electricity came from low-carbon sources<sup>394</sup> and coal use has fallen dramatically, with periods of coal free generation in both 2017 and 2018.

The CGS outlines how UK homes and commercial buildings have become more efficient in the way they use energy which helps to reduce emissions and also cut energy bills; for example, in 2016, average household energy consumption fell by 17% compared with 1990 levels. Automotive engine technology has helped reduce emissions per kilometre driven by up to 16% and driving a new car bought in 2015 will save car owners up to £200 on their annual fuel bill, compared to a car bought new in 2000. In 2016, England recycled nearly four times more than it did in 2000.<sup>395</sup>

This progress has been aided by the falling costs of many low-carbon technologies: renewable power sources like solar and wind are comparable in cost to coal and gas in many countries; energy efficient light bulbs were over 80% cheaper in 2016 than in 2010; and the cost of electric vehicle battery packs has tumbled by over 70% in this time.<sup>396</sup>

As a result of this technological innovation, new high value jobs, industries and companies have been created. And this is driving a new, technologically innovative, high growth and high value 'low-carbon' sector of the UK economy. Not only are we rapidly decarbonising parts of the domestic economy, but thanks to our world leading expertise in technologies such as offshore wind, power electronics for low-carbon vehicles and electric motors, and global leadership in green finance, we are successfully exporting goods and services around the world; for example, in 2018 one in every five electric vehicles sold in Europe was made in the UK. The latest published data found that in 2017 there were nearly 400,000 jobs in low-carbon businesses and their supply chains, employing people in locations across the country.<sup>397</sup>

This progress has altered the way that we see many of the trade-offs between investing in low-carbon technologies that help secure our future but that might incur costs today. It is clear that actions to cut our emissions can be a win-win: cutting consumer bills, driving economic growth, creating high value jobs and helping to improve our quality of life<sup>398</sup>.

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<sup>394</sup> Digest of UK Energy Statistics (DUKES) 2019, Chapter 5 [www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes](http://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes)

<sup>395</sup> The Clean Growth Strategy, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>396</sup> The Clean Growth Strategy, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>397</sup> ONS (2019). Low Carbon and Renewable Energy Economy Survey: 2017 Final Estimates [www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalesimates/2017](http://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalesimates/2017)

<sup>398</sup> The Clean Growth Strategy, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

*ii Current level of public and, where available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers*

This is set out in section 2.5(i).

The UK's Office of National Statistics (ONS) publishes estimates of total private sector R&D, but this is not broken down by ETRDI. We are not aware of any formal reporting of data broken down in this way as there is no formal record of different private sector ETRDI projects.

The UK government actively encourages private sector participation in public ETRDI Programmes, recognizing the clear economic benefits such as supporting jobs and increasing export potential.

iii Breakdown of current price elements that make up the main three price components (energy, network, taxes/levies)

### UK Energy price breakdowns 2018<sup>399</sup>

**Table 39: Household Gas and Electricity price breakdowns**

<i>Per MWh</i>	Gas (D2)		Electricity (DC)	
	Euros	Pounds	Euros	Pounds
Energy & Supply	32.20	28.70	95.60	85.00
Network Costs	11.30	10.10	40.90	36.40
Taxes, Fees, Levies & Charges	4.40	3.90	57.60	51.20
<b>Total Price</b>	<b>47.90</b>	<b>42.70</b>	<b>194.10</b>	<b>172.60</b>

**Table 40: Medium Business energy price breakdowns, excluding VAT**

<i>Per MWh</i>	Gas (I3)		Electricity (DI)	
	Euros	Pounds	Euros	Pounds
Energy & Supply	20.40	18.20	73.10	65.00
Network Costs	4.90	4.30	26.50	23.60
Taxes, Fees, Levies & Charges	6.20	5.50	55.00	48.90
<b>Total Price</b>	<b>31.50</b>	<b>28.00</b>	<b>154.60</b>	<b>137.50</b>

<sup>399</sup> Eurostat Energy Statistics, [https://ec.europa.eu/eurostat/data/database?p\\_p\\_id=NavTreeportletprod\\_WAR\\_NavTreeportletprod\\_INSTANCE\\_nPqeVbPXRmWQ&p\\_p\\_lifecycle=0&p\\_p\\_state=normal&p\\_p\\_mode=view&p\\_p\\_col\\_id=column-2&p\\_p\\_col\\_pos=1&p\\_p\\_col\\_count=2](https://ec.europa.eu/eurostat/data/database?p_p_id=NavTreeportletprod_WAR_NavTreeportletprod_INSTANCE_nPqeVbPXRmWQ&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_pos=1&p_p_col_count=2)

**Table 41: Large Gas Business & Extra-Large Electricity Business energy price breakdowns, excluding VAT**

<i>Per MWh</i>	Gas (I4)		Electricity (IF)	
	Euros	Pounds	Euros	Pounds
Energy & Supply	16.30	14.50	68.90	61.30
Network Costs	3.90	3.50	22.40	19.90
Taxes, Fees, Levies & Charges	4.90	4.40	48.60	43.20
<b>Total Price</b>	<b>25.10</b>	<b>22.40</b>	<b>139.90</b>	<b>124.40</b>

*iv Description of energy subsidies, including for fossil fuels*

As set out in section 3.1.3(iv), the UK uses a definition of fossil fuel subsidies agreed and used by the Commission, and Member States which are members of the G20, in making returns to the G20. Unlike the definition used in the Commission's Energy Prices and Costs Report of earlier this year, this definition excludes tax treatment. The UK has no fossil fuel subsidies.

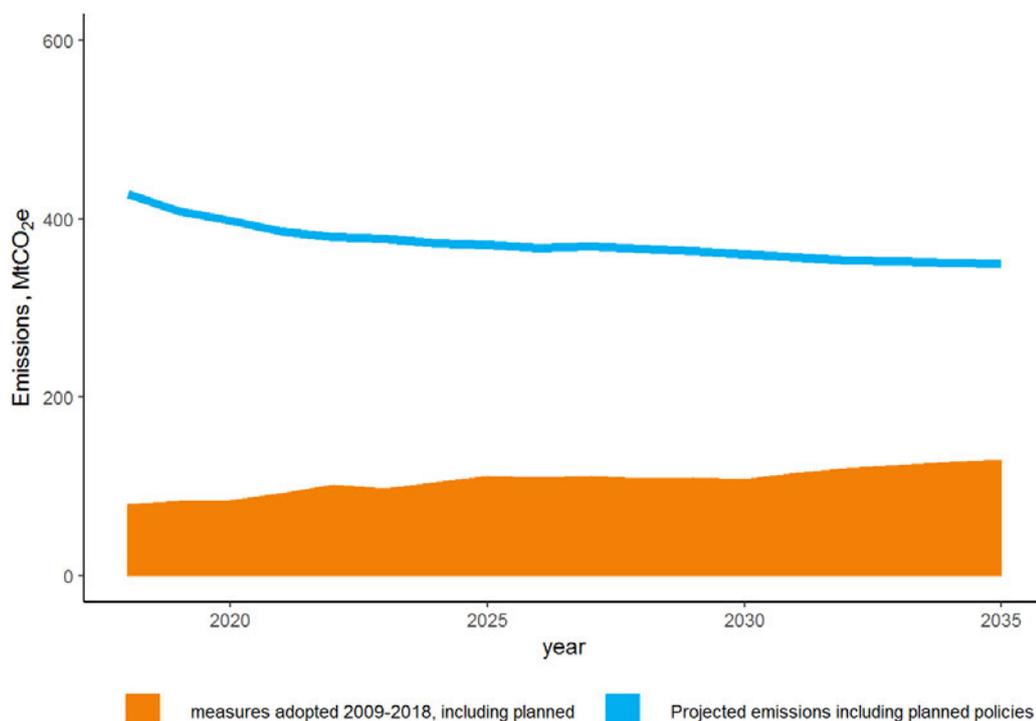
## 5. Impact assessment of planned policies and measures

### 5.1 Impacts of planned policies and measures described in section 3 on energy system and GHG emissions and removals including comparison to projections with existing policies and measures (as described in section 4)

*i Projections of the development of the energy system and GHG emissions and removals as well as, where relevant of emissions of air pollutants in accordance with Directive (EU) 2016/2284 under the planned policies and measures at least until ten years after the period covered by the plan (including for the last year of the period covered by the plan), including relevant Union policies and measures*

The projections presented in [section 4](#) (the ‘with existing measures’ scenario) include the impact of all the UK’s implemented and adopted policies and measures. It does not include those policies which are classified as planned. Policies and proposals for mitigating climate change go through an established development process. As the development is completed, the impact of policies is quantified in updated Energy and Emissions Projections (EEP), which are published by the UK government annually. This is a continuous process and the latest EEP, published in April 2019, shows future emissions under the suite of policies that were fully developed as of 2018.

The UK treats the policies adopted before 2009, when carbon budgets were set at the time of the 2009 Budget and the Low Carbon Transition Plan (LCTP), as part of the baseline. Figure 20 and Table 42 show the estimated emissions savings and the effect on projected emissions attributable to policies adopted between April 2009 and July 2018, as published in the 2018 UK EEP. For example, in 2020 we project that existing UK policies adopted since the LCTP will deliver emissions reductions of over 84 MtCO<sub>2e</sub>. Further emissions reductions are expected from planned policies.

**Figure 20: Projected impact of policies**


To avoid double counting in the calculation of savings from policies, our projections use a hierarchy of mitigation actions which consider energy demand and emissions reductions after the application of measures further up the hierarchy. This hierarchy considers the level of imperative imposed by a policy, that is to say whether there is regulation, incentive or advice, and the date of implementation of a policy.

**Table 42: Projected impact of policies adopted in the period 2009-2018, MtCO<sub>2</sub>e<sup>400</sup>**

Scenario	2018	2020	2025	2030	2035
Baseline	514	490	488	475	486
...with existing measures	428	398	370	364	356
...with additional measures	428	398	371	361	350

The differences in projected emissions between scenarios does not exactly match the sum of emissions reductions provided by individual policies due to price interactions and adjustments to policy impacts to improve accuracy.

The CGS set out over fifty policies and proposals that will drive emissions down throughout the next decade and beyond. Through preparing this Strategy, the UK government identified areas where it will need to see the greatest progress, both through technological breakthroughs and large-scale deployment, in order to meet its national emissions reduction targets.

<sup>400</sup> Updated Energy and Emissions Projections, 2018, Annex A [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

## Air quality

The UK government has pledged that this will be the first generation to leave the environment in a better state than we inherited it.

The UK has ambitious 2020 and 2030 emission reduction commitments in place for five key air pollutants. The UK government published a comprehensive Clean Air Strategy in January 2019 setting out a plan to meet these goals and reduce emissions, with subsequent technical analysis published in March. To measure progress towards these commitments, the UK government annually compiles national air pollutant emissions in the National Atmospheric Emissions Inventory (NAEI), which includes the UK Greenhouse Gas Inventory, used for reporting to the UNFCCC. We also produce air pollutant emissions projections for 2020, 2025 and 2030 which rely on data from various sources, key among which are the Updated Energy and Emissions Projections which take account of measures in place as far as is possible, given the data available.

UK government analysis indicated in its NAPCP that our selected PaMs have the potential to reduce GHG emissions by between 2.2 and 2.9 Mt CO<sub>2</sub>e per annum by 2030. We will work across government to realise the opportunities for mitigating climate change and improving air quality building on the work already achieved. The Clean Air Strategy included a commitment to consult on making coal to biomass conversions ineligible for future rounds of the Contracts for Difference scheme.

We also consulted on banning new Renewable Heat Incentive (RHI) biomass applications installed in urban areas that are on the gas grid, as well as introducing mandatory maintenance checks for those installations already accredited on the RHI. The RHI is a UK government subsidy scheme for eligible renewable heating technology, including biomass. The RHI has air quality requirements that participants using biomass are required to meet before they can claim support under the scheme. These include: limits on the emissions of particulate matter (PM) and oxides of nitrogen (NO<sub>x</sub>), a requirement to use sustainable fuel that is listed on the emissions certificate of the accredited boiler, and an annual obligation to submit relevant permits and exemptions to evidence compliance with all local and national environmental regulations, including those relating to air quality impacts.

As outlined in the Clean Air Strategy, the UK Department for Environment, Food and Rural Affairs (DEFRA) and BEIS have worked together to ensure air quality is considered at the outset of policy development, and that appropriate tools and evidence are used to assess the impact on air pollution emissions. Building on the framework established for bioenergy, we seek to strengthen the collaboration between DEFRA and BEIS, so that we fairly and objectively articulate the trade-offs between energy and air pollution emissions when developing strategies to meet air quality and carbon targets. Similarly, the UK Department for Transport has committed to end the sale of conventional petrol and diesel cars and vans by 2040, which is factored into the NAPCP air quality analysis.

*ii Assessment of policy interactions at least until the last year of the period covered by the plan, in particular to establish a robust understanding of the impact of energy efficiency / energy savings policies on the sizing of the energy system and to reduce the risk of stranded investment in energy supply*

To avoid double counting in the calculation of savings from policies, our projections use a hierarchy of mitigation actions; energy demand and emissions reductions for a given policy are considered after the application of measures further up the hierarchy. This hierarchy considers the level of imperative imposed by a policy (i.e. whether it enforces regulation, incentive or advice) and the date of implementation of a policy.

The Updated EEP 2018, Annex D<sup>401</sup>, gives details on how policy interactions are addressed in our modelling of energy savings. For example, when evaluating the potential savings of a particular policy, the savings of existing policies are taken into account to ensure that the savings are only attributed to one policy. New policies will be incorporated once they are sufficiently advanced to meet the criteria set out in the UNFCCC definitions. Where possible, policies are modelled by incorporating them into the BEIS Energy and Emissions Projection Model. Other policies enter the model as demand reductions or as an off-model adjustment.

*iii Assessment of interactions between existing policies and measures and planned policies and measures*

This information is set out in 3.1.1, which details the policies and measures drawn from, and updated since, the 7th National Communication.<sup>402</sup>

Table 43 provides a summary of impact assessments of energy efficiency policies and regulations expected up to 2030.

**Table 43: Summary of energy efficiency policy impact assessments expected up to 2030**

Policy	Description	Total NPV (Social)	Carbon Savings
<a href="#">The Private Rented Sector Energy Efficiency Regulations - Domestic</a>	This policy is intended to amend the current domestic Private Rented Sector Energy Efficiency Regulations to ensure that action is taken to upgrade the energy efficiency of the sector. The intended effects are to: make progress against the UK government’s statutory fuel poverty and climate change commitments; reduce energy demand in the Private Rented Sector, thereby lowering energy bills and improving energy security; and improve thermal comfort and associated health outcomes.	£580m (2017 Prices)	0.4 MtCO <sub>2</sub> e over CB4

<sup>401</sup> Updated Energy and Emissions Projections, 2018, Annex D [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

<sup>402</sup> 7th National Communication, December 2017, [http://unfccc.int/files/national\\_reports/annex\\_i\\_natcom/submitted\\_natcom/application/pdf/19603845\\_united\\_kingdom-nc7-br3-1-gbr\\_nc7\\_and\\_br3\\_with\\_annexes\\_\(1\).pdf](http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/19603845_united_kingdom-nc7-br3-1-gbr_nc7_and_br3_with_annexes_(1).pdf)

Policy	Description	Total NPV (Social)	Carbon Savings
<a href="#">The Private Rented Sector Energy Efficiency Regulations – Non-Domestic</a>	This policy is intended to amend the current domestic Private Rented Sector Energy Efficiency Regulations to ensure that action is taken to upgrade the energy efficiency of the sector. The intended effects are to: make progress against the UK government’s statutory fuel poverty and climate change commitments; reduce energy demand in the Private Rented Sector, thereby lowering energy bills and improving energy security; and improve thermal comfort and associated health outcomes.	£2bn (2013 Prices)	3 MtCO <sub>2</sub> e over CB3 and CB4
<a href="#">Energy Savings Opportunity Scheme</a>	The objectives of the policy are to promote the take up of cost effective energy efficiency measures whilst minimising the cost to business of complying with the mandatory auditing requirements. By providing enterprises with tailored information about how they can make cost-effective savings ESOS should increase the take up of cost effective energy efficiency measures. This will increase productivity, support higher economic growth, reduce carbon emissions and improve security of supply.	£1.6bn (2014 prices)	10.1 MtCO <sub>2</sub> e over 2014-2030
<a href="#">Streamlined Energy and Carbon Reporting Framework (SECR)</a>	The policy objectives of a SECR framework are to reduce the overall administrative burdens on participants, whilst improving the incentive for organisations to save energy through energy efficiency – thus reducing energy bills and carbon emissions. Requiring organisations to report on their energy use is intended to drive behaviour change by raising awareness of energy efficiency with organisational decision makers, and increasing the importance of energy efficiency to organisations through reputational drivers. Increased transparency for investors and others will make them more able to hold companies to account.	£1,549m (2017 Prices)	12.9 MtCO <sub>2</sub> e over 2019 - 2035
<a href="#">Smart metering (Non-domestic)</a>	To roll-out smart metering to GB residential and small and medium sized non-domestic gas and electricity customers in a cost-effective way, optimising the benefits to consumers, energy suppliers, network operators and other energy market participants and delivering environmental and other policy goals.	£5,746m (2011 Prices)	29.67 MtCO <sub>2</sub> e over lifetime of the policy (2013-2027)

Policy	Description	Total NPV (Social)	Carbon Savings
<a href="#">Carbon Emissions Reduction Target</a>	The purpose of the CERT obligation is to help electricity and gas consumers in the household sector to reduce the carbon impact (footprint) of their home by using energy more efficiently, reducing consumption and using energy from renewable/microgeneration sources. In doing so they will reduce their fuel costs (and/or enjoy greater comfort). Through achieving carbon dioxide savings, the primary aim of the CERT is to make a significant contribution to the UK's legally binding target under the Kyoto protocol to cut greenhouse gas emissions by 12.5% below 1990 levels by 2008–2012 and its domestic goal to cut emissions of carbon dioxide by 20% below 1990 levels by 2010. It is expected that it will also contribute to the alleviation of fuel	£10.3bn (2007 Prices)	154 MtCO <sub>2e</sub> over the lifetime measures (2008-2051)  4.2 MtCO <sub>2</sub> over 2008-2011
<a href="#">Community Energy Savings Programme</a>	Community Energy Savings Programme has the twin objective of significantly reducing the fuel bills of some of those living in deprived areas (proposed to be defined as Super Output Areas in bottom decile of the income domain of the Indices of Multiple Deprivation); and contributing to the improvement of the energy efficiency of the existing housing stock in order to reduce the UK's GHG emissions.	£122mn (2009 Prices)	2.9 MtCO <sub>2e</sub> Over 2009-2011
<a href="#">Energy Company Obligation – ECO3</a>	The policy is intended to drive uptake of energy efficiency measures in the residential sector that would not have occurred in the absence of intervention, in particular among low income and vulnerable households in or at risk of fuel poverty. The intended effects are to: make progress against the UK government's statutory fuel poverty and climate change commitments; reduce energy demand in the residential sector, thereby lowering energy bills and improving energy security; improve thermal comfort and subsequent health outcomes; and support jobs and growth.	£718m (2017 Prices)	1.32 MtCO <sub>2e</sub> over CB5 (2028-2032)  11.08 MtCO <sub>2e</sub> over the lifetime of policy measures

Policy	Description	Total NPV (Social)	Carbon Savings
<a href="#">Boiler Plus</a>	The policy objectives are to deliver additional energy and carbon savings from the domestic heating sector in England by lowering overall gas demand from domestic properties, thereby reducing fuel bills for these properties and contributing towards meeting the UK's legally binding carbon budgets. It aims to do this by increasing the deployment of devices which increase the efficiency of domestic heating systems, through controls and measures to make gas boilers heat homes more efficiently.	£483m (2016 Prices)	2 MtCO <sub>2</sub> e in CB4,  3.2 MtCO <sub>2</sub> e in CB5

The UK government has a rigorous monitoring and reporting framework to track progress against its domestic and international targets. Each year the UK government publishes its Greenhouse Gas Inventory, and Energy and Emissions Projections.

The Climate Change Act (2008) requires the UK government to set five yearly carbon budgets, and then produce a plan to meet these budgets. The most recent was the Clean Growth Strategy, published in October 2017. The CCC, the UK's independent advisory body, published an assessment of this plan in January 2018.

The CCC also produces an annual progress report, with the UK government laying a response before Parliament later in the same year. From 2018, the UK government has used its response to the CCC's annual progress report to bring together reporting against the Clean Growth Strategy on the Emissions Intensity Ratio, metrics and actions. The UK government also provides updates on key elements of the Strategy, as we look ahead towards setting the sixth carbon budget by the statutory deadline of 30 June 2021.

See section 1.1(ii) for more detail on the CCC's net zero recommendation and other UK commitments.

## 5.2 Macroeconomic and, to the extent feasible, the health, environmental, employment and education, skills and social impacts including just transition aspects (in terms of costs and benefits as well as cost-effectiveness) of the planned policies and measures described in section 3 at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

It is clear that the continued transition away from coal generation, which has been underway for some years, will have an impact on jobs and communities given the number of people employed at a typical power station. In addition, jobs associated with supply chains, such as port and rail infrastructure will be affected, as will the coal mining industry, although there remain other markets for UK coal. These changes can have a secondary effect on local economies.

Our analysis suggests that the majority of coal plants are likely to close ahead of the intervention in 2025. However, regardless of whether the end of the coal generation sector is a result of direct intervention or other factors, we recognise that there will be an effect on a number of people, largely in the Yorkshire/Humber region, and in South Wales.

The UK government is clear that we need to build an economy that delivers good, skilled, well-paid jobs and creates the conditions for competitive, world leading businesses to prosper and grow right across the UK. Since the consultation was held in November 2016, the UK government has published the Clean Growth Strategy<sup>403</sup> and the Industrial Strategy White Paper.<sup>404</sup>

The move to cleaner growth, including through low-carbon technologies, is one of the most significant and foreseeable global economic trends, and represents one of the greatest industrial opportunities of our time. The UK is well placed to benefit; according to one estimate, our clean economy could grow at four times the rate of GDP. We are determined to make the most of these opportunities. We are already seeing jobs, regional investment and export sales flowing from UK supply chains for clean power technologies, as a result of the on-going transition to a cleaner, smarter power sector. We expect that the losses in activity associated with the closure of unabated coal generators will be compensated by increased activity in new, clean generation. There is a notable opportunity for the UK to become one of the most advanced economies for smart energy and related technologies. The Smart Systems and Flexibility Plan<sup>405</sup> we launched in July 2018 aims to grow the markets for these technologies, and the new innovation challenge announced in our Industrial Strategy, 'Prospering from the energy revolution', aims to accelerate innovation so that cutting edge technologies and systems are developed in the UK.

The UK is likely to feel the impact of climate change both directly and through impacts in other parts of the world. In its recent UK Climate Change Risk Assessment, the UK government

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<sup>403</sup> Clean Growth Strategy, 2017, available at: [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>404</sup> Building a Britain fit for the future, 2017, available at [www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future](http://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future)

<sup>405</sup> Upgrading our energy system: Smart systems and flexibility plan, 2017, available at: [www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan](http://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan)

endorsed the six key climate change risks for the UK identified in an independent review by the Adaptation Sub-Committee: flooding and coastal change; shortages in public water supply; risks to health, wellbeing and productivity from high temperatures; risks to natural capital and our ecosystems; risks to food security and trade; and new pests and diseases. Therefore, future investments are likely to be highly sensitive to how climate change evolves over the next two to three decades.

Actions to mitigate climate change can have wider positive impacts on the economy, the environment and health, beyond the direct benefits of avoided climate change. Co-benefits can include substantial air quality improvements from avoided fuel combustion, the health and wellbeing benefits of active travel, and warmer homes that have lower bills.

The transition to a net zero economy also presents a major opportunity for the UK to be a world-leading hub for jobs, businesses and exports in low-carbon sectors. Already there are almost 400,000 jobs in low-carbon businesses and their supply chains across the country and low-carbon exports are worth billions of pounds each year. According to one estimate, the UK low-carbon economy could grow more than four times faster than the rest of the economy between 2015 and 2030 – delivering up to £170 billion of exports and supporting up to 2 million jobs.

To realise these opportunities, the UK government has placed Clean Growth at the heart of our Industrial Strategy by making it one of four 'Grand Challenges' – global trends that the UK is determined to be at the forefront of. By aligning our Clean Growth and Industrial Strategies, we are ensuring that our policies across government on skills, business support, innovation, infrastructure and regional growth help to deliver emissions reductions and promote our strengths in low-carbon technologies, systems and services.

We are focusing on areas where the UK has established or emerging strengths, in order to capitalise on significant future markets and export opportunities. These include technologies and approaches central to the shift to a net zero economy such as electric vehicles, smart systems, green finance and offshore wind. For example, the UK is a global leader in offshore wind with the largest installed capacity in the world, and our Offshore Wind Sector Deal sets out how we will work with industry to deliver increased capacity while boosting the economy, creating new export opportunities and thousands of new jobs.

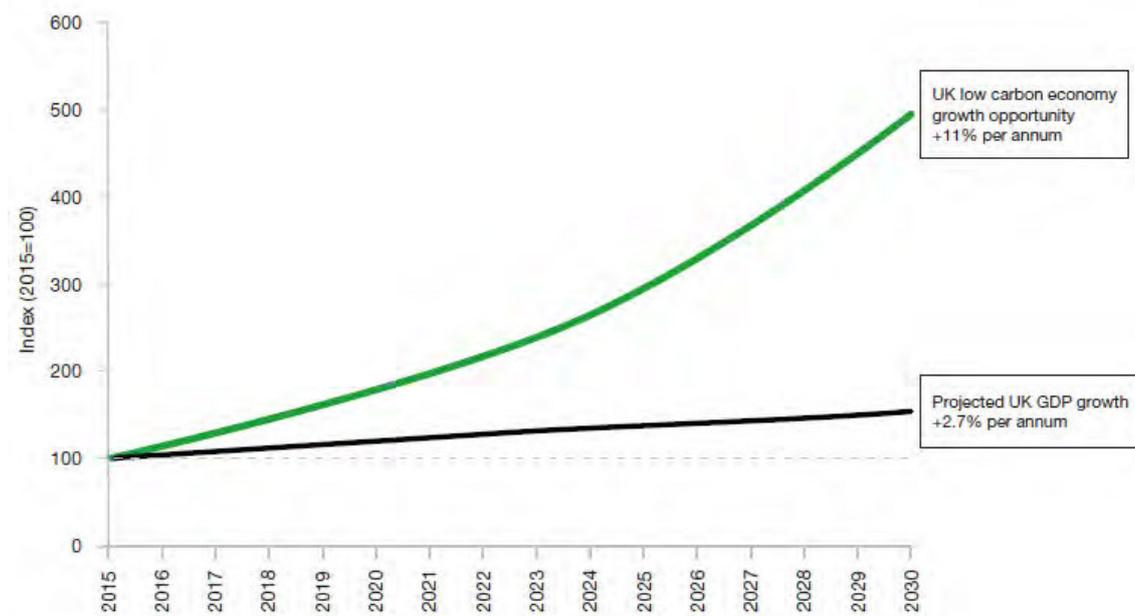
We are investing in the UK's most important asset – our workforce – to ensure that people have the right skills to deliver the low-carbon transition and thrive in the high-value jobs this will create. STEM, digital and technical skills will be essential, and the UK government has announced substantial spending commitments to develop these skills in schools. We have also introduced T Levels as the technical equivalent of A Levels – including T Levels for Construction, which will help to develop the skills needed for sustainable construction so that our buildings are energy efficient and fit for the future.

Industry has pledged to provide 1,000 work placements for T Level students through the Construction Sector Deal. In addition, the Offshore Wind Sector Deal commits to supporting the development of a sector-wide curriculum to deliver a skilled and diverse workforce across the country, whilst challenging the sector to more than double the proportion of women working in the industry to at least 33% by 2030.

As our economy evolves, it is vital that this transition is managed in a way that is fair and just. This is why alongside the UK government's announcement of legislating for net zero, it also announced that HM Treasury will be conducting a review into the costs of decarbonisation

including how to achieve this transition, in a way that works for households, businesses and public finances, as well as the implications for UK competitiveness. We are committed to supporting workers and communities who may face disruption as we move away from high-carbon industries, by providing them with opportunities to retrain and re-skill so that the benefits of clean growth are experienced by people across the UK. This was underlined when the UK signed up to the Silesia Declaration in December 2018, promoting efforts to ensure that no workers or communities are left behind in this transition.

**Figure 21: Potential Growth in the UK Low Carbon Economy<sup>406</sup>**



However, there is inherent uncertainty around projecting what any existing or future policy can achieve, and this uncertainty becomes even more challenging when looking at the longer-term economy out to 2050. Recent years have shown that we should be flexible in our approach to our future energy mix, as global action can transform the cost and installation of different technologies. Other uncertainties include macroeconomic factors, such as gas prices, policy impacts and how society will respond to incentives, developments in the science evidence base, and future shifts in consumer and business behaviour.

In the CGS, we outlined how we explore this uncertainty by testing different potential versions of the future, based on current knowledge, and we described one possible pathway (the ‘2032 pathway’) for meeting the fifth carbon budget through domestic action. Delivering the 2032 pathway would result in a wide range of costs and benefits as illustrated in Table 44 below.

<sup>406</sup> The Clean Growth Strategy, 2017 [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

**Table 44: Costs and benefits of the 2032 pathway<sup>407</sup>**

<b>Capital and operating costs</b>	The incremental costs of installing and running low carbon technologies
<b>Finance costs</b>	The real social cost of providing finance for capital investments, which varies between sectors
<b>Energy savings</b>	The value of lower energy use due to improved efficiency of energy consumption, or switching from fossil fuels to low carbon alternatives
<b>Greenhouse Gas emissions impacts</b>	The benefits associated with reduced emissions. Where emissions are covered by the EU ETS, this benefit will be the avoided financial cost of purchasing EU emissions allowances. Reductions in non-traded emissions are valued using the government's non-traded carbon values.
<b>Impacts on air quality</b>	The benefits associated with lower emissions of NO <sub>x</sub> , PM <sub>2.5</sub> and other air pollutants detrimental to the health of individuals.
<b>Other cost and benefits</b>	These include the hassle cost to households for installing measures, benefits of shorter journey times due to low congestion, less noise pollution and warmer homes from energy efficiency improvements.

These costs and benefits can vary significantly. In particular, they will depend on a wide range of social and economic factors such as growth in population and gross domestic product, on how innovation results in new and lower cost low-carbon technologies, and on the precise actions that are taken in the years ahead.

The extent of these costs and benefits is not fully known at this time because they will depend on the final design of the policies and proposals to meet carbon budgets. When setting the fifth carbon budget, an indicative set of costs and benefits was estimated and set out in the accompanying impact assessment.<sup>408</sup> Overall, it was estimated that meeting the fifth carbon budget through domestic action alone could be achieved with a net benefit to the UK of up to £5.5 billion over the fifth carbon budget period. The impact assessment also set out the sensitivity of these estimates to a range of underlying social and economic factors. These factors in particular included uncertainty around technology costs, energy prices, underlying drivers of UK emissions, and non-cost barriers to delivery.

As noted, these estimates only provide an illustration of the potential scale of impacts. The 2032 pathway shows what is considered possible through domestic action, although this is only one of several plausible pathways. As the UK government continues to deliver the Clean Growth Strategy and finalise policies, these will be accompanied with their own impact assessments where appropriate, which will set out the specific costs and benefits of the proposals.

<sup>407</sup> Costs and benefits of the 2032 pathway, page 150 of the Clean Growth Strategy, published 2017 [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

<sup>408</sup> DECC (2016) Impact Assessment for the level of the fifth carbon budget [www.legislation.gov.uk/ukSI/2016/785/impacts](http://www.legislation.gov.uk/ukSI/2016/785/impacts) section 4.1.

## 5.3 Overview of investment needs

*i existing investment flows and forward investment assumptions with regard to the planned policies and measures*

The CGS set out proposals across the economy, – in homes, business, transport, and the natural environment; building on the progress made so far, to meet the UK’s carbon budgets.

**Table 45: Examples of UK Investment Pledges in the Clean Growth Strategy<sup>409</sup>**

Investment Amount	Investment Area
£2.5 billion, with more recent announcements increasing this to £3 billion <sup>410</sup>	Supporting low-carbon innovation from 2015 to 2021.
£162 million	Research and innovation in energy, resource and process efficiency.
Up to £20 million	Support new clean technology early investment funding.
Up to £100 million	Innovation in carbon capture usage and storage technologies.
£14 million	Support innovative energy technologies and processes through the Entrepreneurs Fund.
Around £3.6 billion	Upgrade around a million homes through the Energy Company Obligation (ECO), and to extend support for home energy efficiency improvements until 2028 at the current level of ECO funding.
£4.5 billion	Invest in low-carbon heating, reforming the Renewable Heat Incentive and supporting innovative low-carbon heat technologies in homes and businesses between 2016 and 2021.
£1.5 billion	Supporting the take-up of ultra low emission vehicles.
£184 million + two new £10 million innovation programmes	Develop new energy efficiency and heating technologies to enable lower cost low-carbon homes.
£80 million	Electric vehicle charging infrastructure deployment.

<sup>409</sup> The Clean Growth Strategy, 2017, [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy). This is not an exhaustive list of all future UK Government investments.

<sup>410</sup> BEIS internal analysis.

Investment Amount	Investment Area
£250 million (matched by industry)	Research, development and demonstration of Connected and Autonomous Vehicle technologies.
£841 million	Innovation in low-carbon transport technology and fuels.
Up to £557 million	Further Contract for Difference auctions.
£900 million	Innovation in smart systems, renewable and nuclear energy.
£99 million	Innovation technology and research for agri-tech, land use, greenhouse gas removal technologies, waste and resource efficiency.
£255 million	Funding for public sector energy efficiency improvements in England.

Since publishing the CGS the UK has announced a range of further measures to drive investment in support of our climate targets. For example, since setting the net zero target in June 2019, the UK has committed more than £2 billion to support decarbonisation in sectors across the economy from industry to transport, including:

- £390 million of investment in hydrogen and low-carbon technology to [reduce emissions from industry](#), including steel - which accounts for 15% of industry emissions in the UK;
- up to [£1 billion additional funding](#) to develop and embed the next generation of cutting-edge electric vehicle technologies;
- £400 million of investment in new charging infrastructure for electric vehicles;
- plans to use [new financing models](#) to roll out more new nuclear, including up to £18 million for the UK's first mini nuclear reactor to be operational in the early 2030s - creating 40,000 jobs at its peak and powering 750,000 homes;
- £26 million of additional funding for carbon capture technology, including investment in the [UK's largest project to be operational by next year](#);
- £222 million [investment](#) in a visionary fusion reactor design programme;
- £5 million to help the financial sector develop green financial products, including green mortgages;
- £10 million innovation fund to cut the cost of retrofitting old homes.

More broadly, the National Productivity Investment Fund will provide an additional £4.7 billion, with an extra £2 billion a year by 2020-21, representing the largest increase in public spending on UK science, research and innovation since 1979.<sup>411</sup>

<sup>411</sup> The Clean Growth Strategy, 2017 [www.gov.uk/government/publications/clean-growth-strategy](http://www.gov.uk/government/publications/clean-growth-strategy)

## The Green Finance Strategy

Green finance will be central in delivering the Clean Growth Strategy and the UK's international climate objectives. The UK government's Green Finance Strategy<sup>412</sup>, published on 2 July 2019, sets out the UK's approach to accelerating green finance, with the overarching objective to align private sector financial flows with clean, environmentally sustainable and resilient growth, and strengthen the competitiveness of the UK financial sector.

The Strategy sets out the UK governments approach to accelerating green finance, with actions grouped under three themes:

1. **Greening finance:** Integrating climate and environmental factors into mainstream decision making in the private sector to ensure climate-related financial risks and opportunities are effectively managed.
2. **Financing green:** accelerating investment to support the UK's Clean Growth and Environmental ambitions, and international objectives.
3. **Capturing the opportunity:** ensuring the UK is well placed to capture the commercial opportunities in green finance.

The Green Finance Strategy is in part a response to the work of the Green Finance Taskforce, which was established in 2017 by the UK government to provide recommendations on how to accelerate the growth of green finance. The Taskforce identified a range of barriers to green investment, such as access to climate data and transparency of green investment opportunities; and set out a series of recommendations to overcome them in their report published in March 2018.<sup>413</sup> The UK government has taken action to implement the Taskforce's recommendations in a range of areas, for example:

- Announcing the establishment of a new Green Finance Institute with the overarching mission to accelerate the domestic and global transition to a clean, resilient and environmentally sustainable economy through accelerating UK leadership in green finance.
- Launching a new clean growth venture capital fund to support the development and commercialisation of innovation clean technologies.
- Strengthening engagement with local actors on green finance through a series of regional green finance workshops and conferences.
- Introducing new regulation to clarify and strengthen trustees' investment duties in relation to ESG factors, including climate change.
- Setting out an expectation for all listed companies and large asset owners to disclose in line with the Task Force on Climate-related Financial Disclosures (TCFD) recommendations by 2022.
- Setting out a package of measures to drive demand and supply of green lending products, such as through a new Green Home Finance Innovation Fund.

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<sup>412</sup> The Green Finance Strategy, 2019 [www.gov.uk/government/publications/green-finance-strategy](http://www.gov.uk/government/publications/green-finance-strategy)

<sup>413</sup> Accelerating green finance: Green Finance Taskforce report, 2018, [www.gov.uk/government/publications/accelerating-green-finance-green-finance-taskforce-report](http://www.gov.uk/government/publications/accelerating-green-finance-green-finance-taskforce-report)

We continue to work closely with stakeholders to build our understanding of investment barriers and risks, for example, through hosting the inaugural Public Sector Green Finance Summit on 17 October 2019.

The UK clean growth sector has invested over £94 billion of public and private green investment in clean energy in the UK since 2010.<sup>414</sup> The UK was the first country in the world to establish a Green Investment Bank (GIB) attracting much needed private finance to address the challenge of climate change. Thanks in part to the GIB, the green investment market has improved in terms of the private sector capital available, which in turn has meant that green investment has now become more mainstream.

Through the UK's Clean Growth Strategy, the 25 Year Environment Plan and the Industrial Strategy the UK government is putting in place policy frameworks capable of building on this momentum.

The UK has put in place supporting policies to leverage private investment in key clean growth sectors:

**Power:**

- The sector has attracted more than £94 billion of investment in clean energy in the UK since 2010 (BNEF 2019).

**Homes:**

- The Heat Networks Investment Project seeks to leverage in around £1 billion of private sector and other investment.
- The Private Rented Property EPC E Minimum Standard for England and Wales has the potential to attract around £500 million of investment.
- The Clean Growth Strategy's aspiration of upgrading as many homes as possible to EPC Band C is estimated to require investment of between £35 billion and £65 billion.

**Transport:**

- We are investing nearly £1.5 billion between April 2015 and March 2021, with grants available for ULEV cars, vans, lorries, buses, taxis, and motorcycles, and schemes to support charge point infrastructure at home and workplaces on residential streets.
- The UK government has announced up to £1 billion of additional funding to develop UK supply chains for the large-scale production of electric vehicles, and for further EV research and development.

**Business and Industrial Energy Use:**

- The £315 million Industrial Energy Transformation Fund will support businesses with high energy use transition to a low-carbon future and cut their bills through increased energy efficiency.

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<sup>414</sup> Bloomberg NEF (2018), Statement of Clean Energy Investment, <https://about.bnef.com/clean-energy-investment/>

- We are developing an Industrial Energy Transformation Fund, backed by up to £315 million of investment, to support businesses with high energy use to transition to a low-carbon future and to cut their bills through increased energy efficiency. The UK government has consulted on the design of the fund.

#### **Public sector:**

- Fund improvements in the public sector through the public sector energy efficiency loan scheme.

To improve access to finance the UK government has allocated substantial resource to fund investment in clean energy and natural capital growth. These funds are leveraging in larger sums from the private sector in order to achieve the overall level of investment required. For example, the Heat Networks Investment Project, provided as 'gap funding' to grow the market, aims to have a transformational impact on the development of cost-effective carbon savings required to meet the UK's future carbon reduction commitments. In return for a public investment of £320 million, the project is aiming to lever in around £1 billion of private and other capital by 2021.

The UK government is expanding its portfolio of blended innovation funds to ensure that public investment acts as a catalyst, increasing access to finance for promising new technologies and investment models:

- A new clean growth venture capital fund will be launched with £20 million capital contribution from BEIS with a view to attracting a matching or potentially greater capital sum from the private sector. In addition to catalysing clean growth equity financing market, this money will be invested on commercial terms in UK companies seeking to commercialise promising clean technologies.
- The £400 million Charging Infrastructure Investment Fund will accelerate the roll-out of charging infrastructure by providing access to finance to companies that deliver public charge points. The UK government will invest up to £200 million in the Fund, to be matched by private investors.
- We are developing an Industrial Energy Transformation Fund, backed by up to £315 million of investment, to support businesses with high energy use to transition to a low-carbon future and to cut their bills through increased energy efficiency. The UK government has consulted on the design of the fund.
- We are investigating options to increase the size of the Public Sector Energy Efficiency Loan Scheme (managed by Salix Finance). The scheme has funded over 17,000 projects, enabling public sector organisations to reduce their bills, with savings recycled into a dedicated fund for reinvestment.

Through the Green Finance Strategy, the UK government has also committed to developing and enhancing our approach for measuring progress on our objectives, including how best to monitor flows of green finance in the UK.

#### *ii sector- or market-risk factors or barriers in the national or regional context*

Decarbonisation must be achieved while maintaining security of supply (including a diversity of generation) and in the most cost-effective way, to provide affordable electricity for consumers and the UK economy more generally.

New low-carbon generators and investors often have to overcome relatively high barriers to market entry. High construction costs and market liquidity make it more difficult for low-carbon generation to compete with fossil fuels and impede market access. Small and independent players are also particularly affected by the risk of not being able to find long-term buyers for their electricity.

As highlighted by the CCC, greenhouse gas removal (GGR) technologies are likely to have an important role to play in offsetting difficult to cut emissions, by removing greenhouse gases from the air. However, there are uncertainties around their costs, deployment potential and impacts on the environment.

*iii analysis of additional public finance support or resources to fill identified gaps identified under section ii*

The Contracts for Difference (CfD) scheme for renewables is designed to decarbonise the electricity system cost-effectively, making the development of renewable generation cheaper for both investors and consumers. The CfD is designed to increase certainty over returns to the generator in order to bring forward investment in new low-carbon electricity generating capacity at minimum cost to consumers, whilst retaining the need for the generator to sell its power in the commercial market. The CfD provides greater long-term predictability of revenues to developers by reducing the exposure to volatile wholesale prices, thereby reducing the cost of capital and thus the level of support required. The two-way nature of the CfD also reduces or removes support for generators when electricity wholesale prices are high.

The CfD also mitigates problems faced by independent generators by reducing the long-term price risk they face, which will make Power Purchase Agreements (PPAs) simpler and less costly for offtakers to provide and should lead to greater competition in the market. The 'Offtaker of Last Resort' scheme provides eligible independent renewable generators holding a CfD with a guaranteed 'backstop' route-to-market, which enables them to have more flexibility in their contracting strategy for the sale of their power, supporting competition and reducing overall support costs. The total budget of the CfD scheme (as set out in the State aid approval for the scheme, 2014) is £15 billion. In the first auction held in 2014/15, developers of 27 projects (over 2GW) were offered contracts. At the time of contract award, the estimated budget spend was calculated as £315 million (2012 prices). In the second auction in 2017, developers of 11 projects (3.3GW capacity) were offered contracts. At the time of contract award, the estimated budget spend was calculated as £176 million (2012 prices). In the third auction in 2019, developers of 12 projects (5.8GW capacity) were offered contracts. At the time of contract award, due to all strike prices being below the reference prices forecast at the time of the auction, the estimated budget impact in the valuation years considered was calculated as zero.

To help promote and support GGR technologies, the UK government has created a programme of research and development, which aims to improve our understanding and overcome uncertainties. We have been working with the Research Councils, who launched a new £8.6 million research programme looking at all GGR technologies in April 2017. The UK government will also consider the scope for removing barriers and strengthening incentives to support the deployment of FFR, for example by developing a carbon offset market and exploring how UK timber could be used in construction.

The Smart Export Guarantee has been introduced to address concern that smaller-scale generators of low-carbon electricity may find it difficult to access a competitive market for the electricity they produce. It requires most licensed electricity suppliers to provide at least one

tariff for power exported from small-scale low-carbon installations. It does this in an intentionally flexible manner that enables a range of smart approaches such as small-scale electricity storage to be incorporated. By allowing suppliers to choose both the type, and the level, of the tariff(s) they offer, this policy encourages the creation of a competitive market between suppliers. The UK government has asked independent market regulator Ofgem to report annually on the provisions made by suppliers for smaller scale exporters, including the range, nature and uptake of tariffs offered by suppliers in response to SEG obligations (as well as any other similar tariffs suppliers are willing to share details of).

## 5.4 Impacts of planned policies and measures described in section 3 on EU Member States and regional cooperation at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

*i Impacts on the energy system in neighbouring EU Member States in the region to the extent possible*

The UK remains a net importer of electricity and imported 19.1 TWh of electricity in 2018.

**Table 46: Net Imports Via Interconnectors, 2016-2018<sup>415</sup>**

### Net Imports (GWh)

	France – GB	Ireland – N. Ireland	Netherlands – GB	Ireland – Wales	Total
<b>Capacity (MW)</b>	2,000	540	1,000	500	4,040
<b>Net Imports (GWh)</b>					
2016	9,728	399	7,306	313	17,745
2017	7,181	-110	6,858	831	14,760
2018	12,890	-471	6,185	504	19,108
<b>Utilisation (%)</b>					
2016	71%	19%	86%	33%	63%
2017	67%	14%	83%	46%	61%
2018	78%	26%	75%	47%	67%

*ii Impacts on energy prices, utilities and energy market integration*

The new Capacity Market that was introduced as part of the redesign of the SEM has provided a significant saving in terms of the overall cost to the consumer of making sure that sufficient capacity is available to meet demand. The cost of the previous capacity arrangements was

<sup>415</sup> Figures taken from the demand data available on the National Grid website at

[www2.nationalgrid.com/UK/Industryinformation/Electricity-transmission-operational-data/Data-Explorer](http://www2.nationalgrid.com/UK/Industryinformation/Electricity-transmission-operational-data/Data-Explorer)

Figures taken from data available on the SEMO website at

[www.semo.com/marketdata/pages/energysettlement.aspx](http://www.semo.com/marketdata/pages/energysettlement.aspx)

Utilisation is total imports and exports across the interconnector in the year divided by the total possible imports and exports.

around £500 million per year for the whole island.<sup>416</sup> There have now been three T-1 auctions to secure capacity between 2018 and 2021. These have averaged £309 million per year, offering a clear saving which is passed directly to consumers. The redesign of the SEM to align with the European Target Model also allows for implicit / efficient electricity trading over interconnectors, with the SEM having access to the Single Day Ahead Coupling mechanism until the end of the Transition Period. Both of these factors have placed a downwards pressure on wholesale electricity prices. The future model of electricity trading over interconnectors the SEM will enjoy is dependent on the energy outcome of the UK-EU Future Relationship. In the absence of an agreed outcome, default arrangements are likely to be less efficient, with possible inflationary impacts on prices and a negative effect on security of supply.

Since its introduction in 2007, the SEM has been an excellent example of energy market integration. The structures which have been put in place to govern the SEM require cooperation at regulatory, technical and governmental levels.

*iii Where relevant, impacts on regional cooperation*

Not applicable.

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<sup>416</sup> Single Electricity Market Operator, [http://lg.sem-o.com/Pages/MDB\\_ValueOfMarket.aspx](http://lg.sem-o.com/Pages/MDB_ValueOfMarket.aspx)

# Annex A – Commission recommendations following review of the draft NECP and UK government responses

	Commission Recommendation	UK Government Response
1	<p>Further specify and quantify the impacts of the additional policies and measures, also beyond the building and transport sectors, to achieve the 2030 greenhouse gas target for sectors not covered by the EU emissions trading system of -37% compared to 2005. This includes the corresponding commitment under Regulation (EU) 841/2018 of the European Parliament and of the Council that land use, land use change and forestry emissions do not exceed removals and requires applying the underpinning accounting rules.</p>	<p>We have provided a list of our policies and measures in section 3.1.1. The Clean Growth Strategy includes ambitious policies on housing, business, transport and the natural environment, and the UK government is already transparent in publishing quantitative data on the impact of those policies in the National Archives.<sup>417</sup> As we said in the Strategy, some policies and proposals are yet to be fully developed, and these go through an established development process and are quantified at the appropriate time. As this work is completed, the impact of these policies is reflected in our updated energy and emissions projections, which are published each year.</p> <p>As of 31 January 2020, the UK has left the EU and will therefore not contribute to EU targets after the Transition Periods ends. The UK’s legally binding domestic carbon emissions reduction targets are among the most stringent in the world. Our fifth carbon budget requires an average reduction in emissions of 57% over 2028-32, compared with a 1990 baseline. We have met our first two carbon budgets and are on track to meet the third. The latest published emissions projections suggest we are on track to deliver over 90% of the required performance against 1990 levels for the fourth and fifth carbon budgets, even before many of the policies and proposals in the Clean Growth Strategy are taken into account.</p>

<sup>417</sup> Legislation.gov.uk delivered by the National Archives, [www.legislation.gov.uk/ukia](http://www.legislation.gov.uk/ukia)

Commission Recommendation		UK Government Response
2	<p>Put forward, as United Kingdom’s contribution to the EU 2030 target for renewable energy, a renewable energy share of at least 27 % indicated by the formula in Annex II under Regulation (EU) 2018/1999. Include an indicative trajectory in the final integrated national energy and climate plan that reaches all the reference points pursuant to Article 4(a)(2) of Regulation (EU) 2018/1999 in accordance with that share, in view of the need to increase the level of efforts for reaching this target collectively. Put forward detailed and quantified policies and measures that are in line with the obligations laid down in Directive (EU) 2018/2001 of the European Parliament and of the Council, to enable a timely and cost-effective achievement of this contribution. Increase the level of ambition in the heating and cooling sector to meet the indicative target included in Article 23 of Directive (EU) 2018/2001, and increase the level of ambition to meet the transport target in Article 25 of Directive (EU) 2018/2001. Provide additional details on the enabling frameworks for renewable self-consumption and renewable energy communities, in line with Articles 21 and 22 of Directive (EU) 2018/2001.</p>	<p>See section 2.1.2.</p>
3	<p>Set national contributions that would be substantially more ambitious than the projections from the modelling quoted in the draft integrated national energy and climate plan in view of the need to increase the level of efforts to reach the Union’s 2030 energy efficiency target. Propose more ambitious policies and measures that would deliver additional energy savings by 2030. Indicate policies and measures for the whole 2021 to 2030 period. Provide an impact assessment for the planned policies and measures in energy efficiency, in particular in terms of expected energy savings they are to deliver.</p>	<p>See section 2.2.</p> <p>Policies and proposals for mitigating climate change go through an established development process. As the development is completed, the impact of policies is quantified in updated EEP, which are published by the UK government annually.</p> <p>A summary of policies that would contribute to energy efficiency savings up to 2030 and their impact assessments is set out in section 5.1(iii).</p>

Commission Recommendation		UK Government Response
4	Specify the measures supporting the energy security objectives on diversification and reduction of energy dependency, including measures ensuring flexibility and the long-term supply of nuclear fuel, in view of the possible development of its nuclear generation capacity.	See section 2.3(ii).
5	Define forward-looking objectives and targets concerning market integration, in particular outline a strategy and timeline for progressing towards fully market-based prices.	<p>See sections 2.4.2(i), 2.4.3 and 4.5.3. Given that interconnection from the UK to most neighbouring markets requires subsea connection, this has meant the UK has historically had lower levels of interconnection relative to other European countries.</p> <p>With regard to the Great Britain electricity market, the UK's Clean Growth Strategy has stated that there is potential for at least 17.9GW of interconnection to the Great British electricity market. This figure is based on projects that have all either entered the construction phase or undergone regulatory assessment, and which are all targeting delivery by 2030. This strong pipeline of projects will significantly increase the UK level of interconnection by 2030.</p> <p>We are continuing to develop more electricity interconnection to open-up trade with neighbouring markets, with interconnector capacity in Great Britain recently increasing by 25% with the construction of Nemo Link between England and Belgium. The development of further interconnection is supported by Ofgem's Cap and Floor regime, which is the regulated route for interconnector investment in Great Britain (England, Scotland and Wales).</p>

	Commission Recommendation	UK Government Response
		<p>This regime has reduced risks with financing interconnector projects and unlocked substantial investment in interconnection, reflected in the number of new interconnectors under construction, including from England to France, Norway and Denmark, and those that have received regulatory approval for projects.</p> <p>In addition to this, the Single Electricity Market on the island of Ireland increases UK capacity through existing shared transmission lines and a future North-South interconnector, linking the wholesale electricity systems of Ireland and Northern Ireland.</p> <p>There are two temporary price caps in place in GB's retail energy market, the Default Tariff Cap and the Pre-Payment Meter (PPM) Cap, both of which strike the balance between protecting consumers and ensuring competition. In 2018, the UK the Domestic Gas and Electricity (Tariff Cap) Act placed a duty on Ofgem, the GB energy market regulator, to introduce a cap on the rate at which suppliers could charge consumers on standard variable and default rate tariffs ('the Default Tariff Cap'). The temporary measure is a response to the 2016 energy market investigation (EMI) conducted by the Competition and Markets Authority (CMA), which found consumers to be paying £1.4 billion per annum more than they would do in a fully competitive market. The Default Tariff Cap will cease to have effect by the end of 2023 at the latest, although may be removed beforehand. The Pre-Payment Meter (PPM) Cap (the 'PPM Cap') was put in place in 2017 by order of the CMA following its 2016 EMI, which found pre-payment meter customers were overpaying for their energy and were less able to switch tariffs than other energy consumers.</p>

Commission Recommendation		UK Government Response
		The PPM Cap is also a targeted measure to protect consumers on variable and default pre-payment tariffs from being overcharged, and is now being maintained by Ofgem. These measures are focused interventions designed to protect a specific segment of consumers from non-competitive pricing practices by limiting the upper boundary of charges. Therefore, market participants remain in control of how they purchase wholesale energy and setting their retail tariffs.
6	Clarify the national objectives and funding targets in research, innovation and competitiveness, specifically related to the Energy Union, to be achieved between 2023 and 2030, so that they are readily measurable and fit for purpose to support the implementation of targets in the other dimensions of the integrated national energy and climate plan. Underpin such objectives with specific and adequate policies and measures, including those to be developed in cooperation with other Member States, such as the Strategic Energy Technology Plan.	See section 2.5. As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union. Our future research and innovation activities will be designed to achieve our legally binding domestic carbon budgets and our new commitment to achieve net zero greenhouse gas emissions from the UK by 2050. Our research and innovation priorities and related spending to deliver these targets are in the process of being considered and agreed, but in the meantime, our intention is to remain closely engaged with international research and innovation activities to meet these world leading commitments. We have an overall target of spending an amount equal to 2.4% of GDP on UK research and innovation more generally, with energy research and innovation a part of this.
7	Build on the framework of the North Seas Energy Cooperation regarding the exchange of good practices for offshore wind support schemes and potential projects, in order to deliver on the Energy Union objectives of greater energy security, sustainability and competitiveness. In light of the United Kingdom's decision to leave the European Union, it should foresee measures to ensure continued regional cooperation with Ireland on emergency preparedness and response for electricity, and security of supply for gas and oil.	Section 1.4 includes text on the UK's participation in the North Seas Energy Cooperation. Sections 1.4 and 3.3 include further detail on gas and electricity security of supply, emergency preparedness and oil stocking arrangements, all in relation to regional cooperation (particularly with Ireland). As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union.

Commission Recommendation		UK Government Response
8	<p>Improve its analysis of investment expenditures and sources across Energy Union dimensions, including appropriate financing at national and regional level, which is currently provided for a list of areas, and complement it by a general overview of investment needs, risks and barriers.</p>	<p>Section 5.3 (i) sets out the supportive policies in place to leverage private investment in key clean growth sectors.</p> <p>As of 31 January 2020, the UK has left the EU and is no longer part of the Energy Union. Green finance will be central in delivering the UK's emission reduction targets and the UK's international climate objectives. The UK government's Green Finance Strategy, published on 2 July 2019, set out the UK's approach to accelerating green finance, with the overarching objective to align private sector financial flows with clean, environmentally sustainable and resilient growth, and strengthen the competitiveness of the UK financial sector. As part of the Green Finance Strategy the UK government has committed to developing and enhancing our approach for measuring progress on our green finance objectives, including how best to monitor flows of green finance in the UK.</p>
9	<p>List all energy subsidies, including in particular for fossil fuels, and actions undertaken as well as plans to phase them out.</p>	<p>See sections 3.1.3(iv) and 4.6(iv).</p>
10	<p>Present the impacts on air pollution for the various scenarios, providing underpinning information, and considering synergies and trade-off effects.</p>	<p>See section 5.1(i). The UK government has pledged that this will be the first generation to leave the environment in a better state than we inherited it.</p> <p>The UK has ambitious 2020 and 2030 emission reduction commitments in place for five key air pollutants. The UK government published a comprehensive Clean Air Strategy in January 2019 setting out a plan to meet these goals and reduce emissions, with subsequent technical analysis published in March.</p>

Commission Recommendation		UK Government Response
		<p>To measure progress towards these commitments, the UK government annually compiles national air pollutant emissions in the National Atmospheric Emissions Inventory (NAEI), which includes the UK Greenhouse Gas Inventory, used for reporting to the UNFCCC. We also produce air pollutant emissions projections for 2020, 2025 and 2030 which rely on data from various sources, key among which are the Updated Energy and Emissions Projections which take account of measures in place as far as is possible, given the data available.</p>
11	<p>Detail just and fair transition aspects, notably by designating the assessment of energy poverty, stating related objectives and describing the social, employment and skills impacts of the policies, measures and objectives. Special attention should be given to coal and carbon-intensive regions and how they will be impacted by the energy transition. Include a dedicated assessment of energy poverty issues, along with any related objectives or specific policies or measures, as required by the Regulation (EU) 2018/1999.</p>	<p>The UK government carries out a full impact assessment for each carbon budget at the point when that budget is set. The latest impact assessment available is that for the fifth carbon budget (2028-32) and was published in 2016. This included a set of costs and benefits that was indicative because the extent of these costs and benefits was not fully known at the time, as they were dependent on the final design of policies and proposals. The impact assessment also set out the sensitivity of these estimates to a range of underlying social and economic factors. As the UK government continues to deliver the Clean Growth Strategy and to finalise policies in line with established development processes, these policies will be accompanied with their own impact assessments where appropriate, which will set out the specific costs and benefits. The sixth carbon budget (2033-37) must be set by June 2021 and the UK government will produce a full impact assessment ahead of introducing any legislation to set it.</p> <p>Further information on energy poverty, which is a devolved area, has been provided in sections 2.4.4 and 3.4.4 to address this recommendation.</p>

## Annex B – Further information pursuant to requirements under Annex III of the Governance Regulation

Methodology pursuant to point 5 of Annex V to Directive 2012/27/EU for the operation of the energy efficiency obligation schemes and alternative policy measures referred to in Articles 7a and 7b and Article 20(6) of that Directive.

1. Calculation of the level of the energy savings requirement to be achieved over the whole period from 1 January 2021 to 31 December 2030, showing how the following elements are taken into account:

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
<b>Cumulative savings (ktoe)</b>	1,124	2,248	3,372	4,496	5,620	6,745	7,869	8,993	10,117	11,241

(a) the annual final energy consumption, averaged over the most recent three-year period prior to 1 January 2019;

	Final Energy Consumption (ktoe)			
	2016	2017	2018	Average over 2016-18
<b>All sectors</b>	140,789	139,397	141,346	140,511

(b) the total cumulative amount of end-use energy savings to be achieved;

<b>Total savings before exemption (ktoe)</b>	<b>61,825</b>
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(c) data used in the calculation of final energy consumption and sources of such data;

<b>Data Source</b>	<b>Energy Emissions Projections 2018<sup>418</sup></b>
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The Energy Emissions Projections (EEP) give an accurate picture of the UK's final energy consumption after incorporating the effects of energy policies and macroeconomic drivers behind energy demand.

Our calculations for Article 7 take the final energy consumption data (including aviation) from the EEP to form an average over 2016-2018. The required 0.8% level of savings to be achieved annually is then calculated from this average cumulatively from 2021 to 2030. This results in total energy savings of 61,825 ktoe to be achieved by 2030 (or 719 TWhs).

<sup>418</sup> Energy and Emissions Projections 2018, available at: [www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018](http://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018)

2. Calculation of the level of the energy savings to be achieved over the whole period from 1 January 2021 to 31 December 2030

As of 31 January 2020, the UK has left the EU and will not be bound by EU targets after the Transition Period ends. Beyond the end of the Transition Period, the UK has already put in place a range of policies and measures domestically which are projected to achieve significant energy savings between 2021-2030 (see Table 1). Total estimated energy savings are equivalent to around 938 Terawatt hours (TWh).

**Table 1: Estimated energy savings from UK policies 2021 - 2030 (TWh)**

Policy	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total (TWh)
Energy Company Obligation	5	5	5	5	5	5	5	5	5	5	49
Building Regulations - non-domestic (Existing build)	12	14	15	16	17	18	20	21	22	23	177
Building Regulations - domestic (Existing build)	13	14	15	16	17	18	19	20	21	21	172
Building Regulations - domestic (New build)	7	8	9	10	11	12	13	14	14	15	114
Building Regulations - non-domestic (New build)	5	6	7	7	8	8	9	9	10	10	79
Climate Change Agreements	2	2	2	2	1	1	1	1	1	1	14
Climate Change Levy	4	5	5	6	6	6	7	7	7	7	61
CRC Energy Efficiency Scheme	5	5	5	5	5	3	2	0	0	0	31
Energy Savings Opportunity Scheme	3	3	3	3	3	3	3	3	3	3	30
Low Emission Vehicle policies	1	1	1	1	1	1	1	1	1	1	6
Private Rented Sector Regulation (England & Wales) - domestic	1	1	1	1	1	1	1	1	1	1	5
Private Rented Sector Regulation (England & Wales) - non-domestic	3	5	7	9	9	10	10	11	11	12	87
Rail electrification	1	1	1	1	1	1	1	1	1	1	7
Re:Fit	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1
Salix public sector finance	1	2	2	2	2	3	3	3	3	3	22

Policy	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total (TWh)
Smart metering (Non-domestic)	3	3	3	3	3	3	3	3	3	3	31
Sustainable Energy Programme (Northern Ireland)	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.1	0.1	0.0	3
Welsh Government Energy Service	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1
Warm Homes Programme	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1
Boiler Plus	1	1	2	2	2	2	3	3	3	3	23
Streamlined Energy and Carbon Reporting Framework (SECR)	2	2	2	2	2	2	2	2	2	2	23
<b>Total (TWh)</b>	<b>71</b>	<b>77</b>	<b>84</b>	<b>90</b>	<b>95</b>	<b>98</b>	<b>101</b>	<b>104</b>	<b>107</b>	<b>112</b>	<b>938</b>

Note: totals may not sum due to rounding

### 3. Policy measures in view of the achievement of the savings requirement referred to in Article 7(1) of Directive 2012/27/EU

As of 31 January 2020, the UK has left the EU and will not be bound by the Energy Efficiency Directive after the Transition Period ends. However, for the purposes of this Annex we provide a description of policy measures below which are projected to achieve significant energy savings for the UK between 2021-2030.

#### 3.1. Energy efficiency obligation schemes referred to in Article 7a

Measure	Description	Obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure	Specific actions and share of savings to be achieved in households affected by energy poverty	Savings achieved by energy service providers or other third parties	'Banking and borrowing' in accordance with point (b) of Article 7a(6)	Information on trading of energy savings
Energy Company Obligation (ECO)	The Energy Company Obligation (ECO) scheme is set by the Department for Business, Energy and Industrial Strategy (BEIS) and administered by the Office of Gas and Electricity Markets (Ofgem). ECO is a GB energy efficiency scheme.  ECO places an obligation on larger energy suppliers to	Ofgem is the administrator of the ECO scheme. Currently, energy suppliers with over 200,000 domestic customer accounts and supply volumes of over 1,100 GWh/year gas and/or 400 GWh/year electricity are obligated under the scheme and from April 1 2020, suppliers with over 150,000 domestic customer accounts	This policy targets low income, vulnerable and fuel poor homes. It is open to all domestic tenures with certain restrictions for social and private rented sector housing.	Details of eligible measures are contained in the statutory instrument <sup>419</sup> and set out in Ofgem guidance. <sup>420</sup>  Eligible measures include insulation (for example, solid, cavity, underfloor and loft) and heating	The current ECO scheme is fully focused on those who are low income, vulnerable or fuel poor.  The target for the current scheme, which has been running since December 2018, is £8.253bn in notional	The obligated energy suppliers are ultimately responsible for ensuring the measures are delivered under the ECO scheme. This saving is currently estimated	In previous iterations of ECO, as well as the current scheme, we have allowed obligated suppliers to 'carry over' certain measures from a previous obligation to the next. This enables suppliers to deliver above their obligation to manage risk, enabling surplus savings to count towards a future scheme. Whether this will be permitted beyond March 2022 will depend on what	Suppliers may, subject to approval, trade energy savings as it may simplify administration of their obligation. Suppliers may also choose to trade all or part of their obligation, subject to approval, as this could be economically more efficient. Ofgem

<sup>419</sup> [www.legislation.gov.uk/ukxi/2018/1183/contents/made](http://www.legislation.gov.uk/ukxi/2018/1183/contents/made) and [www.legislation.gov.uk/ukxi/2019/1441/contents/made](http://www.legislation.gov.uk/ukxi/2019/1441/contents/made)

<sup>420</sup> [www.ofgem.gov.uk/publications-and-updates/eco3-measures-table](http://www.ofgem.gov.uk/publications-and-updates/eco3-measures-table)

Measure	Description	Obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure	Specific actions and share of savings to be achieved in households affected by energy poverty	Savings achieved by energy service providers or other third parties	'Banking and borrowing' in accordance with point (b) of Article 7a(6)	Information on trading of energy savings
	<p>deliver energy efficiency and heating measures to low income, vulnerable and fuel poor homes. The scheme is funded at an estimated £640m per year and has been in place since January 2013; delivering around 2.6 million improvements in over 2 million homes.</p> <p>The current iteration of the ECO scheme runs till 31 March 2022.</p>	<p>and supply volumes of over 700GWh/year gas and/or 300 GWh/year electricity.</p> <p>It is the energy suppliers' responsibility to deliver set lifetime energy bill savings targets through the installation of specified measures. These are generally delivered by installers who are contracted by the energy suppliers.</p> <p>The target for the current scheme is £8.253bn in notional lifetime bill savings to be achieved by March 2022. These are apportioned to suppliers based on their market share.</p>		<p>measures (gas, electric, district and renewable).</p> <p>There is also an allowance and process for encouraging measures not previously installed under the scheme.</p>	<p>lifetime bill savings to be achieved by March 2022. Suppliers' individual targets are based on their market share.</p>	<p>to be 49 TWh over the eligible period.</p>	<p>policy follows the current scheme.</p>	<p>administers the trading process.</p>

3.2 Alternative measures referred to in Article 7b and Article 20(6) of Directive 2012/27/EU (except taxation)

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
<p>Building Regulations – Domestic and Non-Domestic (New and existing build)</p>	<p>Building Regulations in England are set and administered by the Ministry of Housing, Communities &amp; Local Government (MHCLG). In Scotland, Wales and Northern Ireland, the administration of Building Regulations are a devolved matter, and are made and maintained by the Welsh Government and the Northern Ireland Department of Finance and Personnel. The regulatory framework is similar to that in England (regulations supported by guidance) having similar target sectors.</p> <p>In England and Wales, enforcement of the regulations can be carried out by either the local authority or the private sector (approved inspectors). However, the enforcement of the Northern Ireland building regulations is carried out by District Councils.</p>	<p>Ministry of Housing, Communities &amp; Local Government (MHCLG), Welsh Government, Northern Ireland Government.</p> <p>Local authority or private sector building control bodies in England &amp; Wales. District councils in Northern Ireland.</p> <p>The person carrying out building work is responsible for ensuring that the work complies with the relevant requirements of the building regulations. They usually arrange for their work to be checked by an independent third party to make sure that their work meets the required standards. In some cases, the installer can certify themselves that their work complies.<sup>421</sup></p>	<p>New homes, new non-domestic buildings and when building work is carried out to existing properties for which Part L of the building regulations applies including extensions, conversions, renovation of the building envelope and replacement boilers and windows.</p>	<p>Details of eligible measures are contained in the statutory guidance (Approved Documents).</p> <p>These Approved Documents set minimum standards for new buildings for the thermal transmittance for walls, roofs, windows and doors together with minimum efficiency standards for heating systems. Work to existing buildings must meet similar standards when extensions and conversions are planned together with standards for replacement heating systems (e.g. the requirement to fit a high efficiency condensing boilers).</p>

<sup>421</sup> Details of building regulations and enforcement can be found: [www.gov.uk/government/policies/providing-effective-building-regulations-so-that-new-and-altered-buildings-are-safe-accessible-and-efficient/supporting-pages/building-control-system](http://www.gov.uk/government/policies/providing-effective-building-regulations-so-that-new-and-altered-buildings-are-safe-accessible-and-efficient/supporting-pages/building-control-system)

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Climate Change Agreements	<p>Climate Change Agreements (CCAs), which were introduced alongside the Climate Change Levy (CCL), have the dual policy aims of mitigating the impact of the CCL on energy intensive industry and delivering energy/carbon savings. CCAs are voluntary agreements giving participants from eligible sectors a discount on the main rates of CCL in exchange for signing up to energy efficiency or carbon reduction targets. As of 1 April 2019, the relief currently provides a 93% CCL discount on electricity and 78% discount on gas and other taxable fuels. These are increased discount rates introduced on 1 April 2019 to take account of the increased rates of CCL which took effect on the same date.</p> <p>The current CCA scheme will be in place until 31 March 2023.</p>	<p>Participation in the Scheme is on a voluntary basis. Once entered into, the conditions of a CCA are binding in order to claim the discount on the CCL.</p> <p>The scheme is administered by the Government's Environment Agency (EA). The EA enters into Umbrella Agreements with sector trade associations and underlying agreements with CCA participants or 'Target Units'. The role of the EA as administrator includes administration of applications from companies wishing to join the scheme and the unit targets of companies, the reporting process, administration of buyout and surplus, and audits and compliance. Government is responsible for eligibility of sectors and setting of sector commitments.</p>	<p>The scheme covers 53 sectors, chiefly in industrial energy-intensive sectors.</p>	<p>Targets were set in 2012 on a biannual basis (with 4 target periods covering 2013 to 2020) and cover electricity and non-traded direct emissions. Scheme participants or 'target units' ('Tus') are able to meet their targets either by direct action, or by using a buy-out mechanism for any shortfall against targets. The buy-out was increased in 2017 from £12/t to £14/t CO<sub>2</sub>e. Any over-achievement by a target unit ('surplus') may be banked and used by that target unit in subsequent target periods.</p>

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
<p>CRC Energy Efficiency Scheme</p>	<p>The CRC Energy Efficiency Scheme (CRC, formally the Carbon Reduction Commitment) is a mandatory scheme aimed at improving energy efficiency and cutting emissions in large users of energy in the public and private sectors. These organisations are responsible for around 10% of the UK’s greenhouse gas emissions.</p> <p>The scheme features a range of drivers which aim to encourage organisations to develop energy management strategies that promote a better understanding of energy usage. It is designed to target energy supplies not already covered by Climate Change Agreements (CCAs) and the EU Emissions Trading System.</p> <p>The Environment Agency administers the scheme for the UK i.e. maintaining the CRC Registry into which information on energy use is entered by participants, through which allowances are obtained through trading on the secondary market – and surrendered, and from which the annual reports on emissions are generated for publications.</p>	<p>Organisations within the UK fell within the CRC if they had:</p> <ul style="list-style-type: none"> <li>• At least one settled half hourly electricity meter</li> <li>• Consumed at least 6,000 megawatt hours (MWh) or more of qualifying electricity supplied on the settled half hourly market.</li> </ul> <p>Some public bodies were required to take part in CRC regardless of how much electricity they used. These are called mandated participants and they include all UK central government departments and devolved administrations.</p>	<p>Non-domestic large energy users.</p>	<p>The CRC is technology neutral and so incentivises a range of measures (measuring, recording, reporting and managing of energy use). The modelling distinguished between behavioural and technical measures. Behavioural measures may not have a capital cost associated with them but require a change in use of energy consuming products to generate savings. Technical measures in contrast require a piece of equipment to be installed to generate energy savings and have a capital cost.</p>

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
	<p>The 2018/19 financial year was the final CRC compliance year, with the scheme having now closed (other than requirements for participants to keep records for potential auditing and some duties on the scheme administrator which run to 2025).</p>			
<p>Energy Savings Opportunity Scheme (ESOS)</p>	<p>The Energy Savings Opportunity Scheme (ESOS) is an energy assessment scheme that is mandatory for all large undertakings (non-SMEs) in the UK.</p> <p>The objectives of the policy are to promote the take up of cost-effective energy efficiency measures whilst minimising the cost to business of complying with the mandatory energy auditing requirements. By providing enterprises with tailored information about how they can make cost-effective savings ESOS should increase the take up of cost-effective energy efficiency measures. This will increase productivity, support higher economic growth, reduce carbon emissions and improve security of supply.</p>	<p>ESOS is mandatory for large undertakings registered in the UK. These are organisations that carry out a trade or business which employ 250 or more people or employ fewer than 250 people but have both an annual turnover exceeding €50m and a balance sheet exceeding €43m. An undertaking will also qualify for ESOS if it is part of a corporate group containing at least one 'large undertaking' as defined above.</p> <p>The UK Environment Agency (EA) is responsible for administering the scheme, and the EA and regional agencies are responsible for enforcing and auditing compliance with the scheme. Energy audits will be carried out by the private sector.</p>	<p>Non-domestic sector (non-SMEs enterprises).</p>	<p>Energy audits carried out for/by non-SMEs in scope of the scheme will result in recommendations being made to those organisations of measures that could be taken in order to make energy savings. The nature of the recommended measures will depend on the nature of the audited organisation's energy use and will be determined on a case-by-case basis by the auditors in question, depending on the energy efficiency opportunities that are relevant to participant organisations.</p> <p>Organisations which are in scope of ESOS must carry out energy audits on assets and activities relating to buildings, industrial processes and transport, that account for at least 90% of their total annual energy consumption to identify cost-effective energy saving measures.</p>

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
	<p>SMEs across the UK are encouraged through ESOS guidance to undertake an energy audit on a voluntary basis to identify ways to reduce energy consumption and to demonstrate their commitment to energy efficiency. Those who notify compliance have their details published by the Environment Agency to show they have complied. Research conducted by BEIS in 2017 showed that 42% of organisations of a medium size (50-249 employees) had undertaken an energy audit.</p> <p>ESOS is a regulation that does not have an end date i.e. it will remain active until such time that it is repealed through legislation.</p> <p>There are intermediate obligation periods of 4 years for conducting ESOS assessments (with deadlines to confirm compliance by December 2019 and every 4 years thereafter).</p>			

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Low Emission Vehicles	<p>The policy purpose of the Office for Low Emission Vehicles (OLEV) is to reduce the level of greenhouse gas emission (particularly CO<sub>2</sub>) from road transport by supporting the early market for ultra-low emission vehicles. Ultra-Low Emission Vehicles (ULEVs) will present opportunities for better and more efficient energy management.</p>	<p>OLEV is made up of officials from the Department for Transport and the Department for Business, Energy and Industrial Strategy. OLEV work across UK government to support the early market for ULEVs. OLEV provides support to position the UK at the global forefront of ULEV development, manufacture and use. This support is intended to contribute to economic growth and help reduce greenhouse gas emissions and air pollution on UK roads.</p>	<p>Transport sector – road.</p>	<p>The UK government’s investment in low-carbon vehicles has a primary aim of saving carbon which is met through a combination of energy efficiency and low-carbon energy sources. The energy savings presented are the net final energy saving. Two schemes run to incentivise low-emission light vehicles (one for vans and one for cars). These cover new cars and vans, with type approval and meeting certain performance criteria, with CO<sub>2</sub> emissions below 75g/km. Manufacturers must demonstrate that vehicles meet these criteria: a list of eligible vehicles is published on the gov.uk website<sup>422</sup>.</p> <p>The increase in ULEVs will present opportunities for better and more efficient energy management. This will be particularly true with the introduction of intelligent power supply networks (smart grids) and the roll-out of electricity and gas smart meters to domestic properties (and several million smaller non-domestic businesses) which is underway in Great Britain.</p>

<sup>422</sup> [www.gov.uk/plug-in-car-van-grants/overview](http://www.gov.uk/plug-in-car-van-grants/overview)

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
<p>Private Rented Sector Regulation (England &amp; Wales) – Domestic and Non-Domestic</p>	<p>This policy is intended to ensure that action is taken to upgrade the energy efficiency of the sector. The intended effects are to make progress against the UK government’s statutory fuel poverty and climate change commitments; reduce energy demand in the Private Rented Sector, thereby lowering energy bills and improving energy security; and improve thermal comfort and associated health outcomes.</p> <p>This policy required landlords improve their properties to an EPC rating of E or above prior to entering into new tenancies, or the renewal/extension of an existing tenancy.</p> <p>Domestic landlords of EPC Band F and Band G rated homes are required to invest, or co-invest, in improving the energy performance of these properties to EPC Band E, if no third-party funding is available or is insufficient. The landlord spend requirement is capped at £3,500 inclusive of VAT.</p>	<p>Local authorities are the enforcement authorities. Landlords owning domestic and non-domestic private rented sector properties which are below an EPC rating of E are required to improve their property to at least an EPC rating of E or register an exemption.</p>	<p>The policy is primarily aimed at improving the energy performance of the least energy efficient properties in the domestic and non-domestic private rented sector.</p>	<p>Landlords are required to install ‘relevant energy efficiency improvements’ which are defined under the regulations, to meet the minimum EPC E rating.</p> <p>The landlord may register for exemptions, including where the cost of measures exceeds the £3,500 domestic cost cap, or fails to meet the 7-year payback for non-domestic properties.</p>

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
	<p>Prohibition on granting a new tenancy or renewing / extending a tenancy applied from the 1 April 2018. The backstop date from which the regulations will apply to all existing tenancies is the 1 April 2020 for domestic properties, and 1 April 2023 for non-domestic properties.</p>			
<p>Rail Electrification</p>	<p>The Department for Transport (DfT) set out a rail electrification policy and associated funding for nominated schemes through its former Rail Investment Strategy covering rail investments in the period 2014 to 2019.</p> <p>Some of the planned electrification schemes under development have been delivered, including part of the Midland Main Line and Great Western Main Line. Some of the electrification schemes were paused when the programme was re-scoped.</p> <p>DfT is now working with Network Rail, the owner of the rail infrastructure in the UK, on a Traction Decarbonisation Network Strategy (TDNS). This will consider the most appropriate technology, including electrification, for decarbonisation of the remaining unelectrified lines in the country.</p>	<p>Network Rail, the owner of the rail infrastructure in the UK, is responsible for delivering the electrification schemes identified with the funding agreed with DfT.</p>	<p>Transport sector – railway.</p>	<p>The UK government’s investment in rail electrification is driven by the cost savings, carbon benefits and improved reliability and performance of running electric trains instead of diesels. A significant element of the cost savings arise from the improved energy efficiency of electric trains combined with the use of electricity instead of diesel as a fuel.</p> <p>Following the completed electrification schemes, 80% of passenger km are undertaken on the electrified network.</p>

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Re:Fit	<p>The Re:Fit programme is a procurement framework for public sector organisations to procure energy efficiency improvements to their buildings from Energy Service Companies (ESCOs). This is an embryonic market in the UK, and the Greater London Authority provides support for public bodies in accessing this novel contracting arrangement within London. BEIS and Local Partnerships work jointly to provide similar support in the rest of England.</p> <p>Government support, through BEIS, for the current Re:Fit programme is due to end in March 2020. Local Partnerships and Welsh Government are currently designing a successor programme which will operate without BEIS support.</p> <p>In Wales, the Re:Fit Cymru Programme Implementation Unit<sup>423</sup> provides end to end support to the Welsh public sector to develop and implement projects using the Re:Fit framework.</p>	<p>The Re:Fit framework is open to all public sector bodies. They are able to use the framework in order to make energy efficiency improvements to their estate. It is an entirely voluntary programme; the public bodies chose to make use of the framework, securing financing and working with ESCOs to ensure the measures are properly designed and implemented. The role of the ESCO is to design and implement the energy efficiency improvements, then monitor their performance to guarantee the energy savings.</p>	<p>All public sector buildings in England and Wales.</p>	<p>Re:Fit is an output based procurement tool – as such any energy efficiency building improvement measure that relates to the fabric of the building is within scope.</p>

<sup>423</sup> [www.gov.wales/topics/environmentcountryside/energy/efficiency/re-fit-cymru/?lang=en](http://www.gov.wales/topics/environmentcountryside/energy/efficiency/re-fit-cymru/?lang=en)

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Salix Public Sector Finance	The Public Sector Energy Efficiency Loan Scheme <sup>424</sup> provides interest-free loans, via a revolving fund, to public sector and higher education organisations, for energy efficiency projects. Total funds will rise to £385m by 2020.	<p>Salix Finance is funded by BEIS, and the Welsh and Scottish Governments and provides interest-free loans to Public Sector bodies to fund energy efficiency improvement projects.</p> <p>The energy savings made enable the Public Sector body to repay the loan to Salix over an agreed repayment period. The majority of repayments are then allocated to further energy-efficiency projects by agreeing further loans.</p> <p>Salix loans are available to all public sector bodies, other than central government and NDPBs.</p>	Public sector organisations.	<p>Salix Finance supports a broad range of energy-efficiency technologies, which all have lifetime energy saving estimates based on an established methodology. Examples of commonly funded energy-efficiency technologies include:</p> <ul style="list-style-type: none"> <li>• Energy efficient lighting eg. LED/T5 lamps</li> <li>• Installation and upgrading of building energy management systems</li> <li>• Energy efficient street lighting eg. part night dimming systems/LED replacements</li> <li>• Improvements to heating systems eg. implementing heat recovery and switching from oil to gas boilers</li> <li>• Building fabric insulation improvements, such a cavity wall and loft insulation</li> </ul>

<sup>424</sup> [www.salixfinance.co.uk](http://www.salixfinance.co.uk)

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
<p>Smart Metering (Non-Domestic)</p>	<p>Smart Meters are the next generation of gas and electricity meters and provide consumers with more accurate information, putting an end to estimated billing. Smart meters can provide near real-time information to help consumers control and manage their energy use, save money and reduce emissions. Alongside the roll-out of smart meters to all homes in Great Britain (GB), the Government's vision is for all smaller non-domestic premises to benefit from smart metering.</p> <p>In the period to end-September 2019, over 1.1 million smart and advanced meters are in operation in smaller non-domestic sites.<sup>425</sup></p> <p>Energy suppliers are responsible for the provision and installation of smart meters in non-domestic premises and are required under conditions in their licences to take all reasonable steps to install smart (or advanced) meters in all relevant non-domestic premises by the end of 2020.</p>	<p>Energy suppliers are responsible for the provision and installation of smart meters in non-domestic premises. They are required under conditions in the gas and electricity supply licences to take all reasonable steps to install smart (or advanced) meters in all non-domestic premises covered by the rollout by the end of 2020, and report progress to Ofgem, the GB independent energy regulator with a responsibility for regulating the roll-out.</p>	<p>Smaller and medium-sized non-domestic premises in GB. This captures electricity meters in profile classes 3 and 4 (Non-domestic Unrestricted Customers and Non-domestic Economy 7 Customers) and gas meters where average annual gas consumption is below 732MWh. These are the least energy intensive non-domestic customers and are, typically, smaller non-domestic organisations.</p>	<p>The non-domestic roll-out covers around three million meters in around two million sites. These sites are very varied, including private and public sector organisations, small shops to chain stores and compact industrial units to schools.</p> <p>Microbusiness consumers must be provided with a smart meter which complies with the latest version of the Smart Metering Equipment Technical Specification (SMETS2). Non-microbusiness consumers can be offered a choice between a SMETS2 meter and an Advanced meter (these meters provide half-hourly data, and are established in the larger industrial and commercial sector).</p>

<sup>425</sup> BEIS (2019) Statistical release and data: Smart Meters, Great Britain, quarter 3 2019, available at: [www.gov.uk/government/statistics/statistical-release-and-data-smart-meters-great-britain-quarter-3-2019](http://www.gov.uk/government/statistics/statistical-release-and-data-smart-meters-great-britain-quarter-3-2019)

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
	<p>Since June 2019 the ‘new and replacement obligation’ has applied, which (subject to certain exceptions) requires energy suppliers to take all reasonable steps to ensure a smart is installed where a meter is replaced or installed for the first time (e.g. in new build premises). In September 2019 the Government consulted on a number of proposals to help inform the policy framework for energy suppliers to continue installing smart meters after 31 December 2020, when the current rollout duty ends.<sup>426</sup></p>			
<p>Northern Ireland Sustainable Energy Programme (NISEP)</p>	<p>The NISEP is a voluntary energy efficiency programme in which money is collected from electricity customers through a Public Service Obligation (PSO). The charge is a flat rate (around 0.113 pence) per kilowatt hour which means that customers who use higher volumes pay more than those who use less. A competition to bid for funds to run energy efficiency schemes is carried out on an annual basis.</p>	<p>NISEP is set up and overseen by the Northern Ireland Authority for Utility Regulation (UR).</p> <p>The Energy Saving Trust (EST) acts as Programme Administrator to manage the programme on behalf of UR.</p> <p>NIE Ltd, the owner of the distribution network in NI, collects the fund and pays it out to organisations running approved energy saving schemes, in accordance with a condition in its distribution licence.</p>	<p>Domestic &amp; non-domestic buildings, where 80% of the funding is ring-fenced for schemes that target priority (vulnerable/low-income) households. The other 20% of funding is used for schemes that target non-priority domestic households and/or the commercial sector. All energy types are targeted for savings including electricity, gas, oil, coal etc.</p>	<p>Insulation – loft, cavity wall, solid wall (internal or external), hot water cylinder and pipe;</p> <p>Heating systems, including high heat retention storage heaters and boiler and controls – natural gas or oil (if not on the gas network);</p> <p>Energy efficient lighting (in domestic sector can be included in a scheme but lighting only schemes are no longer allowed);</p> <p>Domestic refrigeration and appliances (these measures have not been included in schemes for a number of years);</p>

<sup>426</sup> [www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020](http://www.gov.uk/government/consultations/smart-meter-policy-framework-post-2020)

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
		<p>All Northern Ireland licenced electricity and gas companies are eligible to become Primary Bidders and bid for funds to undertake schemes – in practice only five electricity and gas suppliers participate in the programme – Power NI, SSE Airtricity, firmus energy, Energia and Electric Ireland.</p> <p>Primary Bidders are totally responsible for the undertaking of their schemes and must sign an agreement with UR to agree to undertake the schemes in accordance with the NISEP Framework Document.</p>		<p>Other technologies for commercial sector e.g. variable speed drives and compressors, heat exchangers, high bay lighting and liquid refrigerant pumping technology.</p> <p>This is not an exhaustive list, other measures will be considered if they are proven technologies that meet or exceed relevant standards (e.g. safety, quality), the present value of the lifetime customer benefits exceeds the cost of the measures and if approved by the Energy Savings Trust.</p> <p>There should be no overlap with other grant or incentive schemes external to the NISEP for the particular measure eg. most renewable micro generation measures are no longer eligible for NISEP funding since Government incentives have been introduced.</p>

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
<p>Welsh Government Energy Service</p>	<p>The Welsh Government Energy Service succeeds Green Growth Wales and offers technical, commercial and financial support for Welsh energy efficiency, renewable and heat projects.</p> <p>Available to public sector organisations, the capital finance is available through Salix (above) and is interest-free.</p> <p>With funding from the Welsh Government, Salix Finance SEELS (Salix Energy Efficient Loan Scheme) loans have been used by 47 different Welsh public sector bodies since 2009. More than £80m has been invested by our clients in Welsh energy efficiency projects which, over their lifetime, are forecasted to save approximately £140m. The service has further stimulated another £27m of investment from other sources.</p>	<p>Paid for by Welsh Government, the fund is administered by Salix.</p>	<p>Public sector organisations.</p>	<p>Only those projects where the resultant energy savings, over the lifetime of the project, go directly back to the public sector and the public sector gains a direct financial benefit are eligible.</p>

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
<p>Warm Homes Programme</p>	<p>The Welsh Government's Warm Homes Programme has been in place since 2009. Investment has reached over £327m in the past decade. It has improved the energy efficiency of more than 55,000 homes in Wales. By the end of the current funding period in March 2021, Welsh Government investment will have reached more than £344m and over 75,000 homes will have benefitted. Over 129,506 people have received energy efficiency advice through the programme since 2011.</p> <p>As part of the programme, the Warm Homes Nest and Arbed Schemes have supported some of the most vulnerable people in society by improving their resilience to avoidable ill health and preventing premature death.</p>	<p>The programme has received funding from European, UK and Welsh Governments.</p>	<p>Domestic households living in fuel poverty.</p>	<p>Between 2018-19, the Nest scheme has helped people claim their entitlement to a Warm Homes Discount from their energy supplier and more than 3,800 homes have benefited from home energy efficiency measures during this reporting period.</p> <p>Although the Arbed Scheme is not predominantly a decarbonisation scheme, it's approach to retrofitting housing does contribute to wider decarbonisation efforts.</p>

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Boiler Plus	<p>The policy objectives are to deliver additional energy and carbon savings from the domestic heating sector in England by lowering overall gas demand from domestic properties, thereby reducing fuel bills for these properties and contributing towards meeting the UK's legally binding carbon budgets. It aims to do this by increasing the deployment of devices which increase the efficiency of domestic heating systems, through controls and measures to make gas boilers heat homes more efficiently.</p> <p>New standards for domestic boilers in the Building regulations for England came into force in April 2018 and will remain in force indefinitely.</p>	<p>The standards create an obligation on the person carrying out the work when a gas boiler is installed in an existing dwelling in England. Compliance and enforcement of standards pertaining to fixed building services is the responsibility of Building Control, which are teams of surveyors responsible for checking all aspects of construction.</p>	<p>Existing domestic buildings in England dependent on gas boilers.</p>	<p>The measure applies to all households in England in the domestic sector with an existing combi gas boiler.</p> <p>The standards require:</p> <p>All gas boilers installed into existing systems to have Energy Related Products (ErP) methodology rating of at least 92%;</p> <p>Time and temperature controls to be installed at the same time, if not already present and working;</p> <p>Combination boiler replacements to include the provision of an additional energy efficiency measure to be installed at the same time. But to reflect the diverse needs and circumstances of homes and households, the requirement will provide flexibility to allow a wide range of technology options to be considered.</p>

Measure	Description	Implementing public authorities, obligated parties and their responsibilities	Target sectors	Eligible actions provided for under the measure
Streamlined Energy and Carbon Reporting Framework (SECR)	<p>SECR reporting came into force on 1 April 2019 to coincide with the removal of the CRC Energy Efficiency Scheme allowance price and the increase in CCL rates. SECR aims to reduce the administrative burdens of the current overlapping suite of reporting requirements while increasing corporate transparency, further incentivising energy efficiency and reducing carbon emissions.</p> <p>SECR builds on – but does not replace – existing requirements that companies may face, such as mandatory greenhouse gas (GHG) reporting for quoted companies, the Energy Savings Opportunity Scheme (ESOS), Climate Change Agreements (CCA) Scheme, and the EU Emissions Trading Scheme (ETS).</p>	SECR extends the reporting requirements for quoted companies and mandates new annual disclosures for large unquoted and limited liability partnerships (LLPs).	Large or quoted UK businesses.	Requiring organisations to report on their energy use is intended to drive behaviour change by raising awareness of energy efficiency with organisational decision makers and increasing the importance of energy efficiency to organisations through reputational drivers. Increased transparency for investors and others will make them more able to hold companies to account.

### 3.3. Information on taxation measures

Taxation Measure	Description	Duration	Implementing public authority	Expected cumulative and annual amount of savings	Target sectors and segment of taxpayers	Calculation methodology
Climate Change Levy	The CCL is a levy on the supply of energy to business and public-sector consumers. Each of the four main groups of taxable commodities (electricity, gas, coal, and liquefied petroleum gas) has its own main rate per unit of energy. The main rates of the CCL are intended to change business behaviour to reduce energy consumption. CCL rates will be increased from 1 April 2019 by 31% on electricity and 40% for gas and other taxable fuels. <sup>427</sup>	The CCL was introduced in 2001. There is no planned end date so is assumed to continue for the whole period 2014-2020. The CCL rate is set each year by HMRC.	HM Revenue & Customs	<p>The estimated energy savings from the CCL over the period 2014-20 have been set out in Table 1. These are presented as annual savings over the seven-year period.</p> <p>The savings presented are based on the impact of the duty charged that is additional to the EU Energy Taxation Directive (ETD) minimum rates for CCL taxable commodities.</p>	<p>The main rates of climate change levy are paid on supplies of taxable commodities to business consumers including consumers in industry, commerce, agriculture, public administration, and other services. The main rates of CCL do not apply to taxable commodities supplied for use by domestic consumers or to charities for non-business use, while use in metallurgical and mineralogical processes, non-fuel and dual use applications, transport and the production of electricity and energy products is exempt.</p> <p>Commodities must register with HMRC and account for tax due on a quarterly basis.</p>	<p>The calculation of energy savings has been made based on long-run price elasticities applicable to the sectors within the UK from published academic literature.</p> <p>Organisations within a range of sectors can claim partial exemption from the CCL if they have a Climate Change Agreement (CCA).</p> <p>For participants within the Climate Change Agreement, their CCL rate is reduced to approximately the Energy Tax Directive (ETD) minimum rate. Savings within the CCA sector are presented separately.</p> <p>Given the CCL is an existing policy measure the analysis estimates what increase in energy consumption would be observed if the CCL was not charged above the ETD minimum.</p>

<sup>427</sup> [www.gov.uk/government/publications/rates-and-allowances-climate-change-levy/climate-change-levy-rates](http://www.gov.uk/government/publications/rates-and-allowances-climate-change-levy/climate-change-levy-rates)

4. Calculation methodology for measures notified under Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU (except for taxation measures)

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Energy Company Obligation (ECO)	<p>Scoring is delegated to the administrator of the scheme, Ofgem. Ofgem work with the Building Research Establishment to produce 'deemed' scores for each energy efficiency measure.</p> <p>Savings from this policy are considered deemed savings.</p>	Final savings.	<p>Assumptions are made about the lifetime of each eligible energy efficiency measure under the scheme. The lifetime assumptions are integrated into scores attributed to each energy efficiency measure delivered under the scheme.<sup>428</sup></p>	Deemed scores are lifetime scores and they relate to the average treatable area for the measure type.	We model the scheme net of the counterfactual and consider overlap with other related policies.	There is no variation based on climatic conditions.

<sup>428</sup> [www.ofgem.gov.uk/publications-and-updates/eco3-deemed-scores](http://www.ofgem.gov.uk/publications-and-updates/eco3-deemed-scores)

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
<p>Building Regulations – Domestic and Non-Domestic (New and existing build)</p>	<p>Savings are calculated by measuring the uplifts to Part L of building regulations against a counterfactual scenario of energy savings that would have occurred without Part L changes.</p>	<p>Final savings.</p>	<p>Assumptions were made about the approximate asset life of each measure.</p> <p>Building fabric (external walls, floors, roofs) – 60 years</p> <p>External windows and doors – 30 and 25 years respectively.</p> <p>Heating, ventilation and air conditioning (HVAC) equipment and lighting – 15 and 20 years respectively.</p> <p>The policy is assumed to apply to all building developments over a 10-year period from introduction.</p>	<p>Calculation of overall building energy performance for new buildings is undertaken using the UK National Calculation Methodology approved for use in transposition of Article 3 of Directive 2010/31/EU. This considers the range of criteria set out within Annex 1 of that Directive and is applied for new dwellings through the UK government’s Standard Assessment Procedure (SAP) and, for new non-domestic buildings, the Simplified Building Energy Model (SBEM).</p>	<p>The policy impacts estimated does not overlap with other policies, so any estimated impacts are considered additional.</p>	<p>The methodology for calculating the energy performance of buildings approved by the regulations includes climate data. The UK methodology for dwellings (SAP<sup>429</sup>) applies average UK data for heating load assessment and regional factors for solar radiation and cooling loads. The UK methodology for non-domestic buildings (SBEM39) does include a number of climate zones across the UK.</p>

<sup>429</sup> [www.bre.co.uk/sap2009/](http://www.bre.co.uk/sap2009/)

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
			<p>The estimated energy savings and incremental costs associated with tightening the Regulations are accumulated and discounted over the 60-year life of each building developed during the policy period.</p>	<p>Calculation of the performance of building elements is demonstrated through reference to the relevant standards.</p>		
<p>Climate Change Agreements</p>	<p>Targets are set for the energy use of a firm. To set relative targets a throughput measure is needed that relates accurately to energy consumption or carbon emissions - the actual production level in the target year is compared with the energy that would have been used for the same level of production and mix of products at the efficiency of production in the base year.</p>	<p>Final savings.</p>	<p>It is not possible to give an estimate of the average lifetime of these measures as conditions may vary between technologies and sectors.</p>	<p>CCAs have been in place since 2001 and DECC has collected data from a consultation exercise and has received feedback from participants; this forms the basis of much of this analysis. Many of proposals been consulted on previously and have provided further evidence that has improved the quantification of costs and benefits.</p>	<p>A CCA double counting mechanism ensures there is no double counting. Where an operator has surplus EU ETS allowances, this is offset by the CCA target being tightened to become more demanding. This is an emissions reduction but is achieved by tightening the CCA target to make it more demanding.</p>	<p>These are not deemed significant in the non-domestic sector.</p>

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
					<p>Alternatively, if operators do not want to use the double counting mechanism they can avoid it completely by retiring all their surplus EU ETS allowances that form the overlap. Any failure to retire all the surplus EU ETS allowances leads to the full implementation of the double counting mechanism, with no allowance being made for any part of the EU ETS surplus that might have been retired.</p>	

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
CRC Energy Efficiency Scheme	The analysis on the impact of CRC on energy savings is based on modelling take up rates <sup>430</sup> of energy efficiency potential in response to carbon prices. It assumes that CRC organisations will take up measures that equate to a cost of up to the corresponding price of CRC allowances.	Final savings.	The weighted average lifetime of technical/capital measures is nine years, while behavioural measures are assumed to be replaced/reintroduced every three years. The analysis also assumes that measures continue to be replaced at an annual rate of 0.3% a year (however the actual rate may be higher than this if the introduction of the CRC stimulates additional research and development).	Analysis on the impacts of the CRC on carbon savings and energy bills is based on two databases of technological and behavioural measures: BRE's abatement cost curves for the non-domestic sector and the ENUSIM model for industrial sectors as modified by Enviro for the Energy Efficiency Innovation Review (2005). It assumes that over time (and in response to the introduction of the scheme) the existing cost-effective potential for emission reductions will be taken up by participant organisations.	These measures are expected to target energy savings potential not already covered by the policies operational at the time CRC was conceived (i.e. CCA and EU ETS). The analysis then deducts the impact of other policies that were implemented before the actual start of CRC and would have overlapped with the scheme, which include non-domestic Smart Meters, Energy Performance of Building Directive, Green Deal and Products Policy.	These are not deemed significant in the non-domestic sector.

<sup>430</sup> Energy Efficiency and Trading Part II: Options for the Implementation of a New Mandatory UK Emissions Trading Scheme. Department for the Environment, Food and Rural Affairs. 28 April 2006.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
					<p>The scheme coverage has been adjusted to account for the exclusion of metallurgical and mineralogical processes from the CRC, following the introduction of an exemption from the Climate Change Levy (CCL) for energy used for these processes.<sup>431</sup></p> <p>Finally, energy savings have been adjusted to remove the impact of savings incentivised by these policies prior to 2014. This is done by removing legacy savings of technologies that the abatement potential analysis suggests will be adopted up to 2013.</p>	

<sup>431</sup> The impacts of this change have been presented in the February 2014 Impact Assessment – ‘Finalising CRC simplification: treatment of renewable energy & the metallurgical and mineralogical sectors’: [www.gov.uk/government/consultations/finalising-crc-simplification-treatment-of-renewable-energy-the-metallurgical-and-mineralogical-sectors](http://www.gov.uk/government/consultations/finalising-crc-simplification-treatment-of-renewable-energy-the-metallurgical-and-mineralogical-sectors)

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Energy Savings Opportunity Scheme (ESOS)	Energy savings from energy efficiency measures implemented as a result of ESOS assessments. This is net of the counterfactual in which measures would be implemented due to rising energy prices of another government policy.	Final savings.	Organisations in scope of ESOS will not be legally obligated to implement energy efficiency measures recommended through an ESOS assessment.  Therefore, we cannot anticipate the lifetime of energy efficiency measures implemented, though it would be reasonable to assume measures implemented will be permanent rather than temporary.	For the building sector, the estimate of technical potential is based on the Non-Domestic Energy and Emission Model (N-DEEM) dataset, which provides data on the total potential in non-domestic buildings and the associated capital costs. The costs are incurred upfront, and have been adjusted to include the cost of replacement for measures.  For industrial processes, cost and potential estimates are based on a number of datasets from AEA and Arup.	Energy savings are calculated compared to the counterfactual. Overlaps with other policies are currently being considered.	These are not deemed significant in the non-domestic sector.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Low Emission Vehicles	Data is collated for each vehicle sold, meaning information is held on how many vehicles emitting a certain level of CO2 have been sold.	Final savings.	The DVLA database indicates that the typical operational lifetime of a car is around twelve years, so it is expected that vehicles already purchased with the support of OLEV will remain in the UK fleet until the mid to late 2020s.	Total emissions from vehicles receiving grant funding can be calculated and compared to average emissions from the UK fleet.	Dealerships are required to check the identity of grant claimants to ensure they are UK residents. The claims progress through a number of stages prior to payment. The key stage is an online verification process which automatically cross checks the vehicle's registration number against the DVLA database to ensure it is an eligible vehicle and has not already received the grant.	Not applicable. Vehicles supported under OLEV schemes are in use throughout the UK and designed for use in a range of European climatic conditions.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
<p>Private Rented Sector Regulation (England &amp; Wales) – Domestic</p>	<p>Energy savings are net of counterfactual uptake (that is, measures that would be delivered in the absence of the Regulations – i.e., uptake due to self-financing, or through other Government policies).</p>	<p>Final savings.</p>	<p>The assumed lifetimes of the most common measures for the domestic sector are:</p> <ul style="list-style-type: none"> <li>Loft insulation – 42 years</li> <li>Low energy light bulbs – 10 years</li> <li>Cavity wall insulation – 42 years</li> <li>Hot water cylinder insulation – 10 years</li> </ul>	<p>Energy savings are calculated based on the Standard Assessment Procedure (SAP), which is operated by the Building Research Establishment (BRE) on behalf of the Department for Business, Energy and Industrial Strategy.</p> <p>Energy savings are net of counterfactual uptake (that is, measures that would be delivered in the absence of the Regulations – i.e., uptake due to self-financing, or through other Government policies).</p> <p>The profile of take up in the counterfactual in the domestic sector has been determined from modelling in the Green Deal Household Model (GDHM).</p>	<p>We model the scheme net of the counterfactual and consider overlap with other related policies.</p>	<p>The UK methodology for dwellings (SAP) applies average UK data for heating load assessment and regional factors for solar radiation and cooling loads. A full explanation of the methodology is available from the Building Research Establishment.<sup>432</sup></p>

<sup>432</sup> [www.bre.co.uk/sap2012](http://www.bre.co.uk/sap2012)

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
<p>Private Rented Sector Regulation (England &amp; Wales) – Non-Domestic</p>	<p>Energy savings are net of counterfactual uptake (that is, measures that would be delivered in the absence of the Regulations – i.e., uptake due to self-financing, or through other Government policies).</p> <p>The analysis is based on scaled energy savings.</p>	<p>Final savings.</p>	<p>The assumed lifetimes of the most common measures for the non-domestic sector are:</p> <p>Condensing boilers – 12 years</p> <p>Air source heat pump – 15 years</p> <p>Properties in scope of this policy (those with EPC F or G) are assumed as part of business as usual to carry out replacement/upgrades when measures come to the end of their life.</p>	<p>Energy savings are calculated based on the Building Research Establishment’s SBEM.</p> <p>The non-domestic counterfactual is based on research underpinning the non-domestic green deal model, both referenced in the Green Deal and ECO 2012 Final Impact Assessment annexes.<sup>433</sup></p> <p>The National Household Model (NHM) discards packages that are above the £3,500 cost cap. The NHM then finds the package of that minimises costs of reaching an ‘E’ rating.</p>	<p>We model the scheme net of the counterfactual and consider overlap with other related policies.</p>	<p>SBEM methodology.</p>

<sup>433</sup> [www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/42984/5533-final-stage-impact-assessment-for-the-green-deal-a.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42984/5533-final-stage-impact-assessment-for-the-green-deal-a.pdf)

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
				<p>Where measures can be installed under the cost cap, but the property cannot reach an EPC rating of E, the NHM installs the package of measures that maximises the improvement in energy efficiency of the property whilst still remaining under the cost cap.</p>		

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Rail Electrification	Savings data is an output of Department for Transport's Rail Emission Model (REM). REM estimates energy consumption of each rail passenger service operating in GB on the basis of each service's characteristics (stock type, stopping pattern, speed, etc.). The model is calibrated to actual annual energy (gas oil and electricity) consumption as reported by individual train operating companies. REM was run twice, once with rail electrification schemes and once without.	Final savings.	60 years which is the nominal life of the electrification infrastructure.	REM was run twice, once with rail electrification schemes and once without. The expected savings are the difference between the outputs of these two runs, converted to TWh. The savings presented by electrification are considered additional to business as usual. This is because government intervention – both in terms of policy and funding - is required to deliver rail electrification schemes. This is partly because of the high capital costs involved but also because of the impact of electrification on the wider rail system (such as the need to introduce new electric trains).	We model the scheme net of the counterfactual and consider overlap with other related policies.	The design of electrification schemes takes account of expected changes in climate eg. wind loadings and temperature variation, over the design life of the infrastructure.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Re:Fit	<p>Energy saving estimates are based on the performance of previous projects under the London Re:Fit scheme, which have been used to estimate:</p> <ul style="list-style-type: none"> <li>• The expected number of projects that will be completed each year</li> <li>• The expected average capital value of projects</li> <li>• The expected average payback timescale of the projects</li> </ul>	Final savings.	Given the wide variety of measures, there is a large range of lifetimes, as is standard in energy efficiency measures, for the improvements from 6-15 years.	<p>Energy saving estimates are considered deemed savings which are based on the performance of previous projects under the London Re:Fit scheme, which have been used to estimate:</p> <ul style="list-style-type: none"> <li>• The expected number of projects that will be completed each year</li> <li>• The expected average capital value of projects</li> <li>• The expected average payback timescale of the projects.</li> </ul> <p>This has been used to estimate the average annual energy bill saving arising from the projects, which has been combined with an assumed electricity price to estimate the total energy savings from Re:Fit projects in a particular year out to 2020.</p>	The Re:Fit team checks estimated savings and ensures that these are reported through the client's mechanism with Re:Fit maintaining an overview.	Every proposal under the scheme contains a measurement and verification plan which takes account of climatic variation in calculating the technological savings to be achieved.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
				<p>This has been used to estimate the average annual energy bill saving arising from the projects, which has been combined with an assumed electricity price to estimate the total energy savings from Re:Fit projects in a particular year out to 2020.</p> <p>All projects within the scheme are additional and we have assumed that all savings are expressed as electricity.</p>		

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Salix Public Sector Finance	The forecast number of Salix projects is determined by the level of funding. While some elements are confirmed due to the recycling of funding from loan repayments, there is no guarantee that the scheme will receive new funding in any year.	Final savings.	<p>Where a public sector body identifies that a project will be installed on a site with an estimated lifespan which is lower than the technology lifespan, the site life will be used in the lifetime savings calculations.</p> <p>A distribution of persistence factors has been calculated based on the persistence factors for different types of energy efficiency projects. The energy savings from an energy efficiency project are assumed to reduce with time. Energy savings are assumed to reduce from 100% in years 1, 2, 3 and 4 to 98% in year 5 and 96% in year 6.</p>	An average annual energy saving of 2.6 kWh per £1 invested is assumed, and this is based on SEELS projects carried out in 2012/13, 2013/2014 & 2014/2015. There are a number of factors which can affect this, primarily the mix of projects which reduce heating consumption (predominantly gas) or electricity use. It is worth noting that Salix has funded a number of projects, largely CHP, which give carbon and financial savings through a reduction in electricity consumption, but result in a net increase in kWh consumption, due to the increase in gas usage. These projects are factored into the average.	All applications are subject to the same technical assessment procedures. Checks made include a comparison of variables such as payback with a knowledgebase consisting of previously funded projects. This allows Salix to check for any which fall out of normal limits. Additional checks include manual review of supporting information such as calculations and technical literature for the proposed energy-efficiency technology.	The impact of climatic variation, such as varying hours of darkness or heating degree-days, may have on the savings estimated for projects will differ dependent on the type and location of the project being undertaken. As public sector bodies are aware of the specific climatic variations for their region and how these impact projects, this impact will form part of their estimation of savings prior to submission to Salix.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
				In this analysis it has been assumed that over two-thirds of the energy savings are additional to existing measures and would not have been realised without Salix.		
Smart Metering	<p>In the non-domestic sector, we assume that smart/advanced meters, together with provision of data, reduce energy consumption by 2.8% (electricity) and 4.5% (gas) per meter in central scenarios. The primary source of evidence for this is a trial of advanced metering in 538 SME sites carried out by the Carbon Trust in 2007.<sup>434</sup></p> <p>The savings for this policy are considered deemed savings.</p>	Final savings.	An installed smart meter has an assumed lifetime of 15 years. Savings are included since the beginning of the smart meter rollout in 2013.	The calculation methodology used is consistent with the approach set out in the 2019 Smart Meter Cost Benefit Analysis <sup>435</sup> .	Double counting is avoided by the method utilised. An energy savings rate is calculated, and then applied to a fixed average consumption figure for non-domestic properties covered by the smart meters mandate. The energy savings percentage was derived from a controlled study, which removed any possible impacts from other energy saving measures.	No climatic variations are considered in the analysis. Energy savings assumptions have been informed by trials both in the UK and internationally and, as a result of this, the observed energy reduction anticipated will already reflect climatic variations.

<sup>434</sup> [www.carbontrust.com/resources/reports/technology/advanced-metering-for-smes](http://www.carbontrust.com/resources/reports/technology/advanced-metering-for-smes)

<sup>435</sup> [www.gov.uk/government/publications/smart-meter-roll-out-cost-benefit-analysis-2019](http://www.gov.uk/government/publications/smart-meter-roll-out-cost-benefit-analysis-2019)

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Northern Ireland Sustainable Energy Programme (NISEP)	The Energy Saving Trust (EST) uses a SAP based model <sup>436</sup> as the main source of assessing the energy savings from domestic schemes. The model calculates the energy requirements of domestic dwellings and estimates the likely savings resulting from energy efficiency improvements.	Final savings.	Cavity wall insulation (40 years) Internal/external solid wall insulation (36 years) Loft insulation (30 years) Efficient boiler (15 years) Hot water cylinder and pipe insulation (10 years) Energy efficient lighting (various) Domestic refrigeration and appliances (various) Commercial technologies (various)	Primary Bidders are required, as part of the post-implementation reporting of schemes, to fill in a spreadsheet with the number of and types of measures installed in different types of properties. The spreadsheet, compiled by EST, then automatically calculates the energy savings achieved. So that the savings of different fuels can be expressed in a consistent manner, the savings are calculated in 'fuel standardised' terms that reflect the fuel's carbon content. The carbon factors used are consistent (with the exception of electricity which is derived from the generation mix on the island of Ireland) with those published by Defra.	UR/EST works with the Northern Ireland Housing Executive/ Department for Communities (DfC) to ensure there is no double counting of measures installed under NISEP with the DfC funded Affordable Warmth Scheme.  This includes annual assessment of data provided by DfC/NIHE.	Not applicable. The NISEP funding is only for measures installed within Northern Ireland and there is no substantial climatic variation across the country.

<sup>436</sup> Housing model build using the government's Standard Assessment Procedure (SAP) methodology 2012.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Welsh Government Energy Service	The project is deemed completed when all installations have taken place, the equipment has been commissioned and has started generating savings for the PSB and all internal completion documents have been signed off. Only then will funding be provided.	Final savings.	<p>Where a public sector body identifies that a project will be installed on a site with an estimated lifespan which is lower than the technology lifespan, the site life will be used in the lifetime savings calculations.</p> <p>A distribution of persistence factors has been calculated based on the persistence factors for different types of energy efficiency projects. The energy savings from an energy efficiency project are assumed to reduce with time. Energy savings are assumed to reduce from 100% in years 1, 2, 3 and 4 to 98% in year 5 and 96% in year 6.</p>	The repayment value is expected as a direct result from savings projected in energy bills achieved from the completion of the project, making the funding self-sufficient.	All applications are subject to the same technical assessment procedures. Checks made include a comparison of variables with a knowledge base consisting of previous projects.	Not applicable.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Warm Homes Programme	The average improvement in the energy performance rating (which is measured by Standard Assessment Procedure, or SAP) of each property receiving assistance in 2018/19 was 14.1 points.	Final savings.	Not currently estimated as beneficiaries of the schemes are not currently able to apply for a further grant once a grant for works has been approved.	Warm Homes Programme schemes publish annual reports setting out carbon savings for schemes during the reporting year.	Improvements in energy efficiency are reported to Welsh Government by the scheme agents. Benefits delivered by the scheme agents using funding from UK government schemes are disaggregated.	Not applicable. The Warm Homes Programme treats Wales as a single climatic zone and offers the same set of range of solutions to all households regardless of location and local climate.
Boiler Plus	The energy savings estimates as a result of this regulation change are considered in terms of how the energy savings benefits will accrue in the case that all households make the same technology choice e.g. the installation of load compensators.	Final savings.	Heating controls are expected to have a lifetime of 15 years, so this policy covers one replacement cycle of the English household stock. The benefits are continued to be collected for a further period of 15 years from the last year of installations.	Consumers are assumed to be driven by two distinct motives when making the choice, cost minimisation (minimise up-front costs, so choosing the lowest technology cost option i.e. load compensator) or benefit maximisation (optimising annual bill savings over the lifetime i.e. choose the highest performing technology of the choice list which is the learning thermostat).	The policy impacts estimated does not overlap with other policies, so any estimated impacts are considered additional.	Not applicable.

Scheme/Measure	Measurement methods used	Method to express the energy savings (primary or final savings)	Lifetime of measures	Description of the calculation methodology	Information on how double counting of energy savings is avoided	Climatic variations and approach used
Streamlined Energy and Carbon Reporting Framework (SECR)	In addition to information on GHG emissions, energy usage and a chosen emissions intensity ratio, reports must include a narrative description of measures taken to improve the businesses' energy efficiency in that year. Where possible, resulting energy saving from the actions reported should also be stated. If no measures have been taken this should also be included.	Final savings.	Reporting is done annually.	The methodology used by companies must be disclosed in their reporting and although no methodology is prescribed, it must be robust, transparent and widely accepted.	Detailed guidance published to assist companies in adopting best practice and thereby avoid double counting.	Not applicable. Reporting is done at entity level.

5. Monitoring and verification

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Energy Company Obligation (ECO)	<p>There is a statutory requirement on OFGEM, the administrator of the ECO scheme to determine whether an obligated supplier has achieved its obligation.</p> <p>In line with requirements under EED, OFGEM requires suppliers to conduct technical and score monitoring inspections on ECO measures to ensure the required standards of installation are met and measures are scored accurately. Technical monitoring verifies whether measures have been installed to the relevant installation standards by a person of appropriate qualification and expertise. Score monitoring verifies that the installer of a measure has selected the correct deemed score based on the characteristics of the property where the measure was installed</p>	<p>OFGEM is currently required to oversee monitoring of the ECO scheme and verify that an obligated supplier has met its targets.</p> <p>It was recently decided to integrate a Government Endorsed Quality Scheme, TrustMark, into the ECO scheme, requiring that relevant measures must be installed by a TrustMark registered business or equivalent. The greater oversight across the market, provided by Trustmark, is expected to increase standards and give the consumers better protection.</p>	<p>Monitoring must be carried out by a suitably qualified monitoring agent which is independent from the obligated supplier, installer, any party involved in the installation or assessment of the measure and any party that has control or ownership of the premises.</p>	<p>When notifying an installed measure to OFGEM, obligated suppliers provide information about that measure. OFGEM may audit suppliers' compliance with their legislative requirements so suppliers must make sure that they have relevant documents available on request.</p> <p>OFGEM is required to submit to the Secretary of State a report each month setting out the progress which participants have made towards achieving their obligation.</p> <p>BEIS publishes monthly government statistics on ECO.<sup>437</sup></p>	<p>OFGEM, which is also the energy market regulator, deals with compliance and enforcement. There has only been minor non-compliance since the scheme began in 2013, which has generally been dealt with by way of 'alternative action' agreed between OFGEM and the relevant supplier, such as non-statutory undertakings or assurances to ensure future compliance or voluntary action by a company. For example, in one case a supplier paid into a redress fund. OFGEM also has statutory enforcement options including issuing final/provisional orders, imposing financial penalties and making consumer redress orders.</p> <p>Where OFGEM has concerns around a supplier's delivery progress, they increase the level of engagement to identify what the delivery barriers are and assist where possible in overcoming them.</p>

<sup>437</sup> <https://data.gov.uk/dataset/1656fb7d-1ca3-462d-a11b-8078acc33275/household-energy-efficiency-statistics>

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	<p>To ensure that monitoring conducted by a supplier is representative of both the installers used and the measure types notified, for both technical and score monitoring, a supplier must:</p> <p>Monitor at least 5% of measures of each measure type notified in a quarter;</p> <p>Monitor at least 3% of measures notified as being installed by a single installer in a quarter;</p> <p>Monitor at least one measure for any subset that is fewer than 100 measures.</p> <p>Using notification data, OFGEM can determine whether these 'minimum monitoring rates' have been met. Where they haven't, they request further inspections.</p> <p>For each installer, OFGEM set a minimum pass rate. If this is not met, OFGEM will place the set of measures on a pathway to compliance, which requires suppliers to take further actions to provide them with confidence in the quality and accuracy of the measures concerned.</p>	<p>The TrustMark Framework requires compliance and certification with installation standards for relevant ECO measures and has developed systems for checking that certification is current and in place for the measures being delivered by installers.</p> <p>TrustMark is in the process of creating a monitoring framework that takes over from Ofgem the responsibility of administering technical monitoring for measures delivered within the TrustMark framework. The expectation is that responsibility for technical monitoring will start to be transitioned to TrustMark for such measures. TrustMark is due to begin a pilot programme during spring 2020 as part of the development of their framework.</p>			<p>With regard to those measures that are to be installed by TrustMark registered businesses, to ensure a smooth transition embedding the new TrustMark quality scheme into the ECO scheme, OFGEM will retain a role in dealing directly with compliance and enforcement of specific installation standards and financial protection requirements for a transitional period, after which compliance and enforcement in respect of those specific requirements will be directly dealt with by TrustMark in line with its own framework.<sup>438</sup></p>

<sup>438</sup> [www.trustmark.org.uk/docs/default-source/framework-operating-requirements/trustmark-framework\\_version-1\\_4oct2018.pdf?sfvrsn=51659307\\_12](http://www.trustmark.org.uk/docs/default-source/framework-operating-requirements/trustmark-framework_version-1_4oct2018.pdf?sfvrsn=51659307_12)

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		<p>During this pilot programme, we expect Ofgem to continue to administer technical monitoring as normal. TrustMark will assume full responsibility for technical monitoring for measures delivered within the TrustMark framework once the pilot is completed successfully, which is expected by June 2021 at the latest.</p>			

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<p>Building Regulations – Domestic and Non-Domestic (New and existing build)</p>	<p>The Building Regulations require that an approved methodology be used for showing compliance with energy performance requirements. The national calculation methodology for setting and showing compliance with the energy performance requirements for new houses and apartments is the Standard Assessment Procedure (SAP). For most non-residential buildings the approved methodology is the Simplified Building Energy Model (SBEM). Dynamic Simulation Models are approved for use to calculate energy performance requirements for more complex non-residential buildings. These approved methodologies take into account all of the requirements of the common general framework for the calculation of energy performance at Annex 1 of the Energy Performance of Buildings Directive (EPBD).</p>	<p>Building control bodies check that building work has been carried out according to the building regulations. Building control bodies can either be from the local council or the private sector (called 'approved inspectors'). In some cases the installer can certify themselves that their work complies.</p> <p>The Ministry of Housing, Communities and Local Government (MHCLG) is in charge of authorising competent person schemes. To make sure that the standards are consistent, there are rules that scheme operators must follow and conditions of authorisation they must meet including having robust systems for assessing members competences, physically checking members work and effective sanctions for cases of non-compliance or breaches of scheme rules.</p>	<p>Only Building Regulations compliance submissions that use approved calculation methodologies and software applications will be accepted as evidence of compliance by Building Control Bodies enforcing the energy performance requirements. Building Control Bodies cannot give a compliance certificate for a new building until they are satisfied that the building's actual carbon dioxide emission rate does not exceed its target emission rate as calculated using approved calculation methodologies and their software applications.</p>	<p>Not applicable. Compliance and enforcement of standards pertaining to fixed building services is the responsibility of Building Control.</p>	<p>The Local Authority has a duty to enforce the Building Regulations in its area and will seek to do so by informal means wherever possible. If a person carrying out building work contravenes the Building Regulations, the Local Authority may decide to take them to the magistrates' court where they could be fined up to £5,000 for the contravention, and up to £50 for each day the contravention continues after conviction (section 35 of the Building Act 1984). This action will usually be taken against the builder or main contractor, and proceedings must be taken within two years from the completion of the work.</p> <p>Alternatively, or in addition, the local authority may serve an enforcement notice on the owner requiring them to alter or remove work which contravenes the regulations (section 36 of the 1984 Act).</p>

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			<p>Similarly, only qualified and accredited energy assessors using approved calculation methodologies and software applications can lodge data onto the national register of energy performance certificates. Register security protocols automatically prevent all other software and persons from doing so.</p>		

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Climate Change Agreements	<p>Data on scheme participants' energy use or total number of tonnes of carbon dioxide equivalent emitted is reported to the Environment Agency by Target Units every two years.</p> <p>A report is published by the Environment Agency following the end of each Target Period. Guidance on data reporting and verification is contained within the CCA Operations Manual (Chapter 10).<sup>439</sup> Audits may be conducted by the Environment Agency.</p> <p>The Environment Agency carries out audits on selected target unit operators and sector associations through the lifetime of the scheme to verify eligibility and performance. This follows a mixed risk based and random selection approach. There is no quota for the number of participants to be audited. If an operator does not take action in response to audit recommendations within the agreed timescale, a penalty may be imposed on the operator or, in the worst case, their agreement may be terminated due to non-compliance.</p>	Environment Agency (EA)	The EA is independent of obligated parties.	Data on scheme participants' energy use or total number of tonnes of carbon dioxide equivalent emitted is reported to the Environment Agency by Target Units every two years.	<p>As part of the milestone reviews, the EA may issue financial penalties to an operator. In line with article 13 the penalty system in the new CCA scheme is designed to be flexible and aims to promote compliance to ensure the success of the scheme. Financial penalties may be issued on the basis that an operator:</p> <p>Fails to report by 1 May following the end of the target period;</p> <p>Fails to provide any further information the EA has requested by the deadline set;</p> <p>Provides inaccurate information;</p> <p>Doesn't tell the EA about any changes to their operations that would affect its CCA.</p>

<sup>439</sup> [www.gov.uk/government/publications/climate-change-agreements-operations-manual--2](http://www.gov.uk/government/publications/climate-change-agreements-operations-manual--2)

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CRC Energy Efficiency Scheme	<p>CRC participants must keep records to validate any information they have submitted about their organisation, energy supplies and use. They should keep this in an evidence pack that the regulators can examine during an audit. They also need to carry out their own internal audit of their records at least once a year. Their evidence pack must include an audit certificate signed by a senior officer.</p>	<p>The CRC is fully monitored by the Environment Agency (EA). The EA ensures compliance amongst participants with a programme of audits based on risk assessment with additional financial penalties levied on those found not to have complied, along with publication of non-compliance. The enforcement action is set in legislation and a guide is published to help participants understand how this works.</p>	<p>An organisation's regulator in England, Scotland, Wales or Northern Ireland may carry out an audit to check they are keeping sufficient records in their evidence pack and reporting their emissions accurately.</p> <p>The regulator will either carry out the audit itself or use its trained and approved contractors.</p>	<p>CRC participants must keep records to validate any information they have submitted about their organisation, energy supplies and use. They should keep this in an evidence pack that the regulators can examine during an audit. They also need to carry out their own internal audit of their records at least once a year. Their evidence pack must include an audit certificate signed by a senior officer.</p>	<p>The Environment Agency can issue civil penalties to organisations that don't comply with the CRC obligations by the deadlines set. It can also publish on this website the name of the organisation receiving the civil penalty, details of the failure and the penalty amount.</p> <p>Organisations could incur civil penalties if they don't:</p> <ul style="list-style-type: none"> <li>• Register</li> <li>• Disclose info on registration</li> <li>• Submit an annual report on time</li> <li>• Provide accurate info or notifications</li> <li>• Provide an accurate annual report</li> <li>• Surrender allowances</li> <li>• Maintain an evidence pack</li> </ul>

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Energy Savings Opportunity Scheme (ESOS)	ESOS audits can be conducted in-house or by external professionals but audits must be reviewed for compliance with ESOS by a qualified lead assessor, who must belong to a register maintained by a professional body and approved by the scheme administrator. ISO 50001 is also a valid compliance route if covering at least 90% of an organisations total energy consumption, requiring a valid ISO certification.	The Environment Agency is the scheme administrator for the whole of the UK. As such, it is responsible for receiving notifications of compliance from ESOS participants, maintaining guidance on compliance and approving registers of Lead Assessors. Responsibility for compliance and enforcement rests with the EA in England and the equivalent devolved agencies in Scotland, Wales and Northern Ireland.	Responsibility for monitoring and enforcing ESOS will lie with independent public bodies (the EA in England, the Scottish Environment Protection Agency, Natural Resources Wales and, in Northern Ireland, the Northern Ireland Environment Agency).	Qualifying organisations must measure their total energy consumption and carry out audits of the energy used by their buildings, industrial processes and transport to identify cost-effective energy saving measures, to help stimulate uptake of cost-effective energy efficiency potential by 5 December 2015 and every four years thereafter.	<p>Three types of notice are available under the ESOS Regulations.</p> <ol style="list-style-type: none"> <li>1. A compliance notice – This is an information request from the regulator to the participant requesting information to enable the regulator to determine if the participant is complying with its obligations under ESOS</li> <li>2. An enforcement notice – informing the participant what to do to comply with a requirement of ESOS</li> <li>3. A penalty notice – this imposes civil penalties for breaches of the ESOS regulations.</li> </ol> <p>Participants who fail to comply with the scheme could be fined in the region of £5,000 to £50,000 for non-compliance as per paragraph 43-47 of the ESOS Regulations; however penalties are subject to the nature of the non-compliances and are at the discretion of the regulators.</p>

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<p>Low Emission Vehicles</p>	<p>Vehicles are accepted onto the scheme on the basis of a clear, published set of eligibility criteria.<sup>440</sup> Applications are assessed by an expert panel made up of officials from Vehicle Certification Agency (VCA), Department for Transport (DfT) and Department for Business, Energy and Industrial Strategy (BEIS).</p> <p>Dealerships are required to check the identity of grant claimants to ensure they are UK residents. Plug-in grant claims are submitted by dealerships via an online claims portal administered on behalf of OLEV by DVLA-. The key stage is an online verification process which automatically cross checks the vehicle's registration number against the DVLA database to ensure it is an eligible vehicle – i.e. one that meets the PICG eligibility criteria and is registered for use on UK roads.</p> <p>In order to be eligible for the grants, vehicles must meet criteria for carbon emissions and zero emission range.</p>	<p>OLEV is made up of officials from DfT and BEIS. OLEV is a team working across UK government to support the early market for ultra-low emission vehicles (ULEVs). OLEV provides support to position the UK at the global forefront of ULEV development, manufacture and use.</p>	<p>Vehicles are assessed by a cross-departmental panel of BEIS, DfT and VCA specialist experts on their eligibility criteria, including checking the emissions of the vehicles.</p>	<p>5% of claims are randomly selected for audit through the online claims process. The current sample size is dependent on the level of inaccuracies found so is kept under review. This audit is administered by DVLA who administer the online claims process. Those selected are required to produce additional documentation including invoices to demonstrate that a sale of an eligible vehicle took place, and that the grant was applied correctly. OLEV are in contact with manufacturers whose responsibility it is to ensure that the claims are accurate.</p>	<p>Not applicable. There are no penalties outlined for non-compliance as it is not a statutory scheme.</p>

<sup>440</sup> [www.gov.uk/government/publications/plug-in-car-grant](http://www.gov.uk/government/publications/plug-in-car-grant)

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<p>Private Rented Sector Regulation (England &amp; Wales) – Domestic</p>	<p>When a tenant makes a request for consent for energy efficiency improvements under the Regulations, the installation of those improvements must be undertaken by a person who meets the relevant installer standards.</p> <p>Where works are paid for by a Green Deal finance plan, only an authorised Green Deal Installer can install energy efficiency improvements. Additionally, only authorised installers can identify themselves as 'Green Deal Installers' and use the Green Deal Quality Mark.</p>	<p>The Regulations state that Local Authorities will be the enforcement body for the domestic sector.</p>	<p>A review of the regulations is required at least every 5 year. An evaluation has been commissioned to collect evidence on the impact of the regulations and is being delivered by an independent.</p>	<p>There are no formal reporting duties for local authorities who are the enforcement body for the domestic PRS.</p>	<p>Enforcement bodies will determine whether and when a civil penalty should be imposed. Any penalty notice must be reviewed by the enforcement body at the landlord's request, and in the event of a dispute, the matter may be referred to a Tribunal.</p> <p>Non-compliance occurs where a private rental property leased to a new tenant or a renewing tenant after 2018 (or all tenants after the back-stop date) which does not meet the E EPC rating and is not registered on the PRS Exemptions database. There are also penalties for providing false or misleading information.</p>

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<p>Private Rented Sector Regulation (England &amp; Wales) – Non-Domestic</p>	<p>The enforcement authority is responsible for ensuring properties meet the minimum energy efficiency standards of EPC E.</p> <p>They have access to the PRS Exemptions Register and rights to issue compliance notice and penalties to ensure properties in scope meet requirements.</p>	<p>The Regulations state that local weights and measures authorities will be the enforcement body for the non-domestic sector.</p>	<p>A review of the regulations is required at least every 5 years.</p> <p>The enforcement authority may carry out audits on exemptions registered on the PRS Register to verify evidence submitted.</p>	<p>There are no formal reporting duties for local weights and measures who are the enforcement body for the domestic PRS.</p>	<p>Enforcement bodies will determine whether and when a civil penalty should be imposed. Any penalty notice must be reviewed by the enforcement body at the landlord's request, and in the event of a dispute, the matter may be referred to a Tribunal.</p> <p>Non-compliance occurs where a private rental property leased to a new tenant or a renewing tenant after 2018 (or all tenants after the back-stop date) which does not meet the E EPC rating and is not registered on the PRS Exemptions database. There are also penalties for providing false or misleading information.</p>

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<p>Rail Electrification</p>	<p>Trains using this new electrification infrastructure will be fitted with energy meters complying with accuracy limits prescribed by domestic (Railway Group Standards) or EU Regulations that will measure electricity consumption and allow this to be compared to historic diesel consumption data. Network Rail has established a comprehensive protocol governing how this data is provided through a metering data interface specification. In this way the energy and carbon benefits (using diesel and power generating emission factors) can be accurately assessed.</p>	<p>Railway Group Standards</p>	<p>As part of its rail franchising programme, the Department for Transport will require operators of train franchises to collect robust data on environmental impacts including energy consumption and carbon emissions. This includes a requirement to have environmental and energy management systems compliant with and audited against ISO14001 and ISO50001.</p>	<p>In order to be billed for electricity consumption, the electrification infrastructure provider (Network Rail) requires train operators to introduce appropriate monitoring and verification processes and also stipulates minimum accuracy requirements for the electricity meters themselves.</p>	<p>The fitting of energy metering equipment (on ground and on board) is now covered in the EU Energy Technical Specification for Interoperability; 'COMMISSION IMPLEMENTING REGULATION (EU) 2018/868 of 13 June 2018 amending Regulation (EU) No 1301/2014 and Regulation (EU) No 1302/2014 as regards provisions on energy measuring system and data collecting system'. These standards are enforced by the ORR under the Railways Interoperability Regulations 2011.</p>

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Re:Fit	<p>All contractors will have been through an OJEU tender process to verify their suitability to be part of the Re:Fit framework. Overall the public body is assessing the contractor's ability to deliver alongside its partner fit with the public sector for the duration of the project.</p> <p>Public bodies wishing to procure energy efficiency improvements through the Re:Fit scheme detail the requirement for the tender in terms of the nature of their buildings, the amount of capital they are prepared to invest, the level of energy saving they would like to achieve and the payback periods. A mini procurement competition is then run amongst the pre-tendered panel of 13 Energy Service Companies (ESCOs) who will produce bids based on the requirement including visiting the buildings.</p>	<p>Local Partnerships, which runs the England-wide roll-out of Re:Fit, provides BEIS with quarterly returns detailing the projects delivered under the scheme and the level of estimated savings attached to each, along with any additional information that is required. If it became clear the scheme was not delivering value for money Local Partnerships and BEIS would consider whether it was appropriate to continue to fund the programme.</p>	<p>How the ESCOs monitor is a contractual decision between the ESCO and the client. Some choose to employ third parties, whilst others will leave the monitoring to the relevant ESCO.</p>	<p>After bidding, the ESCOs will then produce an investment grade proposal including the detailed design of the improvements along with a guaranteed forecast for how the building's energy bills will reduce. The forecast energy savings do not include energy price inflation and exclude savings in maintenance costs.</p> <p>The performance of the improvements is then monitored through the energy bills of the relevant buildings relative to the ESCO's plan.</p> <p>There is a requirement for ESCOs to monitor built into both the Re:Fit framework and the contract between the ESCOs and the client.</p>	<p>Not applicable. If the agreed cost savings are not met, ESCOs must install extra measures to reach the agreed cost savings or pay the clients the difference. This model provides a financial motivation for the ESCOs to ensure the guaranteed savings are achieved.</p>

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Salix Public Sector Finance	<p>The assessment methodology undertaken by Salix does not in itself directly confirm that the reported savings will be achieved. It is a framework that delivers energy saving measures, ensuring that everything possible is done to complete the projects and realise the associated energy savings.</p> <p>The methodology includes procedures for detecting those projects with unusual costs or forecast savings so that Salix can check that the approach taken by the Public Sector bodies is appropriate for estimating the likely savings.</p>	As the key funder of the Salix scheme, if the scheme does not effectively perform, BEIS can simply cease funding.	Salix has engaged KPMG LLP (UK) (Chartered Accountants) to provide assurance over the application of the procedures and processes which Salix operates in order to ensure the consistency of approach, reliability and appropriateness of the estimates of carbon savings generated by clients for the projects which they undertake. As part of this audit, projects committed in the previous financial year are selected at random so that they can be tested, and the client interviewed to ensure all required processes have been followed. If an audit highlighted any issue, it would be raised with the board. If the issue continued, DECC could be consulted.	Business cases for larger projects include details of monitoring and verification plans to be put in place on completion of projects. Post-project audits on specific funded projects are undertaken as part of the limited assurance audit and this will include confirming that the savings have been achieved.	Not applicable. There are no penalties outlined for non-compliance as it is not a statutory scheme.

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Smart Metering	Energy suppliers are required to install smart meters which are compliant with the Smart Metering Equipment Technical Specifications (or advanced meters which meet the requirements of gas and electricity supply licence conditions).	Ofgem's role as the energy industry regulator is to ensure that consumers remain protected during the rollout and to monitor suppliers' compliance with their obligations, as well as enforce these where needed through their financial penalties and consumer redress policy.	Ofgem is the GB independent energy regulator.	<p>Energy suppliers are required by licence conditions to submit plans and report the progress of their non-domestic smart meter roll out to Ofgem.</p> <p>For larger suppliers, these plans must consist of two sections:</p> <p>a) progress against annual milestones, including quantitative data highlighting the percentage of domestic and smaller non-domestic premises which have a smart or relevant advanced meter installed by the end of the calendar year;</p> <p>b) a narrative section, in which suppliers explain any difference between their submitted milestone for the previous calendar year and their actual performance.</p>	<p>Ofgem hold all responsibility for imposing penalties in the case of non-compliance, as laid out in the Gas Act 1986 and the Electricity Act 1989. The Acts provide that any penalty must be reasonable. Ofgem must have regard to its statement of policy with respect to penalties, which provides that penalties should be proportionate and act as a deterrent; penalties imposed must pay regard to the principle that 'non-compliance should be more costly than compliance' and that enforcement should deliver strong deterrence against future non-compliance.<sup>441</sup></p> <p>Ofgem have outlined that they will consider enforcement action where annual milestones have been missed, as well where the overall 2020 obligation has not been achieved.<sup>442</sup></p>

<sup>441</sup> [www.ofgem.gov.uk/publications-and-updates/statement-policy-respect-financial-penalties-and-consumer-redress](http://www.ofgem.gov.uk/publications-and-updates/statement-policy-respect-financial-penalties-and-consumer-redress)

<sup>442</sup> [www.ofgem.gov.uk/publications-and-updates/decision-supplier-reporting-ofgem-during-smart-meter-rollout](http://www.ofgem.gov.uk/publications-and-updates/decision-supplier-reporting-ofgem-during-smart-meter-rollout)

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				<p>Smaller suppliers are required to submit annual progress updates on the number of smart meters they have installed by the end of the preceding calendar year.</p> <p>Ofgem have also published proposals for a new reporting framework in light of the Government consultation on a proposed new post-2020 smart meter rollout obligation.<sup>443</sup></p>	

<sup>443</sup> [www.ofgem.gov.uk/publications-and-updates/statutory-consultation-post-2020-smart-meter-rollout-reporting-requirements](http://www.ofgem.gov.uk/publications-and-updates/statutory-consultation-post-2020-smart-meter-rollout-reporting-requirements)

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Northern Ireland Sustainable Energy Programme (NISEP)	<p>The Energy Saving Trust (EST) engages a professionally qualified auditor or accountant to carry out audits on all completed schemes to ensure Primary Bidders are implementing the schemes as required. This includes checking paperwork that provides evidence that the quality assurance requirements have been carried out. If any quality issues are discovered at the audit stage, the Primary Bidder will be asked to rectify them and any incentive payment (Primary Bidders can earn an incentive by exceeding cost-effectiveness targets set for individual schemes) due will be withheld until the necessary work has been carried out. The Utility Regulation (UR) will seek assurance from Primary Bidders that any quality issues with previous schemes have been sorted out before any further funding is awarded in the next round of bidding.</p>	<p>The UR oversee the NISEP and have overall responsibility, including final approval of decisions and policy direction, for the programme.</p> <p>The EST acts as Programme Administrator responsible for day to day management of the programme including liaison with Primary Bidders (organisations undertaking schemes), processing payment claims, reporting and auditing.</p>	<p>Primary Bidders are responsible for quality assurance and monitoring of installations carried out under their schemes. Primary Bidders must engage a qualified inspector, independent from the party carrying out the installations, to carry out the quality inspections.</p> <p>The Primary Bidder must meet all relevant standards in accordance with the Framework Document. It is the responsibility of the Primary Bidder to ensure that any work carried out by scheme participants conforms to best practice customer satisfaction and quality standards, and that all customers are provided with the appropriate guarantees and warranties.</p>	<p>The EST selects a sample of schemes from each Primary Bidder for audit. The audit covers, financial information, procurement, installation of measures, delivery mechanisms, energy savings, additionality and monitoring (customer and quality) processes.</p>	<p>Agreement between UR and the Primary Bidder permits the UR to ask for the return of any funds that have been mis-spent or not spent in accordance with the Framework Document. The UR adopts a policy of zero intolerance to fraud and as part of the registration process to become a Primary Bidder a company's policy on fraud must be submitted.</p>

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			<p>The Primary Bidder must apply for Building Control for all domestic measure installs i.e. heating and insulation, evidence of which is requested as part of the monthly claim process and the audit. A valid cavity wall insulation guarantee certificate must be provided to the customer when cavity wall insulation work has been completed. A copy of the certificate is requested as part of the monthly claim process and the audit.</p>		

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
<p>Welsh Government Energy Service</p>	<p>The project is deemed complete when all installations have taken place, the equipment has been commissioned and has started generating savings for the Public Sector Body (PSB) and all internal completion documents have been signed off. At this stage the applicant will submit the Completion Certificate to Salix, clearly outlining any changes to costs and scope of the project since application and the reasons. Any changes to the project scope, which includes the number of fittings or size of equipment and their impact on energy savings, must be supported by the submission of a compliance tool with the updated annual energy savings figures and attached savings calculations to support the changes.</p>	<p>The key funder of the energy service is the Welsh Government.</p>	<p>Responsibility for monitoring and enforcing will lie with Salix. Where required, Salix will conduct a technical assessment on the revisions before proceeding with the completion and payment steps.</p>	<p>Successful applicants must provide regular updates on progress of the project in order to ensure that project completion is progressing as agreed. Failure to do so may result in funding being returned.</p> <p>Projects which increase in cost to the extent that they are no longer compliant with the programme's criteria cannot be funded unless the public sector body is prepared to cover the additional costs.</p> <p>Clear visibility on key project milestones, inclusion of contingencies and evaluation of any risks to the project delivery is included in the application and forms a key part of the technical assessment.</p>	<p>Not applicable. There are no penalties outlined for non-compliance as it is not a statutory scheme.</p>

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Warm Homes Programme	The measures installed will depend on the recommendations of a qualified and independent energy assessor following a Whole House Assessment of each property.	Welsh Government	The Warm Homes Programme are subject to independent periodic evaluation and subject to scrutiny by the Office of the Auditor General for Wales.	Not applicable. Compliance and enforcement of standards is the responsibility of the Office of the Auditor General for Wales.	Not applicable. There are no penalties outlined for non-compliance as it is not a statutory scheme.
Boiler Plus	The standards create an obligation on the person carrying out the work when a gas boiler is installed in and existing dwelling in England.	Compliance and enforcement of standards pertaining to fixed building services is the responsibility of Building Control.	Building Control have direct responsibility for ensuring quality standards are met, while the Gas Safe Register also contributes to quality assurance, although required only to monitor safety considerations. The boiler industry also adopts a range of self-regulation procedures, most notably the Benchmark checklist.	Not applicable. Compliance and enforcement of standards pertaining to fixed building services is the responsibility of Building Control.	Enforcement of these standards will be conducted through the present Building Regulations framework.  The Local Authority has a duty to enforce the Building Regulations in its area and will seek to do so by informal means wherever possible. If a person carrying out building work contravenes the Building Regulations, the Local Authority may decide to take them to the magistrates' court where they could be fined up to £5,000 for the contravention, and up to £50 for each day the contravention continues after conviction (section 35 of the Building Act 1984). This action will usually be taken against the builder or main contractor, and proceedings must be taken within two years from the completion of the work.

Scheme/Measure	Description of the monitoring and verification system and the process of verification	Implementing public authority	Independence of monitoring and verification from obligated parties	Reporting obligations for obligated parties	Member State law on penalties to be applied in the case of non-compliance
Streamlined Energy and Carbon Reporting Framework (SECR)	Qualifying companies will need to include information in line with the SECR framework in their Directors' Report, or an equivalent Energy and Carbon Report for LLPs, for financial years beginning on or after 1 April 2019.	Department for Business, Energy and Industrial Strategy (BEIS)	Whilst not a requirement, external verification or assurance is recommended as best practice to ensure the accuracy, completeness and consistency of data for both internal and external stakeholders.	<p>The reporting requirements differ for quoted companies, large unquoted companies and LLPs. Requirements include energy use from electricity, gas and transport fuel, GHG emissions and emissions intensity metric for the current and previous reporting periods.</p> <p>Reporting exemptions exists for companies that can confirm their energy use is low - 40MWh or less over the reporting period. These companies will still need to include a statement in their report confirming that they are a low energy user. If preparing a group report, the low energy user threshold applies to the energy consumption of the parent group and its subsidiaries.</p>	Aligned with requirements for UK companies to submit annual reports to Companies House – with, for example, financial (civil) penalties for late or incomplete filings.

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June 2021

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# Progress in reducing emissions

## 2021 Report to Parliament



Progress in reducing emissions  
2021 Report to Parliament

Climate Change Committee  
June 2021

Presented to Parliament pursuant to Section 36(1) and Section 59 (1) of the Climate Change Act 2008. This report is published in two volumes. Volume 1 (Progress in reducing emissions – 2021 Report to Parliament) and Volume 2 (Progress in adapting to climate change – 2021 Report to Parliament)

Both volumes were laid before Parliament on 24 June 2021 and are available online at:  
[www.theccc.org.uk/publications](http://www.theccc.org.uk/publications)

Book 1 of 2

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# Joint Foreword

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The UK's Climate Change Act had extraordinary foresight. It laid the groundwork for the nation's escalating climate ambition. It anticipated, correctly, the need to cajole governments into climate plans that would not otherwise fit the political cycle. It has kept UK climate policies rooted in the scientific realities and the technical feasibilities.

That framework now faces its sternest test, as demand grows to see Net Zero delivered; as the urgency becomes more obvious; and as the inadequacies of our planning for the impacts of climate change become clear.

The rigour of the Climate Change Act helped bring COP26 to the UK, but it is not enough for Ministers to point to the Glasgow summit and hope that this will carry the day with the public. Leadership is required, detail on the steps the UK will take in the coming years, clarity on tax changes and public spending commitments, active engagement with people and businesses across the country. These steps are essential, so people can see opportunity in climate-positive choices. We cannot rely on good will alone.

This demands a step change in Government action, but it is hard to discern any comprehensive strategy in the climate plans we have seen in the last 12 months. There are gaps and ambiguities. Climate resilience remains a second-order issue, if it is considered at all. We continue to blunder into high-carbon choices. Our Planning system and other fundamental structures have not been recast to meet our legal and international climate commitments.

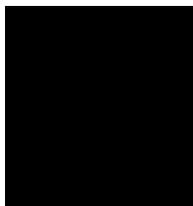
We commend Ministers for accepting our advice on the future path for UK emissions. The setting of the UK's 2030 NDC, the passing into law of the Sixth Carbon Budget, the decision to bring international aviation and shipping emissions within the UK carbon budgets; all were made on the Committee's recommendation. But the Committee's advice to step-up the ambition and resourcing of adaptation continues to go unheeded. And the willingness to set emissions targets of genuine ambition contrasts with a reluctance to implement the realistic policies necessary to achieve them.

It has therefore been a year of climate contradictions. Important statements of ambition, like the agreement to phase out the sale of petrol and diesel cars and vans, have been undermined by delays to essential legislation and much-needed plans to decarbonise buildings and improve their climate resilience. We await a Treasury Net Zero Review, once promised in autumn 2020. The transport decarbonisation plan is still slated, somewhat optimistically, for spring 2021. A pattern has emerged of Government strategies that are later than planned and, when they do emerge, short of the required policy ambition.

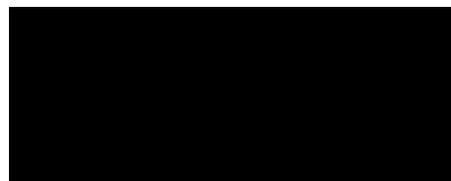
There is still time to address this. This Progress Report offers more than 200 policy recommendations, covering every part of Government. The opportunity to implement them is there. Before COP26, a Net Zero Strategy is promised, which will carry the greatest weight if it is accompanied by Treasury's review of funding. The Government's climate change risk assessment, due in early 2022, can change the tone on adaptation and climate risk management. But it is time for the Government to implement these changes with the urgency that the science demands.

COVID-19 casts a long shadow, but there are three broad lessons from the pandemic: first, we have seen the critical importance of effective planning for high-impact eventualities; second, we have experienced the ability of government to act with pace and scale when it is required; and third, we have learned that people are willing to support change when they have the information before them.

These lessons can shape a successful COP26 summit in November. With strong climate plans at home, the UK Presidency can have global influence. Our message to Government is simple: act quickly – be bold and decisive. Your moment has arrived.



Lord Deben  
Chairman, Climate Change Committee



Baroness Brown  
Chair of the Adaptation Committee

# Overall progress in climate policy: Net Zero and adaptation

The 2020s must be a decisive decade for climate action.

We are in the decisive decade for tackling climate change. Global emissions of greenhouse gases are as high as they have ever been. Nevertheless, green shoots of progress suggest this can change. And it must. The 2010s was the hottest decade on record globally, driving dangerous weather patterns and affecting societies and ecosystems around the world. Without a much stronger and urgent effort, we will breach 1.5°C of warming in the early 2030s and remain ill-prepared for the future.

The world needs to cut emissions and adapt to climate risks.

Global emissions must be cut rapidly to Net Zero, integrated with actions to adapt to the climate risks and impacts. Action must occur across the world, with richer countries acting earliest, while offering support for poorer countries. As host of the upcoming UN climate talks ('COP26') the UK has a particular responsibility to implement effective climate action and drive global efforts.

The UK's record to date is strong in parts, but it has fallen behind on adapting to the changing climate and has not yet provided a coherent plan to reduce emissions in the critical decade ahead:

The UK has a strong track record on climate action, but it is incomplete.

- **Statutory framework for climate.** The UK has a strong climate framework under the Climate Change Act (2008), with legally-binding emissions targets, a process to integrate climate risks into policy, and a central role for independent evidence-based advice and monitoring. This model has inspired similar climate legislation across the world.
- **Emissions targets.** The UK has adopted ambitious territorial emissions targets aligned to the Paris Agreement: the Sixth Carbon Budget requires an emissions reduction of 63% from 2019 to 2035, on the way to Net Zero by 2050. These are comprehensive targets covering all greenhouse gases and all sectors, including international aviation and shipping.
- **Emissions reduction.** The UK has a leading record in reducing its own emissions: down by 40% from 1990 to 2019, the largest reduction in the G20, while growing the economy (GDP increased by 78% from 1990 to 2019). The rate of reductions since 2012 (of around 20 MtCO<sub>2e</sub> annually) is comparable to that needed in the future.
- **Climate Risk and Adaptation.** The UK has undertaken three comprehensive assessments of the climate risks it faces, and the Government has published plans for adapting to those risks. There have been some actions in response, notably in tackling flooding and water scarcity, but overall progress in planning and delivering adaptation is not keeping up with increasing risk. The UK is less prepared for the changing climate now than it was when the previous risk assessment was published five years ago.
- **Climate finance.** The UK has been a strong contributor to international climate finance, having recently doubled its commitment to £11.6 billion in aggregate over 2021/22 to 2025/26. This spend is split between support for cutting emissions and support for adaptation, which is important given significant underfunding of adaptation globally. However, recent cuts to the UK's overseas aid are undermining these commitments.

The UK's record on climate change compares well with that of other countries. But despite the recent willingness of the Government to raise ambition to cut emissions, delays in policy and implementation continue. Much greater urgency is now required from Ministers:

Delivery must accelerate and broaden.

- **The ambition of the last year must be turned into policy and real-world delivery.** The UK has begun to reinforce its new emissions targets with clear ambition for specific sectors in line with the required path (e.g. 40 GW offshore wind by 2030, phase-out of petrol and diesel cars and vans by 2030, 30,000 hectares annual afforestation by 2025). However, some commitments fall short and key strategies have been delayed, leaving holes in ambition. Policies to deliver on the commitments are mostly still to be developed.
- **Progress must extend across the economy.** The relative success of reducing emissions in the electricity sector to date has not been matched in transport, buildings, industry, or agriculture. Only a few sectors have strong plans to adapt to the current and future climate, leaving key risks to the UK's infrastructure and natural environment. Some government departments are not sufficiently prioritising climate change, and none are yet moving at the pace required.
- **A robust plan is needed for adaptation.** The UK does not yet have a vision for successful adaptation to climate change, nor measurable targets to assess progress. Not one of the 34 priority areas assessed in this year's progress report on adaptation is yet demonstrating strong progress in adapting to climate risk. Policies are being developed without sufficient recognition of the need to adapt to the changing climate. This undermines their goals, locks in climate risks, and stores up costs for the future.
- **The climate challenge must be reflected throughout policy and planning.** Climate risks affect all aspects of society, while any new source of emissions could put the Net Zero path at risk. Climate change must therefore be integrated throughout policy and planning decisions, and must be a key consideration in the Government's proposed planning reforms.

Adaptation policy needs a step change in ambition and action.

As the UK rebuilds after the COVID-19 pandemic, there is an opportunity to make systemic changes that will fill the gaps in the UK's climate response. Now is the time to invest in the UK's future through accelerated action to cut emissions and adapt to the changing climate, while supporting the global transition.

The Net Zero Strategy, due ahead of COP26, should complete the picture on how the UK will cut its emissions.

- **Delivering Net Zero.** The Government has promised a Net Zero Strategy before COP26. It must set clear and integrated ambitions across the economy that will meet the Sixth Carbon Budget, and indicate how they will be funded fairly. Efforts must then shift quickly to focus on implementation and delivery. The pace of policy development must accelerate. Credible policies should be fully functioning and properly funded by the end of the current Parliament (i.e. by 2024) to ensure that almost all investments and purchases are low-carbon by the end of the decade or soon after.
- **Adapting to climate risks.** The Government should set out its vision for a UK that is well-prepared for climate change. It should include clear quantified targets, supported by policies and regulations. Climate adaptation must be embedded in core policies if they are to succeed. Key current and upcoming policies include: the Plan for Growth, the National Infrastructure Strategy, the Environment Bill, the Environmental Land Management

Scheme, the Tree and Peat Action Plans, the Net Zero Strategy, the Planning Bill and developments in energy, housing and health policy.\*

Adaptation is vital to achieving society's goals and must be embedded throughout government policies.

- **Integrating climate policy.** Achieving Net Zero will require effective adaptation. The programmes must be properly integrated. For example, as the energy efficiency of buildings is improved, they must also be protected from overheating. The vast carbon stores of the UK's peatlands and soils must be protected. Trees planted to draw CO<sub>2</sub> from the atmosphere and/or to provide timber should be suited to the future climate and, where possible, provide services such as flood defences, enhancing ecosystems, urban cooling, and accessible green space.
- **Embedding climate action across society.** Reducing emissions and adapting to climate change will require a whole-of-society endeavour. Success will require the public to be engaged in the challenge, building public consent for the changes with a broader understanding of what is required and why. Workers will need help to develop the required skills and to fill the jobs created during the transition. Businesses must be encouraged, and in some cases required, to invest in solutions and make low-carbon, climate-resilient choices.
- **Reinstating overseas aid commitments.** Climate challenges are fundamentally integrated with wider challenges for ecosystems and economies. This means climate finance and climate action are not fully isolated from cuts to the UK's Official Development Assistance (ODA) in practice. The Government has said the cut to ODA is temporary; now that the UK's economic recovery is underway, the Government should provide a firm timeline for reinstating its previous commitment.

Government must lead the change. Reducing emissions and adapting to climate change must be embedded throughout policy. All parts of government have a role, requiring strong coordination and an effective devolution of powers and responsibilities to drive delivery. We set out detailed recommendations for each government department and the national Governments of Scotland, Wales and Northern Ireland in an annex of Tables at the end of this report. We will revisit progress against them at our next annual progress report in a year's time. Our next major report will be a thorough appraisal of the UK's Net Zero Strategy.

Reaching Net Zero and addressing climate risks can help to build a better UK.

The transition to Net Zero and the climate adaptation programme offer a positive vision for the UK's future and for the world. They involve an investment boost that can support the economic recovery. This investment will be rewarded with reduced running costs and reduced costs of adapting to climate change in the future. It will support good-quality new jobs across the country, and bring opportunities to enhance our natural environment, our health and our well-being.

The UK can and should be a global leader on climate change.

The challenge of responding to climate change will not end with COP26 in the autumn or with the completion of the UK Presidency a year later. Global commitments are increasingly moving into line with the Paris Agreement, but we have entered a critical decade of action to consolidate and to deliver them. UK action must continue to provide an attractive model of success to maintain our climate leadership in support of a global response that meets the global challenge.

\* Some of these UK policies only cover England. Equivalent devolved policies must also reflect climate change.

# The Committee



**The Rt. Hon John Gummer, Lord Deben,  
Chairman**

Lord Deben was the UK's longest-serving Secretary of State for the Environment (1993 to 1997). He has held several other high-level ministerial posts, including Secretary of State for Agriculture, Fisheries and Food (1989 to 1993). Lord Deben also runs Sancroft, a corporate responsibility consultancy working with blue-chip companies around the world on environmental, social and ethical issues.



**Professor Keith Bell**

Keith Bell is a co-Director of the UK Energy Research Centre (UKERC), a Chartered Engineer and a Fellow of the Royal Society of Edinburgh. He has been at the University of Strathclyde since 2005, was appointed to the Scottish Power Chair in Smart Grids in 2013 and has been involved in energy system research in collaboration with many academic and industrial partners.



**Professor Nick Chater**

Nick Chater is Professor of Behavioural Science at Warwick Business School. He has particular interests in the cognitive and social foundations of rationality, and applying behavioural insights to public policy and business. Nick is Co-founder and Director of Decision Technology Ltd, a research consultancy.



**Professor Michael Davies**

Michael Davies is Professor of Building Physics and Environment at the UCL Institute for Environmental Design and Engineering (IEDE). At UCL his research interests relate to the complex relationship between the built environment and human wellbeing. He is also Director of the Complex Built Environment Systems Group at UCL and a member of the Scientific Advisory Committee of 'Healthy Polis'.



**Professor Piers Forster**

Piers Forster is Director of the Priestley International Centre for Climate and Professor of Physical Climate Change at the University of Leeds. He has played a significant role authoring Intergovernmental Panel on Climate Change (IPCC) reports, and has a coordinating lead author role for the IPCC's sixth assessment report.



**Dr Rebecca Heaton FICFor**

Rebecca Heaton is responsible for Drax Group's efforts to mitigate climate change, ensuring that sound science underpins climate change policies and business strategy. She is also responsible for developing sustainability and climate change research programmes. Rebecca has a 20-year global career working at the interface between business, science and policy.



**Paul Johnson CBE**

Paul Johnson is Director of the Institute for Fiscal Studies and a visiting professor at University College London (UCL). He is widely published on the economics of public policy, and he co-wrote the 'Mirrlees review' of tax system design. He was previously Chief Economist at the Department for Education (2000 to 2004).



**Professor Corinne Le Quéré FRS**

Corinne Le Quéré is a Royal Society Research Professor at the University of East Anglia (UEA), specialising in the interactions between climate change and the carbon cycle. She was lead author of several assessment reports for the UN's Intergovernmental Panel on Climate Change (IPCC) and she currently Chairs the French Haut Conseil pour le Climat.



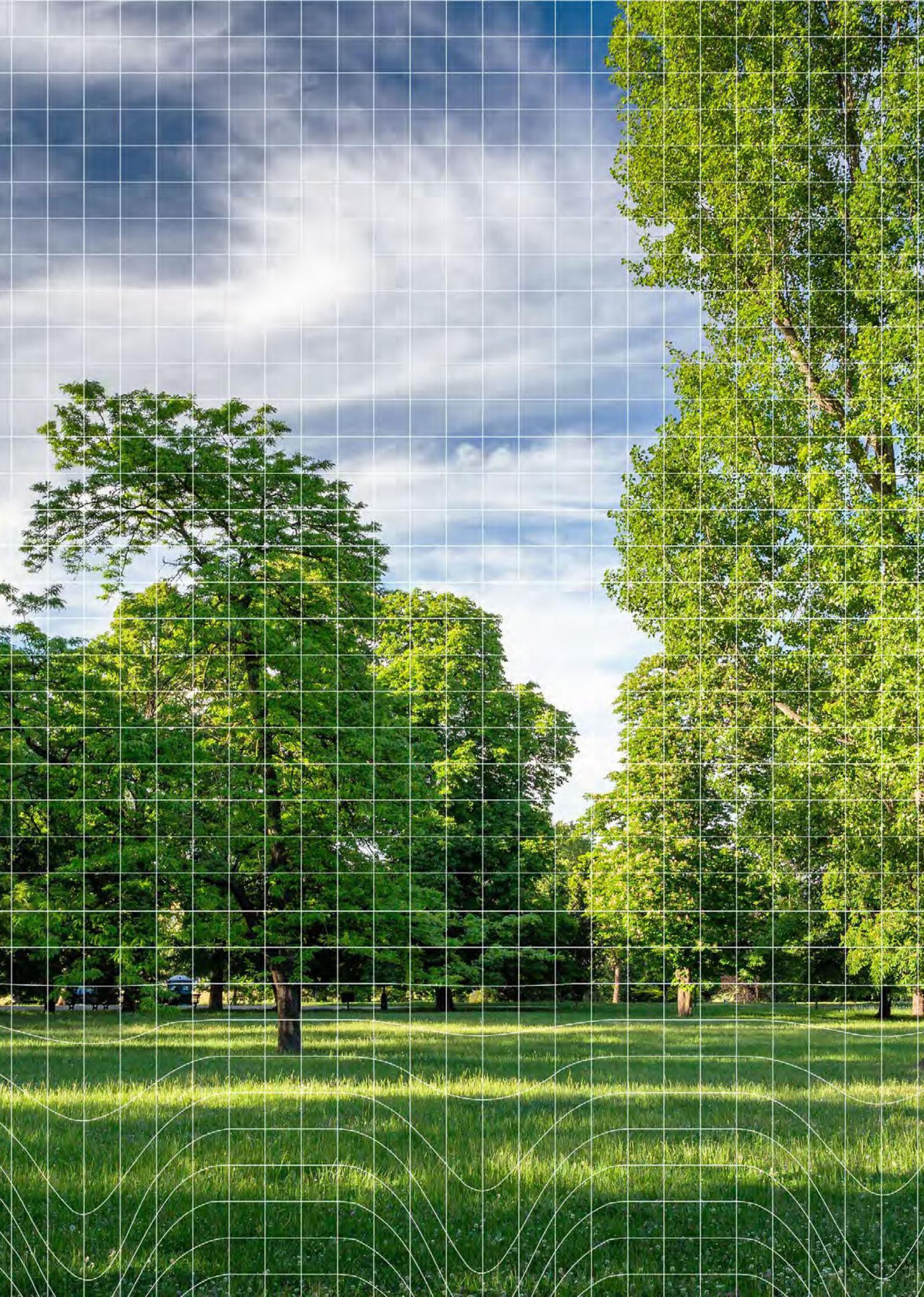
**Pete Betts**  
Expert Adviser to the Committee

Pete was a career civil servant and until 2018 led UK policy on international climate change and energy. He was also Lead Negotiator for the European Union in the UNFCCC negotiations. His current portfolio includes roles at the European Climate Foundation; Willis Towers Watson; IRENA; Grantham School and Chatham House.

# Executive Summary

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We welcome the setting of the Sixth Carbon Budget in accordance with our recommendations.

With the adoption of the Sixth Carbon Budget, in accordance with the Committee's recommendations, the UK has committed to an ambitious path to Net Zero. We welcome this decision and the inclusion of emissions from international aviation and international shipping in the legal scope of carbon budgets for the first time. The Sixth Carbon Budget requires a 63% reduction in emissions from 2019 to 2035 (78% relative to 1990).

The challenge has shifted decisively from target-setting to delivery. This decade will be crucial in getting on track to Net Zero.

This is now the foundation for the necessary scale-up of policy action in all sectors. The challenge has shifted decisively from target-setting to delivery. The steps taken during this Parliament, and the action taken in this decade, will be crucial. The Committee's focus must also shift, towards real-world progress and tougher scrutiny of Government plans.

The Net Zero Strategy has huge significance in setting out the UK's vision for meeting its ambitious targets.

The Net Zero Strategy, promised ahead of November's UN climate talks in Glasgow ('COP26'), now has huge significance. It must set out a coherent vision. It must make plans for the jobs transition, and the necessary supply of skills. It will be the basis of the essential public engagement that must take place on the changes ahead. And it must address the unanswered question of how the transition will be funded in a fair way. Effective leadership, coordination and governance across Government has never been more important.

In assessing the UK's progress in the last year, we acknowledge the increase in the scale of Government efforts. But progress is not yet in step with the urgency of the challenge:

- **Effective policies must be developed at greater pace.** The path to Net Zero requires a rapid scale-up in low-carbon investment and low-carbon choices across the economy. Government must lead that change with more urgency than we have seen so far. Many vital and long-promised plans, such as the Heat and Buildings Strategy and the Treasury's Net Zero Review, have been delayed by a year or more. As a result, there is a large *policy gap*: credible policies for delivery currently cover only around 20% of the required reduction in emissions to meet the Sixth Carbon Budget.
- **The Government has made significant commitments, but there are still important gaps in ambition.** Where ambitions have been set over the last year, they have tended to be a significant step up. Many are now aligned with the path to Net Zero (e.g. 40 GW offshore wind by 2030, phasing out petrol and diesel cars and vans by 2030). However, gaps remain in the Government's stated ambitions (e.g. on diets, aviation demand, waste, low-carbon heat networks), while some announcements fall short of what is likely to be needed (e.g. on peatlands, heat pumps, carbon capture and storage). Together these imply a significant *ambition gap*: current Government commitments that align to the Committee's published pathways cover less than half of the emissions reductions to 2035.
- **Efforts must be increased markedly, especially in the lagging areas.** There are signs of a multi-speed approach within Government to raising ambition and putting in place effective policies. Some departments (e.g. Defra, MHCLG, but also parts of BEIS and the Treasury) are lagging behind others and appear timid in their approach. The path to Net Zero requires high ambition and an effective policy framework in all areas.

The full Net Zero Strategy provides an opportunity for the Government to demonstrate that it means what it says on climate action. It should fill the gaps in ambition, set up a programme of accelerated policy development, tackle the cross-cutting challenges in a joined-up way and ensure alignment of all policy decisions with Net Zero so that the 2020s becomes the decisive decade it must be.

- **The public must be brought along with the transition.** Better public information is needed on the changes that people should expect, and on the timing of their implementation. Meaningful public engagement will help build stronger public consent for the transition, and people should expect to understand the rationale for changes. They should also be able to see a benefit from making low-carbon choices and have easy access to the information and funding required to make changes happen.
- **The Net Zero Strategy must clarify ambition across the economy to match the targets in a credible way.** Quantified, credible pathways for sectoral decarbonisation, technology deployment and behaviour changes must be set out, and backed by specific policies as far as possible. If ambition falls short of the Committee's pathways in some areas the Government must explain how this shortfall will be made up elsewhere. The Net Zero Strategy must include demand-side action, which can come with a range of co-benefits (e.g. healthier diets, more exercise and better air quality), and be backed-up by policies that are carefully designed and implemented.
- **The Treasury must ensure a fair and long-term approach to funding the transition.** The Net Zero Strategy must be underpinned by an approach to funding that distributes the costs, savings and wider benefits of decarbonisation fairly. It must encourage action across society, while protecting vulnerable people and companies at risk of adverse competitiveness impacts. A move to longer-term funding streams and low-risk financing of Net Zero investments will be essential to making sustained progress.
- **The Strategy should set clear timelines for policy development that match the urgency of the challenge.** A strong, coherent and joined-up policy framework is needed. Credible policies to deliver the ambitions of the Net Zero Strategy should be fully in place by the end of the current Parliament at the latest (i.e. by 2024) to ensure that almost all investments and purchases (e.g. cars, heating appliances, new energy supplies) are low-carbon by 2030 or shortly after. All departments must increase their pace.
- **The Strategy should initiate a strengthened role for local delivery.** All levels of government have committed to ambitious climate action: UK, devolved administrations, city regions and local authorities. Better coordination and support is required across these levels, including workable business models, the removal of barriers to action, dedicated funding and an approach that enables sub-national action to complement action at the national level.
- **All policy decisions must be compatible with the Government's climate commitments.** The Net Zero Strategy should set out how the Government will achieve this, for example by introducing an explicit test to ensure compliance. Both the Net Zero Strategy itself and policy more widely must recognise the challenges of adapting as the climate changes. Planning policy (both at UK and devolved level) must also reflect these challenges.

Transport emissions fell sharply in 2020, but will rebound to some degree as we move out of lockdown. Action is required to keep positive changes.

Emissions fell sharply in 2020 (by 13%) to 435 MtCO<sub>2e</sub>, 48% below 1990 levels. The fall was primarily in transport sectors as a result of the COVID-19 pandemic and lockdowns. Much of the 2020 fall is likely to be temporary, although that partly depends on the Government's choices. Action now can lock in beneficial changes seen on walking, cycling and remote working for those that want it, for example through investment in broadband, active travel and public transport. More widely, there is an opportunity to accelerate low-carbon investments, for example on energy infrastructure, homes and electric vehicles.

An effective Net Zero Strategy will support the UK to genuinely 'build back better' and provide authority on the global stage into COP26 and beyond.

The rest of this executive summary is set out in five sections:

1. Emissions in 2020 and underlying progress on decarbonisation
2. Ambition on the path to Net Zero
3. Policy progress on the path to Net Zero
4. Policy priorities and broadening progress across Government
5. The Committee's changing role

We provide our full recommendations, department by department, covering all aspects of the Net Zero challenge, in an annex at the end of this report.

# 1. Emissions in 2020 and underlying progress on decarbonisation

The COVID-19 pandemic and the resulting restrictions caused a substantial drop in emissions, which fell to a level almost half those of 1990. But lasting changes to UK emissions remain far from certain. The Committee's provisional estimate is that UK emissions fell by around 13% in 2020 to 435 MtCO<sub>2</sub>e, with the vast majority of the fall associated with reductions in emissions from surface and air transport (Figure 1 and Box 1).

Estimated UK consumption emissions (i.e. the UK's carbon footprint, including emissions embedded in imports) are considerably higher than the UK's 'territorial' emissions. They rose slightly in 2018, the most recent year for which data are available, following a gradual decline over the preceding decade.

The impact of COVID-19 on travel demand led to an unprecedented 29% fall in transport emissions in 2020.

The impact of COVID-19 on travel demand led to an unprecedented 29% fall in transport emissions in 2020. The impact has been particularly pronounced on demand for public transport, which fell more deeply and recovered more slowly than private car travel following lockdowns being lifted. A new challenge for decarbonisation policy is rebuilding the public's confidence in the safety of public transport to avoid a 'car-led' recovery, and providing people with reliable alternatives to car travel.

The huge changes required during this period to how society operates are not a model for the sustained changes needed for Net Zero, but nevertheless have been instructive, across a range of sectors. We have learned that changes to working and travel behaviour can be made rapidly if required. A consensus has developed that the capital investment required for Net Zero can act to boost the economy as it recovers. The importance of good broadband and telecoms provision has become clearer, and we have seen that there is considerable scope to manage offices and other non-residential buildings in a more energy-efficient manner, especially when they are unoccupied.

Emissions in 2021 may well be higher than in 2020, even with positive developments.

As travel returns, we can expect a significant rebound in transport emissions, even if some of the positive behaviour changes (e.g. increased cycling, less business travel) made in response to the pandemic can be locked in through investment in active travel and broadband. But even with progress in reducing emissions from other sectors, UK emissions in 2021 may well be higher than in 2020.

Sustained progress in reducing emissions will need underlying, structural changes.

The focus must be on underlying progress in order to make lasting reductions in territorial and consumption emissions. Underlying progress to date has been insufficient outside electricity generation:

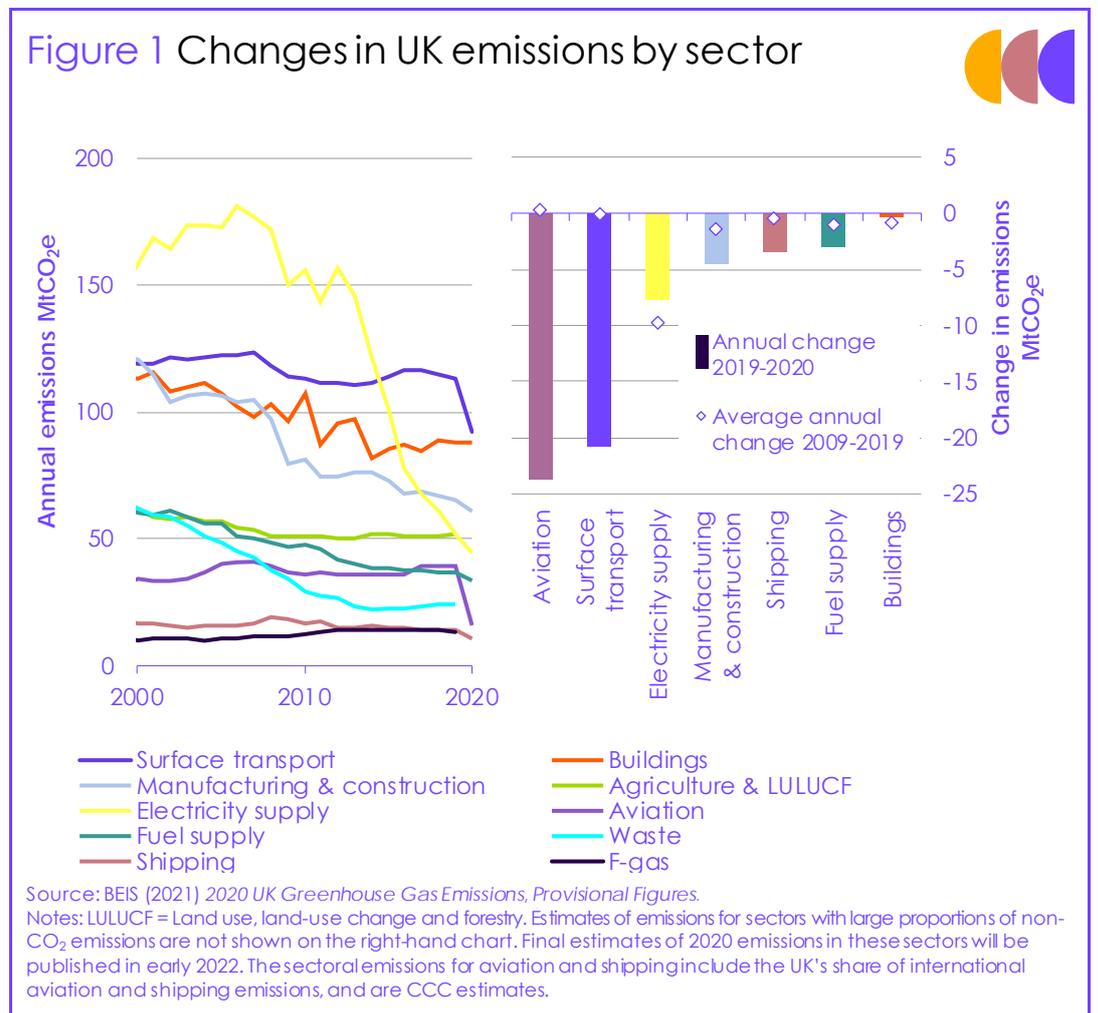
- There has been little of the necessary progress in upgrading the **building stock**. Insulation rates remain well below the peak market delivery achieved up to 2012 before key policies were scrapped, demonstrating clear potential for growth if an effective policy package is put in place. Despite a small improvement in the rates of heat pump installation, these remain far below the levels that are necessary.
- Progress in **agriculture and land use** has repeatedly failed to meet the indicators (e.g. for tree planting and on-farm efficiency measures) outlined in the Committee's progress reports in recent years. There are signs of potential consumer willingness to shift towards less carbon-intensive diets in

future, but this has not yet translated to reduced meat consumption or been backed up by policy to support the change.

- Progress in reducing emissions from **waste** has stalled in recent years following a period of steep emissions reduction from the late-1990s caused by the diversion of waste from landfill.
- Deployment of **renewable electricity generation** has scaled up rapidly. Although the increase in 2020 was at a much slower rate than the average achieved over the previous five years, the growing project pipeline means that this slowdown is likely to be temporary.
- Sales of **electric vehicles** and the deployment of supporting charging infrastructure have increased considerably in recent years. Policies will be required to drive the accelerated uptake required throughout the 2020s (e.g. a zero-emission vehicle mandate). There are also concerning trends, notably the rapid growth in car and van travel during the past decade.
- Although there have been emissions reductions in **industry**, it is unclear how far this reflects structural changes driven by wider factors or genuine improvements in efficiency and carbon intensity.

UK emissions are nearly 50% below 1990 levels, but the journey to Net Zero is far from half done.

UK emissions are nearly 50% below 1990 levels, but the journey to Net Zero is far from half done. Government must now match its bold statements of ambition with effective policies and implementation, and it must move at pace if it is to deliver against the UK's stretching targets.



## Box 1

### Impacts of the COVID-19 pandemic on UK emissions in 2020

Lockdown measures led to a record decrease in UK emissions in 2020 (Figure 1). Emissions fell by around 13% overall with the largest falls in aviation (-60%), shipping (-24%) and surface transport (-18%). Home energy use increased, with residential buildings the only sector to show an overall increase in emissions (+2%).

The fall in emissions in 2020 will have practically zero impact on the UK's past and future contribution to global warming.

Most of the falls in sectoral emissions observed in 2020 are likely to be transient, as they do not reflect structural changes in the underlying economic, social, energy, transportation or land systems. In the absence of these underlying changes, emissions are likely to rebound to some extent in most sectors in 2021.

However, the last year has seen some large changes in patterns of behaviour due to the pandemic. The extent to which these changes will endure is currently unclear. In particular, there is potential for lasting impacts from new working patterns and changes to personal transport choices, with complex and uncertain implications for how our domestic and international transport systems work and the demand for energy in homes and workplaces.

The lasting impacts of the pandemic are still far from certain, but the experience from the last year has shown:

- Emissions fell rapidly, but they can rebound just as quickly. In the absence of underlying structural changes emissions are likely to rebound in most sectors in 2021.
- There is a limited window to change behaviours. If sources of 'behavioural friction' in moving from one pattern of living and working to another can be overcome, people and organisations can often adapt quickly. There are now significant opportunities to lock in and build on positive developments, especially – though not exclusively – regarding travel demand.
- The need for increasingly resilient networks and infrastructure. Our energy (and digital) networks have demonstrated they can be resilient to profound changes in use. The transition towards Net Zero will only increase the challenges of operating an electricity system with high shares of variable and inflexible generation. The non-residential buildings stock can also be improved to respond more efficiently to variations in occupancy.
- Lockdown is not a blueprint for decarbonisation. The fall in UK emissions in 2020 was larger than the annual change needed on the pathway to Net Zero, but did not materially affect the structural changes that are needed to reach Net Zero. Lockdowns heavily restricted movement and had damaging economic and social consequences. This stands in contrast to the fair, well-planned and sustainable transition to Net Zero that is possible. Net Zero should bring improvements to quality of life: new jobs, cleaner air, quieter streets, more green spaces, comfortable homes and healthier lifestyles.

It will be important to sustain climate-positive changes that have developed during the pandemic, but also to act decisively to mitigate the negative changes that could jeopardise efforts towards Net Zero.

## 2. Ambition on the path to Net Zero

The Government has moved to align many of its sectoral commitments with those implied by a Net Zero pathway, significantly strengthening its ambitions since the 2017 Clean Growth Strategy. Individual plans and policies published in recent months have set ambitions closer to those recommended by the Committee. But a notable overall shortfall is now emerging between what has been announced so far and the Committee's detailed recommendations for the Sixth Carbon Budget. The late publication of several strategies is also disappointing and means that we have only a partial picture of ambition:

Announced ambition in many areas is in line with, or close to, the necessary level.

- A number of the important elements of the overall Net Zero Strategy have been delayed. At the time of finalising this report, a range of strategies expected in 2020 had not yet been published, including the Heat and Buildings Strategy, the Transport Decarbonisation Plan, the Treasury's final Net Zero Review, the Aviation Decarbonisation Strategy and the Nature Strategy. Even with these, there are likely to be gaps. We highlight the need to fill a range of gaps on strategy and policy in section 4.
- Announced ambition for electric cars and vans, offshore wind, low-carbon hydrogen production, industrial decarbonisation to 2030 (but not to 2035) and tree planting to 2025 is broadly in line with the Committee's scenarios (Table 1). This is commendable. Together, areas where ambition is beginning to align with the CCC pathway cover almost half of the emissions reduction required for the Sixth Carbon Budget (Figure 2). We expect this to rise further during 2021, as additional strategies are released.
  - These clear commitments have seen responses in the market and from the public. For example, announcements from car manufacturers and increased interest in electric cars have followed the Government's commitment to phase out petrol and diesel cars and vans by 2030. However, clear policies will be required to make this a reality.
  - In other areas, companies are also voicing support for increased ambition, such as for full electricity decarbonisation by 2035, phasing out installation of high-carbon heating systems, rebalancing electricity and gas prices to support electrification, and support for fitting carbon capture, utilisation and storage (CCUS) on Energy from Waste plants.
- However, where ambition has diverged from the CCC pathway to meet the Sixth Carbon Budget, there has been a tendency for ambition to fall short rather than go further (e.g. heat pump deployment that is a third lower in 2028, total CCS ambition that is around half in 2030) (Figure 3).

However, there has been a tendency for ambition to fall short of our recommended pathway to meet the Sixth Carbon Budget.

The Government is not required to commit to the Committee's detailed sectoral pathways, nor to follow our policy advice. But it must set out a credible alternative approach where it chooses not to. Our pathways are designed to be stretching across the economy, so it is difficult to compensate for lower ambition in one area with greater ambition elsewhere. The **Net Zero Strategy**, released later this year, will have to address the shortfall, strengthening weaker commitments to be closer to the Committee's pathways or setting out how emissions can be cut faster in other areas to compensate.

Important gaps remain in Government ambition, particularly on the demand side, and other ambitions need clarification.

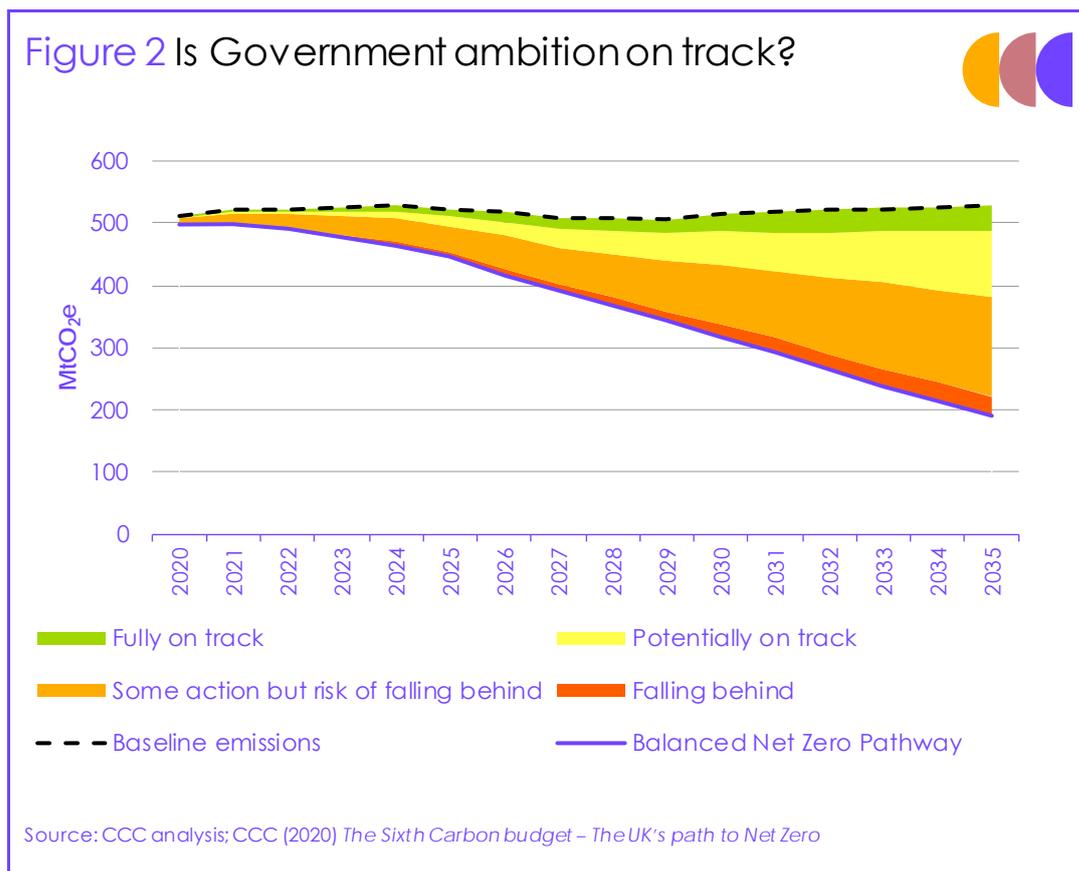
Important gaps also remain in terms of the scale of the Government's ambition in certain sectors, while there is a danger that several of the broad ambitions announced are implemented in a way that would fall short of the CCC scenarios:

- Consumer choices.** So far, the Government's announcements have focused on technologies and largely ignored the potential for changes in consumer choices to reduce emissions. These are particularly important to limit emissions in 'hard to abate' sectors, such as aviation and agriculture. We note that there are a wide range of levers available to promote low-carbon choices, including enabling measures and nudges, ensuring supporting infrastructure is available, and more interventionist measures using regulations and the tax system.
- Ambiguity in ambition.** While some commitments have been made that could be at least as ambitious as our pathways, there remain risks that real-world implementation could fall short. For example, the announced 2030 phase-out date for sale of petrol and diesel cars and vans will allow sale of vehicles with 'significant zero-emission capability' until 2035, well after the 2032 date by which we recommend all such vehicles should be fully zero-emission. The definition of which vehicles can be sold after 2030, currently subject to consultation, will be crucial in ensuring that emissions and motoring costs are kept as low as possible by prioritising fully zero-emission vehicles over hybrids.

The Net Zero Strategy will need to ensure that ambition across the board adds up to a credible approach to meeting the targets.

There also remain a range of issues that have not yet been tackled, and which do not fit neatly into sectoral strategies (see section 4). The Net Zero Strategy will need to fill remaining gaps, clarify existing ambitions, set out a vision for the governance of the transition and ensure that the ambition across the board adds up to a credible and quantified approach to meeting the Sixth Carbon Budget and Net Zero target.

Figure 2 Is Government ambition on track?



**Table 1**

Government commitments compared to the CCC Pathway between 2025-2035

Headline actions	Government commitment <sup>1</sup>	CCC pathway
Offshore wind	40 GW by 2030	40 GW by 2030
Electric vehicles	Phase-out of new fossil fuelled vehicle sales by 2030, with allowance for some hybrids out to 2035	Phase-out of all new fossil-fuelled vehicle sales by 2032
Heat pumps in homes	600,000 heat pump installations / year by 2028	900,000 heat pump installations / year by 2028 1.1 million installations / year by 2030
Low-carbon heat networks (all buildings) <sup>2</sup>	2 TWh of low-carbon heat networks by 2030	25 TWh of low-carbon heat networks by 2030
Low-carbon hydrogen	5 GW (up to 42 TWh) by 2030	30 TWh by 2030
Carbon Capture and Storage <sup>3</sup>	10 MtCO <sub>2</sub> captured and stored annually by 2030, across four industrial clusters, including at least one power project	22 MtCO <sub>2</sub> /year captured and stored in 2030, across at least five industrial clusters, including multiple power projects
Emissions reduction in manufacturing and refining	Around two-thirds by 2035, compared to 2018	73% by 2035, compared to 2018
Tree-planting	30,000 hectares / year by 2025	30,000 hectares / year by 2025 50,000 hectares / year by 2035
Peatland restoration <sup>4</sup>	32,700 hectares / year by 2025	67,000 hectares / year by 2025
Greenhouse gas removals	Innovation support provided, in recognition that engineered removals will be needed, but no firm commitment on deployment yet	5 MtCO <sub>2</sub> /year by 2030
Nuclear power <sup>5</sup>	Final Investment Decision on at least one new nuclear power plant by the end of this Parliament	One new nuclear plant operational by 2030, and a further plant by 2035

Source: CCC analysis.

Notes:

<sup>1</sup> Based on actions in the Ten Point Plan, Energy White Paper, Industrial Decarbonisation Strategy and England Tree and Peat Action Plans between 2025 and 2035 and the CCC's Balanced pathway from the Sixth Carbon Budget.

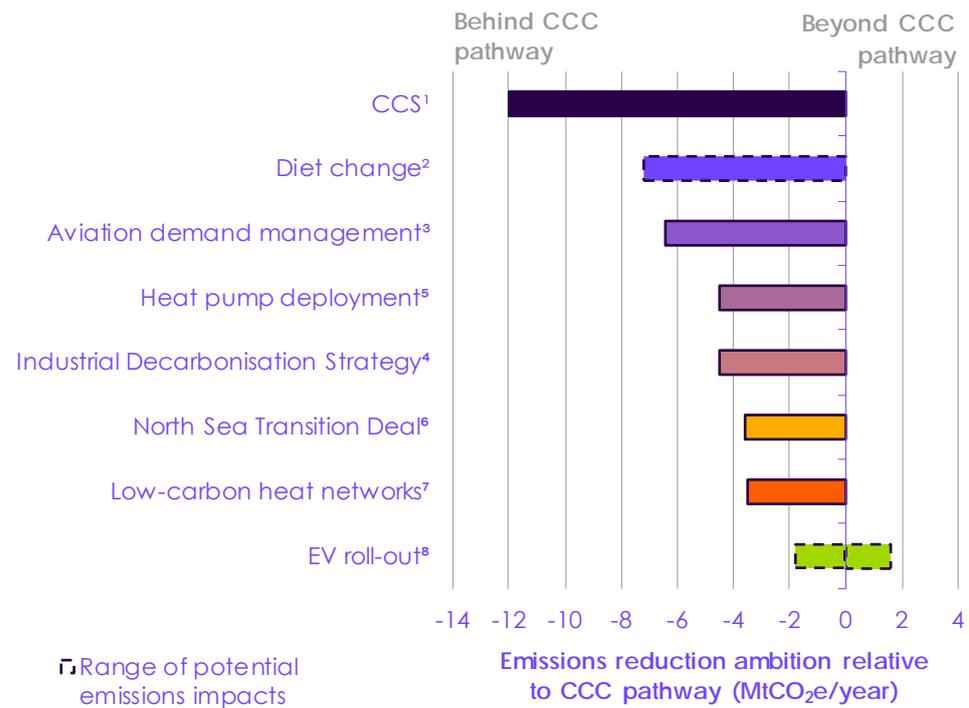
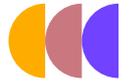
<sup>2</sup> Government commitment on low-carbon heat network deployment is illustrative, and has been inferred from Government spending commitments, using assumptions around expected leveraged investment and the proportion of funding targeted at low-carbon networks.

<sup>3</sup> The difference in carbon captured and stored annually largely comes from projects in the power sector in CCC scenarios, so other technologies could compensate for this shortfall.

<sup>4</sup> Government peatland restoration commitments include Scotland, Wales and England. CCC peatland restoration numbers in 2025 are UK-wide.

<sup>5</sup> The Balanced Pathway produced for the CCC's Sixth Carbon Budget assumed that two new nuclear power stations would be in operation by 2035, in addition to Hinkley Point C.

**Figure 3** Differences in stated Government ambition compared to CCC pathway



Notes: Comparisons are against the Balanced Net Zero Pathway ('CCC pathway') published in the Committee's *Sixth Carbon Budget* advice.

<sup>1</sup> Government CCS ambition for is 10 MtCO<sub>2</sub>/year in 2030, compared to 22 MtCO<sub>2</sub>/year in the CCC pathway.

<sup>2</sup> The level of diet change without explicit policy to support it is uncertain. Emissions could be up to 7.2 MtCO<sub>2</sub>e/year higher than the CCC pathway in 2030.

<sup>3</sup> Lack of ambition for aviation demand management would result in higher emissions of 6.4 MtCO<sub>2</sub>e/year in 2030 relative to the CCC pathway for aviation emissions.

<sup>4</sup> The Industrial Decarbonisation Strategy aims for a 67% reduction by 2035, compared to 73% in the CCC pathway.

<sup>5</sup> Government ambition is for 600,000 installations in homes in 2028, compared to 900,000 in 2028 in the CCC

Pathway. The abatement gap in 2030 is inferred, based on an assumed trajectory of uptake to 2028 under the Government's plans, with annual deployment remaining constant to 2030.

<sup>6</sup> The North Sea Transition deal commits to a reduction that falls short of the CCC pathway by 3.7 MtCO<sub>2</sub>e/year in 2030.

<sup>7</sup> Based on announced Government heat network investment of £0.7 billion (assumed to leverage £2.2 billion, leading to a total investment of £2.9 billion, of which we estimate £1.7 billion will be for low-carbon, with resulting deployment estimated by CCC).

<sup>8</sup> A strict 2030 phase-out of petrol and diesel vehicles would be more ambitious than the CCC pathway, but this depends on the timing of when plug-in hybrid electric vehicles are phased out.

### 3. Policy progress on the path to Net Zero

Policy progress is being made, but it is not yet happening at the necessary pace.

Comprehensive policy frameworks are needed to drive the major scale-up in delivery required by the path to Net Zero. Of the 92 recommendations we made in our 2020 progress report, 72 (i.e. over 75%) have been either achieved, partly achieved or are underway. Clearly, policy progress is being made, but it is not yet happening at the necessary pace – only 11 have been achieved in full.

In many cases, a strategic commitment has been made, but details of policy implementation have not yet caught up with the high-level ambition (Figure 4).

- Progress on setting out policies is significantly behind that on ambition, with only one-fifth of the emissions savings for the Sixth Carbon Budget having policies that are 'potentially on track' for full delivery (e.g. renewable electricity generation).
- In many other areas, some policy plans have been set out but these lack detail and/or do not comprehensively cover the necessary set of issues. Together, areas in which policy is in danger of falling behind cover around three-fifths of the emissions reduction required to 2035.
- A further one-fifth of the emissions reductions still have major policy gaps, including on demand-side action and tackling emissions from landfill and waste incineration. We highlight the need to fill a range of policy gaps in section 4.

The Government has recognised the need to extend delivery, and has launched or begun development of a major programme of strategies, consultations and policies covering all the major emitting sectors (i.e. energy supply, industry, transport, buildings, agriculture and land use). That process is ongoing as this report is published (Box 2).

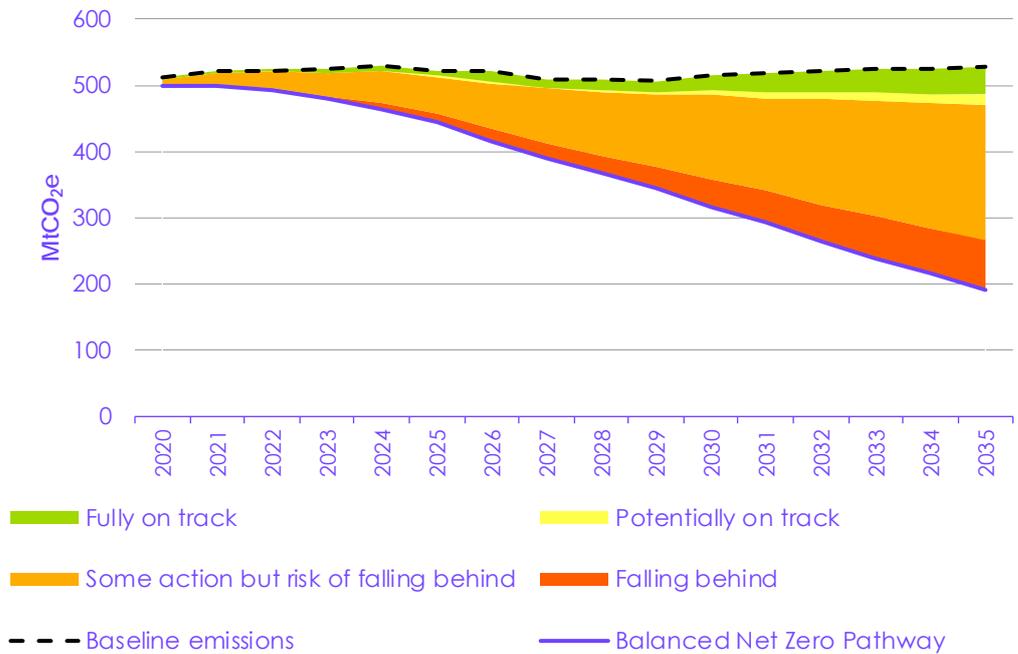
We have also seen, through the failure of the Green Homes Grant, the challenges of real-world implementation and the need for well-designed and well-executed schemes that properly address the barriers to decarbonisation. Failures cannot be avoided completely, but it is critical that effective replacement policies are put in place quickly, drawing on the experience of previous schemes. The Net Zero transition requires a consistent framework that enables supply chains and public buy-in to build over time, without confidence being undermined by sudden policy changes or poor delivery. While the Local Authority Delivery part of the Green Homes Grant scheme has been more successful, there is an urgent need for well-designed, fully-funded policy that works for deployment of energy efficiency improvements and low-carbon heat in the rest of the residential sector.

A coherent approach is needed to achieving Net Zero. All Government policies need to be compatible with the transition to Net Zero and the need to adapt to climate change.

More generally, there is a need for a coherent approach to achieving Net Zero and to ensure that all Government policies are compatible with the transition to Net Zero, together with adapting to climate change. Decisions on road building, planning, fossil fuel production and expansion of waste incineration are not only potentially incompatible with the overall need to reduce emissions but also send mixed messages and could undermine public buy-in to the Net Zero transition. We recommend implementation of a 'Net Zero Test' to ensure that all Government policy decisions are compatible with the legislated emissions targets.

The Government should now focus on delivering their stated policy aims, scaling up the rate of delivery rapidly and putting in place a comprehensive policy framework this Parliament (i.e. to 2024).

Figure 4 Are Government policies on track?



Source: CCC analysis; CCC (2020) *The Sixth Carbon budget – The UK’s path to Net Zero*.

### Box 2

#### Highlights of recent and upcoming policy developments

There have been several high-profile policy publications in the last eight months:

- The **Ten Point Plan for a Green Industrial Revolution** and the accompanying **National Infrastructure Strategy** set a series of headline commitments across the economy that could contribute to Net Zero. Key commitments by 2030 include: 40 GW of offshore wind capacity, 5 GW of hydrogen production capacity, phasing out petrol and diesel cars and vans by 2030 (with some hybrids permitted until 2035), four CCS clusters capturing 10 MtCO<sub>2</sub> annually and 600,000 heat pumps installed annually (by 2028). The Plan allocated initial funding including a £1 billion **Net Zero Innovation Portfolio** and kicked off processes to support delivery of the headline goals and others such as tree planting, sustainable aviation fuels, low-carbon buses and HGVs, greenhouse gas removals, nuclear power, and green finance. Job creation was a key objective, supported by the launch of a **Green Jobs Taskforce**.
- The **Energy White Paper** took further steps to support the Ten Point Plan. These included consultations and explorations of policy options to support a fairer and more flexible energy system, commitments to support at least one power CCS project by 2030, an aim for a final investment decision on one nuclear power plant this Parliament and additional funding for advanced nuclear innovation, a review of institutional arrangements for the energy system, support for electric vehicle charging, a commitment to phase out installation of fossil gas boilers by the mid-2030s, a commitment to set up a UK ETS and to align its cap to the path to Net Zero, and announcements on hydrogen, CCS, industry and oil and gas extraction.
- The **Industrial Decarbonisation Strategy** set a goal to cut industry emissions by around two-thirds from 2018 to 2035. It committed to several calls for evidence, set out preferred options for some funding mechanisms and allocated some initial funding.

- The **North Sea Transition Deal** set targets to reduce emissions from oil and gas supply by 10% in 2025, 25% in 2027, and 50% in 2030 against a 2018 baseline. In addition, the deal outlined how the oil and gas sector could support the deployment of hydrogen and CCS, as well as help hydrocarbon workers during the energy transition.
- The **Peat and Trees Action Plans** published in May sets out England's ambition for peat restoration (30,000 hectares by 2025) and new woodland (7,000 hectares per year by 2025). The Nature for Climate Fund will be the main source of public funding during this period, providing £50 million for peat and £500 million for trees, with options being developed to leverage private sector finance. There is no stated ambition beyond 2025 for either restoration or tree planting, although there is a commitment in the Plan to consult in 2022 on the long-term woodland creation target.

Other publications that have been promised but not yet delivered (by early June 2021, when this report was finalised) include:

- **Treasury Net Zero Review.** HM Treasury (HMT) released its interim review in December, concluding that reaching Net Zero is essential for long-term prosperity, that the costs of tackling climate change are relatively small and depend on policy choices, that a mix of policy levers will be required, and that well-designed policy can reduce costs and risk for investors as well as supporting innovation and the deployment of new technologies. The final report will look at reducing policy uncertainty to encourage innovation, the scope for addressing risks to competitiveness, more detailed analysis of household impacts, and crucially, how HMT can incorporate climate considerations into spending reviews and fiscal events and how to embed the principles of the Net Zero Review into policy making.
- The **Heat and Buildings Strategy** will set out further detail on the Government's plans for decarbonising heating in the UK, along with the 'suite of policy levers' it intends to 'use to encourage consumers and businesses to make the transition'.
- The **Transport Decarbonisation Plan** is the Department's 'plan to decarbonise the UK's entire transport system'. It will cover active travel (i.e. walking and cycling) and public transport; the transition to zero-emission road vehicles (e.g. electric cars) from the perspective of the consumer, suppliers and the energy system; freight and logistics; and aviation and shipping.
- **Net Zero Aviation Strategy.** In light of the UK's new Net Zero target, the Government has committed to a new consultation on aviation decarbonisation in 2021, followed by a Net Zero aviation strategy before COP26.
- The **Hydrogen Strategy** will consider how to support the scale-up of low-carbon hydrogen production, as well as the interaction with storage, distribution and potential end-use demand. It will set out details of hydrogen business models and a revenue mechanism for bringing through private-sector investment, and support for the demand side such as heating trials and support for hydrogen in shipping.
- The **Biomass Strategy** will coordinate across Government departments to assess how biomass should be sourced and used across the economy to contribute best to Net Zero. It will review the UK's current biomass sustainability standards and outline the role of BECCS in delivering greenhouse gas removals.
- **National Food Strategy.** Part Two of the Strategy will cover the environmental impact of our diets (including GHG emissions) and land use.

Alongside these major statements, there have been many smaller, but important, policy developments, including in the buildings sector ahead of the delayed strategy. These are covered in Chapter 4 of this report.

Source: Quotes on future policy plans taken from the Ten Point Plan, Energy White Paper, Net Zero Review: Interim Report, National Infrastructure Strategy, Industrial Decarbonisation Strategy.

## 4. Policy priorities and broadening progress across Government

There has been important progress in the last year. However, we see evidence of a multi-paced Government.

Overall, there has been important progress in the last year. However, we see evidence of a multi-paced Government, with some departments lagging behind others (Table 2):

- The **Ministry of Housing, Communities & Local Government (MHCLG)** is not fully supporting local government to play its part in the transition to Net Zero. Progress has fallen short to date on ensuring that building standards are fit for purpose and properly enforced. The current Planning Bill misses the powerful opportunity to ensure that developments and infrastructure are compliant with Net Zero and appropriately resilient to climate change.
- While the **Department for Environment, Food & Rural Affairs (Defra)** has made important steps forward on ambition for afforestation and peat restoration, progress on agriculture and land use remains slow and partial, and gaps in ambition remain. On waste, large gaps remain both on banning materials from landfill and getting a grip on the rapid expansion of Energy from Waste facilities.
- Even within departments that are performing better overall there are pockets of poor or slow performance. For example, **BEIS's** Heat and Buildings Strategy has been delayed by almost a year, while the **Department for Transport** has not set out any plans for limiting growth in aviation demand.
- More generally, Government progress has been slow on overarching challenges towards Net Zero, which has now been law for two years. The most notable delay is to **HM Treasury's** Net Zero Review, but there are delays and uncertainty to a suite of other challenges: the just transition, jobs and skills, public engagement. In the Spending Review later this year, the Treasury must prioritise Net Zero, ensuring departments are fully equipped to deliver the carbon budgets. There is also a need for strong governance of the transition within Government, including ensuring that wider policy decisions are routinely made compatible with Net Zero.

All parts of Government must play their full role to deliver the path to Net Zero.

For the full programme to align to the challenge, and to provide the leading example that the Government wishes to take to COP26, these failures will have to be addressed.



- **A plan for achieving a just transition** for people, workers, consumers and regions, which ensures that opportunities are taken to create jobs and improve the skills base while maintaining international competitiveness. Alongside this, a credible plan is needed for the fair funding of the transition, starting with completion of the Treasury's Net Zero Review, as well as ensuring that investment is supported by strong financing.
- **Public engagement** around the need for climate action, the health co-benefits of low-carbon choices, information about how individual actions can contribute to reducing emissions and involvement in decisions on how best to achieve the transition.
- **A framework for local delivery** to deliver ambitious climate objectives at different scales (i.e. devolved administrations, regions and local authorities), through workable business models, removal of barriers to action, dedicated resource and an approach that facilitates sub-national action to complement action at the national level.
- **Plans must make climate adaptation an integrated part of the transition to Net Zero.** Across multiple areas, and in particular on buildings and land use, there are benefits to thinking holistically about how policy can reduce emissions, while ensuring it improves resilience to the UK's changing climate. Like Net Zero, climate adaptation will also need to be integrated into core Government policy.

## Essential elements of the transition to Net Zero

We have identified seven indispensable elements to the transition, on which it is crucial that good progress is made.

Progress is needed across a wide range of areas in order to get on track to Net Zero. However, there are several indispensable parts to the transition. We have identified seven priority areas for the Government in which it is crucial that good progress is made, covering a subset of the approximately 200 recommendations for UK Government departments and the devolved administrations for the next year. These are primarily focused on delivery:

- Develop and implement a comprehensive policy package to enable the delivery of the 2030 transition to **electric vehicles**, to build on the phase-out announcement and the positive response of automakers and motorists. This should include a full strategy for widespread deployment of charging infrastructure and a mandate requiring manufacturers to sell a rising proportion of zero-emission vehicles.
- Implement a comprehensive policy package for **buildings decarbonisation**, and enshrine the long-term standards framework in regulation and law, to deliver the ambitions of the upcoming Heat and Buildings Strategy and finalise the roadmap for decarbonising the UK building stock.
- Implement comprehensive delivery mechanisms for landscape-scale **land use change for afforestation and peatland restoration** and a high take-up of **low-carbon farming practices**. This should cover mechanisms for private and public financing and a strategy to address non-financial barriers. Interim policies will be needed to avoid a hiatus in action while awaiting the implementation of the new mechanisms.
- Advance policy for **manufacturing decarbonisation** by establishing incentive mechanisms to support fuel switching and implementing CCS proposals. Alongside this, initiate the development of product and construction standards both to improve energy and resource efficiency

and to develop the option of managing carbon leakage by applying carbon policy to imports.

- Continue **auctions for low-carbon power generation**, together with supporting actions to enhance system flexibility, to deliver an emissions intensity of 50 gCO<sub>2</sub>/kWh or better in electricity generation by 2030.
- Deliver a **Hydrogen Strategy** that sets out a vision of the role of hydrogen on the path to Net Zero and the steps needed to realise it. The strategy should focus on hydrogen use in sectors that cannot decarbonise without it and low-carbon hydrogen production routes to 2035 with aims to start large-scale hydrogen trials in the 2020s.
- **Enable domestic engineered greenhouse gas removals (GGR)** to contribute to UK carbon budgets and Net Zero, and establish GGR support mechanisms and monitoring, verification and reporting (MRV) structures in the UK that ensure that GGR is timely, sustainable and verifiable.

## Gaps that must be addressed

There are specific policy gaps that must be addressed on unabated gas generation, demand-side action, waste and aviation demand.

Our assessment of strategies and policies announced to date has identified specific key gaps that need to be addressed by Government policy:

- Commit to **phasing out unabated gas-fired electricity generation** by 2035, subject to ensuring security of supply. Publish a comprehensive long-term strategy for unabated gas phase-out, including ensuring new gas plants are properly CCS- and/or hydrogen-ready as soon as possible and by 2025 at the latest, and thoroughly assessing the market challenges that will emerge as part of the transition to a fully decarbonised electricity system.
- Include contributions in the Net Zero Strategy from **demand-side action**, on aviation, a shift towards healthier diets and a switch away from cars towards active travel and public transport. This should be accompanied by public engagement to explain how low-carbon choices can contribute to Net Zero and wider co-benefits to health, and policy frameworks that seek to encourage and incentivise these changes.
- Address with urgency the rising emissions from, and use of, **Energy from Waste (EfW)**, including by ensuring that the capacity and utilisation of EfW plants is consistent with necessary improvements in recycling and resource efficiency, providing support to enable existing EfW plants to begin to be retrofitted with CCUS from the late 2020s, and introducing policy to ensure that any new EfW plants are built either with CCUS or are 'CCUS ready'.
- The overdue **Net Zero Aviation Strategy** must set out credible pathways and policies to encourage technological development in the sector but also recognise the potential need to manage aviation demand in future, should improvements in sustainable aviation fuels and low-carbon aircraft fall short of Government and industry ambitions. An assessment of the UK's airport capacity strategy and a mechanism for aviation demand management should be part of the aviation strategy.

We make a comprehensive set of recommendations in the Departmental tables at the end of this report.

We make a more comprehensive set of recommendations in the departmental recommendation tables at the end of this report.

## 5. The Committee's changing role

As Government makes the shift to focusing on implementation, the CCC's task must also evolve to focus on real-world progress and tougher scrutiny of Government plans.

As Government makes the shift to focusing on implementation, the Committee's task must also evolve towards a focus on real-world progress and tougher scrutiny of Government plans. Over the coming year the Committee will develop deeper metrics of progress and consider a better dashboard of indicators. We are also broadening our outlook:

- **Broader view of real-world progress.** The transition to Net Zero requires changes that go beyond the deployment-related metrics we have tended to track to date. We will seek to broaden our assessment of real-world progress, including public attitudes, corporate commitments, finance and the green recovery, as well as consumption emissions and the factors affecting them.
- **Governance and enabling delivery.** The challenge of tackling climate change mitigation and adaptation in a joined-up, coherent way requires a governance structure within central Government and at different geographical scales. We will increasingly look at coordination within UK Government and the interactions with action at the devolved government and local levels.
- **Non-government action.** The transition of UK society towards Net Zero must involve a wide range of actors. We will seek to broaden our advice to give more attention to enabling lifestyle changes and low-carbon choices, corporate strategies, local authority action and community action.
- **The UK as part of global action.** We will seek increasingly to locate the UK's transition within the wider international transition, which is set to gain pace, with important implications for technologies, options and costs, and for policy design (e.g. because of carbon-border adjustment mechanisms). We have also been engaging and sharing lessons with similar bodies to the CCC around the world.
- **Fairness and the just transition.** We are focusing more on fairness, jobs, skills and the equitable distribution of costs and benefits over the transition.

The Committee's next major UK report will be an assessment of the Net Zero Strategy.

We look forward to assessing the Government's Net Zero Strategy later this year, and will aim to align our progress metrics and monitoring with the Government's proposals where we consider those to be credible.

The rest of this report is set out in four chapters:

1. The global context
2. UK emissions and drivers
3. Underlying progress and enablers of progress
4. Policy progress and gaps

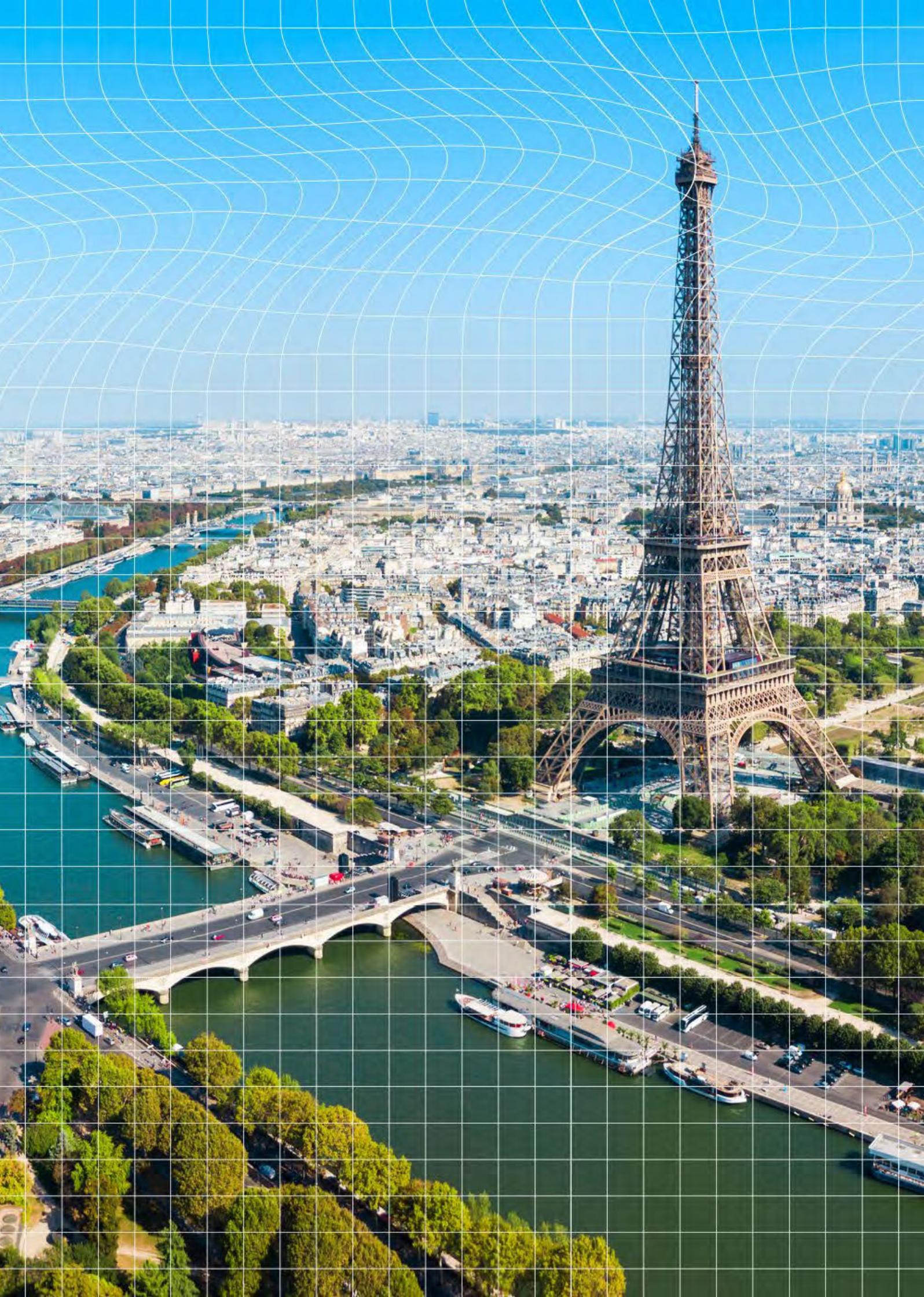
We then set out detailed recommendations for each UK Government department and the national Governments of Scotland, Wales and Northern Ireland in an annex of tables at the end of this report.

# Chapter 1

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## The global context

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## Introduction

This chapter summarises global developments in tackling climate change ahead of COP26.

The 26<sup>th</sup> Conference of Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC), which will take place in Glasgow later this year, was conceived under the Paris Agreement as a key moment to raise global ambition. This chapter outlines global progress in tackling climate change ahead of the COP26 negotiations.

Our conclusions are:

- **COVID-19 related measures had a large, but temporary, impact on global emissions in 2020.** Global emissions fell by 6% in 2020 relative to 2019 levels for the year as a whole, with significantly larger falls in individual countries (particularly developed countries) at the height of lockdowns. These reductions in emissions have proved temporary, with global emissions rates increasing when lockdown measures were lifted. Sustained reductions of similar magnitude to those in 2020 will be required over several decades to achieve the Paris Agreement long-term temperature goal. Fundamentally different ways of reducing emissions to those in 2020 will be required to achieve this, although behavioural changes (e.g. reduced long-haul business travel) could have long-term benefits if maintained.
- **Transitions to low-carbon and low-cost alternatives in electricity and road transport are now underway around the world but need to be scaled up.** Rapid falls in the costs of renewable electricity generation and electric vehicles (EVs) mean that these technologies are now (or very soon will be) at cost-parity with fossil fuel-based alternatives in large parts of the world. In these areas commitments from Governments and companies are being made that would imply a rapid transition. However, commitments need to be delivered and become more global to achieve the emissions reductions over this decade consistent with the Paris Agreement. The provision of supporting infrastructure (e.g. charging points for EVs) will also be necessary to deliver this.
- **There has been a significant increase in global ambition ahead of COP26, but even if met, expected emissions in 2030 would remain well above Paris Agreement compatible pathways.** Most G7 countries have now raised ambition, with pledged decarbonisation pathways from these countries approaching alignment (on aggregate) with those seen in modelled global pathways consistent with the Paris Agreement. Significant additional ambition will be required to close the remaining global 'emissions gap' to pathways expected to keep warming 'well-below' 2°C, or ideally to 1.5°C, above preindustrial levels. These necessitate rapid transitions in developing and emerging economies, that are expected to make up the majority of future emissions. Developed countries have an important role in helping other countries to increase ambition, including through climate finance. Achieving progress on issues of climate finance and adaptation at COP26 will be essential for achieving increases in global ambition on reducing emissions.

Our analysis is summarised in three areas:

1. Global climate, emissions and energy use in 2020
2. Global progress in decarbonisation indicators
3. Progress in international climate policy

# 1. Global climate, emissions and energy use in 2020

2020 was one of the warmest years on record, with climate impacts felt around the world. Global greenhouse gas (GHG) emissions remain high compared to historical levels. This is despite emissions and energy use in 2020 being significantly affected by the measures to combat the global COVID-19 pandemic, with a mixture of short-lived and longer-lasting effects.

This section covers the key indicators of global climate change and its drivers in three subsections:

- a) Global climate change
- b) Global greenhouse gas emissions
- c) Global energy use

## a) Global climate change

Global temperatures continue to rise rapidly – with human influence the driver.

Estimated global human-induced warming has now reached around 1.2°C above 1850-1900 (an approximation for preindustrial levels) (Figure 1.1):\*

- Global mean surface temperature in 2020 was the joint warmest or second warmest year on record across all prominent global temperature datasets, with the six most recent years being the warmest six-year period in the observational record.†
- All of the present day observed warming is estimated to be due to human activities (+/- 20% uncertainty). Natural climate cycles and events (e.g. volcanic eruptions) are not thought to make a significant contribution to the current level of global temperature above preindustrial levels.
- Human-induced warming is rising at around 0.25°C per decade.‡ At this present rate of increase, human-induced warming would exceed 1.5°C above preindustrial levels (the lowest level referred to in the Paris Agreement long-term temperature goal) by the early 2030s.

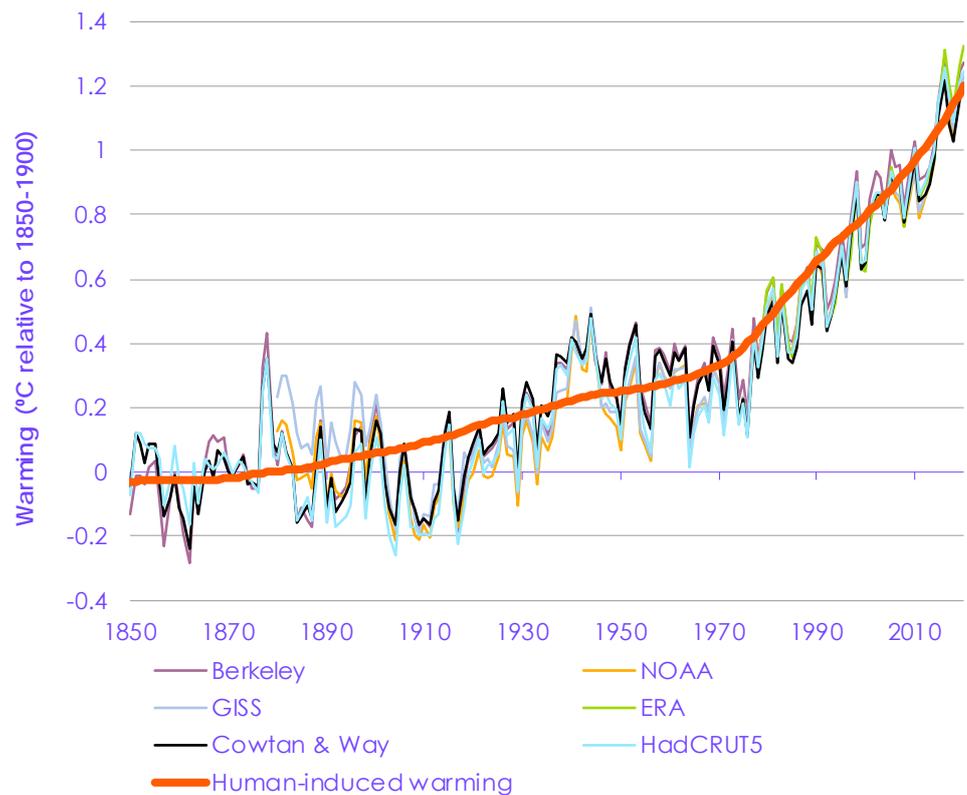
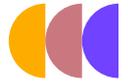
The temporary falls in global CO<sub>2</sub> emissions in 2020 associated with measures to address COVID-19 (section b) did not significantly affect the evolution of atmospheric carbon dioxide concentrations, global temperature or climate hazards, all of which continued to increase as they are primarily determined by cumulative global CO<sub>2</sub> emissions over time.

\* Revisions to UK Met Office dataset (HadCRUT), including providing more spatially complete estimates of global temperature have contributed to higher levels of warming above 1850 – 1900 and therefore contributed somewhat to increases in the estimate human-induced warming compared to previous years.

† The direct observational record of global temperature extends back to the mid-nineteenth century. In some records 2020 was the joint warmest year (with 2016) and in some the second warmest.

‡ This rate of increase in human-induced warming is based on a linear trend over the past decade.

Figure 1.1 Global average surface air temperature change



Source: CCC analysis

Notes: Each thin line represents a different global temperature dataset. The NOAA, GISS and ERA datasets are expressed relative to 1850 - 1900 using the offset over the 1981-2000 period from the HadCRUT5 dataset. Human-induced warming is taken from [globalwarmingindex.org](http://globalwarmingindex.org).

## b) Global greenhouse gas emissions

COVID-19-related measures had a large impact on global emissions in 2020 – particularly in developed countries and the transport sector.

For the year as a whole, global CO<sub>2</sub> emissions from energy fell by around 6% in 2020 (relative to 2019 levels), largely resulting from the effects of measures to address COVID-19.<sup>1</sup> This drop in global emissions varied significantly across different regions, sectors and GHGs:

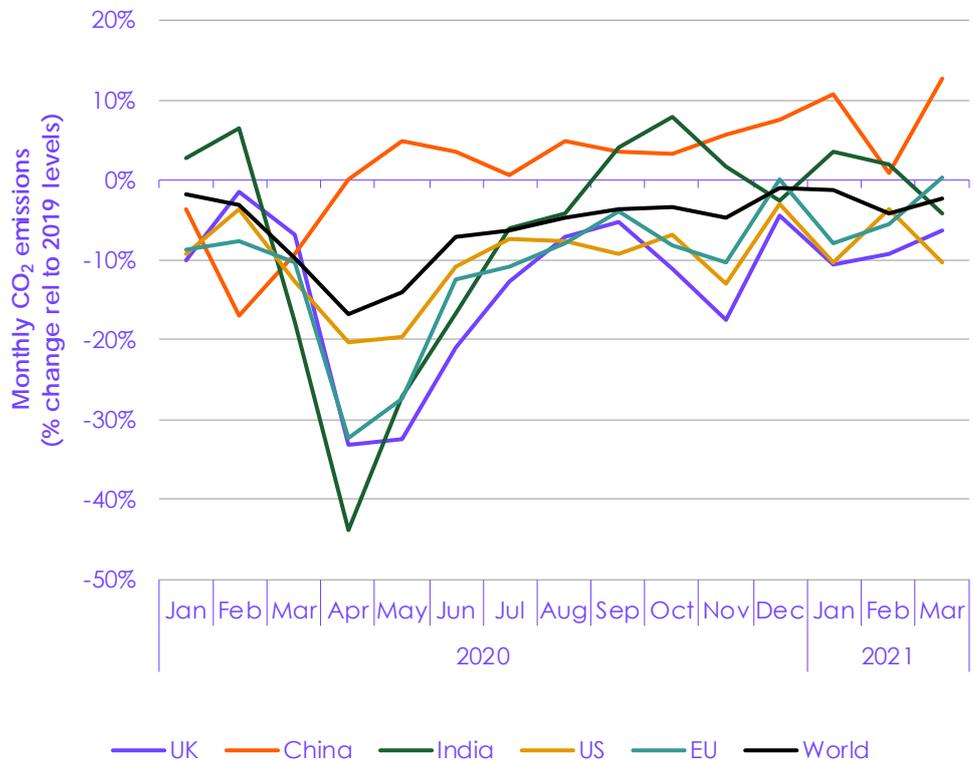
- **Sectors.** Transport emissions displayed the biggest fall of all sectors through 2020 as it was most affected by the COVID-19 lockdowns. Around half of all global emissions reductions came from transport. This reduction comes largely from road transport emissions but aviation emissions were particularly affected in proportional terms – falling around 50% below 2019 levels.
- **Regions.** The largest falls in emissions came from developed countries (e.g. the United States and the European Union) where sectors that were particularly impacted by COVID-19 lockdowns (such as transport) make up a large share of emissions. China's 2020 CO<sub>2</sub> emissions increased by around 1% over 2019 levels – this was in part due to the earlier impact of COVID-19 in China giving more time for economic stimulus to drive up emissions.
- **Greenhouse gases.** Accurate global data on GHG emissions from non-energy sectors and for other GHGs is not yet available. It is expected that there would be much more limited COVID-19-related impacts on these

emissions than energy related CO<sub>2</sub> emissions as the industries responsible for non-CO<sub>2</sub> emissions (e.g. agriculture) were generally less disrupted.

Emissions rates around the world have now significantly recovered.

Temporary reductions due to COVID-19-related measures have now mostly recovered as restrictions have been relaxed. Where significant restrictions are in place emissions remain somewhat suppressed below 2019 levels (Figure 1.2).

Figure 1.2 Monthly CO<sub>2</sub> emissions from the UK and large emitters over the COVID-19 pandemic



Source: Carbon Monitor

### c) Global energy use and economic growth

Global GDP decreased in 2020 with knock-on impacts on energy use.

Global GDP is estimated to have fallen by around 3.3% from 2019 levels in 2020 as a result of the pandemic.<sup>2</sup> Contractions in GDP were generally larger in advanced economies than developing ones, but with significant variation across countries (e.g. India saw GDP decline by around 7% relative to 2019 levels).

This large fall in economic activity had large impacts on the patterns of energy use in 2020:<sup>3</sup>

- **Global energy use** fell by 4% in 2020, with the largest and most sustained reductions occurring in advanced economies.
- **Fossil fuel use** fell, with particularly large falls in oil use (9%) due to the large curtailment in transport activity. Coal use fell by 4% primarily due to lower electricity demand and the prioritisation of generation with low marginal costs (e.g. renewables). Gas use was less affected than other fossil fuels,

Fossil fuel use was more affected than energy use overall and global electricity use only declined slightly.

only falling by 2% relative to 2019 levels, in part due to increased switching to gas use in the power sector.

- **Electricity** demand fell by 1% in 2020 relative to 2019 levels largely due to curtailment of industrial and commercial use in the first half of 2020. Generation from renewable sources grew at the largest rate ever – they now generate 29% of total electricity, up from 27% in 2019 (with the total low-carbon generation share now at 39%).

Global emissions are expected to grow in 2021, but will likely remain below 2019 levels.

Current expectations are for a large rebound in 2021 in global GDP (~6% above 2020 levels, 3% above 2019 levels), energy use (~4.5% above 2020 levels, 0.5% above 2019 levels) and CO<sub>2</sub> emissions (~5% above 2020 levels, 1% below 2019 levels).<sup>3</sup> This would see annual global CO<sub>2</sub> emissions rise back to close to (but still slightly below) 2019 levels in 2021. Significant uncertainty remains regarding the level of global emissions in 2021, which will be affected by both the continuing course of the pandemic and the effects of the economic recovery efforts underway around the world.

## 2. Global progress in decarbonisation indicators

This section looks at progress in the development and deployment of decarbonisation options around the world.

The previous section described the considerable reductions in global energy use and GHG emissions that occurred in 2020 as a result of measures to address the COVID-19 pandemic. Although the impacts on global emissions were large, they are proving temporary as economic activity recovers.

Achieving the global emissions pathways expected to be consistent with the Paris Agreement long-term temperature goal requires rates of emissions reduction nearly as large as those seen in 2020 to be sustained over several decades.\* This will need a rapid and sustained transformation towards a global economy without GHG emissions – very different from the lockdown-related causes of emissions reduction in 2020.

This section describes progress across several leading indicators of the global transition towards Net Zero emissions. This is summarised in three sub-sections:

- a) Transitions with emerging low or no cost low-carbon alternatives
- b) Deep decarbonisation transitions needed for global Net Zero
- c) Transitions in global land-use

### a) Transitions with emerging low or no cost low-carbon alternatives

Cost reductions means that low-carbon alternatives in power and road transport now have no or limited additional costs.

Significant progress has been made in reducing the cost of several key low-carbon technologies particularly driven through learning-by-doing following large-scale deployment over the last decade.<sup>4</sup> In two areas critical to rapid global emissions reductions this decade, low-carbon technologies are now, or soon to be, as or more cost-effective than high-carbon alternatives:

- **Renewable electricity generation.** Analysis from the International Renewable Energy Agency (IRENA) indicates that more than half of installed renewable electricity generation capacity in 2019 was cheaper than new coal plant alternatives.<sup>5</sup> IRENA estimated that over half of existing coal capacity in 2020 would produce more expensive electricity than replacement with new utility-scale solar PV generation. Renewables are also now increasingly cost-competitive with gas-fired generation with some solar generation sources now producing the cheapest electricity in history.<sup>6</sup>
- **Electric Vehicles.** Analysis from Bloomberg New Energy Finance indicates that the cost of batteries (the most expensive part of an EV) has fallen by nearly 90% over the last decade and EVs are expected to be cheaper than fossil fuel vehicles by the mid-2020s across a range of different vehicle types.<sup>7</sup>

The emerging cost-competitiveness of low-carbon options in these two areas supports the prospect of a rapid global shift towards these technologies to meet demand for new investments in electricity generation and road transport. A large and rapid increase in the market penetration of these technologies is key to

\* Global annual CO<sub>2</sub> emissions fell by around 2.5 GtCO<sub>2</sub> in 2020, with falls of around 1 – 2 GtCO<sub>2</sub> per year in the global emissions rate required each year over the 2020s and beyond to keep warming to the Paris Agreement long-term temperature goal. Le Quéré, C, et al. (2021) Fossil CO<sub>2</sub> emissions in the post-COVID-19 era. *Nature Climate Change*, 11, 197–199.

supporting the large reductions in global emissions by 2030 required in global pathways expected to be consistent with the Paris Agreement long-term temperature goal.

Momentum is gathering behind accelerated deployment in these sectors.

Commitments and intentions from major markets suggest momentum is gathering behind a transition in several areas, but further and faster progress is still needed to make a big impact on global emissions:

- **Major car manufacturers are committing to a transition to EVs.** A growing number of car manufacturers are making commitments to end sales of internal combustion engine cars. For example, Jaguar has committed to only selling EVs from 2025, Volvo has committed to becoming an electric only retailer by 2030, General Motors by 2035, and Honda by 2040 (including fuel-cell vehicles). These manufacturer commitments support end dates for new international combustion engine cars targeted by several large car markets such as Japan (2035 date for ending petrol and diesel sales), California (2035 phase-out date) and the UK (2030).
- **EVs are rapidly growing as a market share of new car sales, but these growth rates need to be sustained.** In 2020, the EV share of new sales in some large regions reached new highs (e.g. 10% in Europe and 6% in China). Despite the overall decline in passenger car sales these increased shares correspond to increased numbers of EVs sold, but the impact of COVID-19 on the global car market creates uncertainty about how the EV sales share will change over the coming years. Most major car markets will need to see battery EVs reach 100% of new sales by 2030 – 2040 under pathways expected to keep warming well-below 2°C.
- **Large electricity markets are signalling a shift to low-carbon sources.** The USA (the world's second largest electricity producer) has stated its intention to achieve a carbon-free electricity grid by 2035. Pathways to achieve this target require a large scale-up of low-carbon sources with the share of US electricity generation coming from low-carbon sources (mainly renewables) increasing from 37% today to 70-85% by 2030.<sup>8</sup> China, the world's largest electricity producer, has recently raised its target for the non-fossil electricity generation share for 2030 from 20% to 25%.
- **Projections for renewable deployment are being revised upwards, but investment needs to scale up faster.** More than 80% of new electricity capacity added in 2020 came from renewable sources.<sup>9</sup> The International Energy Agency (IEA) recently increased their forecast for capacity installations for wind and solar electricity generation over the coming years by around 40% relative to a year ago.<sup>10</sup>

Accelerating global deployment significantly this decade will require that other barriers are also addressed.

Other factors will also be important for supporting a rapid increase in the market penetration of these technologies. This includes adapting electricity systems for increasing generation shares from variable renewable sources and ensuring that sustainable supply chains, charging infrastructure, and recycling for the key mineral resources are in place to support a widespread, rapid scale-up in global EV sales.

The existing coal plants in the global power system must also be tackled.

Achieving rapid global emissions reduction this decade will also require addressing the trends that are opposing emissions reduction (e.g. increasing sales of large sports utility vehicles around the world) and tackling the existing high-carbon capital stock in the global power sector which needs to be rapidly retired and replaced (Box 1.1).

## Box 1.1 Emissions from coal-fired power generation

Rapidly reducing global CO<sub>2</sub> emissions from coal electricity generation is one of the key elements to rapid global emissions reductions consistent with the Paris Agreement. The IEA Net Zero by 2050 pathway requires no new coal-fired power plants from today with unabated coal generation eliminated from developed countries by 2030 and all countries by 2040.

Current trends are far from consistent with a rapid reduction pathway:

- The global pipeline for planned new coal power plants held constant in 2020 (following falls each year since 2015). This was almost entirely due to expansion in China (which was the location for 76% of new capacity commissioned) as part of stimulus measures related to COVID-19. New Chinese plants completed in 2020 more than offset the net retirements in the rest of the world, increasing the global coal generation capacity by 12.5 GW.
- Net retirements in coal capacity have thus far largely occurred in developed regions with older coal fleets. Today around 60% of the current global coal capacity is under 20 years old (typical lifetimes can be 40 years or more) and is concentrated in emerging and developing economies. If current plants are run to the end of their natural economic lifetimes, then they will account for a large fraction of the total cumulative CO<sub>2</sub> emissions consistent with keeping warming to the Paris Agreement long-term temperature goal.
- Projections for global coal-fired generation over the coming years indicate an expected plateau, as opposed to a significant decrease. Early retirement and retrofitting with carbon capture and storage on large fractions of the young-life global coal fleet will be needed to achieve emission reductions consistent with the Paris Agreement.

Although the vast majority of young-life and planned coal-fired power plants are in emerging and developing countries, financial institutions in developed countries still play an important role in supporting the planned coal pipeline. A study estimates that developed countries are linked with financing for nearly 40% of cumulative emissions from the existing global coal pipeline on a 'financed-emissions' basis.<sup>11</sup> Action from developed countries to end support for coal finance from public sources (as recently pledged by the G7 countries) and to create frameworks for similar action from the private sector can therefore contribute to a more rapid global coal phase-out.

Source: Global Energy Monitor (2021) *Boom and Bust: Tracking the global coal plant pipeline*; IEA (2020) *World Energy Outlook 2020*; Manych, N. et al. (2021) *Finance-based accounting of coal emissions*. *Environmental Research Letters*, 16, 044028.

## b) Deep decarbonisation transitions needed for global Net Zero

Other technologies outside of power and road transport need to be developed further this decade to enable an at-scale global roll-out towards Net Zero.

A pathway to global Net Zero emissions around or soon after mid-century will require large-scale global deployment of decarbonisation options beyond the power and road transport sectors. Unlike in electricity generation and road transport, low-carbon alternatives in these sectors generally have a cost premium associated with them today, although costs are falling in many areas. Development and deployment of decarbonisation options in these areas this decade will be important for enabling a rapid large-scale global deployment in the following decade.

Around the world there are relevant initiatives underway in several areas:

- **Carbon capture and storage (CCS).** There are presently 65 CCS projects on power and industry in operation or in development globally.<sup>12</sup> Most operating facilities are in North America, supported through tax incentives and in most cases income from use of the captured CO<sub>2</sub> for enhanced oil

recovery. In Europe, a handful of projects based around using CO<sub>2</sub> storage under the North Sea are in advanced stages of planning.

- **Greenhouse Gas Removals (GGR).** There is growing international research and development into engineered GGRs, with a small number of test facilities in operation globally. Additionally, several major global companies have recently made commitments to purchase GGRs to compliment the use of renewables and improved resource efficiency to meet their Net Zero targets. Although small at present, corporate commitments such as these, if replicated more widely, could provide an early market for dedicated GGR credits – helping to facilitate the development and cost discovery needed for engineered removals to play a role in reaching Net Zero.
- **Hydrogen.** By 2030, significant electrolyser capacity (for hydrogen production) is being planned for in France, Germany and the Netherlands (5 GW, 6.5 GW and 3-4 GW respectively) and the European Commission has recently released a new hydrogen strategy aiming to reach 40 GW of electrolyser capacity across the EU.

Rapidly moving from demonstration projections towards constructing clear business models to help support wider deployment will be important to enable global use at scale over the coming decades. Behavioural changes will also be an important complement to moving towards global Net Zero. The IEA recently published a roadmap for how these key pillars of decarbonisation can be deployed together to reach global Net Zero CO<sub>2</sub> emissions by 2050. This roadmap can act as a global guide to investment decisions that may (or may not) be aligned with the more ambitious end (i.e. 1.5°C) of the Paris Agreement long-term temperature goal (Box 1.2).

### Box 1.2

#### International Energy Agency Net Zero Energy 2050 pathway

In May 2021 the International Energy Agency (IEA) published *Net Zero by 2050 A Roadmap for the Global Energy Sector (NZE2050)*. This set out a comprehensive pathway to global Net Zero CO<sub>2</sub> energy and industry emissions (around three-quarters of global GHG emissions) consistent with limiting peak warming to 1.5°C (~50% probability).

The scenario keeps biomass use, residual fossil fuel use, and engineered greenhouse gas removals to the low end of the range from global pathways assessed by the IPCC, and does not use offsetting removals in the land sector. The pathway also involves rapid and deep reductions in methane emissions from the energy sector (falling by 75% by 2030).

Rapid transitions to low-carbon options are required in all energy sectors in the IEA roadmap, with many parallels with the CCC pathway for the UK:

- **Power sector:** Rapid build-out of renewables (particularly solar and wind) enables Net Zero emissions from the power sector to be reached by 2035 in advanced economies, and by around 2040 in developing economies. In 2050 nearly 90% of global power generation is from renewable sources (solar, wind, hydro and bioenergy), with nuclear contributing most of the remainder.
- **Transport:** CO<sub>2</sub> emissions from transport fall 90% by 2050 (from today's levels) despite global passenger demand doubling by 2050 and freight transport increasing by two and a half times. Globally, almost all new light duty vehicle sales are zero emissions vehicles (mostly battery electric) by 2035, and nearly all heavy-duty vehicle sales are fuel cell or electric by 2050. Low-carbon fuels and behaviour change help reduce emissions from aviation and shipping.
- **Buildings:** Widespread retrofitting of existing buildings and requiring all new builds across the world by 2030 to be zero-carbon-ready leads to emissions falling by 40% by 2030 and more than 95% by 2050 relative to today. From 2025, oil and coal boiler

sales end and all new gas boilers installed are hydrogen-ready. Heat pumps become the main space heating technology worldwide from around 2045.

- **Industry:** Fuel-switching to hydrogen and carbon capture both play a major role in decarbonising emissions from industry, which fall 20% by 2030 and 90% by 2050. Key technologies are demonstrated during the 2020s such that from 2030 all new industrial facilities are near-zero emissions.
- **Fuel supply:** No new oil and gas fields and coal mines are approved for development (beyond already committed projects) in the IEA pathway. Low-carbon hydrogen is produced from both natural gas with CCS and electrolysis.

Behaviour change plays a role in almost two thirds of the emissions reductions. Most of this comes through consumer adoption of low-carbon technologies such as electric cars, but 8% of total emissions reductions come from directly changing practices such as reduced business flights.

The IEA estimate that all the technologies required to achieve deep reductions in global emissions by 2030 exist today, with real-world examples of policies to drive their adoption. Sustaining the required rates of decarbonisation after 2030 will require further commercialisation and development this decade of additional options for deeper decarbonisation. The investment for the transition could bring significant additional benefits to global GDP (additional 4% increase in 2030), global energy sector jobs (9 million net increase in employment in 2030) and development (universal access to clean energy by 2030 and major air quality improvements for millions across the world).

Source: International Energy Agency (2021) *Net Zero by 2050 A Roadmap for the Global Energy Sector*.

### c) Land-use transitions

Reducing emissions from global land use change is a key part of pathways towards Net Zero.

CO<sub>2</sub> emissions from land-use change and forestry are about 13% of total global GHG emissions, arising primarily from tropical deforestation of land with very high carbon content, often associated with agricultural expansion.\* Many global pathways consistent with the long-term temperature goal of the Paris Agreement transform this net source of emissions into a net sink over the next few decades.

The world is not on track to achieve its deforestation reduction targets – although some progress has been made.

There has been some progress towards reversing global forest loss (Figure 1.3) but the world is not on track to achieve the UN Strategic Plan for Forests target to increase the global forest area by 3% by 2030 (relative to 2015 levels). Forest cover is still being lost overall as deforestation more than offsets forest expansion:

- **Deforestation.** Around 95% of deforestation occurs within the tropics – 17% of global deforestation occurs within Brazil alone (by area).<sup>13</sup> Around 10–15% of global deforestation is driven by demand for agricultural and food products (e.g. beef) for export to developed countries.<sup>14</sup>
- **Forest expansion.** Forest expansion is comprised of afforestation (intentional creation of new forests) and natural forest expansion (return of forest to previously forested land). Afforestation rates are highest in China where over one million hectares per year are being planted. Natural regeneration contributes another one million hectares per year of increasing forest cover in China – meaning that over 40% of global forest expansion is located there. Net loss of forest is largely concentrated in South America and Africa.

Rapidly reducing tropical deforestation is essential to significantly reducing global land-use change emissions.

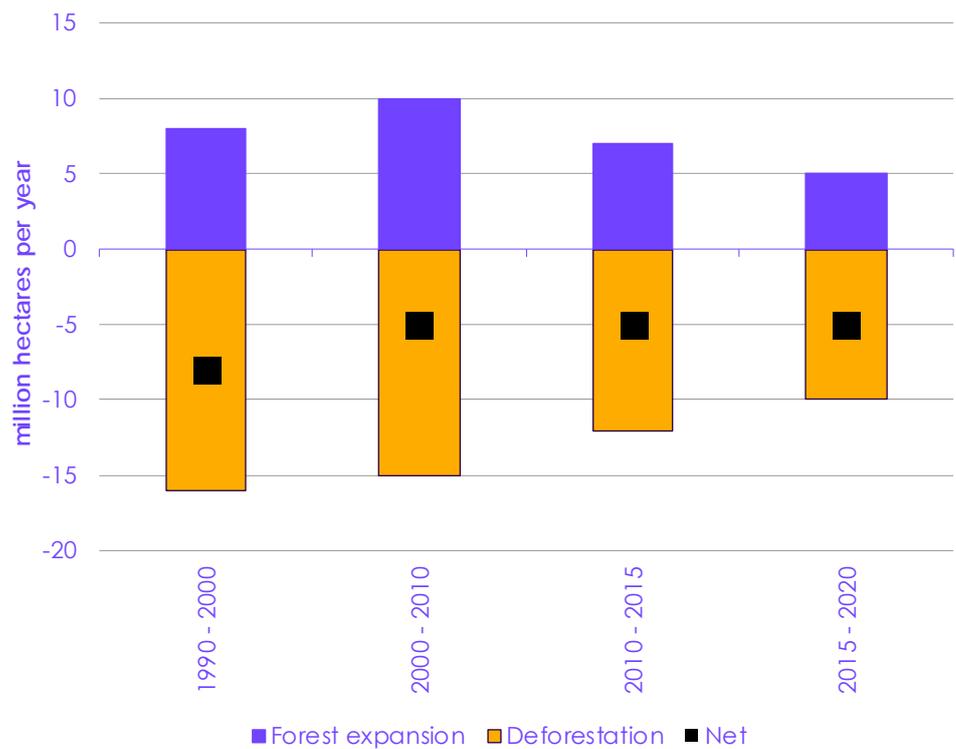
Reducing global emissions from land-use change requires a focus on ending tropical deforestation. This is because deforestation in this part of the world is primarily removing very high-carbon stock primary forest that has never been cut

\* Including agricultural emissions around 25% of total global GHG emissions come from the agricultural and land-use sectors. IPCC (2019) *Special Report on Climate Change and Land*.

before, leading to very large carbon losses into the atmosphere. Emissions from tropical deforestation cannot be compensated with equal areas of afforestation in other parts of the world, although afforestation efforts elsewhere in the world are also important levers for the global effort to reduce emissions and restore biodiversity.

Tropical deforestation is primarily driven by agricultural expansion (for both domestic consumption and export). Developed countries can support ending tropical deforestation by improving corporate supply chain standards to provide incentives for tropical exporters to avoid deforestation, and capacity building to improve agricultural yields in tropical countries to reduce the pressure to convert forested land.

Figure 1.3 Trends in global forest cover



Source: FAO (2021) *State of the World's Forests 2020*.

Notes: Forest expansion is a combination of intentional afforestation and natural forest regeneration.

### 3. Progress in international climate policy

This section looks at progress in all aspects of the Paris Agreement long-term goal.

The Paris Agreement has three aspects to its long-term goal:

1. **Mitigation.** Holding warming to 'well below' 2°C above preindustrial levels and 'pursuing efforts' to limit it to 1.5°C above preindustrial levels.
2. **Adaptation.** Enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change.
3. **Finance.** Aligning financial flows with a pathway towards low greenhouse gas emissions and climate-resilient development.

COP26, to be held in Glasgow in November 2021, is an opportunity to assess progress and raise global ambition across all three aspects of the Paris Agreement long-term goal.

This section looks at progress in all three aspects in turn, before summarising the path to COP26 and the UK's role as the COP26 president.

#### a) Progress in mitigation policy

Countries were expected to 're-communicate' their Nationally Determined Contributions (NDCs) including emissions reduction commitments for the period to 2030, by the end of 2020. Countries were also asked to submit mid-century long-term low GHG emission development strategies by the same date. There is an expectation from many parties that NDC ambition should be raised as parties re-submit their plans, consistent with the ambition 'ratchet' mechanism envisaged under the Paris Agreement.

Countries have been submitting strengthened emissions reduction pledges ahead of COP26.

Strengthening of national emissions reduction targets has focused on two separate time horizons:

- **Mid-century.** More global Net Zero commitments are being made with dates of Net Zero around the middle of the century. Several large emitters including China, USA, EU and Japan have Net Zero commitments for mid-century (2050 – generally including all GHGs – except for China, which has a 2060 commitment). It is estimated that 68% of GDP and 61% of global GHG emissions are now covered by some kind of national Net Zero commitment for mid-century.<sup>15\*</sup> The stringency of these Net Zero commitments varies, with most coverage being from 'aspirational' targets that aren't backed up by law or official policy documents.
- **Near-term.** There has been less commitment for enhanced emissions reduction for the period to 2030 (the period for the first NDCs). The UNFCCC estimated that 40% of countries had submitted revised 2030 NDCs by end of 2020. Significant increases in ambition have been adopted by large G7 emitters over recent months (including the USA, EU, Japan, UK and Canada), aligning their NDC commitments with mid-century Net Zero targets. Under current pledges for 2030, emissions are expected to be

\* These Net Zero targets are of variable stringency, with a wide range of standards applied. Corporate action, including the UN sponsored 'Race to Zero', have also significantly expanded over recent years with even greater variation in the associated conditions.

around 15% lower than 2019 levels (around 5% lower than 2010 levels).<sup>16</sup> It remains unclear whether a significant increase in ambition from China (~25% of global emissions) will be seen ahead of COP26.

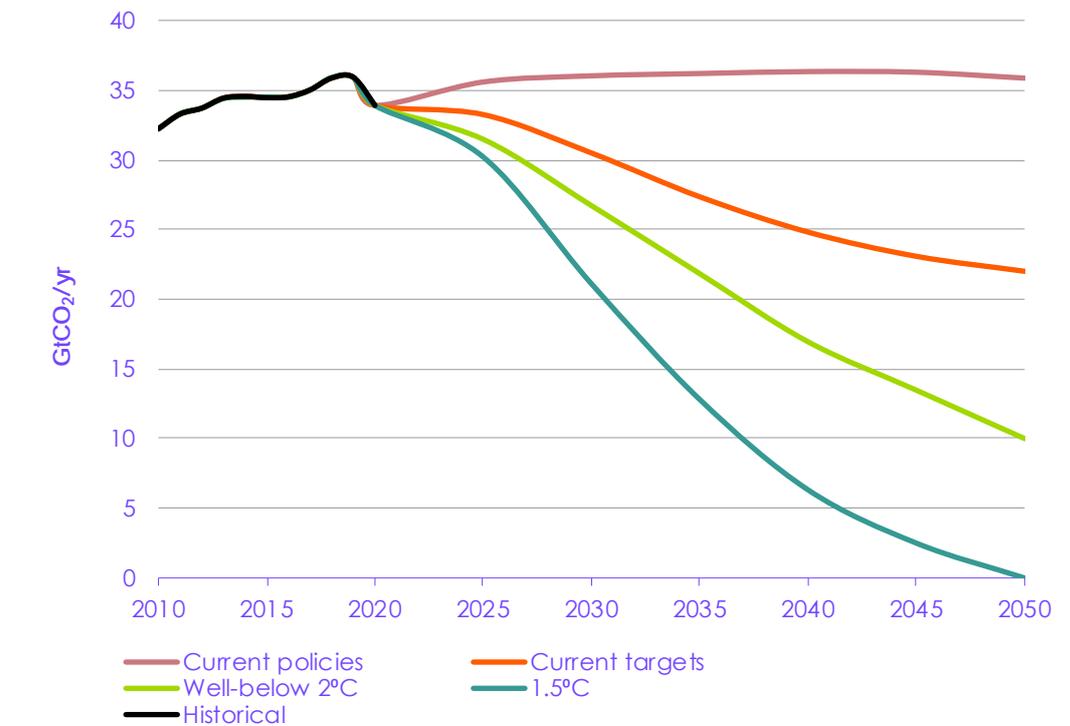
Current trajectories indicate a plateau for global emissions over the coming decade, with a significant gap to Paris Agreement consistent pathways.

If achieved, current commitments (both for 2030 and mid-century), could be consistent with pathways keeping expected (central estimate) warming by 2100 to around 2°C above preindustrial levels. However, global emissions in 2030 would be far above emissions in pathways expected to keep warming to 'well-below' 2°C or 1.5°C (Figure 1.4). Significant increases in Chinese ambition to 2030 will be essential to any efforts to close this gap alongside enhanced commitments from other large emitters that have yet to strengthen their 2030 commitments.

In nearly all cases significant strengthening of climate policies will be required to deliver on the pledged emissions reduction commitments. Current policies imply emissions continuing at recent levels, which would lead to expected warming by 2030 of around 3°C above preindustrial levels.

There is an increasing prevalence of 'framework' climate laws around the world alongside an increasing number of expert climate advisory bodies. These can help provide a structure to support delivery of NDCs and long-term targets if they are designed with robust governance standards to hold Governments effectively to account on delivery over both the long- and short-terms.<sup>17</sup>

Figure 1.4 Global emissions gaps to Paris Agreement consistent pathways



Source: IEA (2021) *Net Zero By 2050: A roadmap for the Global Energy Sector*; IEA (2020) *World Energy Outlook 2020*. Notes: 'Current policies' uses the IEA Stated Policies Scenario (STEPS), 'Current targets' the IEA Announced Pledges Case, the 'Well-below 2°C' the IEA Sustainable Development Scenario (SDS) and '1.5°C' the IEA Net Zero Emissions 2050 scenario. Emissions are CO<sub>2</sub> only emissions from energy and industrial process emissions.

## b) Progress in adaptation

Making progress on adaptation is a key priority for COP26.

Climate impacts are already being experienced around the world at today's level of warming and will increasingly make the achievement of some of the global Sustainable Development Goals (SDGs) more challenging. 81% of developing countries are taking steps to develop National Adaptation Plans, while 20 countries have submitted full plans.\* Around 70% of countries have adopted at least one national-level adaptation planning instrument, but with large variation in their detail.<sup>18</sup> Making progress on the global adaptation goal has been signalled as one of the key priorities for COP26 by the incoming UK Presidency.

Countries can support the raised adaptation ambition across at least three areas:

All countries can do more to mainstream adaptation considerations into policy making.

- **Embedding adaptation in national policy making.** Adaptation considerations need to be mainstreamed across national policy to properly help limit future climate risks. Integration into planning systems will be particularly important to reduce the risks of locking in climate exposure through long-lived infrastructure under construction around the world today. Similarly, adaptation considerations need to be integrated better with mitigation plans to ensure that efforts to achieve NDC and mid-century targets are not compromised by climate risks and that co-benefits for reducing climate risks are maximised.
- **International collaboration.** Building capacity around the world is key to improving resilience to climate impacts. Collaboration between countries to share best practices, technical expertise and policy structure can help accelerate this. New international alliances such as the Climate Adaptation Alliance – launched by the UK and others at the end of 2020 – can help facilitate these collaborations and skill-sharing.
- **Improving the evidence base for effective adaptation.** In many parts of the world taking evidence-based actions to improve climate resilience is hampered by a lack of good data sources on past and present local weather hazards and their impacts. For example, there is a lack of documented data on the history of heatwaves impacts across Africa, making it harder to construct effective early warning systems and heat action plans.<sup>19</sup> The evidence base for assessing the effectiveness of adaptation interventions for reducing climate risks also needs to be improved across the world. The global research capacity can be directed to help close these important evidence gaps.

Better evidence bases – particularly in developing countries – will be key to improving resilience to climate risks.

A successful COP26 outcome will not be possible without significant progress on issues related to global adaptation to climate impacts being experienced today and expected for the future. Developed countries also have a key role to play through the provision of climate finance, and technology/knowledge transfer.

## c) Progress in finance

Delivering the rapid reductions in global emissions needed to restrict warming to the Paris Agreement long-term temperature goal, while building resilience to climate impacts, requires a large shift in global investment patterns. Access to capital sources for this investment is key to realising this, particularly in developing countries.

\* 14 countries have submitted Adaptation Communications (detailing the action that they are taking on adaptation) to the UNFCCC as requested under Article 7 of the Paris Agreement.

Developed countries are not on track to deliver the \$100 billion per year climate finance goal pledged for 2020.

Prior to the Paris Agreement, parties to the UNFCCC adopted a goal of reaching a \$100 billion per year flow of climate finance from developed to developing countries by 2020. Indications are that this commitment has not been met:

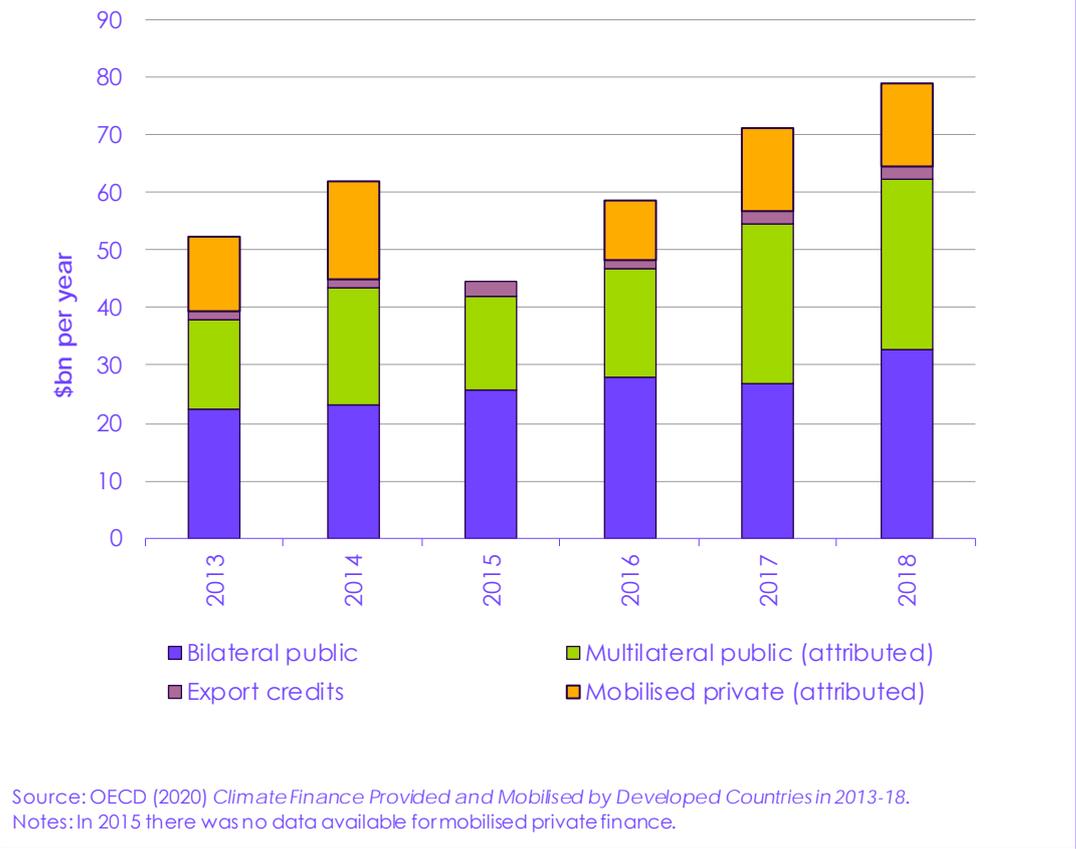
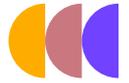
- There is currently no agreed way to measure these climate finance flows, but a report by the UN indicated that it was highly unlikely that the \$100 billion per year commitment was achieved in 2020.<sup>20</sup> The OECD estimates that \$78 billion was mobilised by developed countries in 2018 (Figure 1.5).
- The \$100 billion per year in mobilised climate finance is itself a small fraction of the global investments needed to transform the global economy but has large political significance. Many developing countries see it as a key test of whether developed countries will take their commitments seriously. Many 'conditional' NDCs from developing countries explicitly mention needing climate finance to deliver on the higher level of ambition.
- Due to the effects of COVID-19, spending on emergency healthcare investments and economic relief has restricted many developing countries' capacity for financing adaptation and resilience. Investment in adaptation fell globally in 2020 despite a record number of floods, droughts, wildfires and storms affecting more than 50 million people worldwide.<sup>21</sup> The vast majority (~80%) of adaptation finance is from public sources, but adaptation finance is only around 20% of total climate finance mobilised by developed countries. Developed countries can improve the access to finance for adaptation by allocating it a much larger share of their climate finance spending and by supporting private sector investment.\*

A more equal split between mitigation and adaptation climate finance is needed.

Meeting this commitment is a key expectation from developing countries ahead of COP26. Countries have also agreed that \$100 billion per year in mobilised climate finance should be a floor level for beyond 2020 with an expectation for a new higher goal to be set by 2025. Negotiations on this are expected to start at COP26.

\* For example the UN has launched a 'Race to Resilience' initiative to involve non-state actors (including companies) to reduce vulnerability to climate impacts.

Figure 1.5 Progress towards the \$100 billion per year climate finance goal from developed countries



## d) The path to COP26 and beyond

The period ahead of COP26 is critical for a successful outcome in Glasgow.

The coming months contain several events which will lay the groundwork for a successful COP26. These include important multilateral forums (such as the G20) which present key opportunities for countries to bring forward new commitments on climate finance and emissions reductions from large economies. UNFCCC negotiations sessions in June and at the pre-COP in October will also be critical for securing the negotiated outcome at COP26 itself in Glasgow.

The UK has an important role in ensuring sufficient progress is being made over the months before COP26 as incoming COP president.

The UK has now submitted a full set of commitments to the UNFCCC as required under its international obligations (Box 1.3). Its focus now should be on best utilising the COP26 presidency to secure a genuinely beneficial outcome (Box 1.4).

### Box 1.3

#### The UK's submissions to the UNFCCC in 2020

In December 2020, the UK submitted a set of documents to the UNFCCC in accordance with its international obligations.

- **The UK's first NDC.** The NDC submission contained a target to reduce aggregated GHG emissions by at least 68% in 2030 (relative to 1990 levels) in accordance with the Committee's advice. This headline target does not include the UK's share of emissions from international aviation and shipping – as advised by the Committee. A commitment to include these emissions within the Sixth Carbon Budget has now been made by the Government. The NDC document specified that the Government intends to achieve the target through domestic emissions reductions.
- **Adaptation Communication.** The Government submitted an Adaptation Communication, separate to the UK's NDC. This document summarises the climate risks facing the UK and actions being taken to address them – including the National Adaptation Programme. Progress on adapting to climate change in the UK is assessed in the companion report to this one which finds that, despite progress, significant gaps remain to deliver improved resilience to climate impacts in the UK. No new commitments to raise UK adaptation ambition beyond the actions and policies already being implemented were provided in either the NDC or Adaptation Communication.
- **Finance Biennial Communication.** The document provided a summary of the activities that the UK has supported through its climate finance provision. It also mentions the UK's 2019 commitment to provide £11.6 billion in dedicated climate finance over the 2021/22 – 2025/26 period. This is double the level of support over the previous five-year period and is protected at this level against the announced temporary cuts in UK Official Development Assistance (ODA) from 0.7% to 0.5% of Gross National Income. The £11.6 billion funding is additional to the UK's contribution to the 'core' budget of large multi-lateral development banks, some of which will be used to support climate-related projects. The UK has also committed to align the full extent of its ODA spend with the Paris Agreement and has implemented an end to export finance for overseas fossil fuel investments. The communication also reiterated the UK's commitment to maintaining an approximately equal split between mitigation and adaptation projects in its climate finance.

These documents, together with the legislation of the UK's Sixth Carbon Budget, represent a full summary of the UK's current level of ambition in tackling climate change. The UK should update its mid-century long-term low greenhouse gas emission development strategy with the UNFCCC (currently the *Clean Growth Plan* - targeting the previous long-term target of an 80% reduction in emissions by 2050) with its new Net Zero Strategy when it is published ahead of COP26. This will provide a vision of the actions and policies that will be brought forward to achieve the domestic carbon budgets and Net Zero target.

## Box 1.4

### The UK's role in delivering a COP26 with global climate benefits

The UK will have an important role in delivering a successful COP26 outcome as the COP President (in partnership with Italy), alongside its presidency of the G7 group of countries this year. Updated NDCs are expected from all countries ahead of the main COP26 negotiations and will not be negotiated directly at the conference.

There are several aspects where the UK will be required to play an important role:

- **Continuing to support increases in ambition and implementation.** Several large emitter nations have now updated their 2030 NDCs. However, other large emitters (including China) have yet to update their headline ambition. The UK will need to continue to champion increased NDC ambition through to COP26 and should also bring focus to improving implementation plans to achieve these strengthened targets. Internationally agreed commitments on key aspects of delivery (e.g. ending coal fired power generation) could help facilitate this.
- **Securing buy-in from all countries for a COP26 outcome.** UNFCCC outcomes need to be unanimously agreed by all parties. The UK presidency has a critical role in building support across all countries ahead of the conference. This will mean giving issues of adaptation, climate finance, and loss and damage prominence in the negotiations. The UK can support this by providing a clear commitment ahead of COP26 on the timetable by which the UK's ODA contribution will return to 0.7% of Gross National Income, and by helping to leverage additional finance commitments from other developed countries to demonstrate a clear pathway to achieving and exceeding the \$100 billion per year goal.
- **Championing a 'climate-aligned' recovery from COVID-19.** The global aggregate effects of economic recovery measures resulting from the ongoing COVID-19 pandemic are not consistent with the investment profile needed to sustain continued declines in global emissions this decade.<sup>22</sup> These investments are critical for the trajectory of global emissions this decade and keeping the Paris Agreement long-term temperature goal in reach. Having taken on leadership of UN work on 'Recovering Better For Sustainability', the UK should use its presidency to support a step up in efforts on this front globally. The UK should also be sensitive to the wider challenges facing developing countries emerging from the COVID-19 pandemic and contribute actively to international efforts to address this.
- **Carbon markets and the Paris Agreement rulebook.** A major focus of the negotiations is expected to be finalising the outstanding aspects of the rulebook for the Paris Agreement, including rules on carbon markets and transparency of NDCs under the Agreement. As COP President, the UK has an essential role to ensure that any new rules for international carbon markets have the highest standards, ensuring that they are genuinely supportive of efforts to reduce global emissions. Postponing agreement on market rules at COP26 (as at COP25) would still be preferable to a compromised deal that could lock in a system which may undermine global ambition and accountability. The UK presidency can also champion high-integrity standards in voluntary carbon markets through its COP26 Finance workstream.

Action in these areas, alongside the recommendations to align domestic policy ambition with the UK's Net Zero target, NDC and Sixth Carbon Budget elsewhere in this report, can help the UK maximise the chances of delivering a successful COP26 with genuine benefits for the global effort to address climate change.

The UK should prioritise maintaining international momentum for tackling climate change over the period between COP26 and the global stocktake in 2023.

After COP26 the next significant moment in the Paris Agreement cycle is anticipated to be the first global stocktake in 2023. The UK can help maintain international momentum for the post-COP26 period by championing longer-term initiatives that can help ensure activities and outcomes feeding into COP26 (such as the COP26 campaigns) are maintained and lead to long-term benefits for global efforts to tackle climate change.

As part of this, the UK should publish a new strategy for its international climate policy during its COP26 presidency (which extends for a year after COP26) to refresh its strategy and signal its commitment to supporting international climate action over the long term.\* This should include a recognition of the need for countries to produce credible plans now to deliver on strengthened emissions reduction commitments. The UK's recent commitment to include international aviation and shipping emissions within the Sixth Carbon Budget can also be leveraged internationally, including through international forums to agree a Paris Agreement compatible emissions target for international aviation and a mechanism to deliver it that is fit for purpose.

\* This strategy should flesh out the UK's commitment to place climate change as the number one priority in the recent Integrated Review of foreign and defence policy and ensure that a joined-up perspective is maintained on how the UK's climate finance is spent.

# Endnotes

- <sup>1</sup> IEA (2021) *Global Energy Review: CO<sub>2</sub> Emissions in 2020*.
- <sup>2</sup> International Monetary Fund (2021) *World Economic Outlook (April 2021)*
- <sup>3</sup> IEA (2021) *Global Energy Review 2021*.
- <sup>4</sup> IRENA (2020) *10 years: Progress to Action*.
- <sup>5</sup> IRENA (2020) *Renewable Power Generation Costs in 2019*.
- <sup>6</sup> IEA (2020) *World Energy Outlook 2020*; Lazard (2020) *Levelized Cost of Energy and Levelized Cost of Storage*.
- <sup>7</sup> Bloomberg New Energy Finance (2021) *Hitting the EV inflection point*.
- <sup>8</sup> Princeton (2021) *Net Zero America*.
- <sup>9</sup> IRENA (2021) *Renewable Capacity Statistics 2021*.
- <sup>10</sup> IEA (2021) *Renewable Energy Market Update 2021*.
- <sup>11</sup> Manych, N. et al. (2021) Finance-based accounting of coal emissions. *Environmental Research Letters*, 16, 044028.
- <sup>12</sup> Global CCS Institute (2020) *Global Status of CCS Report 2020*.
- <sup>13</sup> United Nations Food and Agriculture Organisation (2020) *Forest Resources Assessment 2020*.
- <sup>14</sup> Pendrill, F. et al. (2019). Deforestation displaced: trade in forest-risk commodities and the prospects for a global forest transition. *Environmental Research Letters*, 14 (5), 055003; Ritche, H. & Roser, M. (2021) *Forests and Deforestation*. Published at OurWorldInData.org
- <sup>15</sup> ECIU & Oxford Smith School (2021) *Taking stock: A global assessment of net zero targets*.
- <sup>16</sup> Climate Action Tracker Initiative (2021) *Global Update: Climate Summit Momentum*.
- <sup>17</sup> Eskander, S. & Frankhauser, S. (2020) Reduction in greenhouse gas emissions from national climate legislation. *Nature Climate Change*, 10, 750–756; Dudley, H. et al. (2021) Independent expert advisory bodies facilitate ambitious climate policy responses. *ScienceBrief Review*.
- <sup>18</sup> UNEP (2020) *Adaptation Gap Report*.
- <sup>19</sup> Harrington, L. & Otto, F. (2020) Reconciling theory with the reality of African heatwaves. *Nature Climate Change*, 10, 796–798.
- <sup>20</sup> UN Independent Expert Group on Climate Finance (2020) *Delivering on the \$100 billion climate finance commitment and transforming climate finance*.
- <sup>21</sup> IFRC, *World Disasters Report 2020*, 2020
- <sup>22</sup> Global Recovery Observatory (2021) *Are We Building Back Better? Evidence from 2020 and Pathways for Inclusive Green Recovery Spending*; Vivid Economics (2021) *Greenness of Stimulus Index*.

# Chapter 2

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## UK emissions and drivers

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## Introduction

This chapter outlines UK progress towards reducing the UK's greenhouse gas emissions, including the UK's share of international aviation and shipping emissions as covered by the Sixth Carbon Budget.

UK emissions have reduced consistently since 1990, with average annual falls of around 18 MtCO<sub>2</sub>e since 2012, similar to those needed to meet the Sixth Carbon Budget. However, progress so far has been dominated by the power sector, while progress in future will need to cover the whole economy.

The pandemic and resulting restrictions have caused sharp falls in economic activity, energy demand and emissions in 2020.\* UK emissions and output will almost certainly increase as lockdown restrictions are lifted, but the permanent impact of the pandemic on UK emissions and economic activity is still unclear.

Our key messages are:

- **UK greenhouse gas emissions were 499 MtCO<sub>2</sub>e in 2019.** This includes the UK's share of international aviation and shipping emissions.
- **Our greenhouse gas consumption footprint was 703 MtCO<sub>2</sub>e in 2018.** This includes emissions embedded in the goods and services consumed in the UK even if they are produced overseas. Consumption emissions were 37% higher than production emissions in 2018. Data for 2019 will be published next year.
- **From 1990 to 2019, UK emissions fell by 40%, while the economy grew by 78%.** The UK's consumption footprint has fallen at a comparable rate since 2007, but by less (29%) since 1990 (Figure 2.1).
- **UK emissions fell by a record 13% in 2020 to 435 MtCO<sub>2</sub>e,** 48% below 1990 levels. The fall in 2020 was almost entirely due to the impacts of the pandemic, particularly reductions in road and air travel, as well as lower overall energy demands.
- **It is unclear how far the impacts of the pandemic on emissions will persist in future,** but transport emissions are likely to rebound to some extent in 2021 as lockdown measures are lifted.
- **Progress outside the power sector has been limited.** If annual changes in emissions return to the same per-sector trend as the previous decade, the Sixth Carbon Budget will be missed by a huge margin. Now is the time to extend progress across all sectors of the economy.

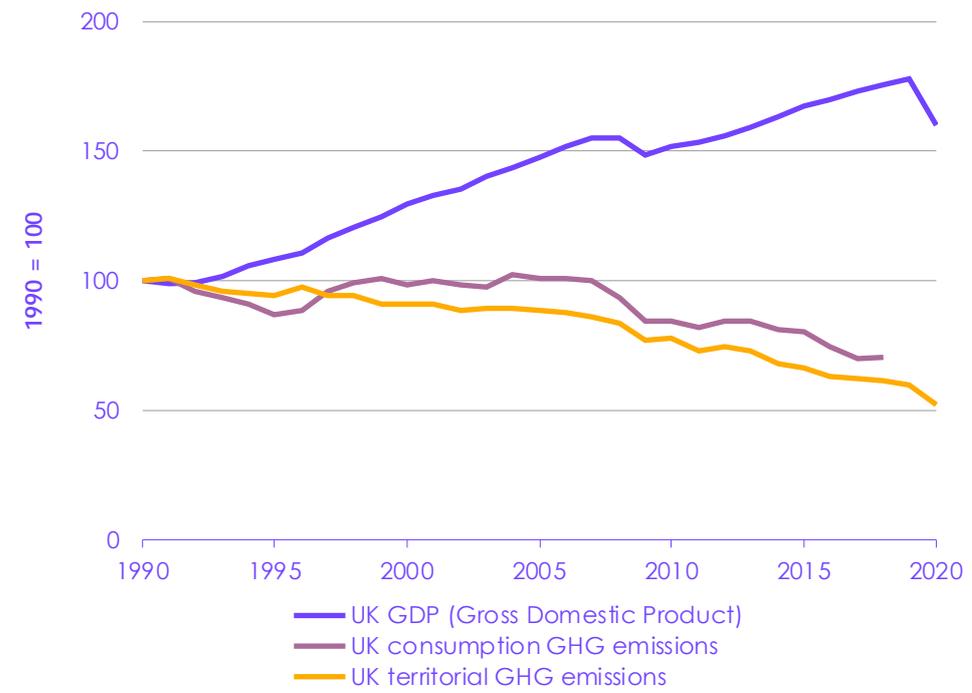
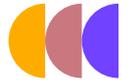
We set out our analysis in the following three sections:

1. Progress reducing UK emissions
2. Impacts of COVID-19 on emissions and behaviours in 2020
3. Progress reducing the UK's carbon footprint

\* Estimates of the UK consumption footprint for 2020 are not yet published, but they will certainly be lower than in 2019 due to both lower territorial emissions and a fall in goods imported to the UK in 2020.

The UK economy has grown by nearly 80% from 1990 to 2019 while both territorial and consumption emissions have fallen.

**Figure 2.1** The UK economy has grown while territorial and consumption emissions have fallen



Source: BEIS (2021) 2020 UK Greenhouse Gas Emissions, Provisional Figures; ONS (2020) Gross Domestic Product: chained volume measures: Seasonally adjusted £m; Defra (2019) UK's carbon footprint; CCC analysis.  
 Notes: The UK's share of International aviation and shipping emissions is included in both the territorial and consumption emissions statistics.

# 1. Progress reducing UK emissions

This section reviews trends in UK emissions in the decade up to 2019, and the change in emissions in 2020 during the pandemic.

In 2020 emissions fell at a record rate, almost entirely due to the COVID-19 lockdowns and the resulting reduced demand for energy, particularly for travel.\* Without action now to lock in beneficial changes to the way people work and travel, these factors are likely to be mostly temporary and will not significantly contribute to the fundamental changes that will be needed to achieve Net Zero, which must be more structural in nature (see Chapter 3).

To meet the Sixth Carbon Budget, UK emissions outside of the power sector must fall by an average of around 17 MtCO<sub>2</sub>e over the next fifteen years – compared to an average fall of just 5 MtCO<sub>2</sub>e per year from 2009 to 2019 – and emissions in the power sector must continue to fall in the context of growing demand.

## a) UK greenhouse gas emissions before 2020

Prior to 2020, electricity decarbonisation was a major success story, but other sectors including surface transport, buildings, agriculture and land use had made little progress in reducing emissions.

Emissions reductions varied significantly across sectors in the ten years before 2020 (Figure 2.2). Our 2020 Progress report set out a detailed breakdown of progress in reducing emissions in each sector since 2008. The key trends in sectoral emissions prior to the pandemic were:

- **Electricity supply was the major success story** of the past decade. Emissions decreased by 65% over the period 2009-2019, while the carbon intensity of the grid fell from nearly 500 gCO<sub>2</sub>/kWh in 2009 to 200 gCO<sub>2</sub>/kWh in 2019. Electricity generated from variable renewables was 9 TWh in 2009 (3% of total generation), and rose to 73 TWh in 2019 (26%).
- **Surface transport is off track**, and since 2015 has been the highest-emitting sector in the UK. Emissions have been broadly flat over the past decade, falling only 1% between 2009 and 2019. Improvements to the efficiency of cars have been lost to a trend towards both driving larger vehicles and driving more miles.
- **Industry saw significant reductions in emissions**, largely resulting from a combination of the changing structure of the UK's manufacturing sector (responsible for around 20% of the fall), improved energy intensity (40%) and a shift to lower-carbon fuels (40%), while overall output has grown.†
- **Buildings saw some progress** from policy-driven action in the first half of the past decade. Temperature-adjusted emissions fell by 7% between 2009 and 2016, but have risen since. The overall efficiency of the boiler stock has improved, but there has been minimal progress on improving insulation or switching to low-carbon heating in recent years.

\* This fall in emissions was also due to warmer than average temperatures, which tend to suppress heating demand, increase cooling demand and on balance decrease overall energy demand, particularly in homes.

† A decomposition analysis covering the period 2012-2017 shows that UK industrial output grew 14%. The 12% fall in direct CO<sub>2</sub> emissions across that period can be attributed to a structural movement towards a less carbon-intensive mix of industrial output (accounting for 20% of the change), improvements in energy intensity (40%) and changes in fuel mix (40%). It is not clear whether these reductions were driven by policy.

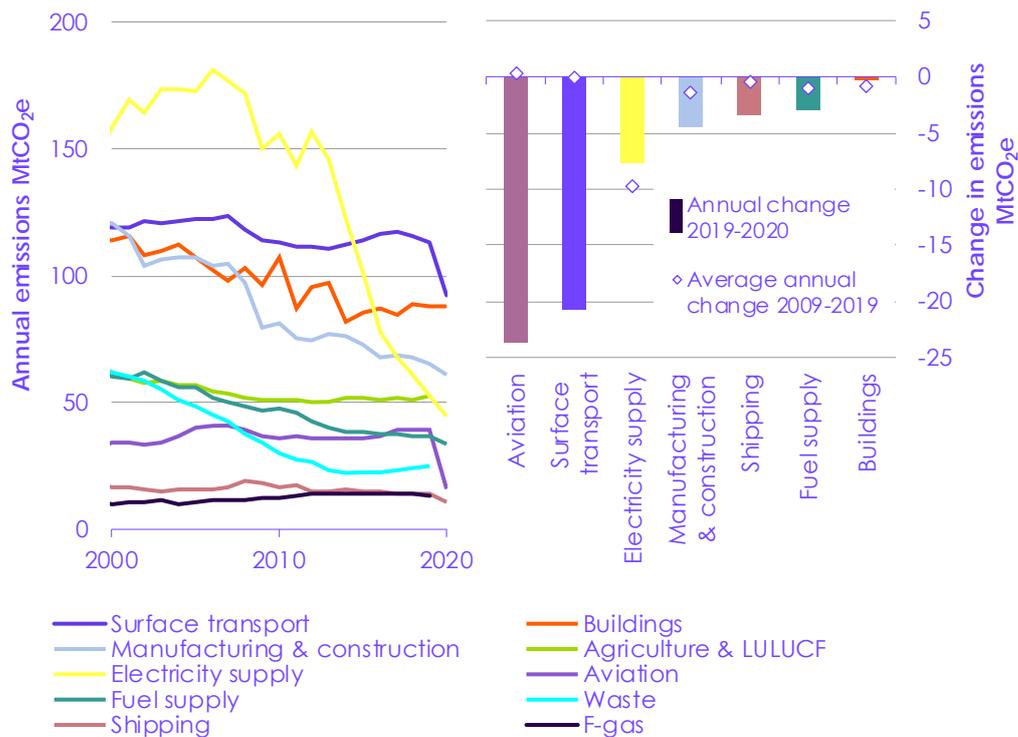
- **Agriculture and land use emissions were broadly flat**, increasing by 2% over the period 2009-2019. These sectors repeatedly failed to meet the indicators outlined in the Committee's progress reports (e.g. for tree planting and on-farm efficiency measures).
- **Aviation emissions and passenger numbers were increasing**. Over the 2009-2019 period, the total number of UK terminal passengers rose by 36% to nearly 300 million in 2019. Efficiency improvements were not enough to offset this rise in demand, with emissions up 7% from 2009 levels to 40 MtCO<sub>2</sub>e in 2019.
- **Shipping emissions fell**, mostly due to reductions in domestic shipping along coasts and in international export shipping. In particular, fewer tonnes of dry and liquid bulk (including coal and crude oil) were transported by ship, although container and roll-on/roll-off freight increased. Emissions in 2019 were 24% lower than in 2009.
- **Waste sector falls were driven exclusively by reductions in landfill emissions**. Waste emissions fell by 28% from 2009 to 2019, but this was primarily due to the landfill tax diverting biodegradable waste away from landfill to other waste treatment, particularly Energy from Waste (EfW) incineration. Recycling rates plateaued, and more local authority waste is now processed by EfW than is recycled or composted in England.
- **F-gas emissions increased, but began to fall towards the end of the 2010s** as new regulations restricting the use of the most harmful gases took effect. Emissions increased by 20% from 2009 to 2017, but fell by 7% in two years to 13.4 MtCO<sub>2</sub>e in 2019.

If progress does not extend outside the power sector, the Sixth Carbon Budget will be missed by a huge margin.

To meet the Sixth Carbon Budget and to deliver the UK's 2030 Nationally Determined Contribution to the Paris Agreement, progress will have to extend quickly beyond the power sector. If annual changes in emissions return to the same per-sector trend as the previous decade, the Sixth Carbon Budget will be missed by a huge margin (Figure 2.3).

Progress has been uneven among sectors in the last decade.

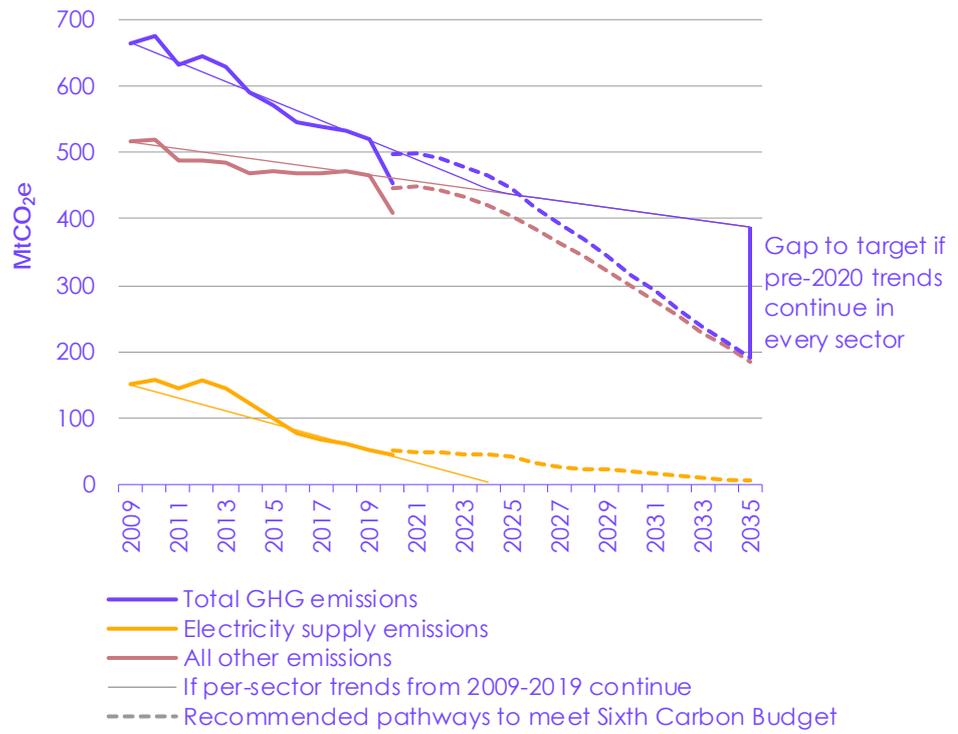
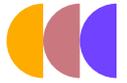
Figure 2.2 Changes in UK emissions by sector



Source: BEIS (2021) 2020 UK Greenhouse Gas Emissions, Provisional Figures.  
 Notes: LULUCF = Land use, land-use change and forestry. Estimates of emissions for sectors with large proportions of non-CO<sub>2</sub> emissions are not shown on the right-hand chart. Final estimates of emissions in these sectors will be published in early 2022. Aviation and shipping include the UK's share of international aviation and shipping emissions.

If individual sectoral emissions stay on the same trend as the last decade, the Sixth Carbon Budget will be missed by a huge margin.

**Figure 2.3** Concerted action is required beyond electricity to meet the Sixth Carbon Budget



Source: BEIS (2021) 2020 UK Greenhouse Gas Emissions, Provisional Figures; CCC analysis.

Notes: Emissions in this chart are adjusted for future increases to the Global Warming Potentials (GWPs) of non-CO<sub>2</sub> gases, and therefore do not match the total published in the latest greenhouse gas inventory. The Sixth Carbon Budget target was recommended on this basis (see Box 2.2).

## b) UK greenhouse gas emissions in 2020

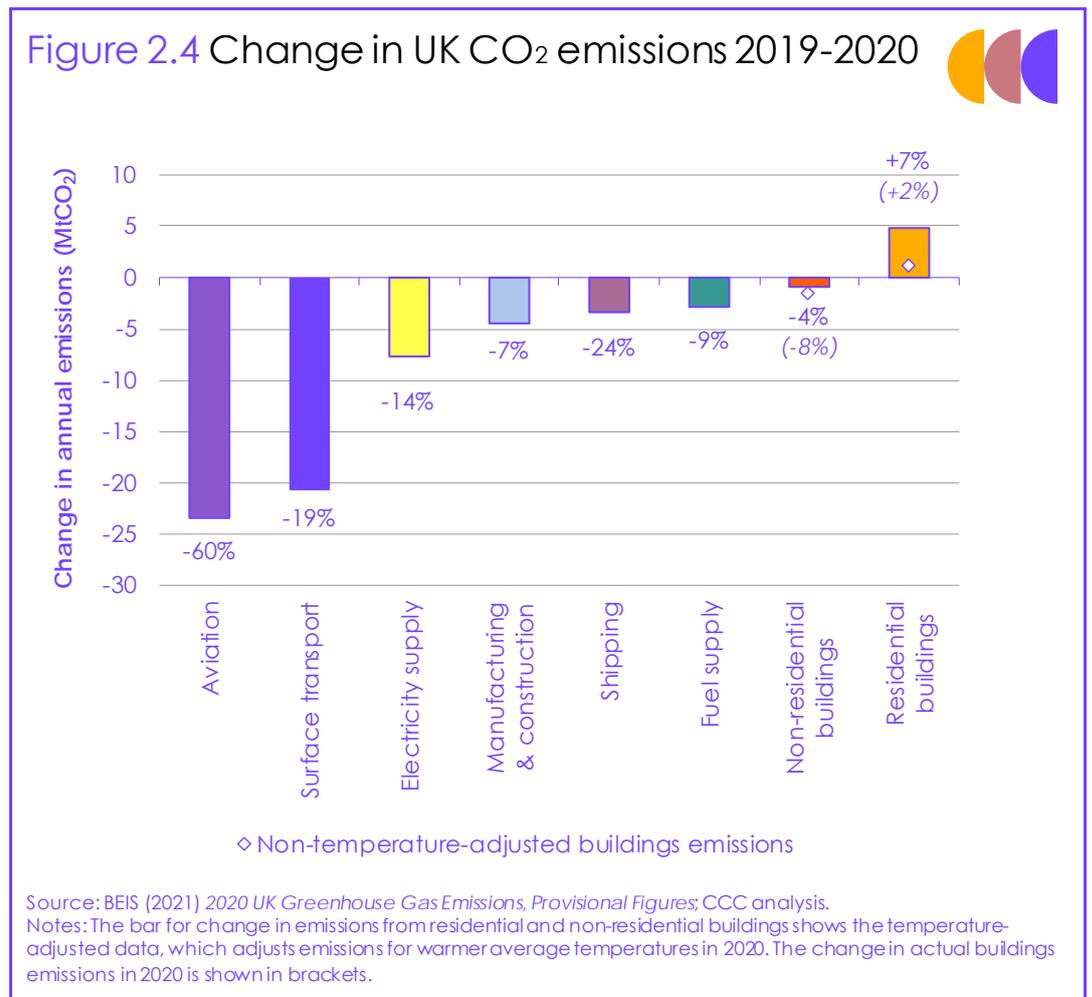
The COVID-19 pandemic and the resulting restrictions caused a substantial drop in emissions, but the lasting changes on UK emissions remain far from certain. Section 2 of this Chapter explores the short-term impacts of COVID-19 on UK emissions in more detail.

Emissions fell by 13% in 2020, almost entirely due to the impacts of lockdown measures.

The Committee's provisional estimate (Box 2.1) shows that UK emissions fell by around 13% in 2020, with the vast majority of the fall associated with reductions in emissions from transport (Figure 2.4).

2020 was the UK's third warmest year on record. Warmer temperatures, particularly during winter months, led to reduced demand for heating and lower greenhouse gas emissions. The temperature-adjusted emissions data presented in Figure 2.4 shows the 'true' underlying change in emissions (i.e. a bigger increase) from 2019 to 2020 if temperatures had instead been average. The temperature effect alone, which has its biggest impact in the residential buildings sector, caused around a 5% fall in UK emissions.

Milder winter temperatures mean that emissions were lower than they would have been in a year of average temperatures.



Estimates of all sources of emissions in 2020 are available, but some (particularly non-CO<sub>2</sub>) estimates are less reliable.

### Box 2.1

#### The provisional estimate of UK emissions in 2020

BEIS have published a provisional estimate of emissions for 2020 that covers most sources, based on various analytical approaches. To produce a complete estimate of UK emissions, the Committee has added its own estimate for international transport emissions that is based on official statistics:

- **CO<sub>2</sub> emissions in the major 'energy system' sectors** are based on fuel consumption data, and therefore account for the impacts of the pandemic (electricity supply, buildings, manufacturing and construction, fuel supply, surface transport and domestic aviation & shipping).
- **CO<sub>2</sub> emissions from other sectors** – particularly CO<sub>2</sub> emissions that are not associated with the combustion of fossil fuels – are held constant from their final estimates for 2019 (mostly in waste, agriculture, LULUCF).
- **Non-CO<sub>2</sub> emissions** are assumed to fall in line with the latest BEIS emissions forecasts for 2019 to 2020. This simple approach does not capture any impact of the pandemic, although we can expect these emissions to be less affected by lockdowns than emissions related to energy use.\*
- BEIS do not publish a provisional estimate of **international aviation and shipping (IAS)** emissions. This year, the Committee has produced a provisional independent estimate of the UK's share of international aviation and shipping emissions based on fuel sales data in 2020.†

These estimates for 2020 are all provisional and will vary to some extent from the final BEIS data for 2020, which will be published in 2022.

Previous large annual falls in emissions were very different to those in 2020, and were driven by cold winter temperatures, recession and/or genuine underlying progress in the electricity sector.

Other years that saw large falls in emissions often reflected temporary factors that saw emissions rebound the following year. While the fall in emissions in 2020 is structurally different (Figure 2.5) to previous falls, it is likely to be largely temporary. There are likely to be lasting, but highly uncertain, changes in behaviour (see section 2) that will have consequences for UK emissions in the future:

- In 2009, the global financial crisis hit multiple sectors, most notably manufacturing and construction, electricity supply, and surface transport. Emissions rebounded in 2010 as the economy began to recover.
- 2011 saw a significant fall of just over 20% in emissions from residential buildings. This was almost entirely driven by milder winter temperatures and lower demand for gas compared to the previous year. The underlying changes were far less significant, with temperature-adjusted emissions actually increasing by around 2% in residential buildings in 2011. Emissions from buildings increased in the following year as temperatures fell relative to 2011.
- In 2014, there was another 17% fall in emissions in residential buildings, again driven by milder winter temperatures, and equivalent to a 1% rise in emissions from residential buildings when temperature-adjusted. That year did, however, see the acceleration of a major success story in electricity generation, with a 16% fall in power sector emissions. This was driven by structural changes in the GB electricity market, and emissions from this sector have continued to fall in every year since.

\* For example, emissions from landfills, livestock or forest growth were less affected by lockdown restrictions than fuel consumption for travel or manufacturing.

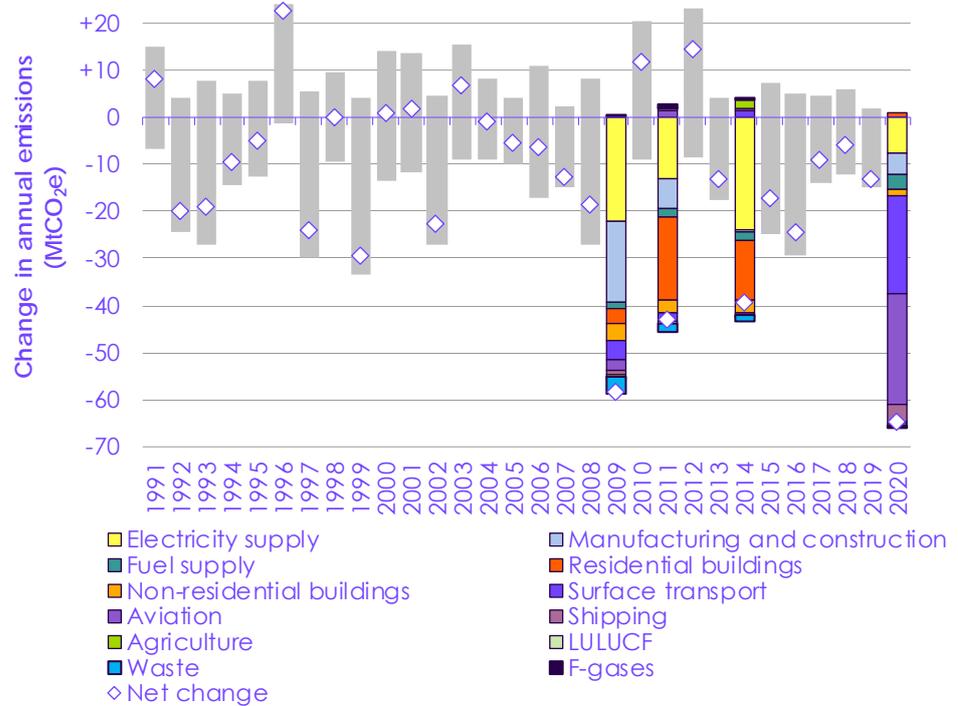
† This is a change from our approach in previous reports, where IAS emissions were held constant at the previous year's level. The pandemic means that this approach would not have produced a valid estimate of IAS emissions in 2020.

- In 2020, the vast majority (74%) of the total fall in emissions was associated with unprecedented pandemic-related reductions in air, sea and land travel. The pandemic also led to falls in emissions from fuel supply and manufacturing and construction (-7%), of a scale that would have been seen as significant in a 'normal' year.

It therefore seems likely that at least some of the fall in emissions made in 2020 will be reversed in 2021, with some increase in transport emissions to be expected. We explore this risk further in the next section and in Chapter 3 seek to identify underlying progress that could underpin sustained progress.

Emissions reductions in 2020 were largely due to pandemic-related restrictions, with little contribution from underlying structural progress.

**Figure 2.5 Annual change in UK emissions, 1990 to 2020**



Source: BEIS (2021) 2020 UK Greenhouse Gas Emissions, Provisional Figures; CCC analysis.  
 Notes: The years containing the most significant annual fall in emissions have been highlighted by sector.

## c) Changes to the UK inventory

The UK produces an annual greenhouse gas inventory, a consistent time series of all estimated sources and sinks of UK greenhouse gas emissions from 1990 onwards.

Every year, the inventory is updated to reflect the best available evidence and latest IPCC guidance.

Each year, the UK greenhouse gas inventory is updated to include emission estimates for any new sources identified in the UK, revised estimates for sources where there is an improved understanding of emissions (i.e. new data sources or a more accurate estimation methodology), and data revisions (for example to energy statistics) (Box 2.1).

The most significant change to the UK inventory this year was due to large revisions in the land use, land-use change and forestry (LULUCF) sector (Figure 2.6). These result from new estimates for peatlands emissions consistent with the 2013 IPCC Wetlands Supplement.<sup>1</sup> There were also revisions of around -1.5 MtCO<sub>2</sub>e to the estimation of annual wastewater methane emissions compared to the previous inventory.

Our Sixth Carbon Budget recommendation anticipated an increase in the estimate of UK emissions due to peatlands of between 17 and 21 MtCO<sub>2</sub>e in 2018. The published revision in UK peatland emissions in the latest inventory is similar to, though marginally smaller than, the range assessed in the Sixth Carbon Budget report, and does not affect the recommended level of the target (Box 2.2).

### Box 2.2

#### Recent and future changes to the UK inventory

Methodology changes to the UK inventory are designed to increase the transparency, accuracy, consistency, comparability, and completeness of the inventory. There are three primary sources of uncertainty in the UK inventory:

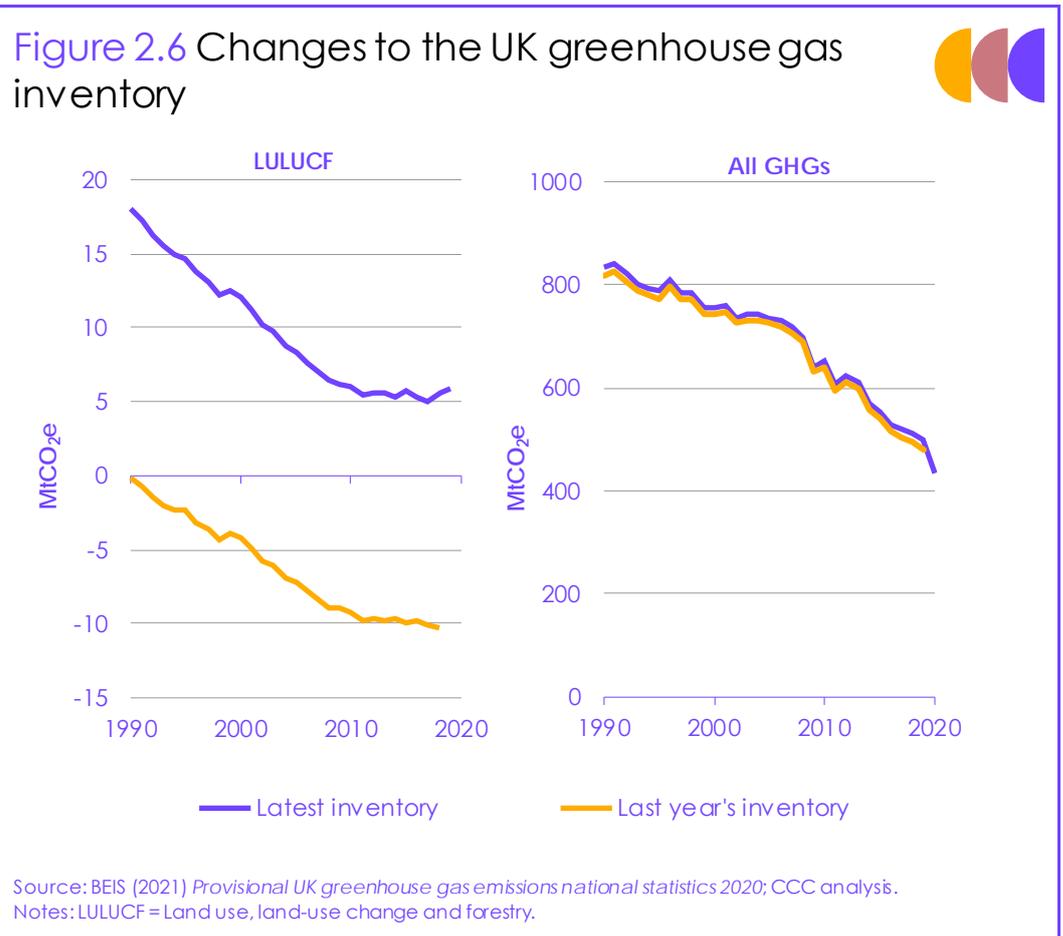
- **Changes to the scope of the inventory.** Certain sources of emissions and activities can be added to or removed from the scope of the UK inventory – adding to (or reducing) overall GHG estimates.
  - **Peatlands.** The most significant change to the UK inventory this year is due to a change of scope, with large revisions to the land use, land-use change and forestry (LULUCF) sector. These result from new estimates for peatlands emissions consistent with the 2013 IPCC Wetlands Supplement. This change added around 15 MtCO<sub>2</sub>e to the UK inventory in 2018 (Figure 2.6) and has turned the LULUCF sector from a net sink (of around 10 MtCO<sub>2</sub>e) to a net source of GHG emissions of almost 6 MtCO<sub>2</sub>e in 2019.
  - **Blue Carbon.** The term 'Blue Carbon' refers to the carbon stored in coastal and marine habitats such as salt marsh, mangroves, and sea grasses. These have had an increasingly important role in both climate change mitigation and adaptation. Chapter 4 of the Wetlands Supplement (Coastal Wetlands) has not yet been adopted in the UK inventory, and uncertainties remain. More research is needed to better understand how much carbon is stored in coastal and marine eco-systems, the annual flux of carbon release and rate of sequestration, and the impact on these of habitat restoration. Government should set out a comprehensive plan to assess the latest science and research gaps with a view to developing measurement protocols to enable emissions impacts of these habitats to be included in the GHG inventory.
- **Changes to Global Warming Potentials (GWPs)** assigned to GHGs. GWPs are used to convert emissions from different gases into a single comparable metric (tonnes of CO<sub>2</sub>-equivalent, or tCO<sub>2</sub>e), and are agreed internationally. There have been multiple changes to the GWP estimates used for CH<sub>4</sub>, N<sub>2</sub>O and F-gases since the inception of the inventory.

The UK inventory will update its GWPs before 2024, adding between 3 and 20 MtCO<sub>2</sub>e to the latest estimate of UK emissions, depending on the methodology that is used.\* We expect further updates when available when the IPCC AR6 (Working Group 1) report is published in August 2021.

- **Uncertainty in the current GHG inventory.** This comprises the statistical uncertainty in emission factors and activity data used in estimating emissions. It is internal to the inventory, is well quantified, and it is possible to formally assess the probability of errors through methods set out in IPCC guidelines. For the most recent inventory publication, the uncertainty was estimated as ±3% with 95% confidence for the UK as a whole. At sector level, land use emissions estimates have the highest uncertainty, followed by waste management and agriculture.

The UK inventory will continue to be updated each year in line with the latest IPCC guidance and to include the most up to date statistics and estimation methodologies.

The land use, land-use change and forestry (LULUCF) sector has seen the biggest changes in emissions. Around 15 MtCO<sub>2</sub>e of annual emissions from UK peatlands have now been included in the scope of the inventory. This change was expected.



\* At COP24 in December 2018 the international community decided to standardise reporting under the Paris Agreement transparency framework using the GWP100 metric (the GWP evaluated over a 100-year time frame). The values to be used are those from the IPCC 5th Assessment Report (AR5). There are two methodologies presented in AR5, with different GWPs, and it is not yet clear which will be used.

## d) Emissions in Scotland, Wales and Northern Ireland

The governments of Scotland, Wales and Northern Ireland will have an increasingly important role to play in tackling climate change as progress extends beyond the power sector and into sectors where key powers are devolved.

Emissions data for the devolved administrations are only available up to 2018 (Figure 2.7). New data for 2019 were due to be published in June 2021, but this was too late for inclusion in this report. The Committee will comment in more detail on 2019 emissions in our annual Scottish Progress Report later this year.

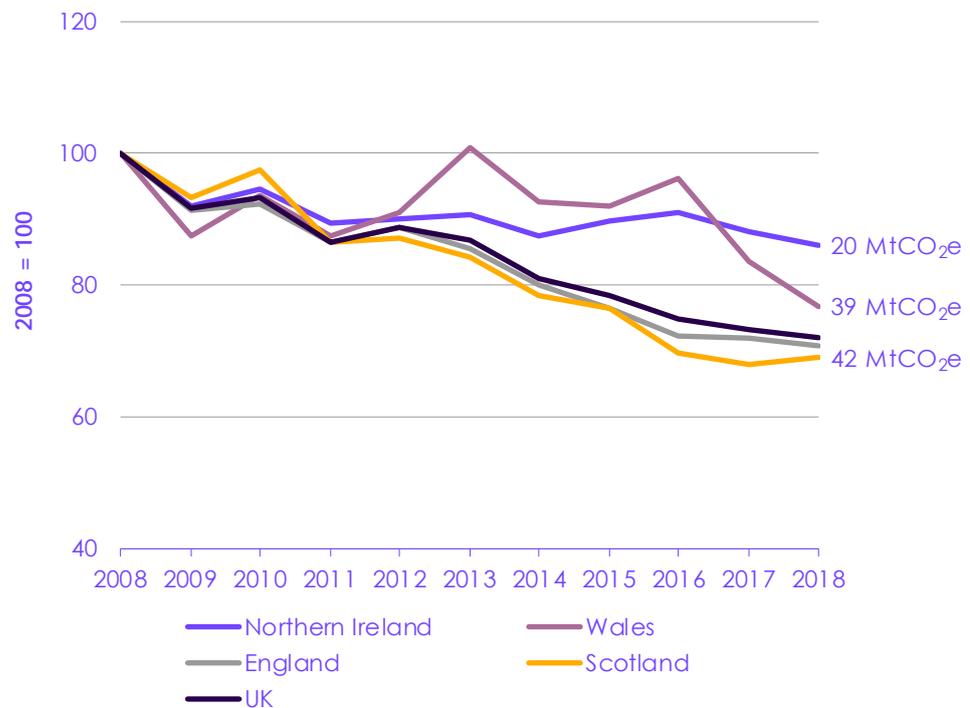
Emissions data for Scotland, Wales and Northern Ireland lags the UK data by more than a year.

Scotland has decarbonised faster than the UK average, while Wales and Northern Ireland have been slower. The most significant factor determining the relative rates of decarbonisation in Scotland, Wales and Northern Ireland compared to the UK average has been the speed and scale of power sector decarbonisation (Figure 2.8).

Emissions data up to 2018 shows that the power sector was the biggest driver of changes in emissions.

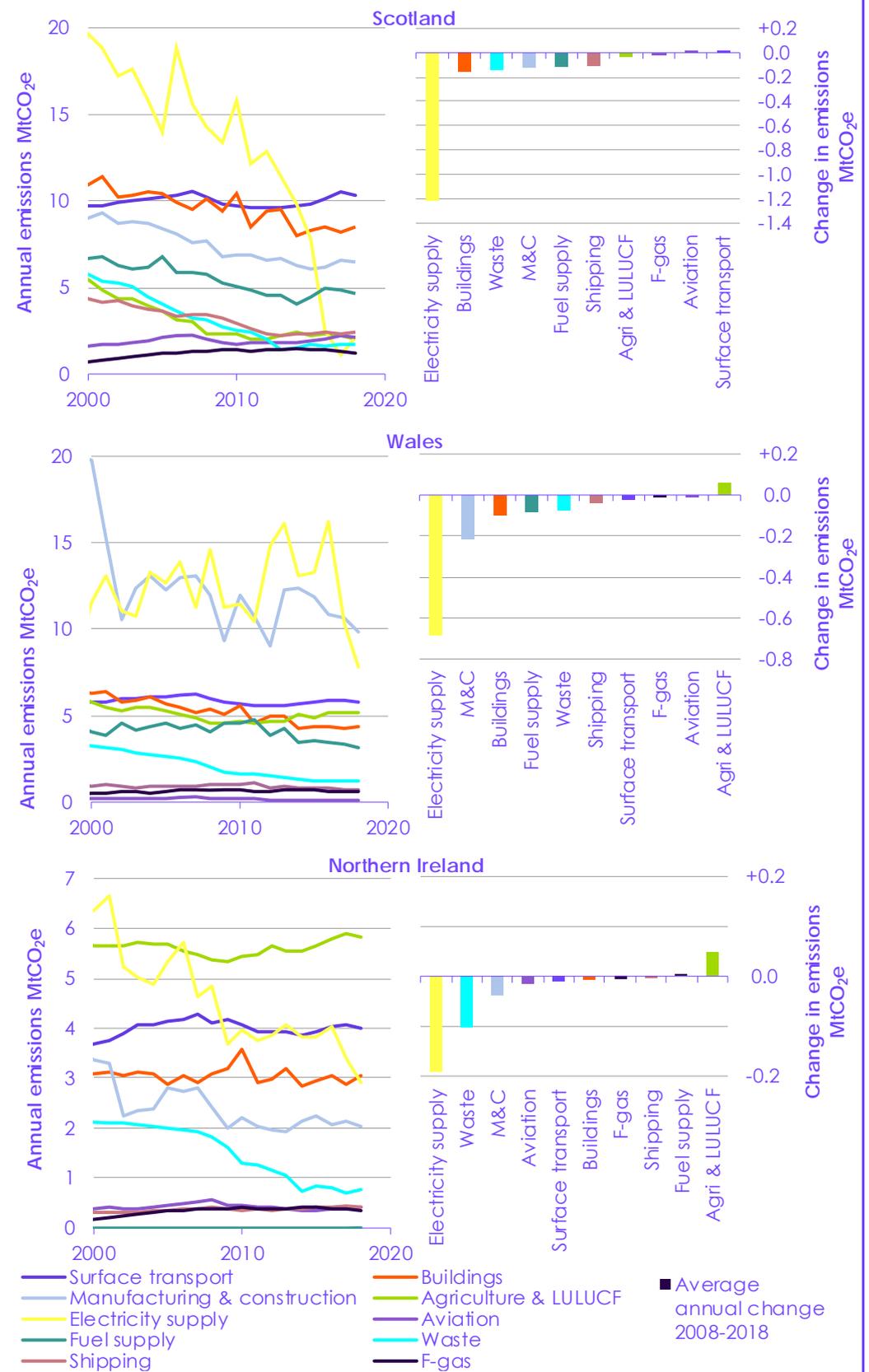
As UK-wide emissions reductions extend beyond the power sector, the next decade presents an opportunity for Scotland, Wales and Northern Ireland to match or exceed UK Government action in key devolved areas such as agriculture, tree planting, waste management, buildings efficiency, and public transport.

Figure 2.7 Greenhouse gas emissions in Scotland, Wales, Northern Ireland and England 2008-2018



Source: NAEI (2020) *Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2018*.

Figure 2.8 Sectoral emissions in Scotland, Wales and Northern Ireland, 2008-2018



Source: NAEI (2020) *Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2018*.  
 Notes: M&C = manufacturing and construction, LULUCF = land use, land-use change and forestry.

## 2. Impacts of COVID-19 on emissions and behaviours in 2020

In this section, we analyse the major changes that caused the sharp drop in emissions in 2020, and identify how lasting changes in behaviour could affect UK emissions in future.

Lockdown measures led to a record decrease in UK emissions in 2020. Most of the falls in sectoral emissions observed in 2020 are likely to be temporary.

Lockdown measures led to a record decrease in UK emissions in 2020. Most of the falls in sectoral emissions observed in 2020 are likely to be transient, as they do not reflect structural changes in the underlying economic, social, energy, transportation or land systems. In the absence of underlying changes, emissions are likely to rebound in most sectors in 2021.

The temporary fall in emissions in 2020 will have practically zero impact on the UK's past and future contribution to global warming. Sustained reductions are needed.

However, the last year has seen some large changes in patterns of behaviour due to the pandemic, and it is currently unclear the extent to which these changes will endure (Table 2.1). It is important to sustain some of the climate-positive changes that have developed during the pandemic, and important to act decisively to mitigate the negative changes that could jeopardise efforts towards Net Zero (Chapter 4).

Some behavioural changes could last that would have a significant impact on decarbonisation – particularly home-working and travel choices.

There is potential for longer-lasting impacts brought about by permanent changes in working and transport behaviour in some sectors, particularly surface transport, buildings and aviation:

- **Working patterns** are likely to be affected long term – people want to continue working from home to some degree,<sup>2</sup> many can continue to do so effectively<sup>3</sup> and many employers are already adapting to this new reality.<sup>4</sup>
  - **Business travel** demand may fall, with a shift to remote working and video conferencing during the pandemic enabling a longer-term reduction in business travel emissions, in both surface transport and aviation. Corporate travel budgets may also be constrained due to increased financial pressures even as the global economy recovers. Business travellers accounted for a significant proportion (25% at Heathrow, and around 15% at other major UK airports) of all UK passengers prior to the pandemic.<sup>5</sup>
  - **Home-working** is likely to affect energy demand in homes and workplaces, while changes to commuting patterns will affect emissions from transport. Around 25% of typical annual car mileage is due to commuting,<sup>6</sup> so reducing this could offer significant scope for reducing these emissions. However, estimating the net impact on UK emissions is complex and far from certain, as increases in emissions from residential buildings could exceed savings in non-residential buildings. Potential lasting effects also include workers moving out of cities, and undertaking less frequent but longer commutes.
- **Personal transport choices** may see enduring changes that could affect travel behaviour, demand and emissions in the future:

- **Decreases in non-business flying.** Aviation demand may be suppressed in the medium term, especially if COVID-19 transmission continues worldwide to some degree. Survey data show that people intend to fly less after lockdowns are lifted.<sup>7</sup> Government should not plan for unconstrained leisure flying at or beyond pre-pandemic levels in its strategy for airport capacity and demand management.
- **Increases in cycling and walking** could be sustained. Nearly 95% of people said they were likely to continue walking and cycling more after the pandemic.<sup>8</sup> Sustained Government investment in infrastructure to support walking and cycling can help encourage these positive changes.
- **Decreases in public transport use.** Hesitancy to use public transport may continue in the medium term. Around half of people surveyed said they will rethink how they use public transport in the future, reducing use compared to before the pandemic.<sup>9</sup> Shifting private car travel to public transport is important for decarbonisation and brings significant co-benefits for air quality, reduced congestion and public health. Government must act to address concerns about safety that could deter use of public transport.

**Table 2.1**  
Potential short- and long-term impacts of COVID-19 by sector

Sector	Average annual change required for CB6	Emissions change 2018-19	Emissions change 2019-20	Shorter-term COVID impacts	Medium- / longer-term COVID impacts
Aviation	+6%	+1%	-60%	<p>Passenger numbers 78% lower in August 2020 compared to 2019.<sup>9</sup></p> <p>Travel restrictions and concerns around safety likely to result in lower passenger numbers compared to pre-pandemic levels over the next year.<sup>10</sup></p>	<p>Impact on business travel is uncertain – the shift to remote working and videoconferencing during the pandemic may result in a lasting reduction in business travel, especially aviation.<sup>11,12</sup></p> <p>Leisure travel may also be impacted – survey data suggest some people intend to fly less than they did before the pandemic.<sup>13</sup></p> <p>The size of the aviation sector that will emerge post-pandemic is still unclear.</p>
Shipping	0%	-2%	-24%	<p>9% drop in global maritime trade in 2020 and comparable fall in tonnes of goods traded in the UK.<sup>14,15</sup></p> <p>Lower trade than pre-pandemic levels expected in 2021.<sup>16</sup></p>	<p>Rebound likely – though economic scarring could have permanent reduction in shipping volume in some sectors.</p>

Surface transport	-5%	-2%	-18%	<p>Demand for travel dropped considerably across all transport modes except walking and cycling during periods of national lockdown.</p> <p>Demand rebounded during the period between lockdowns, but the extent of this varied across modes, with car demand recovering more quickly.</p> <p>Public transport use remains far below pre-pandemic levels, with safety concerns remaining for many.<sup>17</sup></p> <p>Record falls in new car purchases.</p>	<p>Substantial uncertainty around how the impact of COVID-19 will influence the transport system in the longer term.</p> <p>Some of the increase in home-working seen during the pandemic is likely to remain, which could result in fewer (but potentially longer distance) commuting trips.<sup>18</sup></p> <p>Increases in walking and cycling could last, especially if support for necessary infrastructure is maintained and enhanced.</p> <p>Reduced use of public transport may endure – 32% of people said they will reduce use compared to before the pandemic.<sup>19</sup></p>
Residential buildings	-3%	-1%*	+7%*	<p>Changing patterns of occupancy and energy use due to the pandemic response meant direct emissions from homes increased by 7%* and fell by 4% from non-residential buildings.<sup>20</sup></p>	<p>Home-working may be sustained over the long term which would have consequences for occupancy of workplaces and energy use in homes and in non-residential buildings.</p>
Non-residential buildings	-3%	-1%*	-4%*		
Electricity supply	-6%	-14%	-15%	<p>Reduction in non-domestic electricity use resulting in a 4.7% drop in total consumption in 2020, with domestic energy consumption up by 2%.<sup>21</sup></p>	<p>Possible changes in profile of electricity demand, depending on extent of structural shifts such as more flexible working patterns.</p>
Fuel supply	-5%	-1%	-8%	<p>Low oil and gas prices resulted from worldwide lockdowns and associated falls in demand. Output in the UK oil and gas sector also fell as a result.</p> <p>Global oil and gas demand partially recovered since the beginning of the pandemic. Prices are close to pre-pandemic levels.<sup>22</sup></p>	<p>Assessments of long-term impacts of COVID-19 on oil and gas markets vary, with some expecting demand to reach 2019 levels by 2021-22<sup>23</sup> and others suggesting peak oil will be reached earlier than previously expected.<sup>24</sup></p>
Manufacturing & construction	-5%	-3%	-7%	<p>Short-term fall due to national lockdowns, manufacturing revenues temporarily fell to 65-70% of pre-COVID level, and largely recovered.</p>	<p>Rebound likely – though economic scarring could have permanent reduction on emissions in some sectors.</p>
Notes: *Based on temperature-adjusted emissions.					

## a) Aviation (60% fall in emissions in 2020)

Aviation emissions have been most heavily impacted by COVID-19 and continue to face the greatest uncertainties.

We estimate that total emissions from aviation fell by 60% between 2019 and 2020 to 16 MtCO<sub>2</sub>e.

Of all emitting sectors, aviation emissions have been most impacted by COVID-19 and continue to face the greatest uncertainties. We estimate that total emissions from aviation fell by 60% between 2019 and 2020 to 16 MtCO<sub>2</sub>e.

International aviation is likely to continue to be constrained in the medium term, as the UK implements restrictions on international travel and concerns around the safety of international and domestic air travel continue. Longer-term impacts are harder to assess:

- The easing of restrictions during summer 2020 resulted in an increase in flights between June and September, although flights remained far below pre-pandemic levels – air passenger numbers in August were only at 22% of August 2019 levels. Between June and July 2020, the number of passengers departing and arriving in UK airports went from 2% to 12% of 2019 levels.<sup>25</sup> This suggests that pent-up demand may result in surges in flight bookings as travel restrictions are eased.
- The International Air Transport Association (IATA) forecasts a recovery in air passenger numbers to pre-pandemic levels by 2024 and sustained average growth of 2.2% per year to 2030 in all European markets.<sup>26</sup> Their new outlook for the global airline industry points to lower passenger numbers in 2021 than their forecast made in 2020, due to a new surge in virus cases and associated increase in global travel restrictions. The result has been a significant increase in airline debt in 2020,<sup>27</sup> which could impact the longer-term viability of some airlines.
- Health concerns around flying also remain – 88% of people taking part in the National Travel Survey still had concerns with taking flights in August and September 2020, and 55% of respondents said they did not intend to plan an overseas holiday by plane within the next year.<sup>28</sup>

While it is unclear what the combined impact of these factors will be on the size of the sector in the longer term, this year should be used as an opportunity to develop a strategy for managing aviation demand.

This should be based on a reasonable level of international aviation for the UK, consistent with a Net Zero by 2050 target for the sector, and include an assessment of the UK's airport capacity. Government must recognise that planning for an ever-growing aviation sector is not consistent with the UK's Net Zero target as part of its aviation decarbonisation consultation and strategy, due to be published ahead of COP26.

See Chapter 4 for further details on next steps for aviation policy.

## b) Shipping (24% fall in emissions in 2020)

Shipping saw the second-largest sectoral fall in emissions in terms of percentage change. Uncertainties remain around the future level of shipping activity.

Our estimates suggest UK emissions from shipping fell by 24% between 2019 and 2020, to 11 MtCO<sub>2</sub>e. Proportionately, this was the second-largest sectoral fall in emissions. Uncertainties also remain around the future level of shipping activity, especially while COVID-19 remains widespread globally. The World Trade Organisation's latest forecasts suggest a 9.2% decline in the volume of world goods traded in 2020 followed by a 7.2% rise in 2021, while highlighting the high degree of uncertainty surrounding these forecasts as they depend on the pandemic and global responses to it.<sup>29</sup>

Provisional 2020 data show that total freight shipped through the UK's major ports fell by 10% in 2020,<sup>30</sup> largely due to the impacts of the COVID-19 pandemic:

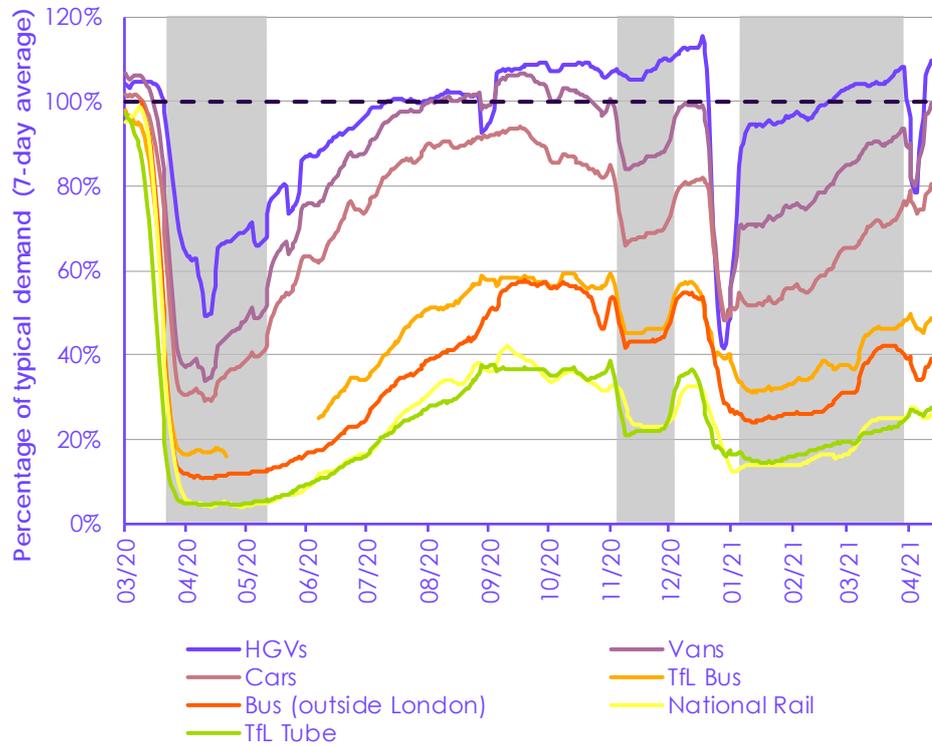
- This effect was particularly pronounced in Quarter 2 of 2020, when freight volumes were 18% lower than normal.
- We expect the impacts to continue to be felt in 2021 as the UK comes out of lockdown, but volumes are expected to return to normal levels of demand by 2022. However, the long-term impacts of COVID-19 on the global shipping sector are uncertain.
- The shipping sector has also been impacted by the uncertainty surrounding the UK's exit from the European Union. This may have caused some part of the reduction in demand seen during 2020.

## c) Surface transport (18% fall in emissions in 2020)

Emissions from surface transport fell by 18% due to lockdown restrictions.

Emissions from the surface transport sector fell by 18% in 2020. This is almost entirely due to the impacts of the COVID-19 pandemic and the resulting restrictions on travel, which have lowered demand across modes (Figure 2.9). There is substantial uncertainty around how the impact of COVID-19 will influence the transport system in the longer-term.

Figure 2.9 Travel demand by mode during the COVID-19 pandemic



Source: DfT (2021) *Transport use during the coronavirus (COVID-19) pandemic*; CCC analysis.

Notes: Figure shows travel relative to typical demand on an equivalent day. For rail and TFL data, this equivalent day is the same week in 2019, whereas for road transport and non-London bus travel, it is a day in early 2020. Therefore, these road and bus figures have not been normalised for any seasonality. The shaded regions represent the periods of national lockdown in England. TFL = Transport for London.

Impacts were different across different travel modes. Cycling increased dramatically, public transport use remains very low, and car, van and HGV use seem to be moving back towards pre-pandemic levels.

During the periods of national lockdown\* (shown by the shaded regions in Figure 2.9), demand for travel dropped considerably across all transport modes, except cycling and walking. Demand rebounded during the period between lockdowns, but the extent of this varied across modes.

- Travel by public transport both fell more deeply during the lockdown periods than private car demand and rebounded more slowly following the first lockdown. As of April 2021, public transport usage remained 50-80% lower than pre-pandemic levels, and car travel around 20% lower.
- Van and HGV travel fell slightly less sharply than car travel in the first lockdown, but levels are now similar to those pre-COVID-19.

\* The shaded regions show the lockdown periods for England. Those in Scotland, Wales and Northern Ireland will vary.

- Cycling rates rose dramatically during the first lockdown and into the summer 2020, but then declined back close to normal during the second half of 2020. Cycling rates are now around pre-pandemic levels, but these may increase again as commuting resumes and the weather improves.
- Walking is the only way of getting around that people are now doing more regularly. Survey evidence shows that 56% of people are walking three times a week or more, compared with 36% before the pandemic.<sup>31</sup>

The impacts on travel behaviour are currently uncertain, but there is likely to be some lasting impact of the pandemic in the medium to long term.

Working from home increased sharply and is likely to stay. This will have implications for commuting patterns as well as home and workplace energy consumption.

Public transport use remains much lower than pre-pandemic levels.

Underpinning these trends are significant changes people have made in their normal way of life and the development of new social behaviours and values. For travel patterns, key changes have been observed in the car market, attitudes towards public transport, increased home-working and online shopping.

- **Home-working and avoiding non-essential travel.** Periods of lockdown and guidance on avoiding non-essential journeys led to lower travel demand, including a significant reduction in commuting as home-working increased dramatically. This led to large reductions in emissions from surface transport, although the overall emissions impacts are complex and uncertain (Box 2.3). It is likely that some of this shift will be retained beyond the pandemic.
- **Public transport use.** The reduction in public transport use was driven by restrictions on travel, social distancing rules and the perception of it being unsafe. Research shows that the pandemic has had a negative impact on people's attitudes towards public transport use, but that there is a gap between perception and experience.
  - In a survey conducted in February 2021,<sup>32</sup> half of respondents said they will rethink how they use public transport in the future, with 32% reporting they are expecting to reduce use compared to before the pandemic. This was more marked for people with disabilities, and less likely for younger people.
  - Nearly 40% of people were concerned about their financial circumstances in the future, which could impact on public transport use. This was higher for ethnic minorities, households with children and younger age groups. Similar concerns could apply to ride-sharing and car-pooling schemes, which could hinder progress in increasing average car occupancy.
  - These results suggest that there are risks that public transport use will take time to recover, particularly as most people report having alternative travel choices. It is likely to be a difficult transition period for operators as social distancing rules reduce capacity and they need to regain trust in services.
- Total **new car sales** in 2020 fell by 30% in 2020 to 1.6 million, the lowest level since 1992.<sup>33</sup> Sales in the second-hand market fell by 15%.<sup>34</sup> However, the car market began to rebound during late-2020 and evidence<sup>35</sup> suggests that consumer purchasing confidence is rebuilding. Where new vehicles are purchased, the Government and vehicle manufacturers should look to prioritise electric vehicle sales wherever possible (see Chapter 4).

New car sales have fallen to the lowest levels since 1992.

- Overall, recent research<sup>36</sup> suggests that the pandemic has been reported as being a greater factor in reducing car ownership than it has been in increasing it to date, with one-quarter of those choosing to give up their car citing a change in work situation or not needing the car as much as before.
- Going forward, the market is likely to be affected by economic considerations, perceptions of safety of public transport and environmental decisions.
  - The increased priority consumers are now placing on health considerations may further stimulate the recovery of this market, although economic factors such as affordability may hinder this.
  - Potential changes in consumer purchasing power as a result of COVID-19 could risk further progress if more affordable EVs, appropriate purchase incentives and a robust second-hand market are not made available.

### Box 2.3

#### The potential impact of increased levels of working from home on transport demand and emissions

The number of people who work at home has generally increased over time, but this shifted dramatically during the COVID-19 pandemic.

- Before the pandemic, around 5% of people in employment worked mainly from home, while a further 12% did so occasionally.<sup>37</sup> As a result of the COVID-19 pandemic, levels of home-working have risen substantially, with an average of around 30% of the workforce working exclusively from home each week between May and December 2020.<sup>38</sup>
  - Both before and during the pandemic, those with higher-skilled occupations\* were more likely to work from home than lower-skilled workers. Those working in administrative and secretarial occupations saw an increase in home-working from 37% to 57% between 2019 and 2020.<sup>39,40</sup>
  - In April 2020, levels of home-working were highest in London, with 57% of workers doing some work from home – 92% of these people citing COVID-19 as the main reason why. Home-working levels were lowest in the West Midlands, with 35% of workers doing some work from home, compared to the UK average of 47%.<sup>41</sup>
- A recent study<sup>42</sup> found that if people continue to work from home at least two days per week in the future, then the number of commuting trips by car would fall by 14%.
  - Our analysis suggests that this could lead to an overall reduction of 15 billion car-kilometres each year, potentially avoiding over 2 MtCO<sub>2</sub>e of emissions per year. For comparison, the abatement delivered by reducing car travel and modal shift in our Balanced Pathway in 2030 is around 7 MtCO<sub>2</sub>e/year.
  - Around a quarter of workers surveyed said that they would work from home a little or much more in the future, with 23% saying they would conduct business meetings online that they would have previously travelled for.
  - Major companies have responded by allowing for more flexible working, with some expecting that employees will work from home for around two days per week.
- The overall impacts of home-working are uncertain and complex.
  - At the household level, working from home increases residential energy demand for heating and electricity in homes and reduces transport energy demand for commuting.

\* Professional, associate professional, technical occupations and managers, directors and senior officials.

A study by the IEA<sup>43</sup> suggests that the net impact of these is a reduction in overall energy consumption where private vehicles are the main means of commuting. The impact may increase emissions, however, where people normally walk, cycle or use public transport.

- There is likely to be reduced energy consumption from office buildings, with the net impact being context-specific. In the UK, offices include a greater share of electric heating suggesting they could also be lower-emission.
- A review of 30 studies<sup>44</sup> suggested that in most cases there was some improvement in energy use and emissions from home-working.
- Wider and potential rebound impacts, such as changing consumption patterns and where people choose to live and work, are also important and add to the uncertainty.

## d) Buildings (4% increase in temperature-adjusted emissions in 2020)

Emissions from homes increased and emissions from non-residential buildings decreased due to changes in occupancy.

Temperature-adjusted buildings emissions in 2020 were 96 MtCO<sub>2</sub>e – an increase of 4% on 2019. Changes to emissions were driven by shifting patterns of occupancy due to the pandemic response:

- Temperature-adjusted emissions from homes increased by 7% due to increased occupancy.
- Temperature-adjusted emissions from non-residential buildings fell by 4%: commercial buildings fell by around 8%, while those from public buildings increased slightly by 1%.

There is potential to improve the design and operation of buildings and their systems to better respond to variations in occupancy.

The net effects of the pandemic on emissions from public buildings appear to have been relatively insignificant, in part expected to be associated with the diverse nature of public buildings, which include hospitals and schools.

Despite dramatic reductions in occupancy,<sup>45</sup> the reduction in emissions from commercial buildings was limited. Analysis suggests that savings achieved across the stock vary widely, but are constrained by limits on adjusting levels of heating and ventilation – particularly in buildings which remain partially occupied, or have older plant and controls.<sup>46</sup> There is scope to enhance the design and operation of buildings and their mechanical and electrical systems, to better respond to variations in occupancy.

It is unclear to what extent shifts in occupancy patterns and behaviour brought about by the COVID-19 pandemic will persist; the impacts of such changes on emissions are uncertain and complex. The overall effects will depend on the levels of increases in energy consumption in residential buildings and decreases in non-residential buildings, and their relative efficiencies, as well as secondary impacts on patterns of living and travel.<sup>47,48</sup>

## e) Manufacturing, construction, fuel supply and electricity generation (average 10% fall in emissions in 2020)

Emissions across these sectors fell by an average of 10% between 2019 and 2020. This was primarily driven by a short-term fall in economic activity and energy demand due to UK and international lockdowns:

Manufacturing and construction revenues and emissions fell temporarily, but are likely to recover as lockdown measures are lifted.

- Manufacturing revenues temporarily fell by 30-35%, and have since largely recovered to pre-COVID levels.<sup>49</sup> Manufacturing emissions fell by around 7% across the year.
- Emissions in fossil fuel production in the UK fell by 8% in 2020, as production fell in response to low prices resulting from low global demand for oil.
  - UK demand fell for road fuels (-20%) and jet fuels (-60%) compared to 2019. Global demand for petroleum products was also down by around 9%.<sup>50</sup> This was a driving force for lower production of petroleum products in the UK, which was down by 17%.<sup>51</sup>
  - UK demand for gas decreased by 6% compared to 2019 levels, reflecting lower demand particularly for electricity generation. Gas production in the UK was stable, while imports were down 6% and exports increased by 17%. The UK remains a significant net importer of natural gas, importing around five times more than was exported in the last five years.<sup>52</sup>
  - Assessments of the long-term impacts of COVID-19 on oil and gas markets vary,<sup>53</sup> but it is expected that demand could potentially return to 2019 levels as early as 2021-22.<sup>54</sup> Sustained impacts on fossil fuel demand largely depend on potential sustained changes in travel patterns (see earlier subsections). Recovery plans that accelerate the pace of a transition for transport towards electrification could contribute to reducing oil demand and reaching peak oil earlier than previously expected.
- Lockdown restrictions had a significant impact on the electricity system over the course of 2020. Lower electricity demand, coupled with higher renewables output, highlighted some of the challenges that will need to be overcome in future for Net Zero (Box 2.4).

Fossil fuel demand fell worldwide, with impacts on the volume of oil produced in the UK. It is unclear how long these changes in demand will last and the impacts on the UK market.

The medium- to long-term impacts in these sectors will depend on UK and international economic recoveries post-COVID. A rebound is likely, although economic scarring or sustained low oil and gas prices could lead to a permanent reduction in emissions in some sectors.

## Box 2.4

### Impacts of COVID-19 on the UK electricity system in 2020

Restrictions that were put in place during 2020 had a significant impact on the electricity system, with reduced demand during lockdown periods. Combined with higher renewable output, this highlighted some of the challenges that will need to be overcome in the future as electricity generation decarbonises.

- Electricity demand fell significantly during the lockdown periods in 2020, but was similar to previous years outside those periods.
  - Electricity demand in 2020 as a whole was only 5% lower than in 2019.
  - The biggest COVID-19 impacts were felt in the lockdown periods, particularly in the second quarter where demand was 12% lower than the same period in 2019.
  - During the lockdown periods, the profile of demand was flatter as well as being lower in aggregate, with within-day peaks much less pronounced (particularly for the morning peak) and differences being smaller between weekdays and weekends.
- The carbon intensity of electricity generation fell, through a combination of higher renewables output and lower demand.
  - Renewables output was 15% higher in 2020 compared to 2019, due to exceptionally windy and sunny conditions early in the year.
  - To compensate for lower demand and higher renewables output, the share of fossil generation fell from 43% in 2019 to 38% in 2020. The country set a record 67-day period without using coal between April and June 2020.
- The combination of lower demand and higher renewables output had implications for the running of the electricity system, and led to lower wholesale prices and rising costs of running the network.
  - The wholesale cost of electricity was 42% lower in the second quarter of 2020 compared to the same period in 2019, reflecting both lower demand and the higher share of zero-marginal-cost generation in the mix. Periods of negative prices were common.
  - The electricity system was able to remain balanced even with lower demand and with record-breaking levels of intermittent renewable generation (e.g. wind generation set new daily records in 2020 for both level of power – 17 GW, and for share of generation – 60%). However, keeping the electricity system balanced was more challenging. Balancing costs rose by 50%, and curtailment costs (paying generators to switch off or reduce their output) doubled.

The challenges of operating with high shares of variable and inflexible generation are likely to be increasingly felt over the coming decade as the electricity system decarbonises. They highlight the importance of a system that is more flexible and provides adequate dispatchable low-carbon generation, and the need for market arrangements which enable that.

Sources: Drax (2020, 2021) *Electric Insights Q1, Q2, Q4 2020*, UKERC (2020) *Electricity demand during week one of COVID-19 lockdown*, National Grid ESO (12 January 2021) *2020 greenest year on record for Britain*.

## f) Other impacts and lessons learned

Estimates of emissions from other sectors in 2020, including agriculture, land use and waste have not yet been produced, though emissions in these sectors are less linked to energy demands and therefore the impacts of lockdown are less certain. However, there are several impacts are notable outside those outlined in previous subsections:

There is some evidence that less food was wasted during lockdown, and some of those effects remained when restrictions were eased.

- **Reduced food waste.** A survey of over 4,000 people undertaken by WRAP on how the pandemic had impacted people's relationship with food revealed that during the first lockdown, people adopted behaviours to better manage food, including freezing, batch cooking and using up leftovers. It is estimated that levels of food waste declined by 43% between November 2019 and April 2020. Even with the easing of lockdown, some of these behaviours persisted and by November 2020, the amount of food wasted was over a fifth less compared to November 2019. Centre for Climate Change and Social Transformations (CAST) survey data also suggest people reduced their food waste during the pandemic, although some of this progress may have reversed between the first lockdown and third lockdowns – 89% of people said they threw away at least some food in October 2020, compared to 84% in May, and 92% before the pandemic.<sup>55</sup>
- **Climate change attitudes.** Concern over the pandemic does not seem to have dampened concern with climate change and other environmental issues. 74% of people surveyed by CAST agreed that tackling climate change was urgent in separate surveys carried out in May and October 2020, compared to 62% in August 2019. Support for measures to tackle climate change (e.g. walking and cycling more, reducing meat and dairy consumption, replacing gas boilers) was high throughout the pandemic (with different measures receiving different levels of support), increasing between May and October 2020.<sup>56</sup>
- **Just transition and inequality.** The pandemic has affected all people in the UK negatively, but has harmed some groups more than others. Inequality has been highlighted – and in many cases increased – across multiple demographic groups, including by age, income, ethnicity, employment type, and geography. Mortality rates from COVID-19 in the most deprived areas in England are double those in the least deprived<sup>57</sup> and were higher in both Black and South Asian ethnic groups than the national average.<sup>58</sup> The lowest-earning 10% of workers were much more likely to work in sectors that closed during lockdown, and less likely to be able to work from home.<sup>59</sup> At the same time, others have been able to work from home and accumulate savings due to reduced opportunities to spend. The need to ensure the transition to Net Zero is a fair and equitable one is arguably even greater now than before the pandemic (see Chapter 3).
- **Air quality.** Positive air quality outcomes can be linked to virtually all of the changes needed to get to Net Zero, and is likely to be amplified further if similar strategies are adopted neighbouring countries.<sup>60</sup> The most pronounced changes in UK air quality during lockdown were in the urban environment, notably for nitrogen oxides (NO<sub>x</sub>) as emissions from vehicles fell. Urban NO<sub>x</sub> concentrations over the lockdown period up to 30 April 2020 were typically 30-40% lower than average. Impacts of lockdown on exposure to other pollutants were not necessarily positive – particulate matter (PM<sub>2.5</sub>) concentrations increased but this was largely due to weather effects, and urban ozone (O<sub>3</sub>) concentrations increased due to secondary air chemistry effects caused by the fall in nitric oxide (NO) emissions.<sup>61</sup>

Support for climate action remains high.

There is a renewed focus on inequalities. The need for a just transition is arguably greater than ever.

The experience from 2020 has highlighted several key lessons for decarbonisation. We have considered these in our policy advice and reflected them where possible (Chapter 4):

There are new lessons we can draw from the experience in 2020 to sustain climate-positive changes that have developed and mitigate the negative changes that could jeopardise efforts towards Net Zero.

- **Emissions fell rapidly, but they can rebound just as quickly.** Across several sectors, including manufacturing & construction, surface transport and freight, activities are beginning to return to near pre-pandemic levels. In general, this should be welcomed as a positive return to economic activity as lockdowns are eased. However, there are some instances where beneficial changes could be lost unless action is taken to support them.
- **There is a limited window to change behaviours.** There are behavioural sources of 'friction' in moving from one pattern of living and working to another, but if those frictions can be overcome, people and organisations can often adapt quickly.<sup>62</sup> In the light of the changes in response to COVID-19, there are now significant opportunities to lock in and build on positive developments, especially – though not exclusively – regarding levels of demand for transport. This includes:
  - Sustaining increases in 'active travel' by providing support for walking, cycling and e-bikes.
  - The possible need for active measures to encourage people back onto public transport, where there has been a shift to car travel.
  - The opportunity to change the narrative on the need for an ever-increasing number of flights and accompanying airport expansion.
- **The need for increasingly resilient networks and infrastructure.** Our energy (and digital) networks have demonstrated they can be resilient to profound changes in use. The transition towards Net Zero will only increase the challenges of operating an electricity system with high shares of variable and inflexible generation. The non-residential buildings stock can be improved to respond more efficiently to variations in occupancy. Our systems need to be more flexible as well as low-carbon, and that can be delivered through long-term planning and clear market mechanisms that incentivise flexibility.
- **Lockdown is not a blueprint for decarbonisation.** The fall in UK emissions in 2020 was much larger than the annual change needed on the pathway to Net Zero. However, it did not materially affect the structural changes that are needed in our underlying economic, social, energy, transportation or land systems to reach Net Zero. In order to combat COVID-19, people in the UK have heavily restricted their movement with damaging economic and social consequences. This stands in contrast to the fair, well-planned and sustainable transition to Net Zero that is possible. It can bring improvements to our quality of lives: new jobs, cleaner air, quieter streets, more green spaces, comfortable homes and healthier lifestyles.

The pandemic has also demonstrated the importance of preparing for known risks and the value of scientific advice, which will both be vital in successfully confronting the climate challenge. It will be important to sustain the beneficial changes that have developed during the pandemic, but also to act decisively to mitigate the negative changes that could jeopardise efforts towards Net Zero.

### 3. Progress reducing the UK's carbon footprint

Under the UK carbon budgets and the Paris Agreement, the UK's greenhouse gas (GHG) emissions reduction targets are based on the UK territorial emissions (i.e. emissions physical occurring within the boundaries of the UK), in accordance with internationally agreed rules for emissions accounting.\*

Tracking the UK's carbon footprint can help us identify actions to reduce emissions from our supply chains and the goods and services we consume.

It is also important to examine the UK's total carbon footprint which allocates GHG emissions along economic supply chains, no matter where in the world they occur. This method allocates emissions to the country where the consumer of the final good or service is based. This is known as *consumption-based accounting* or as the *carbon footprint* of a country. Tracking the UK's consumption emissions footprint is important to consider alongside the legally binding targets set out for UK territorial emissions as it can help identify additional actions that UK consumers and companies can take to help reduce the emissions along their supply chains (such as using low-carbon suppliers) that are not covered within the UK's territorial emissions targets.

Our consumption emissions footprint has fallen over the last decade.

Our 2020 Progress Report showed a sustained decline in the UK's consumption emissions footprint over the last decade (Figure 2.10). Over the period 2009 to 2017, the UK's consumption emissions footprint fell by around 2% per year on average, driven by improvements in the energy- and carbon-intensity of the UK and global economy outweighing the effect of increased overall consumption and changes in the structure of the global economy. This fall in the UK's consumption emissions is slower than for territorial emissions, but there is little evidence that this is associated with 'offshoring' UK territorial emissions as part of decarbonisation efforts over the last decade.

Updated data are now available for the UK's consumption emissions footprint in 2018, showing a 1% increase in emissions relative to 2017 levels.† This small change is likely to be well within the estimated margin of uncertainty for the UK's consumption emissions account (previously estimated to be 3.5-5.5%,<sup>‡</sup> although this may have reduced with recent improvement to the methodology). As such, analysing the breakdown underpinning this change is not useful for identifying robust underlying changes in actions that create emissions at home and abroad.‡

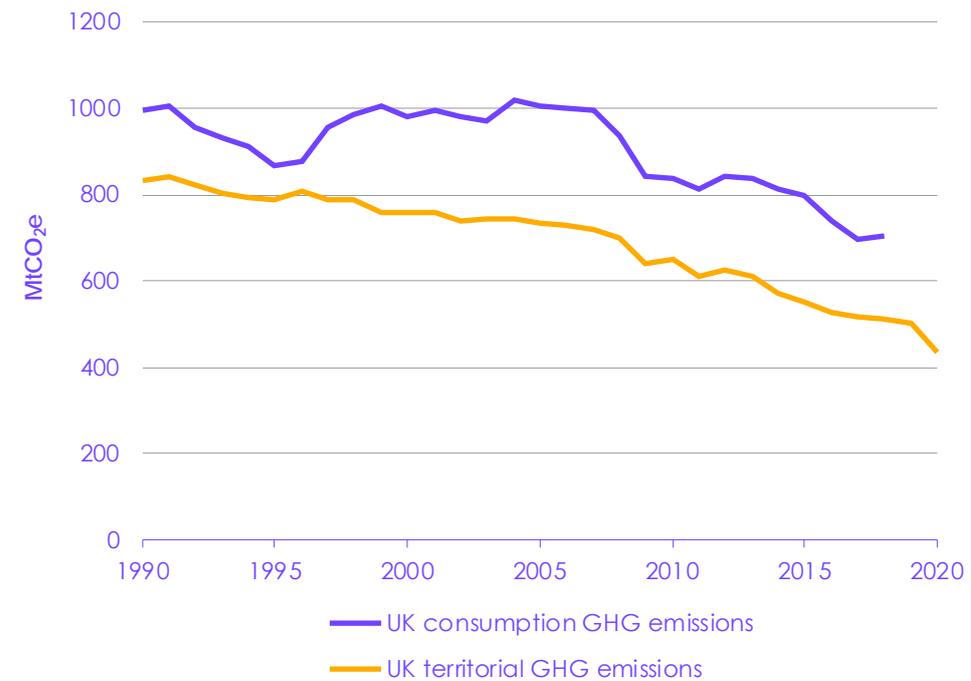
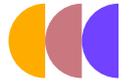
As consumption emissions accounts are generally more variable year-to-year than territorial emissions accounts, looking at the trend over several years is likely to be a more representative picture of underlying trends than year-to-year changes.

\* Emissions from international aviation and shipping are included for the Sixth Carbon Budget.

† F-Gases are included within the UK's carbon footprint statistics for the first time this year.

‡ The consumption emissions statistics suggest this increase was a combination of an increase in UK-sourced emissions and overseas emissions, in particular those arising from the European Union and other OECD countries. On a source basis, increases in emissions from domestic heating (2018 contained a cold winter with the 'Beast from the East' cold snap) and (non-household) transport outweighing decreases from electricity generation and agriculture.

Figure 2.10 Changes in UK consumption and territorial emissions since 1990



Source: Defra (2021) *The UK's carbon footprint*; BEIS (2021) *Final UK greenhouse gas emissions national statistics*.  
 Notes: Emissions from international aviation and shipping are included within both the UK's consumption and territorial emissions accounts in this figure. Emissions from land-use, land-use change and forestry (LULUCF) are not currently included within the UK's consumption emissions accounts.

We outlined exploratory future scenarios for the UK's carbon footprint in our advice on the UK's Sixth Carbon Budget report. These scenarios showed 3-7% average annual reductions between now and 2050 could be possible, depending on UK actions and the degree of global decarbonisation.

Nearly half (45%) of the UK carbon footprint emissions occurring outside the UK are associated with the production of inputs for a domestic economic activity (e.g. imported raw materials or parts, as opposed to finished products or services for an end user).

In our Sixth Carbon Budget Advice Report we highlighted corporate action to reduce emissions along their supply chain as one of the levers that could help reduce this part of the UK's carbon footprint. Recent estimates indicate that around 75% of FTSE100 companies disclose some information related to their Scope 3 emissions (share of emissions arising from the upstream and downstream supply chains), with around one-third having a target to reduce their Scope 3 emissions.<sup>64</sup>

Recent context changes will affect estimated UK consumption emissions – the UK's trade patterns have been changing due to the end of the transition period for exiting the European Union and have been disrupted due to the COVID-19 pandemic, which has also changed UK consumption patterns. The effects of these changes will not be apparent within the UK's consumption emissions accounts until 2023-2024. The climate considerations in the UK's new trade agreement (including with the EU) are summarised in Box 2.5.

Changing trade patterns present both a risk and opportunity for the UK's consumption emissions and support of global decarbonisation efforts.

As the UK's trade relationships continue to change, this presents for risks and opportunities for further decreasing the UK's consumption emissions. Increased trade with high-carbon producers could lead to increased overseas supply-chain emissions, while also potentially undermining domestic decarbonisation efforts through increased availability of low-cost imported products with a high carbon footprint.

Conversely, new trade deals and/or implementation of carbon-border policies could help support global decarbonisation. The UK should explicitly consider climate-related issues when agreeing trade deals and consider supporting trade-related measures such as carbon border adjustments and product standards, to help minimise the global emissions footprint of its international trade.

### Box 2.5

#### Climate considerations in the UK's trade agreements

Since deciding to leave the European Union, the UK has been working to put in place a number of bilateral trade deals to cover trade flows that were previously covered under the European Union's agreements.

The most significant commitments regarding climate change within these trade deals is contained within the **UK-EU Trade and Cooperation Agreement**:

- **Commitment to the Paris Agreement.** The Cooperation Agreement reaffirms both parties' commitment to achieving the goals of the Paris Agreement. Efforts to tackle climate change under the Paris Agreement is referenced as an 'essential element' of the Agreement, violations of which by either side could lead to the Agreement being suspended.
- **Maintaining domestic ambition on climate change.** Commitments are included that both sides will maintain and strive to improve their 'climate level of protection' (which refers to their emissions reductions targets for 2030). The Agreement specifically refers to the EU's previous 40% reduction NDC (relative to 1990 levels) and the UK's share of this target (which the Committee previously estimated to be around a 57% reduction in emissions). This has now been superseded by increased emissions reduction ambition for both the EU (55% reduction relative to 1990 levels) and the UK (a 68% reduction relative to 1990 levels).
- **Cooperation on climate change.** Climate change and emissions reduction is explicitly highlighted as an area for cooperation between the UK and EU, alongside the role of trade as a relevant driver of GHG emissions. The UK is no longer part of the European Energy Union or EU Emissions Trading Scheme (EU ETS). The Agreement commits both parties to work together to find a system for sharing electricity through interconnectors and to 'give serious consideration' to the possibility of linking the new UK ETS to the EU ETS. No decision on whether the UK ETS will be linked with the EU ETS has yet been made.

Aside from the UK-EU Cooperation Agreement there is limited concrete detail related to climate change in other UK trade deals. The need for new trade deals not to contradict existing ones means that the climate commitments within the UK-EU deal could be used more widely as a template for other trade deals agreed by the UK in the future.

*Source: HMG (2020) Trade And Cooperation Agreement Between The European Union And The European Atomic Energy Community, Of The One Part, And The United Kingdom Of Great Britain And Northern Ireland, Of The Other Part.*

# Endnotes

- <sup>1</sup> IPCC (2014) *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland.
- <sup>2</sup> YouGov (2020) *YouGov - Working from home*. Fieldwork: 2nd - 6th September 2020
- <sup>3</sup> YouGov for Microsoft and CIPD (2020) *Work Smarter to Live Better*.
- <sup>4</sup> CIPD (2020) *Embedding new ways of working post-pandemic*
- <sup>5</sup> Department for Transport and CAA (2020) *Purpose of travel at selected UK airports*.
- <sup>6</sup> Department for Transport (2019) *National travel survey*.
- <sup>7</sup> YouGov (2021) *Business Flights Survey Sample: 14th December 2020 - 20th January 2021*.
- <sup>8</sup> Department for Transport (2021), *National travel attitudes study: wave 4 (final)*.
- <sup>9</sup> CAA (2021) *Air Passengers by Type and Nationality of Operator*.
- <sup>10</sup> Department for Transport (2019) *National travel survey*.
- <sup>11</sup> IATA (2020) *Air Passenger Market Analysis*.
- <sup>12</sup> IATA (2021) *Outlook for the global airline industry – April 2021 update*.
- <sup>13</sup> CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change*.
- <sup>14</sup> Department for Transport (2020) *Port freight quarterly statistics: July to September 2020*.
- <sup>15</sup> WTO Secretariat (2020) *Trade statistics and outlook: Trade shows signs of rebound from COVID-19, recovery still uncertain*.
- <sup>16</sup> WTO Secretariat (2020) *Trade statistics and outlook: Trade shows signs of rebound from COVID-19, recovery still uncertain*.
- <sup>17</sup> Department for Transport (2021) *Transport use during the coronavirus (COVID-19) pandemic*.
- <sup>18</sup> Hook, A., Court, V., Sovacool, B. and Sorrell, S., (2020) *A systematic review of the energy and climate impacts of teleworking*. *Environmental Research Letters*, 15(9), p.093003.
- <sup>19</sup> Transport Focus (2021) *Travel during COVID-19 attitudes to travel post-lockdown*.
- <sup>20</sup> CCC analysis; BEIS (2021) *Provisional UK greenhouse gas emissions national statistics 2020*.
- <sup>21</sup> BEIS (2021) *Energy Trends: UK electricity*.
- <sup>22</sup> Reuters (2021) *Total back to pre-pandemic profit levels as oil prices rise*.
- <sup>23</sup> McKinsey & Company (2021) *Global oil supply-and-demand outlook to 2040*.
- <sup>24</sup> Reuters (2021) *Pandemic brings forward predictions for peak oil demand*.
- <sup>25</sup> CAA (2021) *Air Passengers by Type and Nationality of Operator*.
- <sup>26</sup> IATA (2020) *Air Passenger Market Analysis*.
- <sup>27</sup> IATA (2021) *Outlook for the global airline industry – April 2021 update*.
- <sup>28</sup> CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change*.

- <sup>29</sup> WTO Secretariat (2020) *Trade statistics and outlook: Trade shows signs of rebound from COVID-19, recovery still uncertain.*
- <sup>30</sup> Department for Transport (2021) *Port freight statistics, Table 0502.*
- <sup>31</sup> CREDS (2021) *At a crossroads – travel adaptations during Covid-19 restrictions and where next?*
- <sup>32</sup> Transport Focus (2021), *Travel during COVID-19 attitudes to travel post-lockdown.*
- <sup>33</sup> SMMT (2021) *UK automotive looks to green recovery strategy after -29.4% fall in new car registrations in 2020.*
- <sup>34</sup> SMMT (2021) *Used car sales: Q4 2020.*
- <sup>35</sup> McKinsey & Company (2020), *How consumers' behaviour in car buying and mobility is changing amid COVID-19.*
- <sup>36</sup> ONS (2020) *Coronavirus and homeworking in the UK labour market: 2019*
- <sup>37</sup> ONS (2020) *Coronavirus and homeworking in the UK labour market: 2019.*
- <sup>38</sup> ONS (2021) *Social behaviours during the different lockdown periods of the coronavirus (COVID-19) pandemic dataset.*
- <sup>39</sup> ONS (2020) *Coronavirus and homeworking in the UK labour market: 2019.*
- <sup>40</sup> ONS (2020) *Coronavirus and homeworking in the UK: April 2020.*
- <sup>41</sup> ONS (2020) *Coronavirus and homeworking in the UK: April 2020.*
- <sup>42</sup> CREDS (2021) *At a crossroads – travel adaptations during Covid-19 restrictions and where next?*
- <sup>43</sup> IEA (2020) *Working from home can save energy and reduce emissions. But how much?*
- <sup>44</sup> W. O'Brien and F. Aliabadi (2020), *Does telecommuting save energy? A critical review of quantitative studies and their research methods, Energy and Buildings*, 15 October 2020.
- <sup>45</sup> Data suggests office occupancy was down more than 85% for half of the year. Metrikus (2021) *Metrikus Occupancy Index.* <https://index.metrikus.io/>
- <sup>46</sup> Carbon Intelligence (2020) *'Businesses can do more to cut emissions and save costs during lockdown reveals buildings data'.* <https://carbon.ci/news/press-release-businesses-can-do-more-to-cut-emissions-and-save-costs-during-lockdown-reveals-buildings-data/>
- <sup>47</sup> IEA (2020) *Working from home can save energy and reduce emissions. But how much?* <https://www.iea.org/commentaries/working-from-home-can-save-energy-and-reduce-emissions-but-how-much>
- <sup>48</sup> W. O'Brien and F. Aliabadi (2020), *Does telecommuting save energy? A critical review of quantitative studies and their research methods, Energy and Buildings*, 15 October 2020.
- <sup>49</sup> ONS (2020) *The impact of the coronavirus so far: the industries that struggled or recovered.*
- <sup>50</sup> US Energy Information Administration (2021) *Short-Term Energy Outlook (STEO) supplement: Developments in Global Oil Consumption.*
- <sup>51</sup> BEIS (2021) *Energy Trends: March 2021.*
- <sup>52</sup> BEIS (2021) *Energy Trends: March 2021: Natural gas imports and exports (ET 4.3 - monthly).*
- <sup>53</sup> Reuters (2021) *Pandemic brings forward predictions for peak oil demand.*
- <sup>54</sup> McKinsey & Company (2021) *Global oil supply-and-demand outlook to 2040.*
- <sup>55</sup> CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change.*

- <sup>56</sup> CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change.*
- <sup>57</sup> Public Health England (2020) *Disparities in the risk and outcomes of COVID-19.*
- <sup>58</sup> ONS (2020) *Updating ethnic contrasts in deaths involving the coronavirus (COVID-19), England and Wales: deaths occurring 2 March to 28 July 2020.*
- <sup>59</sup> IFS (2020) *Sector shutdowns during the coronavirus crisis: which workers are most exposed?*
- <sup>60</sup> AQEG (2020) *Impacts of Net Zero pathways on future air quality in the UK.*
- <sup>61</sup> AQEG (2020) *Estimation of changes in air pollution emissions, concentrations and exposure during the COVID-19 outbreak in the UK.*
- <sup>62</sup> N. Chater for CCC (2020) *Net Zero after Covid: Behavioural Principles for Building Back Better.*
- <sup>63</sup> Defra (2021) *UK's Carbon Footprint 1997 – 2018.*
- <sup>64</sup> EcoAct (2020) *The 10th Annual Sustainability Reporting Performance of the FTSE 100.*

# Underlying progress and enablers of progress

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## Introduction

Delivering the Sixth Carbon Budget will require an immediate scale-up in action across the economy, building an annual investment programme reaching around £50 billion per year by 2030, up from around £10 billion per year today. This must be accompanied by significant changes in individual and organisational behaviours, alongside major changes in the way we farm and use our land.

This chapter sets up (but does not conclude) a discussion of how to monitor Government progress towards the Sixth Carbon Budget.

The transformation presents a major policy challenge for Government and a delivery challenge for UK business. Both Government and businesses have signalled their commitment to meeting these challenges, but much remains to be done. Now that the Net Zero target and Sixth Carbon Budget have been set, focus must switch to delivery.

In this new context, the Committee's role must also evolve. This chapter sets up (but does not conclude) the discussion of metrics of progress and the right way to monitor Government action.

We look forward to assessing the Government's full Net Zero Strategy later this year, and will aim to align our progress metrics and monitoring with the Government's proposals where we consider those to be credible.

The key messages of this chapter are:

- **Focus on delivery.** Our Sixth Carbon Budget advice identified and quantified many of the changes that need to happen in the next three decades. Now that the target has been set, focus must switch to delivery.
  - Decreases in non-business flying. Aviation demand may be suppressed in the medium term, especially if COVID-19 transmission continues worldwide to some degree. Survey data show that people intend to fly less after lockdowns are lifted.<sup>1</sup> Government should not plan for unconstrained leisure flying at or beyond pre-pandemic levels in its strategy for airport capacity and demand management.
- **There are some signs of progress on key enablers of the path to Net Zero.**
  - The transition to Net Zero requires changes that go beyond the deployment-related metrics we have tended to track to date. We will seek to broaden our assessment of real-world progress, including governance, public attitudes, corporate commitments, finance, just transition and the green recovery, as well as consumption emissions and the factors affecting them.
  - Early signs of progress on key enablers include two Cabinet Committees, the UK Climate Assembly, Scotland's Just Transition Commission, publication of the interim report of the HM Treasury Net Zero Review, and a rapid increase in climate commitments and action from UK businesses.
- **The pace of progress varies across sectors.** Some sectors of the economy are making strong progress towards Net Zero, while others are lagging behind:

- Sales of **electric vehicles** and the deployment of supporting charging infrastructure have increased considerably in recent years. Policies will be required to drive the accelerated uptake required throughout the 2020s (e.g. a zero-emission vehicle mandate). There are also concerning trends, notably the rapid growth in car and van travel and shift towards larger vehicles during the past decade.
- There has been almost none of the necessary progress in upgrading the **building stock**. Despite a small improvement in rates of heat pump installation, these remain far below levels that are necessary. Insulation rates remain well below the peak market delivery achieved up to 2012 before key policies were scrapped, demonstrating clear potential for growth if an effective policy package is in place.
- Deployment of **renewable electricity generation** has scaled up rapidly. The increase in 2020 was at a much slower rate than the average achieved over the previous five years, however, the growing project pipeline means that this slowdown is likely to be temporary.
- Progress in **agriculture and land use** has repeatedly failed to meet the indicators (e.g. for tree planting and on-farm efficiency measures) outlined in the Committee's progress reports in recent years. There are signs of potential consumer willingness to shift towards less carbon-intensive diets, but this has not yet translated to reduced meat consumption or been backed up by policy to support the change.
- Progress in reducing **emissions from waste** have stalled in recent years following a period of steep emissions reductions from the late 1990s caused by the diversion of waste from landfill.
- In the decade prior to 2020, **air passenger** demand increased by 36%. Efficiency improvements were not enough to offset this rise in demand, leading to a rise in emissions.
- Although there have been emissions reductions in **industry**, it is unclear how far this reflects structural changes driven by wider factors or genuine improvements in efficiency and carbon intensity. Tracking progress against our recommended pathway for manufacturing and construction is currently challenging because of a lack of data, which in some cases is because the technologies or approaches are still at an early stage of deployment.

This Chapter is set out in three sections:

1. Tracking underlying progress
2. Underlying progress on key enablers of the path to Net Zero
3. Underlying progress by sector

# 1. Tracking underlying progress

## a) Why we care about underlying progress

Tracking underlying progress is important, to understand whether lasting changes are being put in place that will lead to the necessary emissions reductions later on.

The end goal of domestic emissions reduction policy is to reduce UK greenhouse gas emissions to Net Zero by 2050. Reporting changes in annual greenhouse gas (GHG) emissions and setting targets to reduce those emissions is a fundamental element of monitoring the UK's progress on tackling climate change.

However, reporting annual GHG reductions does not tell the complete story. Chapter 2 sets out how the largest changes in annual emissions in the last decade were driven not only by reductions in the power sector, but also by external factors including winter temperatures, economic recessions, and most recently by lockdown measures during the pandemic (Figure 2.5).

Tracking underlying progress is therefore crucial to understanding what is driving current and future trends in UK emissions, and for identifying areas where the UK is performing well or falling behind.

In particular, we are interested in identifying a sustained shift towards low-carbon investments and behaviours (e.g. an expansion of renewable electricity generation, an increase in the share of electric cars being bought, higher rates of planting trees, a shift from car use towards walking/cycling).

## b) Our basis for monitoring underlying progress in future

In December 2020 the Committee published a Balanced Pathway to Net Zero as the basis for the recommended Sixth Carbon Budget, along with a range of alternative pathways to Net Zero. These pathways identify the changes in investments, choices and behaviours that would deliver the budget and put the UK on track to Net Zero. They give us a reasonable basis against which progress can be measured.

We can compare real-world deployment to the CCC pathway to see whether things are on track.

We recognise that there are options and uncertainties associated with pathways to meet the Net Zero 2050 target and the Sixth Carbon Budget. While the Balanced Pathway – referred to in this report simply as the 'CCC pathway' – sets a basis for the budget, it is not intended to be prescriptive. Rather it is illustrative of what a broadly sensible path without extreme assumptions would look like. A little more or a little less may be achieved in any given area, or alternative low-carbon solutions could be used, but the overall level of ambition and delivery must match. Since the pathway is, by design, stretching in all areas there is only limited scope to diverge significantly in any one area, as credible options to go significantly further in others are limited.

Our pathway modelling approach for the Sixth Carbon Budget was rooted in the technologies, investments and behaviours that are needed to decarbonise. This approach allows us to produce a large range of quantitative metrics of what is needed to achieve Net Zero. These are referenced throughout this chapter.

We will extend our progress reporting in the next year to cover a wider set of underlying drivers of emissions reductions

However, we have not fully quantified all the leading indicators and enablers needed to deliver them, such as strengthening of supply chains, expansions of the skilled workforce, or changes in public attitudes. Over the next year, the Committee will work towards a more complete set of indicators that also aim to track those real-world drivers of underlying progress.

Where we assess them to be credible, we will aim to align our progress monitoring to the Government's plans and proposals.

The Committee's ability to monitor Government performance on climate change also rests heavily on publication of the UK's Net Zero strategy, anticipated later this year. This publication will raise two key questions that will guide the Committee's scrutiny of underlying Government progress in future reports:

- Does the Net Zero Strategy set out a credible pathway to the Sixth Carbon Budget and Net Zero targets?
- Is the Government on track to deliver what was promised in its own Net Zero strategy?

We will aim to align our progress metrics and monitoring with the Government's proposals where we consider those to be credible and practical.

## 2. Underlying progress on key enablers of the path to Net Zero

This section reviews some of the key cross-cutting enablers for delivering Net Zero, and identifies underlying progress in each theme. Our future work will expand on each of these themes in more detail.

### a) Governance and delivery

Government will need to work together effectively at all levels to deliver the pathway to Net Zero.

Good governance will be crucial in enabling delivery of the path to Net Zero. Mitigating and adapting to climate change are challenges that cut across the entire economy, requiring Government to work together at all levels. There has been some activity on this challenge in the last year:

- There are now two Cabinet sub-committees (for Climate Action Strategy, chaired by the Prime Minister, and Climate Action Implementation, chaired by the Secretary of State for Business, Energy and Industrial Strategy). The Government does not report on the content or frequency of these meetings, but it is clear from the increased policy activity and the Committee's own experience that they are being used.
- The Government has recently separated the roles of Secretary of State for Business, Energy and Industrial Strategy and President of COP26.
- At senior official level there is a Climate Change National Strategy Implementation Group, a Net Zero Steering Board and various coordinating working groups. The Business and Energy Secretary has also recently convened a new Net Zero Expert Group as part of Task Force Net Zero, which aims to adopt a whole-system approach to decarbonising the UK economy.
- The Government has set the Bank of England a new mandate to support the Net Zero transition.<sup>2</sup> It has also established a Net Zero Business Champion (see part e) of this section).
- In the past year, parliamentary Select Committees have opened at least 20 inquiries into aspects of the UK's path to Net Zero.
- Both the National Audit Office (NAO) and the Institute for Government (IfG) have made recommendations<sup>3,4</sup> based on their assessments of what structures and approaches would be best within the centre to coordinate the work that is required across all areas of Government business. The recent Dasgupta Review<sup>5</sup> suggested including natural capital within an 'inclusive wealth' approach to national accounting systems to appropriately value sustainable economic growth and development.

This process of embedding Net Zero throughout Government departments must continue through the 2021 Spending Review, for which plans to contribute to Net Zero should be a key criterion.

Government must set a clear strategy for how Net Zero will be delivered across the whole system.

There are further challenges beyond central Government. There will need to be a strong, clear strategy set from the centre, with clear lines of responsibility and accountability alongside appropriate empowerment of those tasked with delivery. The UK Government must coordinate effectively with devolved governments and there must be a clear expectation of, and support for, local government.

- Net Zero and the recent legislation of the Sixth Carbon Budget set a clear direction, but these now need to be developed into a full strategy for delivering the necessary decarbonisation. The build-up to COP26 provides an opportunity for the UK to show leadership in setting out ambitious decarbonisation plans and a roadmap for delivering these. This momentum and Government ambition must be sustained and built upon beyond COP26.
- Each of the devolved administrations contributes to the UK's overall Net Zero target, while Scotland and Wales each have their own Net Zero targets. As such, each devolved administration is developing and implementing policy to reduce emissions – this presents both challenges in terms of aligning policy signals and outcomes, and also opportunities to learn from best practice.
- A lot of the delivery required for Net Zero is inherently local in nature, but local actors (including local authorities, sectoral bodies and business groups) are frequently not properly empowered and supported to deliver the actions required.
  - Nearly three-quarters of local authorities have declared a climate emergency. However, there can be uncertainty around what actions they should take to address this, and delivery of Net Zero can be a challenge in the context of funding shortfalls and competing needs to deliver statutory obligations.
  - As part of our advice on the Sixth Carbon Budget, we commissioned an assessment of the role of local government.<sup>6</sup> This produced several recommendations for how to enable collaborative delivery, including the need for an agreed framework incorporating local and national action, the importance of aligning policy and local powers with ambition and the requirement for appropriate long-term programmatic funding.

Much of the activity that is required to deliver Net Zero will be carried out at the local level. Therefore, it is vital that local actors are properly empowered and supported to deliver these actions.

We intend to consider the governance challenges further during the 2021-22 year, including the work of other organisations and potential lessons from other delivery challenges. We will report back on our findings in our 2022 Progress Report.

## b) People and public engagement

Meeting the Sixth Carbon Budget and the Net Zero target will require increased action from people, as consumers, workers, households, businesses and citizens. Our analysis shows that over half the emissions reductions needed to meet the Sixth Carbon Budget involve people making low-carbon choices, whether adjusting to the different characteristics of low-carbon technologies (e.g. electric cars), or by changing their current consumption patterns (e.g. by eating less meat).

The experience of the Climate Assembly UK shows that people will support the transition to Net Zero if they understand what is needed and why, if they have options and can be involved in decision-making processes. However, for wider society in general, while there is an increased awareness of the need for climate action, there is still a gap in understanding what this means for them. For example, while 80% of people are concerned about climate change, only half are aware that their gas boiler produces emissions.<sup>7</sup> Climate Assembly UK also demonstrated that there is much that government can learn from citizens' lived experience and values that can help in formulating better policy.

The Climate Assembly UK was an important start in engaging the public more in climate policy decisions.

There is a clear requirement for the Government to tell a better story on how people can engage in the transition, while also learning from people's experiences. The need for a Government public engagement strategy was identified as a key policy priority area in our Sixth Carbon Budget advice.

Our future work will include looking at 'what works' for public engagement, further analysing what meeting the Sixth Carbon Budget means for individual choices, and assessing the Government's own public engagement plans.

The Committee will be undertaking further work on how people can be engaged effectively on this path, with a view to making more detailed recommendations to Government in 2022. The work will be informed by stakeholder engagement, literature review, survey data and work with the Climate Citizens project at Lancaster University. It will cover:

- Establishing the principles of what good public engagement for Net Zero looks like. This will include a synthesis of the main findings of different public engagement strategies and models used in the UK and overseas, both within climate change and other policy areas, in order to demonstrate what works and what we can learn from successful engagement.
- Unpacking the key Sixth Carbon Budget actions that actively involve people changing how they do things. This will allow us to identify:
  - Priority areas for engagement.
  - The most appropriate engagement model(s), policies and key delivery partners, drawing on evidence from case studies.
  - The key indicators and survey data with which to track progress against and identify key data gaps.
- Assessing the public engagement aspects of the Government's Net Zero Strategy.

## c) Just Transition – who pays and who gains?

The costs and the benefits must be shared in a way that is fair and is perceived to be fair.

A key challenge on the path to Net Zero is how to spread the costs and benefits of the transition across the economy: for households, businesses and the Exchequer.

The Treasury published their initial findings on this challenge in December, in the interim report of their Net Zero Review. Its conclusions echoed the Committee's in our Net Zero report and in the Sixth Carbon Budget, as well as the conclusions of our Expert Advisory Group on the costs and benefits of Net Zero.<sup>8</sup> Conclusions include that the effects of decarbonisation on economic growth are likely to be small and that the costs of the transition are uncertain but can be minimised with good policy, which should rely on a range of levers (Box 3.1).

There is currently an imbalance between gas and electricity prices. This does not fairly spread the costs of polluting nor incentivise the right decarbonisation decisions.

In the long term, the transition should result in lower energy costs and energy bills, but in the coming decade our scenarios involve further increases in electricity costs before these begin to fall. To date, climate policy costs have been primarily added to electricity prices rather than to gas prices. This has adversely affected particular groups (those with electric heating, who are often fuel poor) and had a distortionary effect by undermining the case for electrification, which should play a major role in meeting the Sixth Carbon Budget both in homes and in industry.

There is growing consensus on the need to tackle the imbalance between electricity and gas prices. For example:

- Public First, supported by five major energy companies, produced an assessment of policy options for energy bill reform that would remove the running cost disincentive on electrified heating, while maintaining affordability of heating for average households across the country, not substantially increasing costs for the fuel poor and without putting an undue fiscal burden on public finances.<sup>9</sup> The 750,000 electrically-heated fuel poor households would benefit. Particular issues include how better to target fuel-poor households and impacts on people moving in and out of fuel poverty (fuel poverty 'churn'), who would be hit by a large bill increase under their proposals.
- In their Fourth Annual Report, the Committee on Fuel Poverty (CFP) recognised the adverse incentives under the current system, which discourage the necessary move away from gas or oil to electricity. The CFP's preference is that climate policy costs are not passed on to consumers via bills but rather recovered in income taxation. However, in the short term they support a shift of policy costs to gas bills, as long as measures are taken to protect fuel-poor households against any resulting bill increases.<sup>10</sup>

Reaching Net Zero will bring tangible benefits to people's lives that overwhelmingly outweigh the negatives. These benefits should be shared as widely as possible.

Alongside the benefits in mitigating climate change, and the potential for lower energy prices in the long term and economic benefits, there are additional benefits on the path to Net Zero. These include significant, tangible improvements to public health, the environment and biodiversity:

- Chapter 5 of the Sixth Carbon Budget set out in detail the range of co-impacts that are likely to arise from decarbonising our economy. The Committee appointed an expert advisory group on health to support our advice on the Sixth Carbon Budget, which concurred strongly with our previous assessment that climate action could bring significant benefits to health, including through healthier diets, more exercise and better air quality.

HM Treasury's Net Zero Review final report is now two years in the making and has many questions still to answer.

- We concluded in the Sixth Carbon budget that the positive co-impacts of reaching Net Zero overwhelmingly outweigh the negatives, especially if supported by the right policy decisions from the Government to maximise societal benefits and minimise the risks.

The final report of the Treasury's Net Zero Review, which was planned for Spring 2021, has been delayed and is now expected later this year – over two years since the Committee recommended it. We expect the Review to address many of the issues around who pays and who gains from a transition to Net Zero, including:

- Developing a plan for funding decarbonisation and reviewing the distribution of costs for businesses, households and the Exchequer. This should set out the main areas where action and funding will be required, the principles on which the distribution of costs should be determined and clarity over how costs will be allocated.
- Considering near-term as well as long-term decarbonisation funding needs and policy implications. One Government cannot make funding commitments that bind future Governments, but the review can set out principles to inform the scale and nature of long-term Government funding and make concrete proposals for action and funding over the next five to ten years, or at least be accompanied by a spending review or budget which does the same.
- Reforming price signals, including the potential to raise offsetting revenues by greater use of carbon taxes (e.g. for sectors like aviation that are currently under-taxed and where equity concerns are less present) and the need to rebalance policy costs between gas and electricity to ensure the take-up of low-carbon electricity solutions is not hindered.

For climate action to be effective, it must reduce global emissions, not just UK territorial emissions. Emissions reductions from UK industry must result from reduced UK consumption and from decarbonising the UK's own industries, rather than 'offshoring' production to other countries (i.e. 'carbon leakage'). It is vital therefore to consider competitiveness as part of the just transition.

Emissions can be reduced while maintaining competitiveness, but this will require policy to support UK industries.

Our advice on the Sixth Carbon Budget identified how emissions can be reduced while managing competitiveness. Government has also set out a vision of how this can be achieved, through strategies including the Industrial Decarbonisation Strategy. The Strategy stated that 'In the immediate future, government's preferred method for mitigating the risk of carbon leakage will continue to be free allocation of UK ETS emissions allowances, which will be decreasing throughout the 2020s.' The Government is consulting on the future of free allocation.

Going forward, we will monitor progress on the development of these policies and consider indicators to track progress on managing competitiveness. We will also consider how policies to manage competitiveness can be designed to reduce the embodied emissions of UK imports.

Managing the transition fairly will be an ongoing process and must continue beyond the publication of the final report of the Treasury's Net Zero Review. We will continue to monitor the Government's progress in delivering a transition that shares costs and benefits fairly across different groups. Our further work on this theme, in addition to tracking government progress, will depend on the findings of the Net Zero Review.

### Box 3.1

#### Findings of the interim report of HM Treasury's Net Zero Review

In May 2019 the Committee's Net Zero report recommended that the Treasury undertake a review of how the costs of achieving Net Zero emissions should be distributed and the benefits returned. The Treasury agreed to undertake the review and published its interim report in December 2020. Key findings of the interim report include:

- **Reaching Net Zero is essential for long-term prosperity.** Global action to limit greenhouse gas emissions is needed to avoid catastrophic climate change with almost unimaginable consequences for societies across the world. But this transformation will also create opportunities for the UK economy, like new industries and jobs that emerge as existing sectors decarbonise or give way to low-carbon equivalents.
- **The effect of UK and global climate action on UK economic growth is likely to be relatively small.** The scale, distribution and balance of new growth opportunities and challenges will depend on how the economy and policy respond to the changes required.
- **The costs of the transition to Net Zero are uncertain and depend on policy choices.** Investment requirements to reach Net Zero and impacts on operating costs are affected by a range of factors which are subject to significant uncertainty (e.g. the precise path of the transition, changes in behaviour and the rate at which technology costs fall and efficiency gains are made).
- **Government needs to use a mix of policy levers to address multiple market failures and support decarbonisation.** Government policy should seek to target market failures directly where possible, subject to distributional and international competitiveness impacts. Carbon pricing is an important lever in addressing the negative externality problem but should be supplemented by other policies.
- **Well-designed policy can reduce costs and risk for investors, support innovation and the deployment of new technologies.** A clear policy framework setting out the government's approach at different levels of technological development can help address uncertainties. Where uncertainty is at its greatest, government may need to provide more direct support.
- **The risk of carbon leakage will increase with efforts to reduce emissions.** Changes required for the transition could lead to carbon leakage if policies achieve their goal of lowering emissions in one jurisdiction but inadvertently increase emissions elsewhere. The size of the risk depends on each sector's costs of decarbonising, their trade exposure and international policies. The government has a number of ways to seek to mitigate this risk, including through its climate diplomacy and the design of policies to support the transition.
- **Government needs to consider household exposure to the transition through their consumption, labour market participation and asset holdings in designing policies.** Different types of household will have different levels of exposure to the transition. Where costs fall will depend on a range of factors, including the cost of decarbonising each sector, the availability of alternative low-carbon products and the distribution of new green jobs in the economy. Government will need to be mindful of these issues as they consider the best way to design policy to support the transition.

Source: HM Treasury (2020) *Net Zero Review: Interim Report*.

## d) Just Transition – workers and skills

There is a transition risk to employment, as high-carbon activity declines and new low-carbon industries are created.

A strategy is needed to ensure a just transition for workers.

The transition to Net Zero will need more of some jobs and fewer of others. There is no reason to think that the total number of jobs should be any lower than in a high-carbon world – a recent report by the Confederation of British Industry set out the potential for the transition to Net Zero to create 240,000 new green jobs by 2030 across the UK,<sup>11</sup> and the International Energy Agency's Roadmap for the Global Energy Sector results in 14 million jobs created globally by 2030.<sup>12</sup> But the shift in jobs from some areas to others brings a significant transition risk.

The transition will affect the whole of the UK, with impacts differing across regions, sectors and workers. Risks of negative localised impacts must be a particular focus for policy. The deindustrialisation that has occurred in the UK to date has already left some regions disproportionately worse off, with previous efforts in the UK to transition workers in declining industries to new jobs achieving limited success.<sup>13</sup> A strategy for the just transition is required to ensure no group is left behind.

Key developments over the last year include publication of the final report of the Scottish Just Transition Commission, establishment of the Green Jobs Taskforce and the Government's plans for a Skills and Post-16 Education Bill:

- The Scottish Just Transition Commission published its final report in March 2021.<sup>14</sup> The report acknowledged that transitioning to Net Zero means a fundamental transformation of the nation's economy, which offers great opportunities, but must be implemented fairly. It made 24 recommendations to ensure the transition is made "by the people of Scotland, not done to the people of Scotland", including four practical recommendations to equip people with the skills and education they need to transition to Net Zero:
  - A flexible and accessible skills and education system.
  - A skills guarantee for workers in carbon-intensive sectors.
  - Support for small and medium enterprises to invest in their workforces.
  - Equipping farmers and land managers with the skills, training and advice they need.
- The Green Jobs Taskforce was convened by BEIS to focus on both immediate and longer-term challenges of delivering skilled workers for the transition to Net Zero. It will produce a Green Jobs Action Plan with solutions and recommendations. These documents had not been published as this year's Progress Report was being finalised and its recommendations were not considered as part of our assessment of progress.
- The 2021 Queen's Speech set out plans for the Government's Lifetime Skills Guarantee, which will offer adults loans to retrain in later life and help them "to gain in-demand skills and open up further job opportunities", as part of the Skills and Post-16 Education Bill. The Bill will also aim to realign the education system around the needs of employers to fill skills gaps in sectors including construction, digital, clean energy and manufacturing.<sup>15</sup>

We will continue our work in this area, drawing on existing external research and analysis and identifying knowledge gaps which the Committee could help to fill.

We will draw on the pathways we developed for the Sixth Carbon Budget and consider in particular the implications for employment and skills policy, and consider what indicators could be used to track success in ensuring a just transition.

### e) Other key drivers of progress

We will continue to develop our understanding of what progress towards Net Zero looks like for businesses, the financial system, UK innovation, carbon pricing, international engagement, and more.

Further enabling actions will be required to meet Net Zero. The Committee's future work on cross-cutting areas will build on previous reports and explore new areas. As with policy development more generally (see Chapter 4), there has been progress in these areas in the last year.

- **Business action.** While the UK government must set the frameworks for the transition and citizens must make low-carbon choices, the private sector must invest and transform their business models. This will often be driven and supported by the third sector. Increasingly, businesses are delivering on these ambitions, by procuring low-carbon electricity, switching to electric vehicles and decarbonising their own operations. Our future work will aim to help businesses make informed decisions that are in line with Net Zero (see Box 3.2) and track how corporate commitments are progressing in the UK. Key developments in the past year include:
  - The UK had the largest share of companies (94 out of 300) in the Financial Times' Europe's Climate Leaders list of companies that have achieved the greatest reduction in greenhouse gas (GHG) emissions intensity\* since 2014.<sup>16</sup>
  - The BSI Net Zero Barometer found that 7 out of 10 businesses in the UK have made or are considering making a commitment to Net Zero, but the vast majority (82%) require more guidance if they are to achieve the target, with cost cited as the biggest barrier.<sup>17</sup>
  - Nearly one in three FTSE100 companies have signed up to the UN's Race to Zero campaign.<sup>18</sup> Small and micro businesses are now also being encouraged to commit to cutting their emissions (in half by 2030 and to Net Zero by 2050 or sooner) through the Together for our Planet campaign and newly-established UK Business Climate Hub.
  - The Government has established a Net Zero Business Champion with direct responsibility to support as many UK businesses as possible to commit to net-zero emissions targets.

**Investment and finance.** The Committee's Expert Advisory Group on Net Zero finance concluded that the investment programme required for the Sixth Carbon Budget is deliverable, but that delivering at the lowest overall cost is dependent on policy in both the 'real' and 'financial' economies. The Group highlighted the need for a regular assessment of investment needs and financial flows for climate action in the UK. Such an assessment would consider the level and sufficiency of capital investment flows made by households, firms and public authorities to achieve the UK's climate goals of Net Zero, adaptation and a just transition. It would also aim to assess the overall alignment of the UK's stock of financial assets with the Paris Agreement and for Net Zero and resilience at both a UK and global scale. Key recent developments in low-carbon finance include:

\* This ranking covers only Scope 1 and Scope 2 emissions, and does not cover Scope 3 emissions from companies' supply chains and the end-use of their products and services.

- London remained top of the Global Green Finance Index (GGFI).<sup>19</sup> The index ranks cities based on the quality and depth of their green finance offerings, capabilities and mechanisms. Ratings rose in almost all centres globally, but Western Europe continues to be the most mature market, accounting for nine of the top 10 and 12 places across the respective rankings.
  - From May 2019 to May 2021, the UK climbed from eight to fourth in EY's rankings for international attractiveness of renewable energy investment and deployment opportunities.<sup>20</sup>
  - The UK has announced its intention to make Task Force on Climate-related Financial Disclosures (TCFD) aligned disclosures mandatory across the economy by 2025, with a significant portion of mandatory requirements in place by 2023.
  - The UK Government announced at least £15 billion of 'green gilts' sovereign bonds for this financial year, and the Bank of England's climate change stress test will be published in June 2021.
  - The remits of the Bank of England's Monetary Policy Committee (MPC) and Financial Policy Committee (FPC) were updated to reflect the Government's economic strategy to achieve economic growth that is consistent with Net Zero.
  - The Prime Minister's Finance Adviser for COP26 has published a Private Finance Strategy for climate change.
- **Innovation and infrastructure** have played a critical role in driving down the costs and improving the efficiencies of the low-carbon technologies we use today. Sustained support for innovation – at all stages of the technology life cycle, including deployment – can ensure costs and efficiencies continue to improve in the future. Scaling up low-carbon technologies will rely on new infrastructure (e.g. electric vehicle charging points, electricity network upgrades and new CO<sub>2</sub> storage and hydrogen networks). This must be reflected in infrastructure decisions in the 2020s and be resilient to a changing climate. Monitoring progress will involve tracking technology costs and uptake, funding available for Net Zero research and innovation, as well as whether the necessary infrastructure is being built. Key recent developments include:
    - HM Treasury confirmed a new Net Zero Innovation Portfolio (NZIP) with funding totalling £1 billion. Funding will be allocated on a competitive basis to sectors including long-duration energy storage; floating offshore wind; biomass and regenerative agriculture.
    - Progress has been made on plans and funding for infrastructure, including the National Infrastructure Strategy, Plan for Growth, and the establishment of the UK Infrastructure Bank.
  - **Cross-economy carbon pricing and obligations.** To incentivise the transition to Net Zero, prices will need to reflect carbon content sufficiently to favour low-carbon options over high-carbon options. That can be achieved through explicit carbon pricing or other financial levers, although these will not be sufficient by themselves and must be backed up by other policy. In principle, all sectors of the economy could be exposed to carbon pricing, although care must be taken in managing impacts when doing so.

Monitoring the impact of carbon pricing will involve tracking the price of emitting (or removing) carbon in the UK, the scope of emissions that is covered by such a scheme, and the impact it is having on real-world decisions. The UK Emissions Trading System (UK ETS) launched at the start of the year. The Government has committed to consulting by September 2021 on a cap for the UK ETS consistent with the Sixth Carbon Budget.

- **International / engagement with other 'Climate Councils' worldwide.** The Committee is working with over 20 other climate councils from around the world to share knowledge and insights, recognising the significant common ground and importance of independent, evidence-led advice in implementing the Paris Agreement. This is being taken forward as a formal international network with events planned around the COP and in future years.

### Box 3.2

#### The role of business in delivering the Sixth Carbon Budget

Corporate action is already driving significant change across the UK and internationally, and accelerating this action will enable the policy, technological, behavioural, and business model changes needed for a zero-carbon society. Yet many businesses within the UK are increasingly looking for information and a better understanding of the future context in which they will operate.

Alongside our advice on the Sixth Carbon Budget we developed a briefing note on how businesses in the UK can act to support the UK's transition to Net Zero. This suggests the following principles to guide business ambition in the UK:

- **Do the basics well – measure, disclose, target, act, adjust.** Companies should account for, and take action on, all emissions they are responsible for and be transparent about their objectives to reduce emissions, and how they plan to do it.
- **Adopt the highest possible ambition,** acknowledging that some, particularly large, businesses may be able to achieve Net Zero earlier than the UK's national objective.
- **Address all emissions, and go beyond.** In particular companies should look at the emissions that occur in their supply chains ('Scope 3' emissions), and go beyond this. In particular we identify two areas to advance progress:
  - Companies can lead the transition to electric vehicles in the UK, and should switch their vehicle fleets to EVs over the 2020s
  - Companies should ensure corporate renewables procurement pays for new low-carbon electricity to be installed, rather than just purchasing existing renewables.
- **Ensure Climate Change is addressed at the highest levels** of corporate leadership, including ensuring climate action is given board level and CEO responsibility.
- **Minimise offsets, phase them out, and ensure only permanent emissions removals remain,** in line with our recommendations around how the UK should meet its national carbon budgets.

Source: CCC (2020) *The role of business in delivering the UK's Net Zero ambition*.

### 3. Underlying progress by sector

This section assesses underlying progress by sector, showing changes in the 'key metrics' that could be used to track progress against our recommended pathway to Net Zero and discussing broader underlying developments that are likely to affect technology deployment, changes in individual and business behaviours, and ultimately UK emissions in future years.

These key metrics are not yet a full indicator framework, but many of these metrics will continue into future progress reports.

#### a) Surface transport (113 MtCO<sub>2e</sub>, 23% of UK emissions in 2019)

Surface transport remains the UK's highest-emitting sector. Delivery of the Balanced Net Zero Pathway ('CCC pathway') from our 2020 Sixth Carbon Budget Report will require substantial progress over the coming years:

During the 2020s, we need to see rapid uptake of EVs, supported by widespread deployment of charging infrastructure.

- Rapid ramp-up of sales of fully electric cars and vans through the 2020s, reaching almost 50% of all new sales by 2025 and 100% by 2030.
- This will need to be supported by the deployment of almost 280,000 public charge points across the country by 2030.
- Trials of zero-emission HGVs to commence in the early 2020s, alongside logistics and efficiency improvements for existing HGV fleets.
- Investment in high-quality public transport and active travel infrastructure, to support a 6% reduction in demand for car travel by 2030 relative to baseline forecasts.

Government needs to invest in attractive alternatives to car travel, to reduce the use of high-carbon transport.

Key surface transport indicators cover emissions intensity, new vehicle efficiency, electric vehicle (EV) take-up, biofuels and travel demand (Table 3.1).

**Table 3.1**

Key metrics for surface transport in the CCC Pathway to meet the Sixth Carbon Budget

Metric		Latest Indicator			Milestones in the CCC pathway				
		Year	Annual change	Value	2025	2030	2035	2050	Trend
Intensity	BEV car registrations (thousands)	2020	+184%	108	1,290	2,750	2,960	3,360	
	Market share (%)	2020		6.5%	48%	97%	100%	100%	
	PHEV car registrations (thousands)	2020	+92%	67	698	0	0	0	
	Market share (%)	2020		4.1%	26%	0%	0%	0%	
	Electric van registrations (thousands)	2020	+64%	6	237	439	460	502	
	Market share (%)	2020		2.0%	56%	99%	100%	100%	
	New car CO <sub>2</sub> emissions (gCO <sub>2</sub> /km)	2020	-12%	113.0	51.4	3.3	0.0	0.0	
	New van CO <sub>2</sub> emissions (gCO <sub>2</sub> /km)	2020	-2%	163.0	74.7	0.1	0.0	0.0	
	HGV emissions intensity (gCO <sub>2</sub> /km)	2020	-12%	592.0	537.0	450.0	246.0	8.1	
	Biofuel uptake (% fuel sales by energy)	2020	+16%	4.7%	4.2%	4.7%	6.3%	17.0%	
Demand	Car-km per driver (km)	2020	-25%	10,000	12,500	12,300	12,100	11,100	
	Car distance driven (billion kms)	2020	-25%	351	441	453	466	483	
	Van distance driven (billion kms)	2020	-9%	84	92	99	107	122	
	HGV distance driven (billion kms)	2020	-6%	28	26	25	26	28	

Source: DfT, SMMT and HMRC (2021); CCC analysis

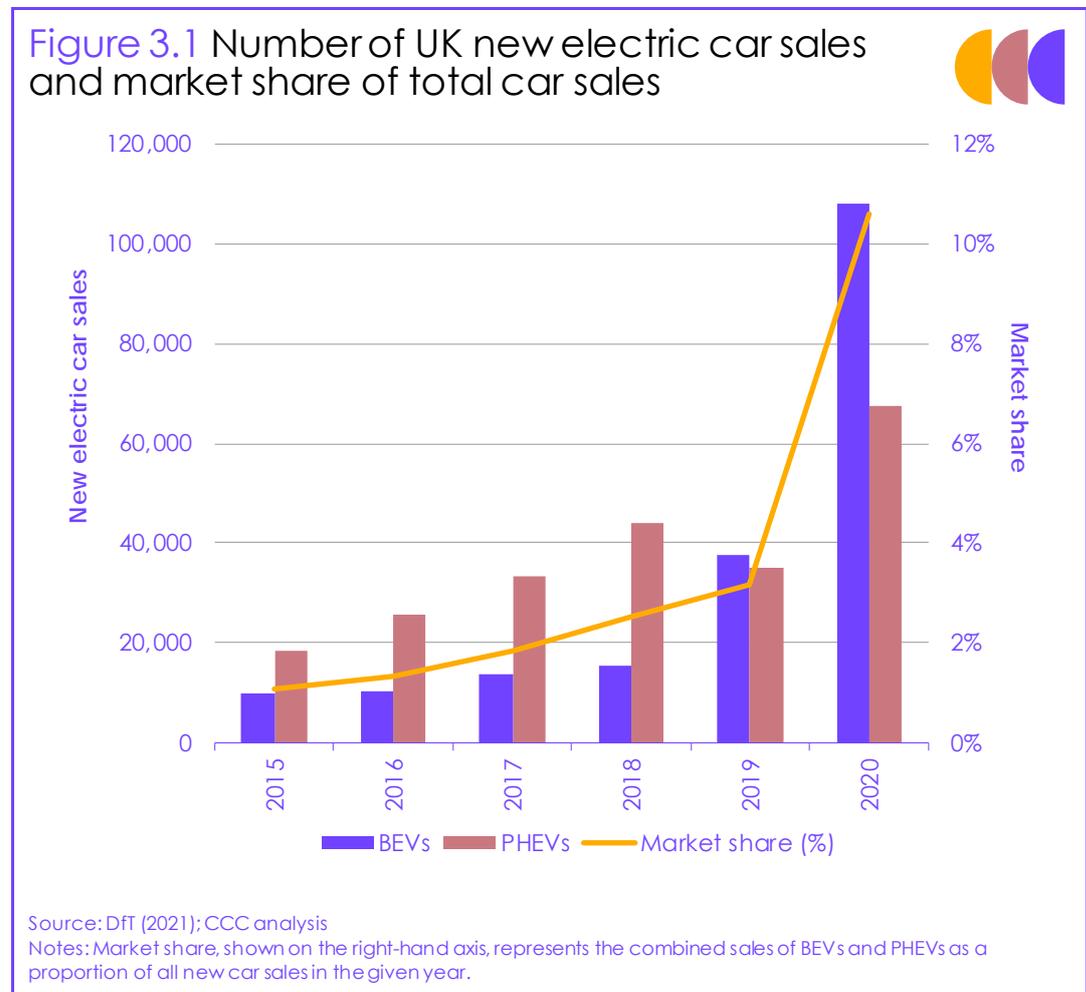
 Notes: 1. New car CO<sub>2</sub> figures are calculated on an NEDC test-cycle basis, to enable comparison with previous years. 2. While indicators that are calculated using travel demand (car-km per driver, car distance driven, van distance driven and HGV distance driven) currently look on track to meet or ahead of CCC Pathway milestones, it is important to note that travel demand in 2020 was significantly lower compared to previous years as a result of COVID-19.

Sales of EVs and the deployment of supporting charging infrastructure have increased considerably in recent years. This will need to accelerate throughout the 2020s. However, there are also concerning trends, notably the rapid growth in car and van travel during the past decade.

EV sales rose to record levels during 2020. Manufacturers are increasingly scaling up their EV offerings.

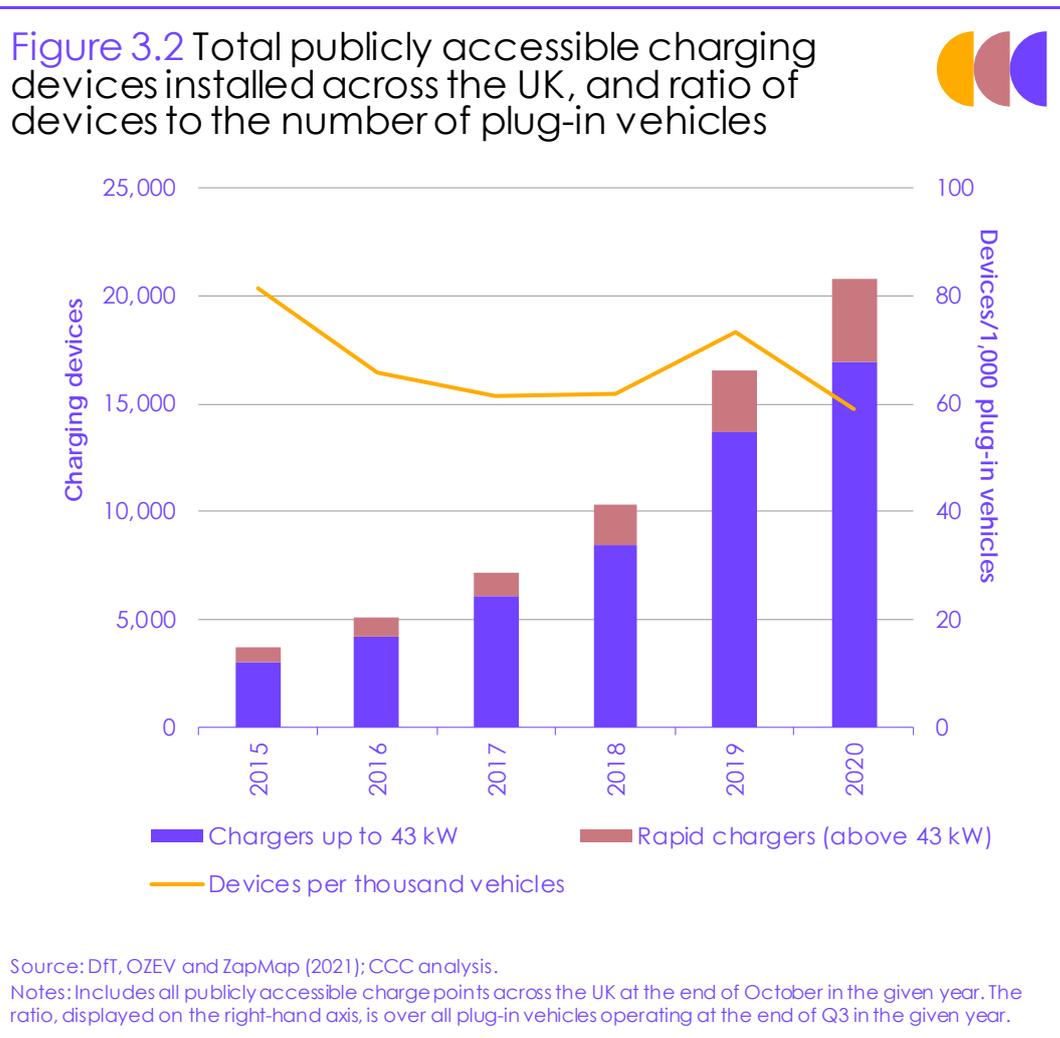
- While total car sales fell 30% in 2020, sales of EVs more than doubled, to 175,000 vehicles or 10.6% of all new car sales (Figure 3.1). There has also been a shift towards battery-electric vehicles (BEVs) from plug-in hybrids (PHEVs) – BEVs now represent over 60% of EV sales, from around 50% in 2019.
  - Manufacturers are increasingly scaling up their EV offerings. There are now around 45 BEV car models on the market, with at least a further 3 expected over the remainder of 2021.
  - Advancing EV technologies are lengthening driving ranges and cutting prices.<sup>21</sup> Research shows that battery prices have fallen by 13% from 2019 to 2020<sup>22</sup>, and popular EV manufacturers<sup>23</sup> have been reducing prices in 2021.
  - Evidence<sup>24</sup> suggests consumers are giving increasing consideration to environmental issues as part of their purchasing decisions.

**Figure 3.1** Number of UK new electric car sales and market share of total car sales



There are now over 20,000 public EV chargers in the UK. Deployment needs to continue to accelerate to make charging readily available across all areas of the country.

- The UK's public charge point network is expanding quickly (Figure 3.2), and there are now 20,800 public EV charge points across the UK, up from 16,500 at the end of 2019.<sup>25</sup> This provision is inconsistent across the country. On a per-capita basis, charge points in England and Northern Ireland are lower than in Scotland and Wales. A disproportionate share of public charge points in England are located in London and other urban areas in the South East.

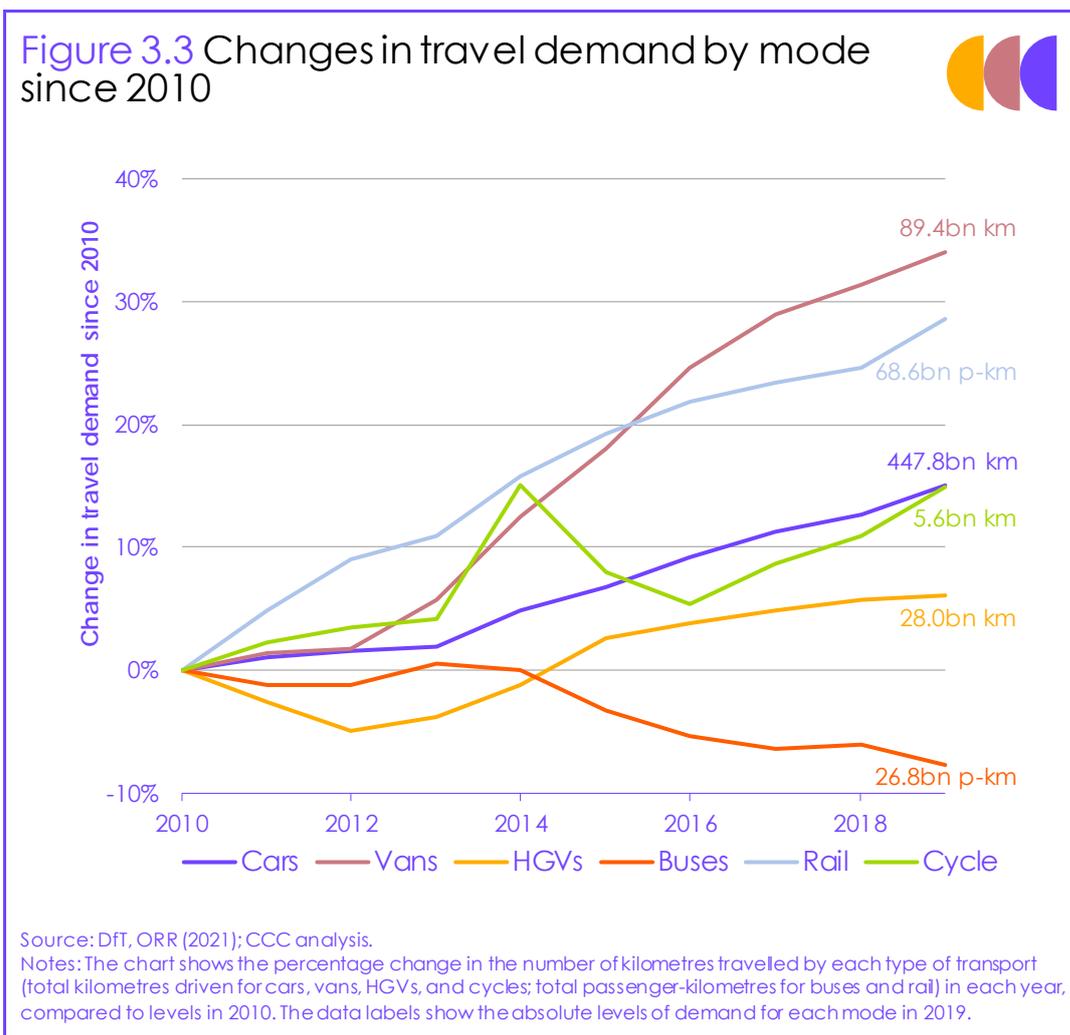


New car CO<sub>2</sub> intensities have risen in recent years, driven by the high proportion of large SUVs purchased.

- Between 2007 and 2016, the average CO<sub>2</sub> emissions of a new car decreased by 27%. This trend reversed between 2017 and 2019, mainly due to increasing sales of higher emitting SUVs. Efficiency improved again in 2020 by 12%<sup>26</sup>, but this was almost entirely due to record sales of electric vehicles (EVs). The high proportion of SUVs, representing one in four new car sales, remains a concern.

Demand for road transport has continually grown year-on-year in recent decades. This is partly due to the falling real-terms cost of driving.

- Road transport demand has risen markedly over the past decade\*, which continued with a 2% increase in 2019 (Figure 3.3). The falling real cost of driving, a large increase in van travel (due in part to the growth in online shopping<sup>27</sup>) and slower growth in HGV demand are key contributors.
  - Over the past decade, the average cost of driving has risen by less than average wages and the cost of living, whereas rail and bus fares have increased more steeply.<sup>28</sup> A recent study<sup>29</sup> linked the freeze in fuel duty since 2011 to a 4% increase in traffic levels, 60 million fewer rail journeys, 200 million fewer bus journeys and 4.5 MtCO<sub>2</sub> of emissions in 2017.
  - From 2021 to 2022, rail fares will increase by the Retail Price Index (RPI) plus 1%, a 2.6% rise.<sup>30</sup> In contrast, the long-haul rates of Air Passenger Duty will increase in line with RPI and short-haul rates will not rise.<sup>31</sup>



The Committee intends to continue tracking these key indicators of EV uptake, charging infrastructure deployment, vehicle efficiency and travel demand by mode, for the Sixth Carbon Budget pathway, in future progress reports. We will also explore opportunities to monitor other key enablers of the transition, including public attitudes to various modes of travel, the scaling-up of EV supply chains and the availability of safe, reliable and attractive alternatives to car travel.

\* The reductions in travel demand seen in 2020 were due to the impacts of the COVID-19 pandemic, and not reflective of the underlying trends observed over recent years.

## b) Buildings (88 MtCO<sub>2</sub>e, 18% of UK emissions in 2019)

The path to Net Zero set out in our advice on the Sixth Carbon Budget sees substantial near-term growth in the deployment of energy efficiency measures and heat pumps as two of four priority areas over the next decade, alongside roll-out of low-carbon heat networks and hydrogen trials. We should not delay on heat pumps or low-carbon heat networks as viable solutions for most of the country – hydrogen can be part of the mix but has not yet been proven at scale and should not be a cause to delay other options.

Substantial near-term growth is needed in the deployment of energy efficiency measures and heat pumps, but delivery rates have continued to stagnate.

Despite this, progress in upgrading the building stock with the necessary measures over the last decade has been very poor. Underlying delivery rates continued to stagnate, with a small improvement in heat pump delivery rates driven by retrofit installations under the Renewable Heat Incentive (RHI) (Table 3.2).<sup>32</sup>

**Table 3.2**  
Key metrics for buildings in the CCC Pathway to meet the Sixth Carbon Budget

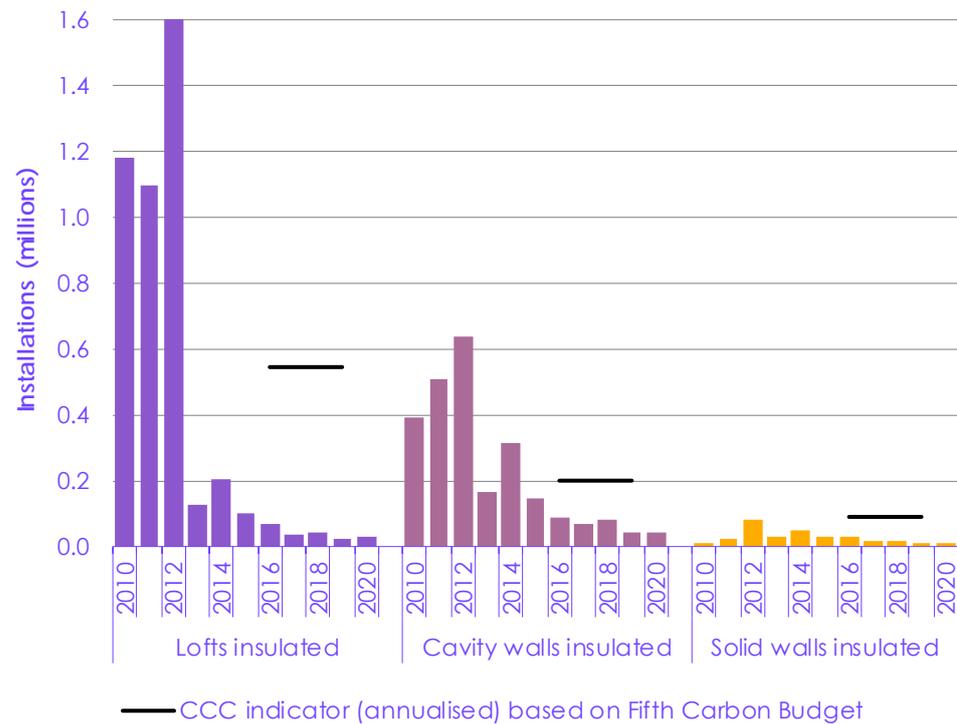
Metric	Latest Indicator			Milestones in the CCC pathway				
	Year	Annual change	Value	2025	2030	2035	2050	Trend
Heat pump installations (thousand per year)	2020	9%	36	415	1,075	1,435	1,525	
Lofts insulated (thousand per year)	2020	26%	32	710	675	200	0	
Cavity walls insulated (thousand per year)	2020	-3%	40	215	175	55	0	
Solid walls insulated (thousand per year)	2020	-22%	10	255	245	45	0	

Source: CCC analysis; BSRIA (2021) *Heat pumps market analysis 2020: United Kingdom*, BSRIA *World Market Intelligence*; BEIS (2021) *Household Energy Efficiency Statistics: Headline Tables*.

Notes: Our scenarios deploy the majority of domestic energy efficiency measures in the 2020s, given the carbon, bill and health benefits, and the need to prepare the stock for widespread low-carbon heat uptake in the 2030s. For this reason, in-year energy efficiency deployment declines in later years relative to deployment levels in the coming decade. Out-turn data for heat pump installations may include some installations which serve multiple dwellings, slightly underestimating the number of homes heated by heat pumps relative to the milestones.

Insulation rates remain well below the peak market delivery achieved up to 2012 (the point at which the Carbon Emissions Reduction Target and the Community Energy Saving Programme ended), which illustrate the growth potential where an effective policy package is in place (Figure 3.4).

**Figure 3.4** Home insulation rates by measure and year

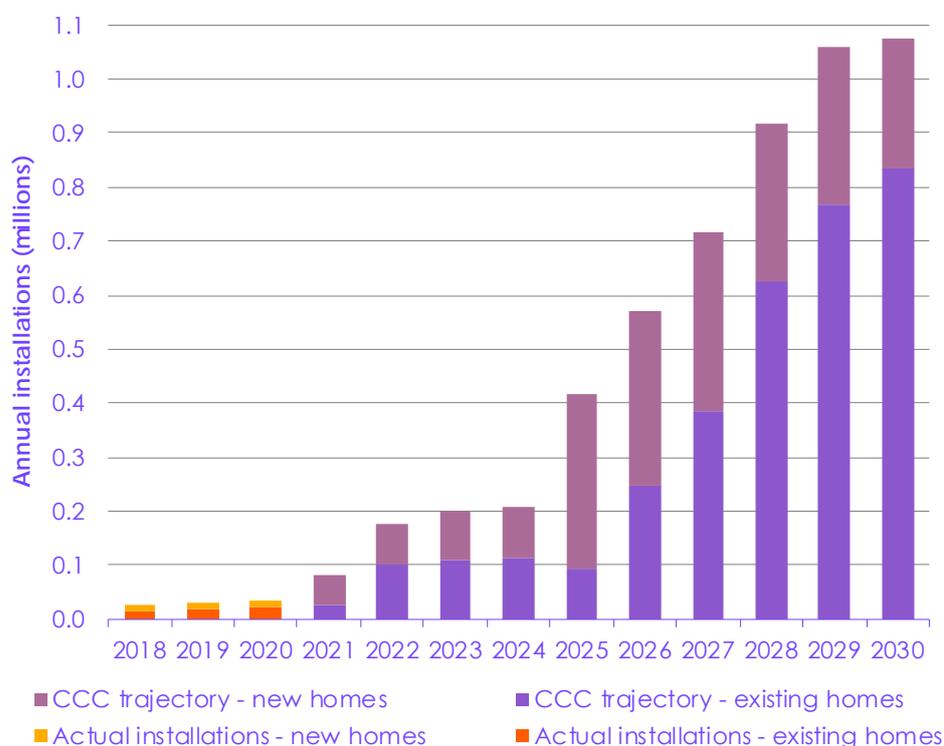


Source: DECC (2014) *Data tables: Green Deal, ECO and Insulation Levels, up to March 2014*, *Green Deal, Energy Company Obligation (ECO) and Insulation Levels in Great Britain*; BEIS (2021) *Household Energy Efficiency Statistics: Headline Tables*; CCC analysis.

Notes: The CCC indicator shown represents the annualised rates of installation based on the Committee's 2015 advice on the Fifth Carbon Budget, which we judged to be a realistic and appropriate annualised installation rate at that time.

Annual heat pump installations in homes rose slightly from 33,000 in 2019 to 36,000 in 2020, driven mainly by an increase in retrofit installations to just under 23,000. This remains significantly below the rates needed over the next few years, which require just over 400,000 heat pump installations per year by 2025, rising to just over 900,000 per year by 2028 (Figure 3.5). These deployment rates remain a fraction of current annual boiler sales of around 1.8 million per year. Deployment in non-domestic buildings also remains very limited, with installations (for systems <50 kW) currently running at less than 1000 per year.

Figure 3.5 Current heat pump installation rates in homes set against the CCC's Balanced Pathway



Source: CCC analysis; BSRIA (2021) *Heat pumps market analysis 2020: United Kingdom*, BSRIA World Market Intelligence.

We will be developing a new indicator framework over the coming year. There is a need for public statistics to evolve to better support monitoring of the low-carbon transition.

We are developing a new indicator framework over the coming year, consistent with the path to Net Zero and the Sixth Carbon Budget:

- We will continue to monitor key areas including heat pump sales and insulation installations alongside biomethane injection. There is substantial scope for publicly available statistics here to be improved to consolidate data on the quantity and nature of UK heat pump and insulation installations, including those outside of government schemes.
- In two key areas there are no annual public statistics: on low-carbon heat networks and on insulation rates in public and commercial buildings. Government should prioritise annual reporting on total heat delivered through heat networks, split by heating technology. We will set out our indicators for public and commercial buildings next year.
- We will also be considering what new indicators may be appropriate, for instance on consumer attitudes, building performance, measures to address overheating and ventilation, building level flexibility, supply chain development and skills.

- Finally, we will put in place a set of policy milestones which factor in Government ambition in the forthcoming Heat and Buildings Strategy, Net Zero Strategy, Hydrogen Strategy, buildings regulations and heat networks policy developments, along with the key phase-out dates from the Sixth Carbon Budget.

### c) Manufacturing and construction (65 MtCO<sub>2e</sub>, 13% of UK emissions in 2019)

The recommended pathway set out in our advice on the Sixth Carbon Budget sees emissions from manufacturing and construction reduce by 43% by 2030 and 71% by 2035 from 2018 levels.

The path to Net Zero set out in our advice on the Sixth Carbon Budget sees emissions from manufacturing and construction reduce by 43% by 2030 and 71% by 2035 from 2018 levels, through improved resource and energy efficiency, material substitution, fuel switching and CCS, as set out in Table 3.3 and Figure 3.6. In addition, supply chains scale up at pace in the pathway, more workers acquire skills to implement low-carbon measures, and the availability of finance increases. The Government's Industrial Decarbonisation Strategy set out a similar pathway, with slightly lower ambition due to lower levels of electrification (see Chapter 4).

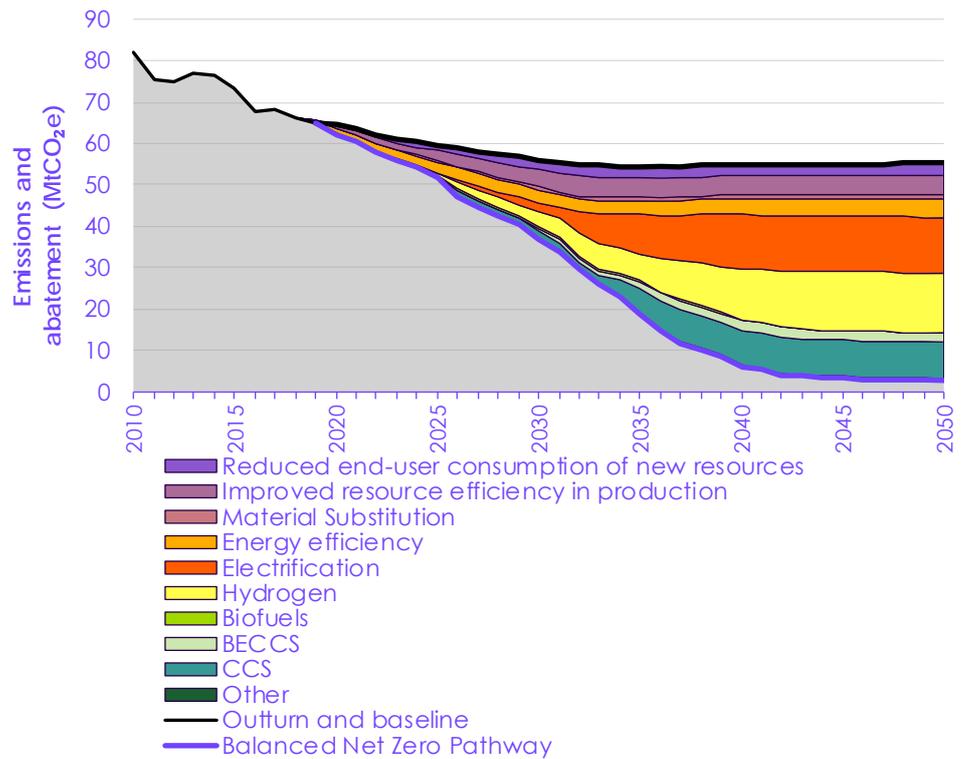
**Table 3.3**

Key metrics for manufacturing and construction in the CCC Pathway to meet the Sixth Carbon Budget

Metric		Latest indicator			Milestones in the CCC pathway				
		Year	Annual change	Value	2025	2030	2035	2050	Trend
Efficiency	Increase in longevity of electronics vs 2019	2019	-	0%	30%	80%	120%	120%	
Electrification, hydrogen and carbon capture and storage	Manufacturing energy use from electricity or hydrogen	2019	+2% points (+8%)	27%	27%	37%	52%	76%	
	CCS in manufacturing (MtCO <sub>2</sub> )	2020	-	0	0.2	2	6	9	

Source: CCC analysis; BEIS (2020) *Digest of UK Energy Statistics (DUKES) 2020*

**Figure 3.6** Source of abatement in the CCC Pathway for the manufacturing and construction sector



Source: CCC analysis, BEIS (2020) *Provisional UK greenhouse gas emissions national statistics 2019*.  
 Notes: The abatement from BECCS in this graph does not include the carbon captured, which is accounted for in the removals subsection of Chapter 3.

Tracking progress against our pathway for manufacturing and construction is currently challenging because of a lack of data, which in some cases is because the technologies or approaches are still at an early stage of deployment.

The limited current data indicate that energy efficiency in manufacturing may have improved and there are examples of early developments with fuel switching and CCS.

The limited current data indicate that energy efficiency in manufacturing may have improved, and there are examples of early developments with fuel switching and CCS.

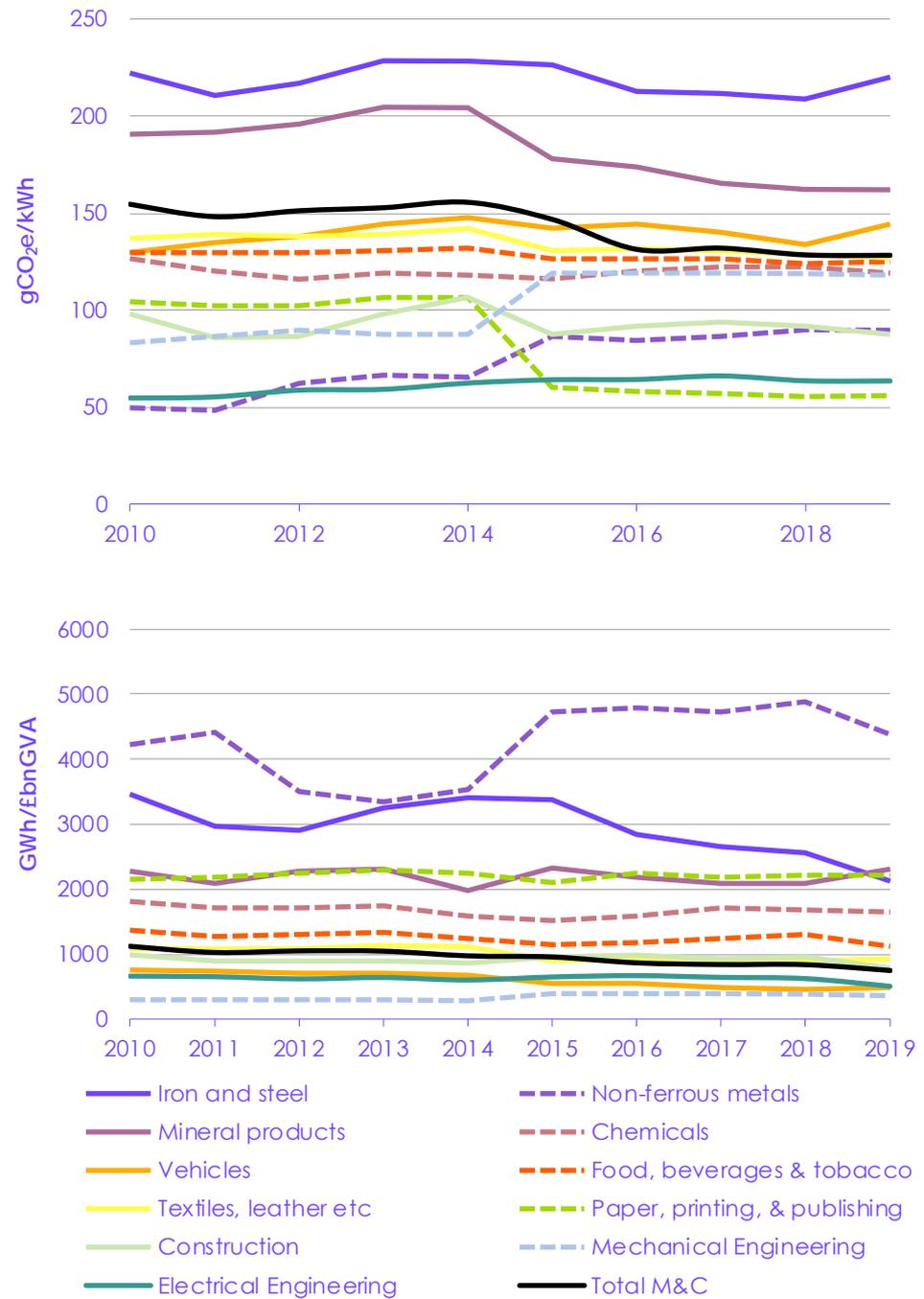
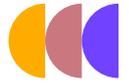
- The energy intensity of manufacturing output fell from 1,120 GWh/£bnGVA in 2010 to 837 GWh/£bnGVA in 2018 and further to 747 GWh/£bnGVA in 2019. However, this partly reflects shifts of GVA from more-energy-intensive subsectors to less-energy-intensive subsectors rather than energy efficiency improvements. At a subsector level (Figure 3.7), energy intensity of manufacturing output has fallen in the 2010-19 period in seven subsectors but risen in four. Within these sectors, this could still reflect shifts from higher-energy-intensity operations to lower-energy-intensity operations, rather than energy efficiency – the available data are not clear.
- However, Government estimate that existing energy efficiency policies<sup>33</sup> in industry have led to abatement of at least 1.1 MtCO<sub>2</sub>e in 2019, up from 0.9 MtCO<sub>2</sub>e in 2018, according to BEIS Energy and Emissions Projections.<sup>34</sup>

- The UK's household recycling rate has plateaued at 44% from 2012 to 2018, indicating that progress on this aspect of resource efficiency has stalled. It will be important for recycling rates to rise to at least 68% by 2030, together with actions to reduce material inputs and increase product longevity, reuse and sharing in order for resource efficiency to contribute fully to achieving the emissions reductions necessary for the Sixth Carbon Budget.
- The carbon intensity of energy use in manufacturing has fallen more slowly than energy intensity, from 155 gCO<sub>2</sub>e/kWh in 2010 to 129 g/kWh in 2018, with no change between 2018 and 2019. The long-term reduction is a result of falling shares from coal and petroleum products, and rising relative contributions from natural gas, bioenergy and waste, and electricity. At a subsector level (Figure 3.7), the emissions intensity of energy in manufacturing has fallen in the 2010-19 period in six subsectors (including paper and pulp, mineral products, and textiles), but risen in five (including non-ferrous metals, construction and mechanical engineering).
- Fuel-switching pilots, such as a commercial-scale biodiesel trial for glass manufacturing, have begun under the Government's Industrial Fuel Switching competition, with the intention of assessing the merits of different low-carbon fuels. CCS pilots are supported under the Carbon Capture and Utilisation Demonstration competition. Some (low) levels of fuel switching for heating in manufacturing have also been supported by the Renewable Heat Incentive, which Government estimate to have contributed 1.9 MtCO<sub>2</sub>e of emissions abatement in 2019, up from 1.7 MtCO<sub>2</sub>e in 2018.<sup>35</sup> This abatement is largely due to uptake of bioenergy supported by the Renewable Heat Incentive.<sup>36</sup>
- The Renewable Transport Fuels Obligation incentivises fuel suppliers for transport and off-road mobile machinery to provide a certain level of biofuels – currently set at 9.75% in 2020 and increasing to 12.4% by 2032.

We will develop an indicator framework for the M&C sector and will monitor progress against this framework beginning with next year's Progress Report.

The Committee will develop an indicator framework based on available data for the manufacturing and construction sector and will monitor progress against this framework beginning with next year's Progress Report. The Government should seek to improve collection and reporting of relevant data to allow for progress to be monitored more effectively.

Figure 3.7 Energy intensity of GVA and direct emissions intensity of energy in manufacturing and construction: 2010 - 2019



Source: DUKES, ONS - GDP low-level aggregates; CCC Analysis

Notes: Unclassified and Other Industry are not shown. In the lower plot, only direct emissions are considered, i.e. not including emissions from electricity production or upstream fuel production.

## d) Agriculture and LULUCF (52 MtCO<sub>2</sub>e, 10% of UK emissions in 2020)

Reaching the Sixth Carbon Budget will mean taking action to reduce emissions on farms, removing emissions from the atmosphere using natural land sinks, shifting to lower-carbon diets and reducing food waste.

The path to meeting the Sixth Carbon Budget and the Net Zero target in 2050 requires a reduction in agricultural emissions of around 30% from 2019 to 2035, and a reversal of the land use sector from a net source currently to a net sink by the mid-2030s. Delivery will require substantial action over the coming years:

- A high take-up of farming practices and technologies to reduce non-CO<sub>2</sub> emissions from managing soils and livestock, and a switch away from fossil fuel use in agricultural machinery to low-carbon alternatives such as electricity.
- Sustainable improvements in agricultural productivity to deliver higher crop yields and increased livestock stocking rates on grassland.
- A significant release of land out of agricultural production (9% by 2035) to enable an acceleration in the planting of trees, hedges, energy crops and the restoration of degraded peatland, all of which can be achieved while delivering other essential functions of land, including maintaining food production and adapting to climate impacts. Other measures include sustainable management of existing broadleaf woodlands and lowland agricultural peat.
- A significant shift in behaviours by 2030, with 20% less meat and dairy consumed on average, and the volume of food waste falling by half.

Key land-based indicators cover agricultural and land use emissions, agricultural productivity, societal behaviour change, and land use change (Table 3.4)

**Table 3.4**

Key metrics for agriculture and LULUCF in the CCC Pathway to meet the Sixth Carbon Budget

Metric		Latest Indicator			Milestones in the CCC pathway				
		Year	Annual change	Value	2025	2030	2035	2050	Trend
Agriculture and land use - GHG emissions	Agriculture (MtCO <sub>2</sub> e)	2019	+1%	55.4	48.6	41.5	39.3	34.9	
	Land use, forestry and peat sector <sup>1</sup> (MtCO <sub>2</sub> e)	2019	+3%	12.9	10.4	6.5	0.9	-19	
Agricultural practices	Crop yields (wheat t/ha), equivalent increases for other crops	Average 2017-19	0	8.2	8.6	9.1	9.5	11.0	
	Livestock numbers <sup>2</sup> (million)	2019	-1%	48	46	41	39	35	
Demand reduction	Weekly meat consumption <sup>3</sup> (g/person) (includes fresh and processed meat)	2020	0	1,045	950	840	800	680	
	Food waste (edible) (million tonnes)	2018	-	8.0	6.5	5.3	5.2	4.7	
Land use	Afforestation (000 hectares/year)	2019 / 2020	+1%	13.7	30	30	50	50	
	Energy crops (000 hectares/year) <sup>4</sup>	2018	0	10	6	27	30	30	
	Peat area restored (000 hectares/year) <sup>5</sup>	2020	-	8.5	67	67	67	9	
	Active broadleaf woodland management (%)	2020	0	20%	40%	80%	80%	80%	

Source: CCC analysis

Notes: 1. Land use net GHG emissions for 2019 is based on the high forestry peat estimate; 2. Covers cattle, sheep and pigs; 3. Per person. 2020 value is an estimate based on the average of the two previous years; 4. 2018 value is total area of SRC and miscanthus in England only; 5. Restoration in 2020 funded by the National Peatlands Action Programme, 2020 (Wales), the £10m Peat Capital Grant Scheme, 2019/20 (England) and Scottish Government funding, 2020.

Underlying progress to reduce emissions from agriculture and land is currently falling behind.

Underlying progress to meet our ambition remains short in most of these areas:

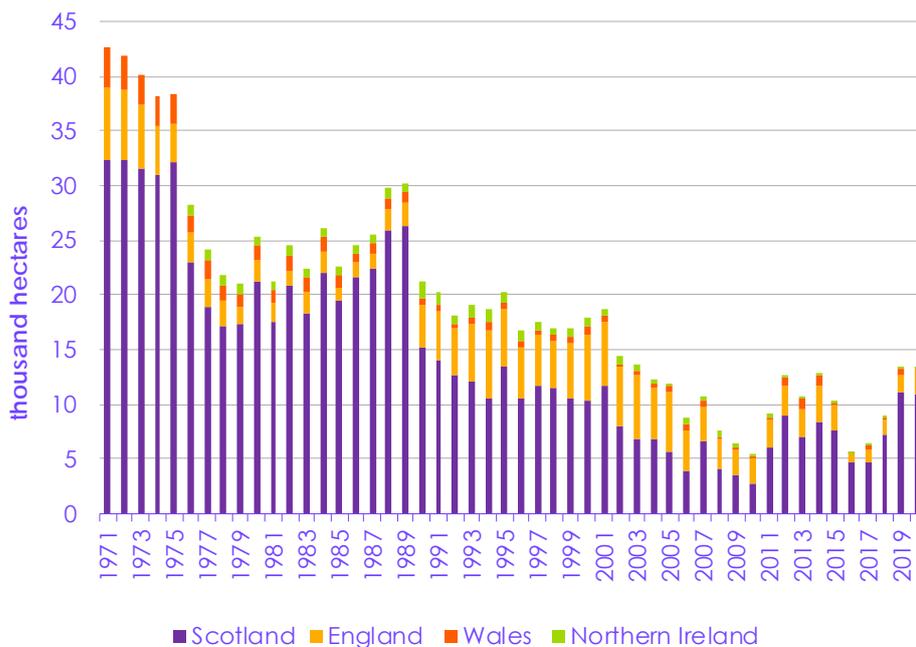
- Releasing land out of agriculture requires an improvement in agricultural productivity. Cereal crop yields have largely plateaued in the last two decades, but better agronomic practices coupled with advances in crop breeding are required to deliver sustainable yield increases. Increasing the utilisation of grassland area by grazing livestock from around 50% currently could allow for increases in stocking rates without impacting feed requirements (quantity and quality), thereby allowing some grassland area to switch to other uses.

- Current rates of UK afforestation of over 13,000 hectares/year in 2018/19 and 2019/20 remain well below the level required to meet the Government's commitment (as set out in the *England Tree Strategy consultation (2020)*), which matches the Sixth Carbon Budget recommendation of 30,000 hectares/year in 2025 (Figure 3.8).
- Peat restoration has been focused on the uplands to date, but meeting the Sixth Carbon Budget pathway will require both an acceleration in the levels of upland restoration to 50,000 hectares/year, and extending activity to lowland peat, which can emit ten times more emissions per hectare compared to the uplands. Options to sustainably manage the area of lowland peat that remains in agricultural production need to be developed.
- The area planted with perennial energy crops (miscanthus and short rotation coppice) totals 10,000 hectares (England only),<sup>37</sup> which has fallen by over a quarter since 2008. The planting of short rotation forestry for bioenergy is non-existent. Combined annual planting rates of all three biomass types need to ramp up to over 25,000 hectares by 2030.
- Take-up of on-farm practices to reduce soil, livestock and waste emissions needs to increase significantly; emissions in agriculture have remained flat for the last ten years. Agricultural survey data reveal more farmers are considering emissions when making decisions on land, with 64% reporting that it was 'very' or 'fairly' important in 2020,<sup>38</sup> increasing from the 49% surveyed in 2017. The same survey found that 66% of farmers were taking actions to reduce emissions, up from 56% in 2017.
- Decarbonising agricultural vehicles will require the market commercialisation of low-carbon solutions beyond the current use of biofuels, including electrification of large machinery (e.g. tractors), which is still at the proto-type stage.
- Official data show that consumption of meat and meat products rose 3% between 2015/16 and 2018/19.<sup>39</sup> There has been a reduction in fresh meat products, but this is more than offset by a rise in processed meat. More recent survey data suggests an increased willingness to eat less meat in the future, with 65% of over 2,000 people surveyed stating that more knowledge on how to plan and cook less meat dishes would help them to cut back.<sup>40</sup>
- Reducing food waste is resource efficient and could free up agricultural land for natural sequestration options. The Waste Reduction Action Programme (WRAP) announced last year that the UK was halfway to achieving the UN's Sustainable Development Goal 12.3 to cut post-farm gate food waste in half by 2030. As of September 2020, around 260 organisations, including 16 retailers and 162 producers/manufacturers had signed up to the Road Map.

The measures outlined above to meet the Sixth Carbon Budget pathway will deliver wider benefits to the natural environment critical to all other economic activity and human well-being. These include flood protection, improved air quality, health and recreation benefits of woodlands, water regulating services as well as improving the natural environment's ability to adapt to climate impacts.

Current levels of tree planting are well below where they need to be. The majority of all UK tree planting in the last five years has happened in Scotland.

Figure 3.8 UK Afforestation rates (1971-2020)



Source: Forestry Commission, Natural Resources Wales, Forest Service and Forestry Commission statistics.  
Notes: Planting year ends end March. Data not available for Northern Ireland from 1971-1975.

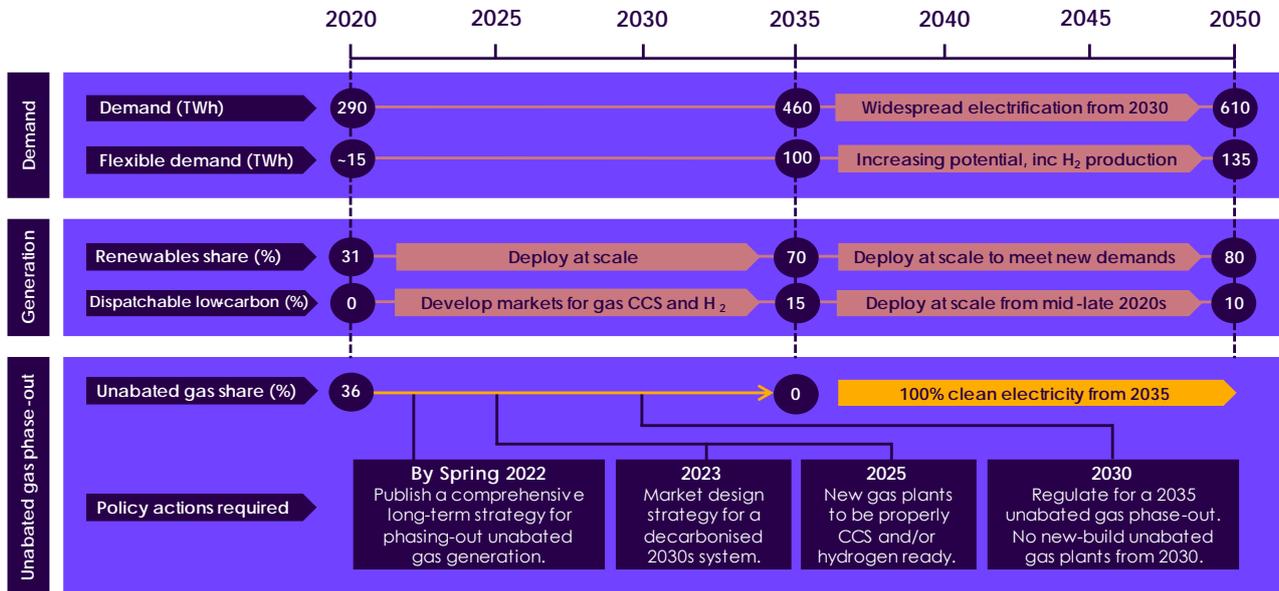
To allow the Committee to track progress against the Sixth Carbon Budget Pathway, we will be developing a comprehensive indicator framework for the agriculture and land use sectors to be included in next year's Progress Report. Key indicators that we will be developing include: agricultural emissions by source (e.g. soils, enteric fermentation) and GHG type; take-up of particular low-carbon farming practices and measures; planting rates of trees on-farm; peat restoration by type (e.g. lowland, upland and forestry); attitudes to diet change and reducing food waste; and the impact of non-financial barriers to changes in land.

## e) Electricity supply (52 MtCO<sub>2e</sub>, 10% of UK emissions in 2019)

Electricity generation should be fully decarbonised by 2035, to enable full benefits to be drawn from the widespread electrification that is needed for Net Zero.

Electricity generation should be fully decarbonised by 2035, while meeting a 50% increase in annual demand. This will require large-scale deployment of new low-carbon generating capacity that is resilient to a changing climate, phasing out unabated gas-fired generation, action on contracting models and on planning and consenting regimes, as well as ensuring networks are ready to accommodate new demands and generation (Figure 3.9).

Figure 3.9 Timeline of key outcomes and policy requirements for electricity generation under the CCC Pathway (2020-50)



Source: CCC (2020) *Policies for the Sixth Carbon Budget and Net Zero*.

Notes: Renewables share includes wind and solar. Dispatchable low-carbon generation includes gas CCS, BECCS, and hydrogen plants. Demand is lower than generation, accounting for losses, flexibility services, and interconnection.

The reductions seen in the power sector in the past five years reflect genuine underlying progress.

Power sector emissions fell by 15% in 2020, in line with the average rate over the preceding five years. That reflects an increase in the capacity and utilisation of low-carbon generation, together with lower demand due to the COVID-19 pandemic that reduced required fossil generation (Table 3.5):

- **Installed capacity of variable renewables** increased in 2020 by 0.8 GW. This is a much slower rate than the average of 3.8 GW achieved over the previous 5 years, although the slowdown is likely to be temporary.
  - Half of the increase in capacity was offshore wind increasing to 10.4 GW of operational capacity. The 0.4 GW increase compares to a minimum growth of 4 GW required per year from the mid-2020s onwards in order to meet the Government's target for 40 GW installed capacity in 2030.
  - This slowdown is likely to be temporary, given the pipeline of new offshore wind projects underway:
    - Offshore wind capacity under construction increased by 60% in 2020 to 7.2 GW, with a further 2.6 GW having secured Government contracts.

- 20 GW of capacity is in development and/or pre-planning.
- In February 2021 the Crown Estate auctioned seabed leases for an additional 8 GW of capacity.

Low-carbon generation increased 5% in 2020. Offshore wind generation increased by 26% due to particularly windy conditions early in the year.

- **Low-carbon generation** increased by 5% in 2020 compared to 2019, against a backdrop of lower overall demand due to COVID-19 restrictions.
  - The majority of that increase was accounted for by offshore wind generation, which rose by 26% due to particularly windy conditions early in the year.
  - As a result, low-carbon generation increased to 62% of total electricity generation in 2020, up from 57% in 2019. The share of variable renewables in total generation increased from 26% to 31%.

Fossil generation fell by 17% in 2020, as unabated gas was squeezed out by higher renewables output, lower demand, and the continued decline of coal.

- **Fossil generation** decreased by 17% in 2020, the largest annual percentage fall in the last 20 years. The reduction was primarily in gas-fired generation, but coal use also continued to decline.
  - Unabated gas generation fell by 17%, as it was squeezed out by a combination of increased renewables output and lower overall demand. As a result, unabated gas comprised 36% of the overall generation mix. This needs to continue to fall, to zero by the mid-2030s, in order to meet the Sixth Carbon Budget.
  - Coal generation fell by 21% in 2020, as further coal plants were closed at Aberthaw and Fiddlers Ferry. This meant coal-fired generation only comprised 2% of total generation in 2020, continuing the long-term decline towards the Government's target of phasing out coal use in the power sector by 2024.

Emissions intensity fell 10% in 2020, reflecting lower demand, higher renewables output and reduced fossil generation.

- **Grid intensity.** The combination of lower demand, increased renewables output, and reduced fossil generation meant the carbon intensity of electricity fell by 10% in 2020 to 182 gCO<sub>2</sub>/kWh. This needs to continue to fall substantially over the 2020s, to less than 50 gCO<sub>2</sub>/kWh in 2030 and around 10 gCO<sub>2</sub>/kWh in 2035.\*

\* Our recommendation is for a fully decarbonised electricity generation sector by 2035. That is consistent with a small positive emissions intensity, which reflects some residual emissions (e.g. from gas CCS) and that negative emissions from use of bioenergy with carbon capture and storage (BECCS) are accounted for separately.

**Table 3.5**

Key metrics for electricity supply in the CCC Pathway to meet the Sixth Carbon Budget

Metric	Latest Indicator			Milestones in the CCC pathway				
	Year	Annual change	Value	2025	2030	2035	2050	Trend
Grid intensity (gCO <sub>2</sub> /kWh)	2020	-20	182	125	45	10	2	
Offshore wind capacity (GW)	2020	+0.4 GW	10.4	25	40	50	95	
Variable renewable generation (%) *	2020	+5% points	31%	45%	55%	70%	80%	
Dispatchable low-carbon generation (%)**	2020	0	0	0	10%	15%	10%	
Unabated gas generation (%)	2020	-5% points	36%	30%	10%	0	0	

Source: CCC analysis based on BEIS (2021) *EnergyTrends*.

Notes: \*Wind and solar generation. \*\*Includes gas with carbon capture and storage, hydrogen and bioenergy with carbon capture and storage.

We will continue to track these milestones over the coming year, while developing additional indicators for assessing the use of flexibility on the demand-side (e.g. through heat pumps and electric vehicles).

### f) Aviation (40 MtCO<sub>2</sub>e, 8% of UK emissions in 2019)

Air passenger demand saw annual growth of around 1.5% per year before 2020. The size of the sector that will emerge post-pandemic is uncertain.

While aviation emissions fell significantly in 2020 this reduction was not driven by underlying progress in decarbonising the sector but rather was a result of the pandemic and associated restrictions.

While there is still uncertainty around the size of the sector that will emerge post-pandemic (see Chapter 2), passenger demand is expected to increase again after travel restrictions are eased, potentially recovering to close to pre-pandemic levels by the mid-2020s. Action to accelerate efficiency improvements and some demand management will therefore be needed to drive emissions gradually down to 2035:

- The pathway used to determine the Sixth Carbon Budget includes an increase in aviation emissions out to 2024 as travel restrictions are eased. Emissions reduce gradually thereafter due to efficiency improvements, demand management and a modest contribution from sustainable aviation fuels (SAF) starting in the mid-2020s. Emissions fall by 16% and 23% to 2030 and 2035 respectively, from 2019 levels.
- Efficiency, as measured by fuel consumption per passenger-kilometre, improved by 1.5% between 2018 and 2019, following on from an average annual improvement of 2.1% between 2008 and 2018. Progress will need to continue at pace to meet the Sixth Carbon Budget – in our pathway fuel

Improvements in flight efficiency must be sustained to meet the Sixth Carbon Budget.

efficiency improves by 1.7% each year between 2020 and 2050, reaching 0.25 kWh/passenger-km by 2050, from 0.44 kWh/passenger-km in 2019.

- Demand, as measured by plane-km flown per person, increased by 1.9% between 2018 and 2019, following on from an average annual increase of 1.5% between 2008 and 2018. The pandemic and related restriction led to a major reduction in demand in 2020. Our pathway assumes some recovery in demand over the first half of the 2020s, to close to pre-pandemic levels, and assumes a modest increase in plane-km per person thereafter (0.3% each year). This growth is considerably less than a 'business as usual' baseline, though clearly what happens next is highly uncertain. Some moderation of demand growth is likely to be required to meet the legislated emissions targets, as pre-pandemic trends in demand growth exceed what we expect can be accommodated in a Net Zero world.

**Table 3.6**  
Key metrics for aviation in the CCC Pathway to meet the Sixth Carbon Budget

Metric		Latest indicator			Milestones in the CCC pathway				
		Year	Annual change	Value	2025	2030	2035	2050	Trend
Demand	Passenger-km per person	2019	+2.0%	5,400	5,500	5,500	5,700	6,800	
Efficiency and hybrids	Fuel consumption (kWh of fuel used per passenger-km)	2019	-1.5%	0.41	0.39	0.36	0.33	0.25	
	Electric-hybrids (% of km flown)	2020	-	-	-	-	-	9	
Sustainable aviation fuels	SAF fuel share (%)	2020	-	-	0.1	2	8	25	

Source: CCC analysis and Department for Transport analysis of Civil Aviation Authority passenger-km data.

Notes: the demand milestone corresponds to passenger-km from departing flights only, which is the convention when measuring aviation demand. This differs to the aviation demand milestones reported in the Sixth Carbon Budget report (Table 2, p27 of the main report), which relate to both departing and arriving flights; CO<sub>2</sub> emissions are from fossil fuel sources only. Fuel efficiency improvements also differ to those cited in the Sixth Carbon Budget (Table 8.1, p261 of the methodology report) as they are based on fuel consumption per passenger-km, and Sixth Carbon Budget figures are based on CO<sub>2</sub>/passenger.

## g) Fuel supply (37 MtCO<sub>2</sub>e, 7% of UK emissions in 2019)

The fuel supply sector covers fossil fuel\*, hydrogen, and bioenergy supply. While new emissions could arise from the production of low-carbon hydrogen in the future, current emissions in the sector come from fossil fuel supply only. In future, we will include in this sector any emissions associated with hydrogen production for use as a fuel in the energy end-use sectors (but not hydrogen produced for other uses, such as fertiliser production).

Fossil fuel supply is currently the only source of emissions in fuel supply.

Emissions associated with hydrogen and bioenergy are currently accounted for in other sectors of the UK inventory and other sections of this chapter.

- Section d) of this chapter covers emissions associated with the cultivation of energy crops and UK forestry.
- Section c) accounts for emissions from current UK high-carbon hydrogen and ammonia production (e.g. for use in industry and agriculture) as well as bioenergy conversion.
- Sections a) f) and i) include emissions from transporting fuels and biomass by land, air and sea.

**Table 3.7**  
Key metrics for fuel supply in the CCC Pathway to meet the Sixth Carbon Budget

		Latest Indicator			Milestones in the CCC pathway				
		Year	Annual change	Value	2025	2030	2035	2050	Trend
Hydrogen	Low-carbon hydrogen production (TWh)	2020	-	-	1	30	105	225	
Fossil fuel production	Demand for unabated oil and gas (TWh)	2019	-1%	1750	1500	1050	665	110	
	Fall in emissions from 2018 levels - fossil fuel supply (%) <sup>1</sup>	2019	1% point fall	-1%	-22%	-54%	-77%	-97%	
	Fall in emissions from 2018 levels - oil and gas production and processing (%) <sup>2</sup>	2019	1% point increase	+1%	-28%	-68%	-87%	-98%	

Source: CCC analysis; BEIS (2020) *2020 UK Greenhouse Gas Emissions, Provisional Figures*; BEIS (2020) *Digest of UK Energy Statistics (DUKES)*

Notes: All figures in TWh have been rounded to the nearest 5. 1. Abatement from fossil fuel supply is relative to 2018 levels. This category refers to emissions associated with oil refining, oil and gas production, oil and gas production terminals (including compression stations and LNG terminals), gas distribution networks, and open and closed coal. 2. Abatement from offshore oil and gas production is relative to 2018 levels. This category comprises emissions from oil and gas platforms and terminals in line with the scope of the North Sea Transition Deal.

\* Fossil fuel supply covers oil refining, oil and gas production, oil and gas processing terminals, gas transmission and distribution networks and open and closed coal mines.

There have been limited emissions reductions resulting from active efforts to decarbonise the sector. Emissions will need to fall sharply across the sector to align to our Sixth Carbon Budget advice, in which emissions reduce by around 75% by 2035.

There have not yet been strong efforts to decarbonise fossil fuel supply

- **Coal production.** The use of coal across the economy has decreased notably due to reduced demand associated with the phase out of coal in electricity supply. In addition, the closure of the last deep coal mine in 2016, and recent closures of surface mines in England have contributed to reducing emissions from 22 MtCO<sub>2e</sub> in 1990 to less than 1 MtCO<sub>2e</sub> in 2020. Around 75% of remaining emissions can be attributed to the leakage of methane from closed coal mines.
- **Electrification and reduced methane flaring and venting** in oil and gas production is limited. There will need to be a rapid ramp up to achieve the required 68% emissions reductions from oil and gas production by 2030 underlying the path to the Sixth Carbon Budget (Table 3.7).
- **Methane leakage** has reduced due to the Iron Mains Risk Reduction Programme, which has contributed to reducing emissions. However, it is unclear whether this policy alone is sufficient to achieve the additional 2.3 MtCO<sub>2e</sub> of abatement required in our analysis by 2030, particularly in the context of possible network decommissioning due to reduced use of natural gas.
- **Carbon capture and storage** can be used in refineries to reduce emissions in the sector, especially in clusters around other manufacturing and power generation sites (see section c)). Our scenarios for the Sixth Carbon Budget advice included use of CCS to reduce emissions by 1.3 MtCO<sub>2e</sub> in 2030. This will require wider deployment of CCS infrastructure to support decarbonisation of industry and electricity generation as well as contributing to Net Zero through hydrogen production and greenhouse gas removals.

Emissions reductions in fossil fuel supply will need to increase rapidly to align to UK targets

The Committee will develop a new set of indicators to track progress in fuel supply in next year's Progress Report, potentially including indicators on the early-stage developments in hydrogen production, the emissions intensity of oil and gas production, private sector plans/commitments, and the monitoring of methane leakage from gas networks.

Government should seek to improve collection and reporting of relevant data to allow for progress to be monitored more effectively.

## h) Waste (25 MtCO<sub>2e</sub>, 5% of UK emissions in 2019)

The path to Net Zero set out in our Sixth Carbon Budget advice sees emissions in the waste sector reduce by 78% compared to today's levels by 2050.

To align to our recommended Net Zero pathway urgent action is needed to address emissions from landfill and Energy from Waste plants, primarily through improvements to recycling and waste prevention.

To get on track, urgent action is needed to reduce methane emissions from landfill, alongside improvements to recycling and resource efficiency, with minimisation of the quantity of waste going to Energy from Waste (EfW) and the emissions from those plants:

- The UK's combined recycling rate\* needs to increase from 52% to at least 59% by 2025 (45% to 50% for household waste), from which point key biodegradable waste streams should be banned from going to landfill.
- Energy from Waste (EfW) emissions, which have been rising rapidly, need to be constrained at approximately today's levels through increased waste prevention, re-use and recycling, and policy to enable EfW plants to be fitted with CCS from the late 2020s.
- Methane capture rates need to increase from 55% to 80% by 2050 to address fugitive emissions from landfill, while further actions are needed to reduce methane emissions from composting and wastewater treatment.

**Table 3.8**  
Key metrics for waste in the CCC Pathway to meet the Sixth Carbon Budget

		Latest Indicator			Milestones in the CCC pathway				
		Year	Annual change	Value	2025	2030	2035	2050	Trend
Resource Efficiency	Residual waste per capita (kg/yr)	2018	+2%	490	400	310	280	300	
Recycling	Combined (Household + C&I) Recycling Rate for UK (%) <sup>1</sup>	2018	+1% point	52	59	68	68	68	
	Household Recycling Rate for UK (%)	2018	-0.5% point	45	50	56	56	56	
Landfill	Biodegradable Waste Sent to Landfill in UK (Million tonnes)	2018	-3%	7.2	1.2	0.9	0.9	0	
	Landfill Methane Capture Rate (%) <sup>2</sup>	2019	-1% point	55	60	64	68	80	
Energy from Waste	Energy from Waste Emissions (MtCO <sub>2</sub> e)	2019	+12%	5.5	6.5	5.0	5.1	0.4	

Source: Milestones: CCC analysis, Methane Capture Rates: NAEI UK GHG Inventory 2019, Household Recycling Rate and Biogenic Municipal Waste to Landfill: DEFRA UK Waste Statistics Publication 2018

Notes: 1. There are inconsistencies in the way waste arisings and recycling data are reported across the UK, and significant data gaps remain – most notably around the availability of recycling data for Commercial and Industrial waste (C&I). Our Balanced Pathway for Waste uses a 'Combined' Recycling Rate for the UK, comprised of Household (approximately equivalent to Waste from Household statistics) and C&I (municipal and non-municipal). The C&I portion of this indicator and associated milestones are based on assumptions of C&I recycling rates. 2. Currently DEFRA only publishes statistics on municipal biodegradable waste to landfill, which is a reasonable proxy for overall biodegradable waste to landfill.

We understand DEFRA is in the process of developing new waste and recycling indicators and statistics, including for municipal and C&I recycling, and biodegradable waste to landfill, which we will seek to reflect in future iterations of this indicator framework.

\* The CCC Pathway for Waste uses a 'Combined' Recycling Rate for the UK, comprised of Household (approximately equivalent to Waste from Household statistics) and C&I (municipal and non-municipal).

Progress in reducing emissions from landfill and in improving recycling have stalled in recent years, while emissions from Energy from Waste plants have risen sharply.

Progress in reducing emissions from waste at a UK level has stalled in recent years as reductions in landfilling of biodegradable municipal waste and improvements to recycling rates have slowed, and landfill methane capture rates have declined.

- The amount of biodegradable municipal waste being sent to landfill in 2019 was around 80% lower than 1995 levels but has plateaued at between 7-8 million tonnes a year since 2015 (Figure 3.10)
- Following rapid improvements through the 2000s\* UK recycling rates have remained at around 44% since 2012 and the EU-derived target of achieving 50% recycling by 2020 looks almost certain to have been missed.
- Landfill methane capture rates peaked at over 74% in 2016 but have since declined to 55%.
- Wales continues to outperform the rest of the UK in terms of recycling, with a 'waste from households'<sup>†</sup> rate of well over 50%, and a municipal recycling rate of 65% in 2019 (Figure 3.11).

Meanwhile, recent years have seen sharp increases in emissions from EfW which has become an increasingly popular waste treatment solution for Local Authorities.<sup>41</sup>

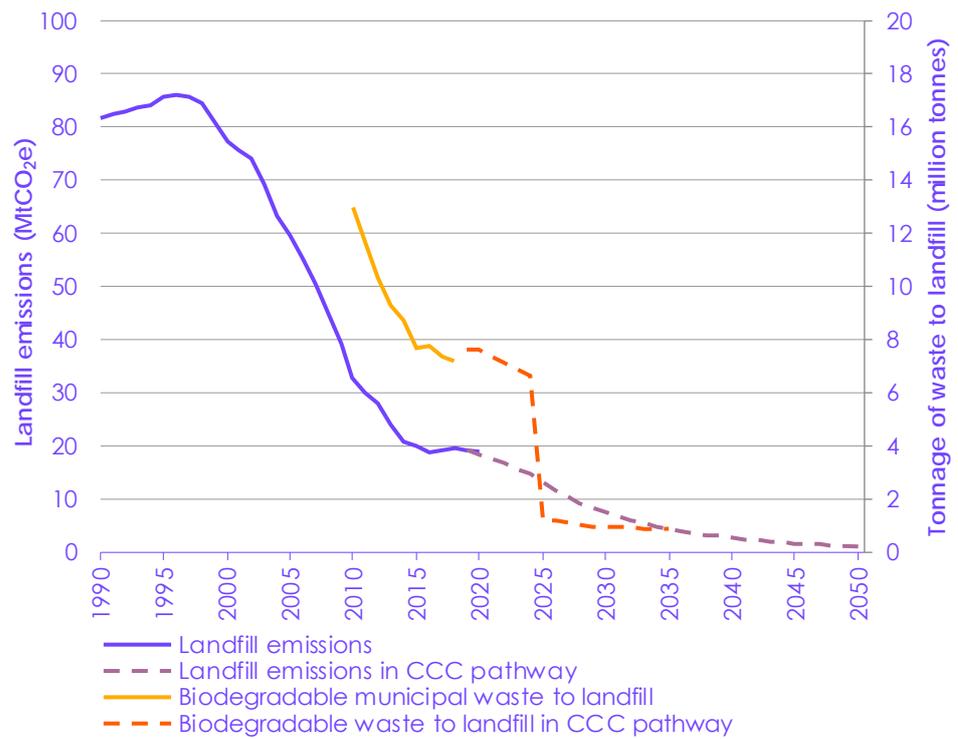
- In 2019, the latest year for which emissions data is available, emissions from EfW increased by over 10% on 2018, putting it on course to overtake emissions from coal power in 2020.
- If EfW usage continues to rise unchecked, then its emissions will exceed the CCC pathway while potentially undermining recycling and re-use efforts.

We are in the process of developing our indicator framework for the waste sector with a view to reporting on this from 2022. This will seek to provide better alignment to UK waste reporting statistics, greater granularity at a devolved administration level and improved coverage of resource efficiency.

\* England's Local Authority Combined Recycling Rate increased from 12% in 2000 to 40% in 2020.

<sup>†</sup> 'Waste from Households (WfH)' is the agreed harmonised UK measure that was previously used to report household recycling to comply with the Waste Framework Directive (2008/98/EC). Under this Directive the UK was required to meet a target to recycle 50% of household waste by 2020.

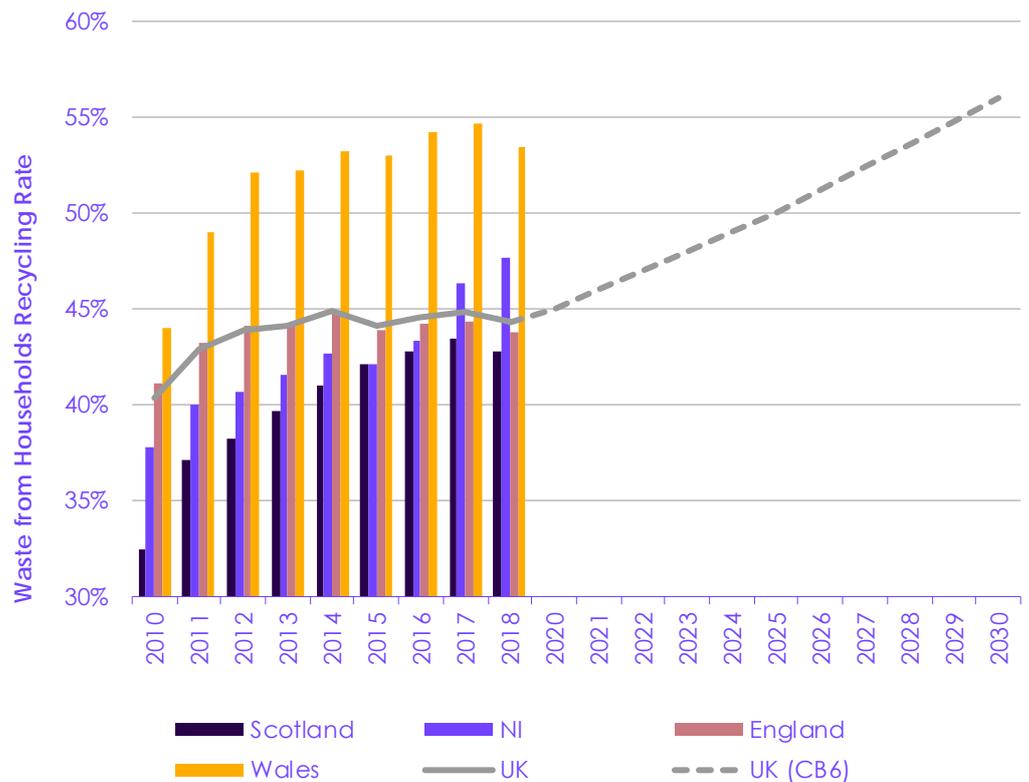
Figure 3.10 UK emissions from Landfill and tonnages of Biodegradable Waste to Landfill



Source: Defra (2018) *UK Statistics on Waste*; BEIS (2021) *Provisional UK greenhouse gas emissions national statistics 2020*.

Notes: 'CCC pathway' is the Balanced Net Zero Pathway published in our December 2020 advice on the Sixth Carbon Budget. Emissions in this chart are adjusted for future changes to the Global Warming Potentials (GWPs) of non-CO<sub>2</sub> greenhouse gases.

Figure 3.11 Waste from Household Recycling Rates across the UK



Source: Defra (2020) UK Statistics on Waste (2018).

Notes: UK (CB6) is the 'Balanced' pathway for household recycling rates set out in our Sixth Carbon Budget Report.

Welsh progress on recycling and resource efficiency is an example to the rest of the UK. Statutory requirements and sustained investment have been key factors to its success to date.

### Box 3.3

#### Welsh Progress on Recycling and Resource Efficiency

Wales continues to lead by example on waste prevention, re-use and recycling, driven by ambitious targets, continued investment in infrastructure and services, and a holistic approach to resource efficiency policy.

- 2019 again saw improvements in recycling, with municipal recycling rates up to 65% from 63% in the previous year – one of the highest recycling rates in the world.
- Key measures to boost recycling have included the setting of statutory Local Authority recycling targets, over £1 billion of investment in recycling services and the provision of separate food waste collections.
- By 2025, Wales has set ambitious targets to reach a 70% recycling rate, and send zero waste to landfill, alongside a 50% reduction in avoidable food waste arisings.
- In March 2021, the Welsh Government published 'Beyond Recycling' – its updated circular economy strategy. This includes a commitment to become zero-waste by 2050 and to make resource efficiency part of Welsh culture.
- The Welsh Government has provided funding and set out robust policy measures to follow through on their commitments, including through an £80m Circular Economy Fund, requirements for non-domestic recycling and Extended Producer Responsibility.
- The Strategy demonstrates an understanding of the need to take a systems approach to resource efficiency, including measures to prevent recyclable materials being diverted to Energy from Waste, efforts to tackle all unnecessary

single-use items (as opposed to just plastics) and consideration of a technical standard for embodied carbon in buildings.

If the activities and commitments set out in the 'Beyond Recycling' strategy are successfully delivered, they would significantly reduce Wales' emissions from waste. The UK Government and other Devolved Administrations should seek to replicate the strong progress made by the Welsh Government in this area, including by learning from the Welsh approach.

Source: Welsh Government (2021) *Beyond recycling*.

### i) Shipping (14 MtCO<sub>2e</sub>, 3% of UK emissions in 2019)

Low-carbon fuels make up the large majority of shipping emissions savings in our CCC Pathway. This will require investment and R&D during the 2020s.

Within the path to Net Zero set out in our Sixth Carbon Budget advice, over 80% of shipping abatement is due to the transition to low-carbon fuels, such as ammonia (Table 3.9). This will require important enabling actions over the coming years:

- While uptake of these fuels in volume is not expected until the 2030s, investment and research and development should ramp-up during the 2020s to showcase proof-of-concept and develop an early market.
- Global shipping emissions have risen by 7% over the decade to 2019. The UK should lead in working with the International Maritime Organisation (IMO) and other willing partners to strengthen international targets and policy mechanisms to meet them.

Global shipping emissions are still rising – the UK should lead in working internationally to reverse this.

**Table 3.9**

Key metrics for shipping in the CCC Pathway to meet the Sixth Carbon Budget

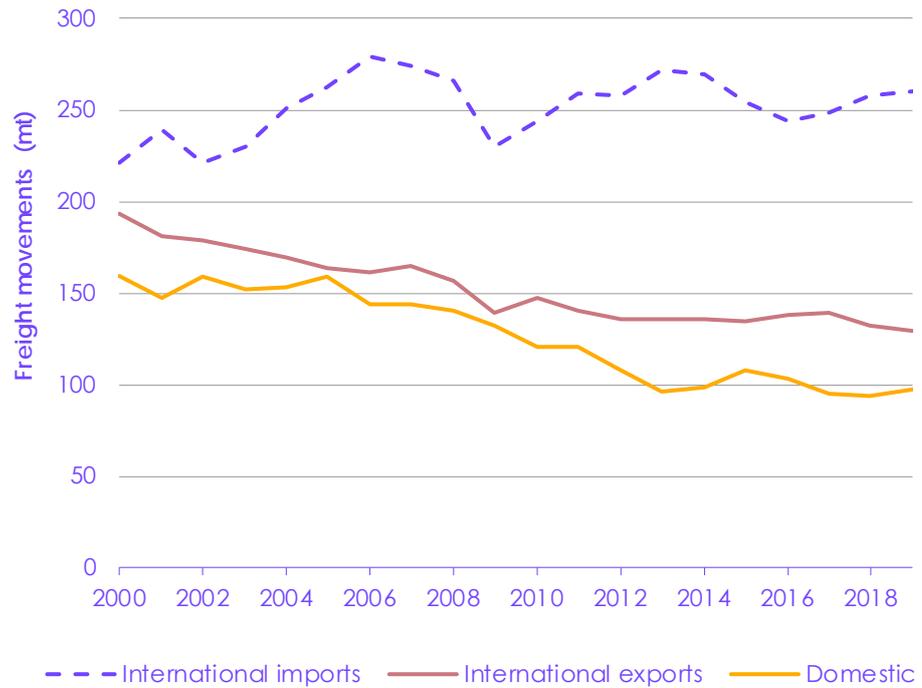
	Latest Indicator			Milestones in the CCC pathway				
	Year	Annual change	Value	2025	2030	2035	2050	Trend
Use of low-carbon fuels (% of demand)	2020	-	0.0%	0.0%	0.2%	34%	91%	
Use of electricity (% of demand)	2020	-	0.0%	0.2%	1%	2%	4%	

Source: CCC analysis.

Notes: Low-carbon fuels comprise the large majority of the emissions savings from shipping within our Balanced Pathway. Deployment of these fuels is expected to ramp up mainly during the 2030s – R&D and market development, alongside progress on vessel efficiency and shore-side electrification, are needed during the 2020s.

Over the decade to 2019, domestic shipping activity fell by 26% and outbound international freight shipping reduced by 7% (Figure 3.12).<sup>42</sup> Overall freight tonnages have fallen by 3%,<sup>43</sup> driven by substantial reductions in imports of oil and coal.

Figure 3.12 UK international and domestic total port traffic, by freight volume



Source: DfT (2020) *Port and domestic waterborne freight statistics*.

Notes: Domestic figures include both coastwise and one-port shipping. International imports are shown with a dashed line since they will typically refuel outside the UK and are thus not included within our UK emissions inventory. See the Section 3 of Chapter 2 on consumption emissions for further discussion.

Global shipping carbon intensities have improved by around 30% over 2008-2018.<sup>44</sup> The IMO has recently introduced new binding energy efficiency and carbon intensity indicators which will increase this to a 40% improvement by 2030. However, there are concerns<sup>45</sup> that this may be insufficient to drive emissions reductions across the sector.

Increasing investment in and use of low-carbon energy and improvements to vessel efficiency will be key indicators of progress in this sector.

In future Progress Reports, we will seek to monitor progress in the enabling actions required to increase availability of low-carbon fuels and vessel efficiency in the shipping sector.

- Government's March 2021 consultation on the future of the Renewable Transport Fuel Obligation (RTFO) proposes to extend the scope of the RTFO to make renewable fuels of non-biological origin (RFNBOs; including hydrogen, ammonia and methanol) for use in the shipping sector eligible for support. We will monitor the levels of investment and production that result from this change.
- Clean maritime clusters and other innovative trials, such as the proposed hydrogen transport hub in Tees Valley, will be important in stimulating the emergence of a market for low-carbon shipping.
- Further improvements could be delivered through shore-side electrification (which could also offer strong air quality benefits<sup>46</sup> by avoiding the use of fossil-fuelled engines in ports, but will require action to surmount barriers to its deployment), provision of the requisite supporting infrastructure and smart efficiency measures, which are all included within the recently launched Clean Maritime Demonstration Competition.

The Committee will seek to monitor progress in each of these areas as part of a fuller indicator framework, which will be used to monitor progress from next year's Progress Report, in 2022.

## j) F-gas emissions (13 MtCO<sub>2</sub>e, 3% of UK emissions in 2019)

The majority of the required fall in emissions of F-gases is expected to fall under strict existing regulations. Our 'baseline' scenario for emissions sees existing regulations drive F-gas emissions down by 75% from current levels by the time of the Sixth Carbon Budget period.

There is some limited evidence that underlying progress is being made against the additional measures we have identified outside the baseline.

- **Enforcing regulations.** Regulations are only as good the rate of compliance. The Environment Audit Committee has reported evidence of suspected non-compliance, especially as the EU F-Gas Regulation increases demand for refrigerants with lower Global Warming Potential (GWP), and a lack of resources for the Environment Agency to carry out adequate inspections.<sup>47</sup>
- **Inhalers.** High GWP metered dose inhalers (MDIs) are still the main type of inhaler used in the UK.
  - NHS England's Long Term Plan has set targets to deliver significant and accelerated reductions in the total emissions from the NHS by moving to lower-carbon inhalers, such as dry powder inhalers (DPIs) that are used widely in Europe.
  - Two major pharmaceutical suppliers to the NHS have committed to action on reducing the carbon impact of their MDIs and, from 2025, reformulating their inhalers so they can be used with low-GWP propellants.
- **Alternative refrigerants.** There is some potential for the low-GWP HFC-32 to be replaced by an ultra-low-GWP alternative. Doing so could reduce F-gas emissions below the level in our Sixth Carbon Budget pathway. Preliminary research is being done into the technical capacity for hydrocarbons to replace HFC-32.

## k) Greenhouse gas removals

Our assessment is that both engineered Greenhouse Gas Removals (GGR) and land-based removals (such as tree planting and peatland restoration - see section d) above), will be essential for reaching Net Zero.

Engineered Greenhouse Gas Removal technologies, presently in early stages of development, will need to make a key contribution to reaching Net Zero.

Engineered removals via Bioenergy with Carbon Capture and Storage (BECCS) applied in a variety of sectors, and Direct Air Capture with Carbon Capture and Storage (DACCS) are at an early stage of development. A small number of BECCS and DACCS test facilities are presently in operation worldwide. Investment in research and development needs to be complemented with policy design to support engineered GGR scale-up during the mid-to-late 2020s.

**Table 3.10**  
Key metrics for greenhouse gas removals in the CCC Pathway to meet the Sixth Carbon Budget

		Latest indicator		Milestones in the CCC pathway				
		Year	Value	2025	2030	2035	2050	Trend
Removals (all values in MtCO <sub>2</sub> )	Total	2020	-	<1	-4.8	-22.5	-58.3	
	BECCS	2020	-	-	-4.6	-22.3	-52.9	
	DACCS	2020	-	-	-	-	-5	
	Wood in Construction	2020	-	-0.1	-0.2	-0.2	-0.4	

Source: CCC analysis.

Notes: Present usage of wood in construction is included in land use, land use change and forestry (LULUCF) inventory account.

A key milestone on the Sixth Carbon Budget pathway is progress towards the commissioning of the first commercial-scale BECCS plant in the late 2020s. This will need to be underpinned by the construction of CO<sub>2</sub> pipeline and storage infrastructures as part of the wider establishment of CCS in the early 2020s, which are capable of timely expansion to accommodate CO<sub>2</sub> from BECCS or DACCS. Progress towards this underpinning infrastructure delivery and the development of support policies for GGR deployment will be considered in next year's Progress Report, in 2022.

# Endnotes

- <sup>1</sup> CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change.*
- <sup>2</sup> Bank of England (2021) *MPC remit statement and letter and FPC remit letter.*
- <sup>3</sup> National Audit Office (2020) *Achieving Net Zero.*
- <sup>4</sup> Institute for Government (2020) *Net Zero: how Government can meet its climate change target.*
- <sup>5</sup> Partha Dasgupta for HM Treasury (2021) *The economics of biodiversity: the Dasgupta review.*
- <sup>6</sup> Louise Marix Evans for the CCC (2020) *Local Authorities and the Sixth Carbon Budget.*
- <sup>7</sup> BEIS (2020) *Public Attitudes Tracker*; Energy Systems Catapult (2020) *Net Zero: A Consumer Perspective*
- <sup>8</sup> CCC (2019) *Report from the Advisory Group on Costs and Benefits of Net Zero.*
- <sup>9</sup> Public First (2021) *Options for Energy Bill Reform.*
- <sup>10</sup> Committee on Fuel Poverty (2020) *Fourth Annual Report.*
- <sup>11</sup> CBI (2021) *Seize the moment.*
- <sup>12</sup> International Energy Agency (2021) *Net Zero by 2050: A Roadmap for the Global Energy Sector.*
- <sup>13</sup> IDDR (2017) *Lessons from previous 'coal transitions'.*
- <sup>14</sup> Just Transition Commission (2021) *A National Mission for a fairer, greener Scotland.*
- <sup>15</sup> HM Government (2021) *The Queen's Speech 2021.*
- <sup>16</sup> Financial Times (2021) *Europe's Climate Leaders 2021.*
- <sup>17</sup> BSI (2021) *Net Zero Barometer Report.*
- <sup>18</sup> UNFCCC (2021) *Race To Zero Campaign.*
- <sup>19</sup> Z/Yen Group (2021) *The Global Green Finance Index 7.*
- <sup>20</sup> EY (2021) *Renewable Energy Country Attractiveness Index (RECAI)*
- <sup>21</sup> McKinsey & Company (2020) *McKinsey Electric Vehicle Index: Europe cushions a global plunge in EV sales.*
- <sup>22</sup> Bloomberg New Energy Finance (2020) *Battery price survey.*
- <sup>23</sup> Nissan (2021) *Price reduction for Nissan LEAF 40kWh and 62kWh unlocks full Nissan EV range for revised plug-in car grant.*
- <sup>24</sup> Royal Haskoning DHV (2020) *The impacts of COVID-19 on travel patterns in the UK.*
- <sup>25</sup> Department for Transport (2021) *Electric vehicle charging device statistics.*
- <sup>26</sup> Society of Motor Manufacturers and Traders (2021) *Response to CCC request for data.*
- <sup>27</sup> CCC (2018) *Annex to the 2018 Progress Report: growth in van demand.*
- <sup>28</sup> RAC Foundation (2021) *Transport price index.*
- <sup>29</sup> David Begg and Claire Haigh (2018) *The unintended consequences of freezing fuel duty.*
- <sup>30</sup> Department for Transport (2020) *Rail fare rise to be delayed.*
- <sup>31</sup> HM Revenue & Customs (2020) *Changes to Air Passenger Duty rates from 1 April 2021.*

- <sup>32</sup> BSRIA (2021) *'Heat pumps market analysis 2020: United Kingdom'*, BSRIA World Market Intelligence.
- <sup>33</sup> This includes estimated abatement from the following policies: Building regulations part L 2010 and 2013; CRC-ees; ESOS; Industrial Heat Recovery Support; Products policy, PRS Regulations and Streamlined energy and carbon reporting framework for business (SECR). It does not include any estimate of abatement from carbon pricing policies or Climate Change Agreements, which will have also contributed to improving energy efficiency.
- <sup>34</sup> BEIS (2020) *Updated energy and emissions projections: 2019*.
- <sup>35</sup> BEIS (2020) *Updated energy and emissions projections: 2019*
- <sup>36</sup> BEIS (2020) *Digest of UK Energy Statistics (DUKES) 2020*.
- <sup>37</sup> Defra (2020) *Crops for bioenergy dataset*.
- <sup>38</sup> Defra (2020) *Agriculture statistics and climate change*.
- <sup>39</sup> Defra (2020) *Family Food Survey 2018/19*.
- <sup>40</sup> Yonder for Eating Better Alliance (2020) *Eating Better Survey ONLINE Fieldwork: 21st to 22nd September 2020*.
- <sup>41</sup> The amount of residual waste processed by EfW plants in 2019 increased by 10.5% on 2018 levels. Source: Tolvik (2021) *UK Energy from Waste Statistics 2020*.
- <sup>42</sup> Department for Transport (2019) *Port freight annual statistics*, Table 0102.
- <sup>43</sup> Department for Transport (2019) *Port freight annual statistics*, Table 0201.
- <sup>44</sup> International Maritime Organisation (2020) *Fourth greenhouse gas study*.
- <sup>45</sup> International Council for Clean Transportation (2020) *Potential CO<sub>2</sub> reductions under the Energy Efficiency Existing Ship Index*.
- <sup>46</sup> Tyndall Centre for Climate Change Research at the University of Manchester (2021) *Barriers and solutions for UK shore power*.
- <sup>47</sup> UK Parliament Environmental Audit Committee (2018) *UK Progress on reducing F-gas Emissions*.

## Policy progress and gaps

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## Introduction

Two years ago, the UK was aiming to reduce emissions to at least 80% below 1990 levels, by 2050 (from 48% below 1990 levels in 2020\*). As of 2019, the emissions reduction goal for 2050 is now at least 100% ('Net Zero') and the Government has committed to a reduction in emissions of 78% by 2035, based on the Committee's 2020 advice on the Sixth Carbon Budget.

Having set the level of the Sixth Carbon Budget, the Government must develop a comprehensive set of policies to ensure that it is met. Importantly, the Sixth Carbon Budget will be the first to include emissions from international aviation and shipping (IAS). This ensures that, from now on, the Government's emissions reductions strategies have a formal requirement to cover all areas of the economy, rather than merely leaving 'headroom' for IAS emissions as in previous strategies.

This year is the start of a new era of UK climate action, with the Sixth Carbon Budget legislated, the publication of new evidence for the third Climate Change Risk Assessment (CCRA3) and the UK's hosting of the 26<sup>th</sup> United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP26) in Glasgow in November. Government policy needs to ramp up to match. We expect the Government's forthcoming Net Zero Strategy, ahead of COP26, to provide a blueprint for action over the coming decades.

As part of our advice on the Sixth Carbon Budget, we published a report on *Policies for the Sixth Carbon Budget and Net Zero*. This set out potential ways to address what needs to be done in each emitting sector and an overview of the policy challenges. With Net Zero by 2050 in mind, policy needs to enable a scale-up and roll-out of low-carbon technologies and behaviours, so that by the early 2030s nearly every new investment and purchase is low-carbon.

Our policy report is still the most current overview of the policy challenge for the Sixth Carbon Budget. This chapter recaps the main aspects of that report and covers key developments since. It also offers an appraisal of the Government's current plans, looks back on progress departments have made on last year's recommendations and identifies priority policy recommendations and gaps that need to be addressed.

The key messages in this chapter are:

- **The early foundations for a decade of delivery are being put into place.** The Government is starting to demonstrate that it is taking the Net Zero challenge seriously. It has set up climate action committees on strategy and delivery in Cabinet, it has published a Ten Point Plan for a Green Industrial Revolution, an Energy White Paper, an Industrial Decarbonisation Strategy, an interim Net Zero Review from HM Treasury on the fair allocation of costs during the transition and launched a new UK Emissions Trading Scheme.
- **However, several key strategies and plans are not yet published,** or have been delayed. At the time of finalising this report at the start of June, the Heat and Buildings Strategy, the Transport Decarbonisation Plan, the final HM Treasury Net Zero review, the Net Zero Aviation Strategy and the Nature Strategy had not yet been published. These are needed in order to extend

\* This reduction reflects the impact COVID-19 had on emissions in 2020, much of which is not expected to be permanent. The fall in emissions between 2019 and 1990 was 40%.

action to reduce emissions into all areas of the economy, within a portfolio of policy that accelerates a fair and just transition to Net Zero.

- **The Government has made significant commitments, but there are still significant gaps in ambition.** Where ambitions have been set over the last year, they have tended to be a significant step up. Many are now aligned with the path to Net Zero (e.g. 40 GW of offshore wind, phasing out petrol and diesel cars and vans by 2030). However, gaps remain in the Government's stated ambitions (e.g. on diets, aviation demand, waste, and low-carbon heat networks), while some announcements fall short of what is likely to be needed (e.g. on peatlands, heat pumps, and carbon capture and storage). Together these imply a significant ambition gap: current Government commitments that align to the Committee's published pathways cover less than half of the path to Net Zero.
- **Efforts must be increased markedly, especially in the lagging areas.** There are signs of a multi-speed approach within Government to raising ambition and putting in place effective policies. Some departments (e.g. Defra, MHCLG, but also parts of BEIS and HM Treasury) are lagging behind others, and appear timid in their approach. The path to Net Zero requires high ambition and an effective policy framework in all areas.
- **A major delivery challenge will remain** even once the Net Zero Strategy sets out how the Government intends to drive the transition. Of the 92 recommendations from last year's Progress Report, just 11 have been achieved in full, with 29 partly achieved and 34 underway. Translating strategy into effective policy across the wide range of emitting sectors will require continued focus across Government over the rest of this Parliament and beyond. We set out several priority areas for action as well as approximately 200 recommendations for UK Government departments and the devolved administrations.

This chapter is set out in four sections:

1. The delivery challenge
2. Stated ambition and policy progress
3. Policy priorities and gaps
4. Sectoral progress and next steps for policy

# 1. The delivery challenge

Achieving Net Zero and the Sixth Carbon Budget will require a significant scale-up in delivery of low-carbon policies and actions.

The Committee's December 2020 advice on the Sixth Carbon Budget set out a pathway to achieving the UK's Net Zero 2050 target, based on a comprehensive programme of delivery in the 2020s that covers all areas of decarbonisation. If the required scale-up over the coming decade is to occur, the key building blocks of policy must be introduced in the coming months and developed over the next few years (Figure 4.1, Table 4.1). This Government must be the one to shift the UK decisively onto the path that ends its contribution to global warming.

The Government has committed to set out its plans in the Net Zero Strategy, required by the Climate Change Act and due ahead of the COP26 UN climate talks in Glasgow in November this year. COP26 gives the Net Zero Strategy added significance. Setting out a strong and credible policy package to deliver the scale-up over the next decade would put the UK firmly on track to Net Zero, greatly strengthening its credibility as a climate leader.

The transformational change required means Net Zero and climate adaptation must be integrated into all policymaking.

The Government has accepted the overall challenge by setting the UK's Nationally Determined Contribution (NDC) to the Paris Agreement for 2030 and legislating the Sixth Carbon Budget for 2033-37. Given the scale of the challenge and the often-complex interactions involved, a piecemeal or sector-specific approach will not be enough. Net Zero should be integrated into all policymaking, as should climate adaptation.

## a) Scaling up and rolling out low-carbon technologies and behaviours

The next decade is critical for building supply chains, with policy focussing on widespread roll-out of measures thereafter.

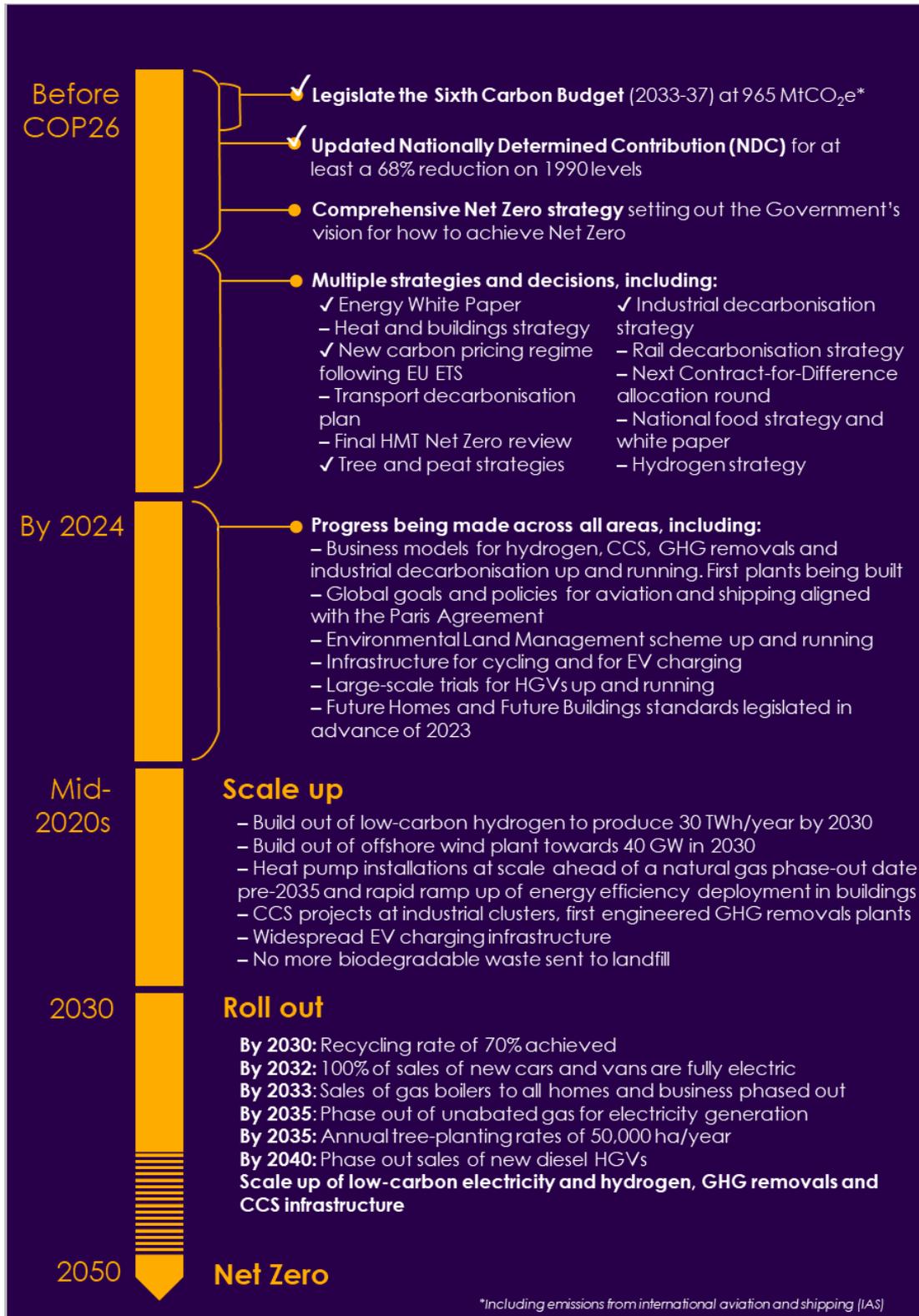
Accompanying our advice on the Sixth Carbon Budget was a report on *Policies for the Sixth Carbon Budget and Net Zero* ('the Sixth Carbon Budget policy report'), which provides recommendations on how to achieve a transition that involves two distinct phases for UK climate policy, with the next decade being vital:

- **The 2020s: scale-up.** The UK must build supply chains and new markets for low-carbon consumer offerings (e.g. electric cars and heat pumps) so that these can scale from being niche offerings to dominating the market and fully pushing out sales of high-carbon alternatives by 2030, or soon after. Alongside this, new options must be developed and scaled up for industrial decarbonisation such as carbon capture and storage (CCS), low-carbon hydrogen and engineered emissions removals, while finishing the job of power sector decarbonisation. Annual tree-planting rates must increase from 13,000 hectares per year today to 30,000 by 2025 in line with the Government's commitment – and continue to rise to 50,000 year by 2035.
- **From the early 2030s to 2050: roll-out.** Having scaled up the required markets for low-carbon technology sales, these will then take around 15 years to flow through the stock of vehicles and buildings as high-carbon assets reach the end of their lives. Mechanisms driving implementation in industry and land use should be well developed and continue to drive roll-out at similar rates. Policy will be less about aiming to scale up markets, instead focusing on continuing achieved rates of roll-out, tackling emerging barriers and systems challenges and ensuring fairness across society.

Most of the recommendations in our Sixth Carbon Budget policy report still stand. What follows in this chapter are the priorities already set out in that report and

updates where recent policy developments have occurred. Government progress on tackling the delivery challenge to date is also addressed. Key milestones for policy and delivery are set out in Table 4.1 and Figure 4.1.

Figure 4.1 Timeline for the decade of delivery, and beyond



Source: CCC analysis based on the Sixth Carbon Budget and HMG (2020) *The Government Response to the Committee on Climate Change's 2020 Progress Report to Parliament*.

Notes: Table 4.1 has a complete list of the milestones and targets to be reached on the path to 2050.

**Table 4.1**

Key outcomes to target over the next few years, and milestones towards 2050

Date	Outcomes and Milestones	
Before COP26	<ul style="list-style-type: none"> <li>✓ Legislate the Sixth Carbon Budget at 965 MtCO<sub>2e</sub>, including emissions from international aviation and shipping</li> <li>• Net Zero Strategy, setting out how the Sixth Carbon Budget and Net Zero are to be met</li> <li>✓ Energy White Paper</li> <li>• Heat and Buildings Strategy</li> <li>✓ New carbon pricing regime following EU ETS</li> <li>• Transport Decarbonisation Plan</li> <li>• Final HMT Net Zero Review</li> <li>✓ England Trees Action Plan</li> <li>✓ England Peat Action Plan, including an end to rotational burning of certain upland peat sites</li> <li>• Hydrogen Strategy, and consultation on hydrogen business models</li> <li>• Governance framework and timeline for decisions on the conversion to hydrogen of the gas transmission and distribution networks</li> <li>• Rail Decarbonisation Strategy</li> <li>✓ Industrial Decarbonisation Strategy</li> <li>• Net Zero carbon hospital standard, and further commitments towards delivering a Net Zero NHS</li> <li>• Publication of Greening Government Commitments</li> <li>• Ofgem's final business model approvals for the RIIO-ED2 period should accommodate network upgrades for EVs and heat pumps</li> <li>• Next Contract-for-Difference allocation round, targeting large volumes of renewables, towards 40 GW offshore wind by 2030</li> </ul>	<ul style="list-style-type: none"> <li>✓ Updated Nationally Determined Contribution (NDC) for at least a 68% reduction on 1990 levels (excl. IAS)</li> <li>✓ Build on the UK's NDC to increase global climate ambition in the run up to COP26</li> <li>• Strengthened UK Adaptation Plans</li> <li>✓ Updated Green Book guidance on climate change</li> <li>✓ Decision on funding model for CCS infrastructure</li> <li>• Ministry of Defence review of climate change and defence</li> <li>✓ Call for evidence on policy for GHG Removals (GGRs)</li> <li>✓ Consultation on Waste Prevention Programme for England and associated consultations on recycling collections, Extended Producer Responsibility and Deposit Return Scheme.</li> <li>• Consultation on mandatory food waste reporting</li> <li>• Consultation on including maritime in the Road Transport Fuel Obligation (RTFO)</li> <li>✓ Scottish Government updated Climate Change plan</li> <li>• Conclusion of Green Jobs Taskforce and publication of Green Jobs Action Plan</li> <li>✓ Environmental Land Management pilots</li> <li>• Implementation of minimum device standards for EV chargers</li> <li>• National Food Strategy and white paper</li> <li>• Welsh Government to publish a plan for meeting the second carbon budget</li> <li>• Net Zero Aviation Strategy</li> <li>✓ North Sea Transition Deal</li> </ul>
By the end of 2022	<ul style="list-style-type: none"> <li>• Carbon capture, utilisation and storage (CCUS) business models decided for power, hydrogen and manufacturing and construction</li> <li>• 3<sup>rd</sup> Climate Change Risk Assessment published by Government (CCRA3)</li> <li>• Cross-Government Bioenergy Strategy</li> <li>• Defra to publish a Nature Strategy for England</li> <li>• ICAO negotiations to set long-term Paris-compatible target for global aviation (align &amp; strengthen CORSIA in 2023)</li> <li>• Strategy for shipping (including international shipping) that reflects UK Net Zero</li> </ul>	

By 2024	<ul style="list-style-type: none"> <li>Business models for hydrogen, CCS, GHG removals and industrial decarbonisation up and running. First plants being built.</li> <li>Environmental Land Management (ELM) scheme up and running in England</li> <li>Universal waste collections and recycling facilities in place across England</li> <li>Implement a trading or auctioning system to deliver private sector investment in tree planting</li> </ul>	<ul style="list-style-type: none"> <li>IMO negotiations revise 2050 target for global shipping in 2023, set new policies</li> <li>Coal phased out of the power system</li> <li>Legislation for the Future Homes and Future Buildings Standards introduced ahead of 2023, and should come into force by 2025 at the latest</li> <li>Large-scale trials for HGVs in place</li> </ul>
Mid-2020s	<ul style="list-style-type: none"> <li>Demonstrate low-carbon hydrogen at scale via 1 GW of hydrogen production capacity by 2025</li> <li>Strategic decisions on the future of the gas grid, including the extent of zoning for heat networks, electrification and any planned conversions of the gas grid to hydrogen</li> <li>All new boilers 'hydrogen-ready' by 2025 at the latest</li> </ul>	<ul style="list-style-type: none"> <li>CO<sub>2</sub> transport and storage infrastructure operational</li> <li>Annual tree-planting rates of at least 30,000 hectares / year</li> <li>First UK sustainable aviation plants operational, policy support in force</li> <li>Main biodegradable municipal and non-municipal waste streams banned from landfill from 2025</li> </ul>
By 2030	<ul style="list-style-type: none"> <li>Nearly 100% of new cars and van sales are battery-electric (or other zero-emission) vehicles</li> <li>Heat pump installations at scale (1 million / year) ahead of a natural gas boiler installation phase-out date pre-2035</li> <li>All buildings except owner-occupied non-fuel poor homes achieve Energy Performance Certificate (EPC) C</li> <li>Sales of oil and coal heating in homes phased out (2028)</li> <li>Rented homes achieve EPC C and homes for sale achieve EPC C (2028)</li> <li>Phase-out of the most harmful F-gases and restricting the use of all F-gases by 80%</li> </ul>	<ul style="list-style-type: none"> <li>CCS and low-carbon hydrogen across 5 industrial clusters, capturing and storing 10 MtCO<sub>2</sub> per year and producing 25 TWh/year of low-carbon hydrogen</li> <li>40 GW of offshore wind installed in UK waters, reducing emissions from electricity generation to less than 50 gCO<sub>2</sub>/kWh</li> <li>Commercial roll-out of low-carbon ammonia and hydrogen starts in shipping, with at least one cluster (&gt;2 TWh/year)</li> <li>Recycling rate of at least 68% achieved across the UK, food waste 50% reduction</li> <li>Commercial scale engineered GHG removals plants operational</li> </ul>
Over the 2030s	<ul style="list-style-type: none"> <li>Sales of gas boilers to all homes and business phased out (by 2033)</li> <li>Phase-out of sales of new diesel HGVs (by 2040)</li> <li>All diesel trains removed from passenger rail operations (by 2040)</li> <li>All ore-based steel-making near-zero emissions (by 2035)</li> </ul>	<ul style="list-style-type: none"> <li>Phase-out of unabated combustion of fossil gas for electricity generation (by 2035)</li> <li>Widespread roll-out of CCS, including on Energy from Waste plants</li> <li>Annual tree planting rates of at least 50 kha/year (by 2035)</li> </ul>
By 2050	<p>Any residual sources of emissions are offset through emissions removals in the UK. Low-carbon electricity, hydrogen and bioenergy provide all the UK's energy, in combination with CCS.</p> <p>Low-carbon technologies and behaviours continue to roll out at scale and all asset replacements continue to be low-carbon.</p>	
<p>Source: CCC analysis based on the milestones to delivering the Sixth Carbon Budget pathway, and HMG (2020) <i>The Government Response to the Committee on Climate Change's 2020 Progress Report to Parliament</i>, Policy Exchange (2020) <i>UK Energy &amp; environment policy timeline</i>. Notes: Ticks mark refer to actions that have been concluded.</p>		

## 2. Stated ambition and policy progress

Material progress has been made since our last Progress Report to Parliament in June 2020. The Government has accepted the Committee's advice on the level of the Sixth Carbon Budget, and the level of the UK's NDC for 2030, setting the UK on an ambitious decarbonisation pathway towards 2050.

Setting the level of the Sixth Carbon Budget and the UK's 2030 NDC are significant steps in the last year and Government is starting to develop policy across all areas.

The Government has also recognised the need for extensive policy strengthening and has started to develop plans in all areas of UK emissions, with significant policy announcements having been set out in the Ten Point Plan for a Green Industrial Revolution, Energy White Paper, Industrial Decarbonisation Strategy and England Trees and Peat Action Plans (Table 4.2).

These publications have significantly strengthened commitments, with many headline ambitions now aligned to the CCC pathway (e.g. 40 GW offshore wind by 2030, phase-out of conventional petrol and diesel cars by 2030, 30,000 hectares afforestation annually by 2025). However, some of the specific targets in these announcements, while improvements on previous commitments, fall short of those in the CCC pathway (e.g. heat pump deployment that is a third lower in 2028, total carbon capture and storage ambition in 2030 that is around half of what we set out) – see Figure 4.2.

There are still gaps and ambiguity in government ambition, including around influencing consumer choices on issues like aviation and diets.

Some important ambition gaps remain in certain sectors, while there is a danger that several of the broad ambitions announced are implemented in a way that would fall short of the CCC scenarios:

- **Consumer choices.** So far, the Government's announcements have focused on technologies and largely ignored the potential for changes in consumer choices to reduce emissions. These are particularly important to limit emissions in 'hard to abate' sectors, such as aviation and agriculture. There are a wide range of levers available to promote low-carbon choices, including enabling measures and nudges, ensuring supporting infrastructure is available, as well as more interventionist measures using regulations and the tax system.
- **Ambiguity in ambition.** While some commitments have been made that could be at least as ambitious as our pathways, there remain risks that real-world implementation could fall short. For example, the announced 2030 phase-out date for sale of petrol and diesel cars and vans will allow sale of hybrid vehicles with "significant zero-emission capability" until 2035, well after the 2032 date by which we recommend all such vehicles should be fully zero-emission. The definition of which vehicles can be sold after 2030, currently subject to consultation, will be crucial in ensuring that emissions and motoring costs are kept as low as possible by prioritising fully zero-emissions vehicles over hybrids.

The Net Zero Strategy will have to make up for emerging shortfalls in ambition and bring together action across every sector.

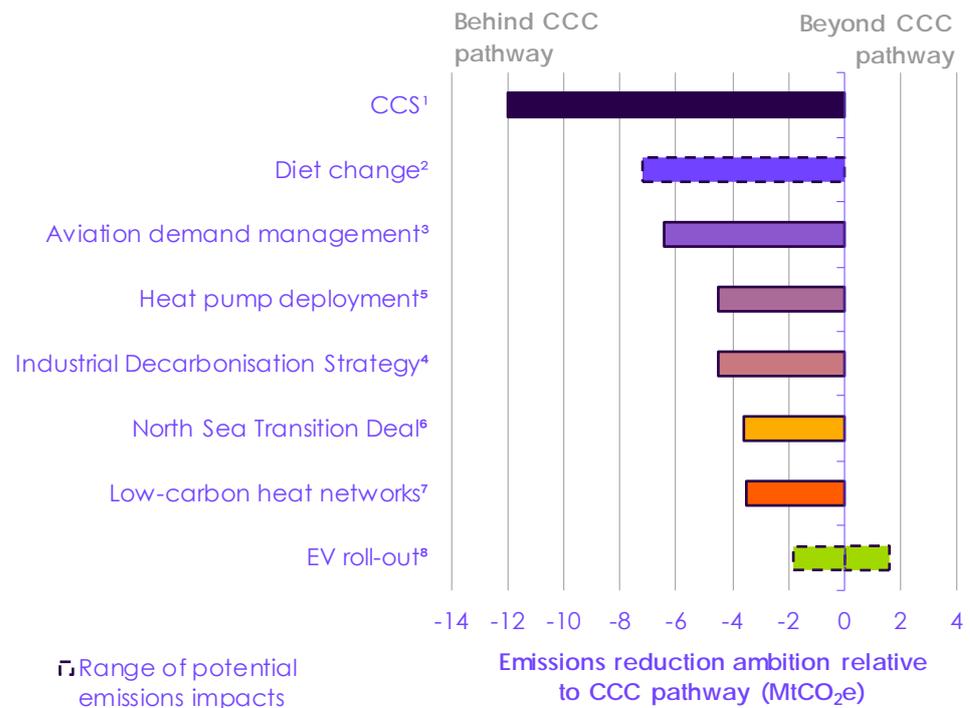
We expect the Government's forthcoming Net Zero Strategy, promised for this year, to provide a blueprint for action over the coming decades. The Net Zero Strategy will need to make up for the shortfalls in ambition illustrated in Figure 4.2 and Table 4.2 and clarify policy mechanisms to meet that ambition:

- The Government is not required to commit to the Committee's detailed sectoral pathways, nor our policy advice. But it must set out a credible alternative approach where it chooses not to.

Our pathways are designed to be stretching across the economy, so it is difficult to compensate for lower ambition in one area with greater ambition elsewhere.

- The Net Zero Strategy, released later this year, will have to address the shortfall, strengthening weaker commitments to be closer to the Committee's pathways or setting out how emissions can be cut faster in other areas to compensate.
- With the path to 2050 becoming clearer, plans must translate into near-term action and Government must organise for the major delivery challenge of Net Zero.

**Figure 4.2** Differences in stated Government ambition compared to CCC Pathway



Notes: Comparisons are against the Balanced Net Zero Pathway ('CCC pathway') published in the Committee's *Sixth Carbon Budget* advice.

<sup>1</sup> Government CCS ambition for is 10 MtCO<sub>2</sub>/year in 2030, compared to 22 MtCO<sub>2</sub>/year in the CCC pathway.

<sup>2</sup> The level of diet change without explicit policy to support it is uncertain. Annual emissions could be up to 7.2 MtCO<sub>2e</sub> higher than the CCC pathway in 2030.

<sup>3</sup> Lack of ambition for aviation demand management would result in higher annual emissions of 6.4 MtCO<sub>2e</sub> in 2030 relative to the CCC pathway for aviation emissions.

<sup>4</sup> The Industrial Decarbonisation Strategy aims for a 67% reduction by 2035, compared to 73% in the CCC pathway.

<sup>5</sup> Government ambition is for 600,000 installations in homes in 2028, compared to 900,000 in 2028 in the CCC Pathway. The abatement gap in 2030 is inferred, based on an assumed trajectory of uptake to 2028 under the Government's plans, with annual deployment remaining constant to 2030.

<sup>6</sup> The North Sea Transition deal commits to a reduction that falls short of the CCC pathway by 3.7 MtCO<sub>2e</sub> in 2030.

<sup>7</sup> Based on announced Government heat network investment of £0.7 billion (assumed to leverage £2.2 billion, leading to a total investment of £2.9 billion, of which we estimate £1.7 billion will be for low-carbon, with resulting deployment estimated by CCC).

<sup>8</sup> A strict 2030 phase-out of petrol and diesel vehicles would be more ambitious than the CCC pathway, but this depends on the timing of when plug-in hybrid electric vehicles are phased out.

**Table 4.2**  
Government commitments compared to the CCC Pathway between 2025-2035

Headline actions	Government commitment <sup>1</sup>	CCC pathway
Offshore wind	40 GW by 2030	40 GW by 2030
Electric vehicles	Phase-out of new fossil fuelled vehicle sales by 2030, with allowance for some hybrids out to 2035	Phase-out of all new fossil fuelled vehicle sales by 2032
Heat pumps in homes	600,000 heat pump installations / year by 2028	900,000 heat pump installations / year by 2028 1.1 million installations / year by 2030
Low-carbon heat networks (all buildings) <sup>2</sup>	2 TWh of low-carbon heat networks by 2030	25 TWh of low-carbon heat networks by 2030
Low-carbon hydrogen	5 GW (up to 42 TWh) by 2030	30 TWh by 2030
Carbon Capture and Storage <sup>3</sup>	10 MtCO <sub>2</sub> / year captured and stored by 2030, across 4 industrial clusters, including at least one power project	22 MtCO <sub>2</sub> / year captured and stored by 2030, across at least 5 industrial clusters, including multiple power projects
Emissions reduction in manufacturing and refining	Around two-thirds by 2035, compared to 2018	73% by 2035, compared to 2018
Tree-planting	30,000 hectares / year by 2025	30,000 hectares / year by 2025 50,000 hectares / year by 2035
Peatland restoration <sup>4</sup>	32,700 hectares / year by 2025	67,000 hectares / year by 2025
Greenhouse gas removals	Innovation support provided, in recognition that engineered removals will be needed, but no firm commitment on deployment yet	5 MtCO <sub>2</sub> / year by 2030
Nuclear power <sup>5</sup>	Final Investment Decision on at least one new nuclear power plant by the end of this Parliament	One new nuclear plant operational by 2030, and a further plant by 2035

Notes:

<sup>1</sup> Based on actions in the Ten Point Plan, Energy White Paper, Industrial Decarbonisation Strategy and England Tree and Peat Action Plans between 2025 and 2035 and the CCC's Balanced pathway from the Sixth Carbon Budget.

<sup>2</sup> Government commitment on low-carbon heat network deployment is illustrative, and has been inferred from Government spending commitments, using assumptions around expected leveraged investment and the proportion of funding targeted at low-carbon networks.

<sup>3</sup> The difference in carbon captured and stored annually largely comes from projects in the power sector in CCC scenarios, so other technologies could compensate for this shortfall.

<sup>4</sup> Government peatland restoration commitments include Scotland, Wales and England. CCC peatland restoration numbers in 2025 are UK-wide.

<sup>5</sup> The Balanced Pathway produced for the CCC's Sixth Carbon Budget assumed that two new nuclear power stations would be in operation by 2035.

## a) Progress against last year's recommendations

11 of the Committee's 94 recommendations from last year have been fully achieved, 29 partly achieved and 32 are underway.

We are reporting on a moving picture of progress as several critical policy documents have not yet been published, with many of these delayed.

We see evidence of a multi-speed Government, with some departments' progress lagging behind others.

The Committee made 92 recommendations to Government departments in our June 2020 Progress Report. Of these, 11 have been achieved in full (which includes the critical cross-cutting recommendations on the level of the Sixth Carbon Budget and the UK's 2030 NDC). Some progress is being made, or is expected soon, against many others, with 29 recommendations partly achieved and 34 underway. Seven recommendations are overdue and 13 have not been achieved (Table 4.3).

While several critical policy documents have been published over the last year, other key strategies and plans remain to be published, or have been delayed:

- At the time of finalising this report in early June, the Heat and Buildings Strategy, the Transport Decarbonisation Plan, the final HM Treasury Net Zero review, the Net Zero Aviation Strategy and the Nature Strategy had not yet been published. These are needed to extend action to reduce emissions into all areas of the economy, within a portfolio of policy that accelerates a fair and just transition to Net Zero.
- The absence of these documents means we are reporting on a moving picture. It will only be possible to judge the overall approach to meet the Sixth Carbon Budget and the Net Zero target when the Government's Net Zero Strategy, as well as other overdue and underway documents, are published.

As the disparities in progress in Table 4.3 illustrate, we see evidence of a multi-paced Government, with some departments lagging behind others:

- The **Ministry of Housing, Communities & Local Government (MHCLG)** is not fully supporting local government to play its part in the transition to Net Zero. Progress has fallen short to date on ensuring that building standards are fit for purpose and properly enforced. The current Planning Bill does not ensure that developments and infrastructure are compliant with Net Zero and appropriately resilient to climate change. It would be serious were this opportunity to be missed.
- While the **Department for Environment, Food & Rural Affairs (Defra)** has made important steps forward on ambition for afforestation and peat restoration – though the latter is short of the CCC pathway and implementation is slow – progress on agriculture and land use remain slow and partial, and gaps in ambition remain. On waste, large gaps remain both on banning materials from landfill and getting a grip on the rapid expansion of Energy from Waste facilities.
- Even within Departments that are performing better overall there are pockets of poor or slow performance. For example, the **Department for Business, Energy and Industrial Strategy's (BEIS)** Heat and Buildings Strategy has been delayed by almost a year, while the **Department for Transport (DfT)** has not set out any plans for limiting growth in aviation demand.
- More generally, Government progress has been slow on overarching challenges towards Net Zero, which has now been law for two years. The most notable delay is to the **HM Treasury's** Net Zero Review, but there are delays and uncertainty to a suite of other challenges: the just transition, jobs and skills, public engagement. With a Spending Review later this year, it is essential that the Treasury clarifies its strategic priorities for the remaining carbon budget in the UK. There is also a need for strong governance of the

transition within Government, including ensuring that wider policy decisions are routinely made compatible with Net Zero.

For the full programme to align to the challenge, and provide the leading example that the Government wishes to take to COP26, government will have to address these failures.

**Table 4.3**  
Progress against departmental recommendations in the Committee's 2020 Progress Report to Parliament

Department	Progress against last year's recommendations
Cabinet Office & No. 10	● ○ ○ ●
FCDO, BEIS & the COP26 Unit	● ○ ○ ● ● ●
HM Treasury	● ● ● ● ● ● ●
Department for Business, Energy and Industrial Strategy	● ● ● ● ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●
Department for Environment, Food and Rural Affairs	● ○ ● ● ● ● ● ● ● ● ● ●
Department for Transport	● ● ● ○ ○ ○ ○ ● ● ● ● ● ● ● ● ● ●
Ministry of Housing, Communities and Local Government	● ● ● ● ● ● ● ●
Department for Education	○ ○
Department for International Trade	○ ○ ●
Department of Health and Social Care	○ ●
Ministry of Defence	● ○ ○
Home Office & Ministry of Justice	○ ○
Department for Digital, Culture, Media and Sport	○ ○ ● ●
Department for Work and Pensions	○ ○

● = action achieved, ○ = underway, ● = partly achieved, ● = overdue, ● = not achieved.

Notes: Based on recommendations in the CCC's 2020 Progress Report to Parliament. Recommendations for all departments, or those relating to adaptation are not included in this table. Some recommendations apply to more than one department, so the sum of recommendations in this table does not add up to the 92 cited in the text. Tables of recommendations and scores is in the supplementary material published alongside this report.

Delivering Net Zero by 2050 will require strong policy frameworks across all levels of Government, and collaboration between the governments of Wales, Scotland and Northern Ireland with Westminster to develop the required policies. The past year has also seen important developments in climate policy in the devolved administrations (Box 4.1), including:

- The Scottish Government updated its Climate Change Plan, which integrates the 2045 Net Zero target and its new interim targets into its delivery plan for emissions reductions out to 2032.
- The Welsh Government increased its 2050 emissions target to Net Zero, from a 95% reduction on 1990 levels, following advice from the Committee.
- The Northern Ireland Assembly is working towards legislating a Climate Change Bill before the next Assembly election in 2022.
- Both Scotland and Wales created ministerial portfolios that focus on Net Zero and decarbonisation following the May 2021 elections.

#### Box 4.1

#### Policy progress in Scotland, Wales and Northern Ireland

The past year has seen significant developments in climate policy in Scotland, Wales and Northern Ireland, even in the midst of the response to the pandemic. This box sets out major climate policy developments since our 2020 Progress Report.

##### Scotland:

- The Scottish Government committed to significant spending in low-carbon areas in its **Budget and Programme for Government**, including £1.8 billion for low-carbon infrastructure and £1.6 billion for heat and energy efficiency measures (or: including £2 billion to decarbonise travel and heating, and promote woodland creation).<sup>1,2</sup>
- Published an **update to the Climate Change Plan** to integrate the 2045 Net Zero target and new interim targets into the plan for the delivery of Scottish emissions reductions until 2032. The update aligns sectoral emissions pathways to the higher ambition of the 2045 goal. We will scrutinise elements of that update in our 2021 Scottish Progress Report.<sup>3</sup>
- Following the May 2021 election, the Scottish Government created a new cabinet position for **Minister for Net Zero, Energy and Transport**, with a portfolio that includes the delivery of Net Zero and COP26, as well as transport, biodiversity, infrastructure and circular economy.
- The **Just Transition Commission** published its final report, and the findings from **Scotland's Climate Assembly** are due to be published around the same time as this Progress Report.<sup>4</sup>
- Scotland's **Draft Heat in Buildings Strategy** was published, setting out a pathway for achieving Net Zero emissions in Scotland's buildings.

##### Wales:

- The Welsh Government legislated a **2050 Net Zero target** and a set of targets on the pathway to that goal, in line with the Committee's advice.<sup>5</sup>
- Published a **Transport Strategy (Llwybr Newydd)**, which places decarbonisation by 2050 at the centre of transport and infrastructure planning.<sup>6</sup>
- Published 'Beyond Recycling', a **circular economy strategy** that sets out policy to promote resource efficiency and make Wales 'zero waste' by 2050.<sup>7</sup>
- Continues to work on the second **Low Carbon Delivery Plan**, which will outline the delivery of the Second Welsh Carbon Budget and beyond.

- Following the May 2021 election, the Welsh Government has created a new cabinet position **Minister for Climate Change**, with responsibilities including decarbonising transport, the housing sector and energy generation.

#### Northern Ireland:

- The Executive requested the **Committee's advice on setting emissions targets** that reflect Northern Ireland's equitable contribution to the UK's 2050 Net Zero target. We published this advice in December 2020.<sup>8</sup>
- The Northern Ireland Assembly is in the process of legislating a **Climate Change Bill** before the next Assembly election in 2022. The Committee will continue to provide evidence throughout the legislative process.
- In March 2021, the Northern Ireland Executive consulted on an **Energy Strategy** and published a set of **decarbonisation scenarios** that would see Northern Ireland's energy systems reach net-zero carbon by 2050. The final strategy is scheduled for publication in November 2021.<sup>9,10</sup>

## b) Judging progress towards the Sixth Carbon Budget

We have assessed Government progress towards the Sixth Carbon Budget by judging whether sufficient ambition is in place, and whether policy is being developed to meet that ambition, for each source of abatement in the CCC pathway to Net Zero\*. Figure 4.3 illustrates our assessment of progress against required emissions abatement, and Table 4.5 sets out our scoring and justification across some of the most significant sources of abatement in the economy. We find a mixed picture:

- **Ambition is beginning to align with what is needed, although there is more limited action or major risks** for almost half of the abatement in the CCC pathway (e.g. heat networks, emissions from landfill and waste incineration, developing greenhouse gas removals). Precise intentions still need to be clarified for around a third of the remaining abatement that is broadly aligned with the targets (e.g. zero-emission cars, energy efficiency in buildings).
- **Progress in setting out policies is significantly behind ambition**, with less than one-fifth of the emissions savings for the Sixth Carbon Budget having policies that are 'potentially on track' or 'fully on track' for delivery (e.g. renewable electricity generation).
  - In many other areas, some policy plans have been set out but these lack detail and/or do not comprehensively cover the necessary set of issues (e.g. in terms of funding, appropriate mechanisms, timing). Together, areas in which policy is in danger of falling behind cover over three-fifths of the emissions reduction required to 2035.
  - A further one-fifth of the emissions reductions still have major policy gaps, including on demand-side action and tackling emissions from landfill and waste incineration. We highlight the need to fill a range of policy gaps in section 4.

Progress in setting out policies is significantly behind ambition, which is broadly on track with some important gaps.

\* The 'CCC pathway' refers to the Balanced pathway to Net Zero developed by the Committee in our December 2020 report, CCC (2020) *Sixth Carbon Budget – The UK's path to Net Zero*.

Table 4.4 provides an overview of the scoring criteria which informed the Committee's judgement in Figure 4.3. A list of scores for all sources of abatement is available in the supplementary materials accompanying this report.

Effective policies must be developed at greater pace. The path to Net Zero requires a rapid scale-up in low-carbon investment and low-carbon choices across the economy. Government must lead that change with more urgency than we have seen so far, and **speed up delivery, which will need to accelerate even where ambition is broadly on track**, for example:

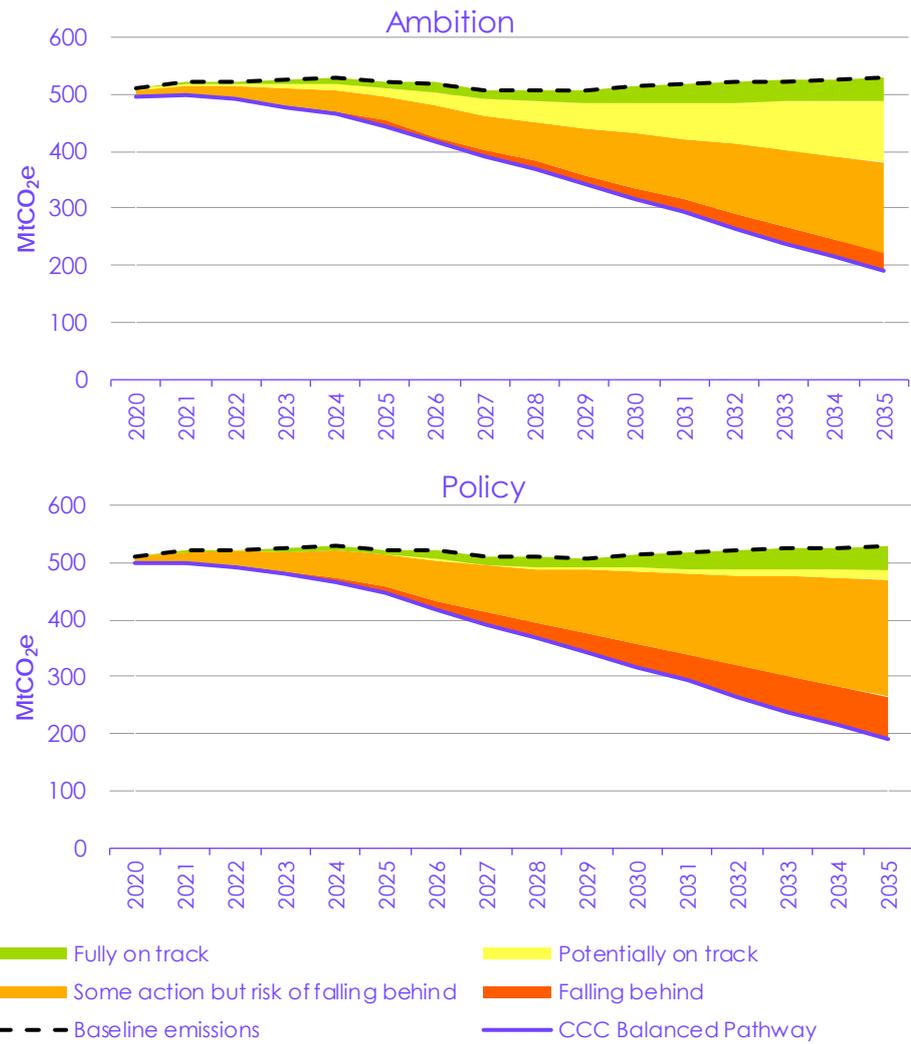
- Although the Government's 2030 target for **offshore wind** is in line with the CCC pathway, a minimum of 4 GW of additional offshore wind capacity will be needed each year from the mid-2020s onwards, significantly greater than the current 2 GW per year.
- The Ten Point Plan set a direction to phase out new internal combustion engine van sales by 2030, which is broadly in line with the pace of the transition required to meet the Sixth Carbon Budget, provided only a limited role for hybrid vehicles is allowed beyond this point. However, the **battery-electric van** market share was only 2% in 2020.
- Government ambition on **tree planting**, which reaches 30,000 hectares of trees each year, is in line with the CCC pathway out to 2025 (although there is not yet a commitment post 2025) but only 13,000 hectares were planted in 2019/20.

Delivery is falling short even where ambition is broadly on track.

**Table 4.4**  
Scoring criteria for ambition and policy against each source of abatement in the CCC pathway

	High-level ambition	Specific policies in place (or imminent)
Fully on track, limited risks	Clear ambition <b>fully in line with or beyond CCC recommendations</b>	<b>Credible, proven policy</b> that is already working
Potentially on track, some risks	<b>Broadly in line with CCC recommendations</b> , subject to clarification	<b>Credible policy</b> in place (or imminent) <b>but not yet proven</b> , or <b>policy only covers the next few years</b> of scale-up but not out to Sixth Carbon Budget period (2033-37)
Some action, more significant risks	Some commitments but there are <b>gaps, or commitments are not ambitious enough</b>	<b>Policy in place</b> (or imminent) that is <b>limited in ambition</b> , or policy is in place but there are <b>risks of it ending without replacement</b>
Falling behind, major risks	<b>No, or very limited, ambition</b> stated	<b>None, very limited, or clearly ineffective policy</b> in place

Figure 4.3 Is Government progress on track?



Source: CCC analysis; CCC (2020) *The Sixth Carbon budget – The UK's path to Net Zero*.

**Table 4.5**

Ambition and policy progress on significant sources of abatement

	Abatement source	Ambition	Policy	Rationale
Surface transport	Zero-emission cars			The confirmation of a 2030 phase-out date is a welcome step, but policy is lacking for how to deliver it. The market share of new battery-electric cars reached 6.5% in 2020, up substantially from 1.6% in 2019.
	Demand-side behaviour change and modal shift			Despite the recent 'Gear Change' and 'Bus Back Better' strategies, Government focus on reducing the need to travel and increasing car occupancy is lacking. Substantial road-building investment continues and car demand is increasing.
Buildings	Residential – low-carbon heat in existing homes			UK Government has only set a clear fossil phase-out ambition for homes off the gas grid i.e. 15% of all homes. 600,000 heat pumps a year committed to by 2028, which is below the 900,000 required in the CCC pathway. Insufficient financial support planned for heat pumps or low-carbon heat networks.
	Residential – energy efficiency and low-carbon heat in new homes			Uplifts in buildings standards announced, but ambition lags for energy efficiency and airtightness, and legislation is not planned until 2024. Risks policy design may not drive heat pump uptake needed from 2021 – heat pumps were installed in 5% of new homes in 2020, far behind the 20% level required by 2021 in the CCC pathway.
	Residential – energy efficiency in existing homes			Success contingent on a comprehensive framework of standards, Energy Performance Certificates and Standard Assessment Procedure (SAP) being made fit for purpose to drive the right measures, and on a successor to the Green Homes Grant. Installations of loft and solid wall insulation are only a third of the rate needed by 2021 in the CCC pathway.
	Non-residential – energy efficiency and behaviour change			Commitments of 20% efficiency savings in business and 50% reduction of public emissions by 2032 are in line with the CCC pathway. Policy proposals only cover private-rented and larger buildings to date and there is little evidence for reduced energy demand at present.
Manufacturing and construction	Resource efficiency			The Waste Prevention Programme consultation sets out planned actions, but is not backed up with sufficient ambition on pace or estimated abatement, which is mostly not indicated.
	Energy efficiency			Abatement from energy efficiency in the Industrial Decarbonisation Strategy is in line with our Sixth Carbon Budget analysis, but it is not clear that this could be delivered by existing policies, such as Climate Change Agreements and the Industrial Energy Transformation Fund.
	Electrification			There is a lack of ambition on future levels of electrification, no specific business models have been developed and there is insufficient policy to address the cost issues around electrification.
	Hydrogen			Ambition potentially exceeds the level in the CCC pathway. BEIS have published updates on a potential hydrogen supply business model. The proposals could provide some support for hydrogen use in manufacturing but may falter as they are not designed for this purpose.

CCS in manufacturing and refining				The Industrial Decarbonisation Strategy has a target of 3 MtCO <sub>2</sub> captured from industry by 2030 that aligns to our advice. Government has also set out a 'minded to' position for an industrial carbon capture business model, although some aspects of the model are yet to be set out in detail.
Fuel Supply – electrification of oil and gas production				The North Sea Transition Deal stated an ambition of 50% emissions reductions by 2030 (from 2018 levels), which falls well below the underlying 68% in the CCC pathway. No credible policy has been implemented beyond the EU Emissions Trading Scheme, which alone was not sufficient to incentivise decarbonisation.
Electricity supply	Offshore wind			The Government's 40 GW target for 2030 is stretching, and Contracts for Difference (CfDs) have been working well to deliver capacity, though clarity is needed on the auction schedule and pathway of volumes to be procured to 2030.
	Other renewables			While onshore wind and solar are now eligible for CfDs, there is no clear medium- to long-term ambition. CfDs are a proven policy for delivering new capacity, but clarity is needed on the auction schedule and pathway of volumes to be procured to 2030.
	Nuclear			Government has made a commitment for at least one further plant and recognises the potential for advanced nuclear innovation. The CCC pathway assumes two large-scale plants are operational by the mid-2030s. Further clarity is needed on contracting models, and deployment of already contracted capacity is falling behind schedule.
	Dispatchable low-carbon generation			Government has committed to deliver at least one Power CCS project by 2030 but there is no equivalent for hydrogen, both of which fall short of the CCC pathway. No commercial deployment but trials are underway globally.
Agriculture and Land use	Diet change			There has been no stated ambition on the role of diet change in meeting climate targets or policy development aimed at diets.
	Peatland restoration			Defra's restoration target of 30,000 hectares by 2025 is less ambitious than the CCC pathway and there is no target beyond 2025. The ban on rotational burning introduced in May 2021 only covers 40% of all upland bog in England, while the commitment to end the sale of peat in horticulture by 2024 captures the amateur market only.
Aviation – demand management				No recognition that demand needs to be managed and several policies (e.g. proposed Air Passenger Duty reductions and airport expansion) are encouraging growth in the sector. Passenger-kilometres travelled per person have been increasing (pre-COVID-19) faster than can be accommodated in the CCC pathway.
Waste				Despite some progress in 2021, e.g. Defra's Waste Prevention Programme for England, delivery of key measures has been delayed and critical gaps remain. Recycling rates have stalled and Energy from Waste emissions are rising.
Removals				Recognition of need for removals but expected amount/timing unspecified. Growing innovation funding committed, but underlying policy frameworks and CCS infrastructure need urgent delivery.
<p> <span style="color: red;">■</span> = falling behind, major risks   <span style="color: orange;">■</span> = some action, more significant risks   <span style="color: yellow;">■</span> = potentially on track, some risks   <span style="color: green;">■</span> = fully on track, limited risks </p> <p>Notes: See Table 4.4 for further description of the 'ambition' and 'policy' scores given to each source of abatement.</p>				

### 3. Policy priorities and gaps

We have identified cross-cutting priorities, essential elements of the transition and significant policy gaps, alongside a detailed set of departmental recommendations for this Progress Report.

We recommend implementation of a Net Zero test to ensure policy is compatible with climate objectives.

Priorities include a Net Zero Strategy, a plan for a just transition and public engagement, a framework for local delivery and integration of adaptation in climate plans.

Through our analysis for the Sixth Carbon Budget and an updated assessment of progress for this report, we have identified a set of five cross-cutting policy priorities and seven essential elements of the Net Zero transition, as well as four significant policy gaps which require urgent action. We make a detailed and comprehensive set of approximately 200 recommendations for UK Government departments and the devolved administrations in the tables in the Annex to this report. These tables also include recommendations on climate change adaptation, which are covered in detail in the Adaptation Progress Report to Parliament.

#### a) Cross-cutting priorities

There is a need for a coherent approach to achieving Net Zero and to ensuring that all Government policies are compatible with the transition to Net Zero. Decisions on road building, fossil fuel production, planning and expansion of waste incineration are not only potentially incompatible with the overall need to reduce emissions but also send mixed messages and could undermine public buy-in to the Net Zero transition. We recommend implementation of a **'Net Zero Test'** to ensure that all Government policy decisions are compatible with the legislated emissions targets.

Several cross-cutting issues must be addressed to enable sector-specific strategies and plans to be rolled out effectively. These are essential in calibrating the public's expectations for what lies ahead and building broad public support for the changes:

- **A comprehensive Net Zero Strategy** is needed this year to fill gaps in ambition and pull together a coherent story of how sectoral efforts fit together to achieve the Net Zero target and interim budgets. The inclusion of international aviation and shipping in targets from the Sixth Carbon Budget and onwards allows for the first comprehensive look at a pathway to Net Zero covering *all* sectors. It should also commit to a 'Net Zero Test' to ensure that all Government decisions are compatible with the legislated emissions targets.
- **A plan for achieving a just transition** for people, workers, consumers and regions, which ensures that opportunities are taken to create jobs and improve the skills base while maintaining international competitiveness. Alongside this, a credible plan is needed for the fair funding of the transition, building on HM Treasury's Net Zero Review, as well as ensuring that investment is supported by strong financing.
- **Public engagement** around the need for climate action, the co-benefits to health of low-carbon choices, information about how individual actions can contribute to reducing emissions and involvement in decisions on how best to achieve a transition.
- **A framework for local delivery** to deliver ambitious climate objectives at different scales (i.e. devolved administrations, regions and local authorities), through workable business models, removal of barriers to action, dedicated resource and an approach that facilitates sub-national action to complement action at the national level.

The economic recovery following COVID-19 should accelerate the transition to Net Zero, avoiding harmful lock-ins and an overshoot in emissions.

- **Plans must make climate adaptation an integrated part of the transition to Net Zero.** Across multiple areas, and in particular on buildings and land use, there are benefits to thinking holistically about how policy can reduce emissions, while ensuring it improves resilience to the UK's changing climate. Like Net Zero, climate adaptation will also need to be integrated into core Government policy.

The Government must also ensure that public funding and investments to encourage an economic recovery are consistent with its Net Zero commitments and the need to adapt to climate change, and avoid harmful lock-ins in emissions or stranded assets. An overshoot in emissions relative to the CCC pathway as the economy recovers from the pandemic – as occurred following the financial crisis of 2008 – can be avoided with the right policies (Box 4.2).

## b) Essential elements of the transition to Net Zero

While progress is needed across a wide range of areas in order to get on track to Net Zero, there are several indispensable parts to the transition. We have identified seven priority areas for the Government, within the approximately 200 recommendations for the next year developed for this report, on which it is crucial that good progress is made. These are primarily focused on delivery:

Delivery priorities for the next year include EV charging infrastructure, a policy package for buildings decarbonisation, delivery mechanisms for land use change, comprehensive manufacturing policy, further auctions for low-carbon power, a hydrogen strategy and GGR support mechanisms.

- Develop and implement a comprehensive policy package to enable the delivery of the 2030 transition to **electric vehicles**, to build on the phase-out announcement and the positive response from automakers and motorists. This should include a full strategy for widespread deployment of charging infrastructure and a mandate requiring manufacturers to sell a rising proportion of zero-emission vehicles.
- Implement a comprehensive policy package for **buildings decarbonisation**, and enshrine the long-term standards framework in regulation and law, to finalise the roadmap for decarbonising the UK building stock.
- Implement comprehensive delivery mechanisms for landscape-scale **land use change for afforestation and peatland restoration** and a high take-up of **low-carbon farming practices**. This should cover mechanisms for private and public financing and a strategy to address non-financial barriers. Interim policies will be needed to avoid a hiatus in action while awaiting the implementation of the new mechanisms.
- Advance policy for **manufacturing decarbonisation** by establishing incentive mechanisms to support fuel switching, implementing CCS proposals, and initiating the development of product and construction standards both to improve energy and resource efficiency and to develop the option of managing carbon leakage by applying carbon policy to imports.
- Continue **auctions for low-carbon capacity**, together with supporting actions to enhance system flexibility, to deliver an emissions intensity of 50 gCO<sub>2</sub>/kWh or better in electricity generation by 2030.
- Deliver a **Hydrogen Strategy** that sets out a vision of the role of hydrogen on the path to Net Zero and the steps needed to realise it. The strategy should focus on hydrogen use in sectors that cannot decarbonise without it and low-carbon hydrogen production routes to 2035 with aims to start large-scale hydrogen trials in the 2020s.

- **Enable domestic engineered greenhouse gas removals (GGR)** to contribute to UK carbon budgets and Net Zero, and establish GGR support mechanisms and monitoring, verification and reporting (MRV) structures in the UK that ensure that GGR is timely, sustainable and verifiable.

### c) Gaps that must be addressed

Key gaps that must be addressed include phasing out unabated gas power generation, public engagement and encouraging behaviour change, addressing emissions from EfW and a Net Zero aviation strategy that addresses airport capacity.

Our assessment of strategies and policies announced to date has identified specific key gaps that need to be addressed by Government policy:

- Commit to **phasing out unabated gas-fired electricity generation** by 2035, subject to ensuring security of supply. Publish a comprehensive long-term strategy for unabated gas phase-out, including ensuring new gas plant are properly CCS- and/or hydrogen-ready as soon as possible and by 2025 at the latest, and thoroughly assessing the market challenges that will emerge.
- Include contributions in the Net Zero Strategy from **demand-side action** – on aviation, a shift towards healthier diets and a switch away from cars towards active travel and public transport. This should be accompanied by public engagement to explain how low-carbon choices can contribute to Net Zero and wider co-benefits to health, and policy frameworks that seek to encourage and incentivise these changes.
- Address with urgency the rising emissions from, and use of, **Energy from Waste (EfW)**, including by ensuring that the capacity and utilisation of EfW plants is consistent with necessary improvements in recycling and resource efficiency, providing support to enable existing EfW plants to begin to be retrofitted with CCS from the late 2020s, and introducing policy to ensure that any new EfW plant are built either with CCS or are 'CCS ready'.
- The overdue **Net Zero Aviation Strategy** must set out credible pathways and policies to encourage technological development in the sector but also recognise the potential need to manage aviation demand in future, should improvements in sustainable aviation fuels and low-carbon aircraft fall short of Government and industry ambitions. An assessment of the UK's airport capacity strategy and a mechanism for aviation demand management should be part of the aviation strategy.

Section 4 of this chapter provides further insights into our assessment of progress in each sector, identifies policy priorities and gaps and provides context for the sectoral recommendations for the next year.

## Box 4.2 Policy for a 'green recovery'

The pandemic and the public health response have had far-reaching consequences for the UK and global economy. As economies locked down, the world has seen recessions, lost jobs and higher Government debt.

This has resulted in a shift in the underlying conditions for reducing emissions and adapting to climate change. Although we are now seeing the start of an economic recovery in the UK, with the Bank of England predicting a 7.25% increase in GDP in 2021, this follows on from a 9.9% decline in 2020.<sup>11</sup> Government support to businesses and individuals affected by the pandemic has boosted the prospect of an economic recovery but also resulted in increased fiscal pressures (Government borrowing reached £355 billion in 2020-21 and is expected to be £234 billion in 2021-22). The pandemic has also highlighted existing wealth- and health-inequality and opened up new dimensions of inequality that were previously perceived as being less significant (for example the ability to work at home, quality of housing, or access to gardens and green spaces).

The Committee previously set out six principles to help guide the recovery in this economic context. These principles remain a useful framing for thinking about short and longer-term recovery from the pandemic:

- **Use climate investments to support the economic recovery and jobs.** Government can act to bring forward investment needed to reduce emissions and manage the social, environmental and economic impacts of climate change, often without direct public funding or by co-financing to accelerate private investment.
- **Lead a shift towards positive long-term behaviours.** There is an opportunity to encourage a 'leap forward' rather than a return to business as usual, on some of the new social norms resulting from the pandemic that benefit wellbeing, improve productivity, and reduce emissions, especially for travel. Government can lead the way through its own operations, public communications and infrastructure provision, and investing in measures to facilitate social distancing on public transport.
- **Tackle the wider 'resilience deficit' on climate change.** Comprehensive plans to reduce emissions and to prepare for climate change are not yet in place. Strong policies from across Government are needed to reduce our vulnerability to the destructive risks of climate change and to avoid a disorderly transition to Net Zero. Business must also play its part, including through full disclosure of climate risks.
- **Embed fairness as a core principle.** The crisis has exacerbated existing inequalities and created new risks to employment in many sectors and regions, placing even greater priority on the fair distribution of policy costs and benefits. The benefits of acting on climate change must be shared widely, and the costs must not burden those who are least able to pay or whose livelihoods are most at risk as the economy changes.
- **Ensure the recovery does not 'lock-in' greenhouse gas emissions or increased climate risk.** It is right that actions are taken to protect jobs and industries in this immediate crisis, but the Government must avoid 'lock-in' to higher emissions or increased vulnerability and exposure to climate change impacts over the long term. Support for carbon-intensive sectors should be contingent on them taking real and lasting action on climate change, and new investments should be resilient to climate change.
- **Strengthen incentives to reduce emissions when considering fiscal changes.** Changes in tax policy can aid the transition to Net Zero emissions. Many sectors of the UK economy do not currently bear the full costs of emitting greenhouse gases. Revenue could be raised by setting or raising carbon prices for these sectors, and low global oil prices provide an opportunity to offset changes in relative prices without hurting consumers.

The UK has taken initial steps towards a green recovery, in line with the principles we set out:

- Doubling the capacity to be contracted in this year's **Contract-for-Difference (CfD)** auction for renewable electricity to up to 12 GW.

- An initial £250 million of funding out of a package of investment of £2 billion over five years for new **cycling and walking** infrastructure and a £5 billion funding package over five years to improve **bus services** and cycle links across the country.
- £40 million of funding for **nature-based investments** such as tree planting and peatland restoration via the Green Recovery Challenge Fund, as well as a £10 million Natural Environment Investment Readiness Fund to encourage private sector investment in nature.
- £5 billion of investment over five years on **flood protection**.
- The **Green Homes Grant** scheme, which provided grants to support investments in greening residential and public buildings, was announced in September 2020 with a budget of £2 billion. However, it reached just 10% of the 600,000 homes it set out to improve and was cancelled by the Government in March 2021. The Government must learn from this experience to develop a replacement to the Green Homes Grant that works (Box 4.3).

Other Government announcements could also contribute to fund a green recovery, if the right rules are developed and put in place:

- A capital investment **super deduction** was announced in the March Budget, which aims to bring forward capital investment in plant and machinery. The transition to Net Zero will be capital intensive, but the super deduction in its current formulation does not rule out investment in high-carbon assets, which could lead to lock-in of higher emissions from these assets.
- The remits of the **Bank of England's Monetary Policy Committee (MPC)** and **Financial Policy Committee (FPC)** were updated to reflect the Government's economic strategy to achieve economic growth that is consistent with Net Zero. The MPC remit update could tilt the preference of the central bank's asset purchases towards low-carbon assets, potentially lowering borrowing costs for these assets.
- A **National Infrastructure Bank (NIB)** with £12 billion in capital and the aim of funding £40 billion worth of public and private projects was announced, with a remit to encourage Net Zero. The NIB is forecast to invest £1.5 billion a year<sup>12</sup>, only a fraction of the investment previously provided by the European Investment Bank each year (around £7 billion), which the UK lost access to after EU exit.
- The Government is issuing **green sovereign bonds** for the first time, committing to issuing £15 billion worth of green bonds in 2021. The rules on what will count as green spend have not been announced. This guidance should ensure that revenue raised through green bonds is used to fund policies that will genuinely contribute to Net Zero.

While fiscal pressures remain, overall UK investment continues to be low. More can be done to boost private investment and increase tax revenues while accelerating decarbonisation. Government announcements, while encouraging, do not go far enough to deliver the level of decarbonisation needed to achieve Net Zero.

## 4. Sectoral progress and next steps for policy

This section revisits key sectoral priorities and gaps identified in the Sixth Carbon Budget policy report and sets out progress since.

The Committee's December 2020 report, *Policies for the Sixth Carbon Budget and Net Zero*, set out comprehensive proposals for policy development across all sectors. This continues to be a relevant guide to policy development. This section revisits key sectoral priorities and gaps identified in the Sixth Carbon Budget policy report and sets out progress since, in sectors where significant developments have occurred. There are no specific sections for shipping and F-gases as material progress has not occurred in these sectors since December 2020 – here the Sixth Carbon Budget policy report continues to be our most up to date assessment of progress and priorities.

Based on this assessment we have put together approximately 200 recommendations for UK Government departments and the devolved administrations. Key priorities within these recommendations were set out in section 3 of this chapter, and the full lists of recommendations are in the Annex to this report.

### a) Surface Transport

We have set out the core requirements of a policy package in transport in the Sixth Carbon Budget policy report. The past year has seen considerable progress in the ambition and strategy for decarbonisation of the UK's transport sector, although specific policies and delivery plans are now needed to deliver on this increased ambition. Key progress over the past year has included:

- The commitment to a 2030 phase-out date for new petrol and diesel cars and vans in the Government's Ten Point Plan for a Green Industrial Revolution. Provided the focus is on a transition to fully electric vehicles (EVs) and the role allowed for hybrids is limited, this should deliver a transition which meets our Sixth Carbon Budget trajectory and delivers cost savings to society. Detailed supporting policies and implementation plans are now required, including:
  - A Zero-Emission Vehicle Mandate, requiring manufacturers to produce a rising percentage of EVs each year, alongside more ambitious CO<sub>2</sub> emissions regulations.
  - Support continues to be offered for purchases of plug-in cars and has been extended to 2022-23, although the maximum value of these grants was recently reduced by £500 to £2,500. Sustained financial support for the cleanest vehicles and disincentives to drive higher emitting cars will help shift the market.
  - The Ten Point Plan also confirmed plans to support the development of UK-based EV supply chains (including giga-factories for battery production) and to accelerate charge point roll-out with increasing focus on on-street charge points near homes and workplaces. A coordinated national strategy for charging infrastructure is needed, to ensure that provision is sufficient and appropriate across all regions of the country and that deployment is meeting the needs of the consumers who rely on public charging (in particular those without private off-street parking).

The commitment to a 2030 phase-out of new petrol and diesel cars and vans is welcome. The focus needs to be on fully battery-electric vehicles, rather than hybrids.

Now is an opportunity to reinforce the increase in walking and cycling and positive public responses to lower air pollution following the pandemic.

Public transport will need support to rebuild public confidence and avoid a car-led recovery.

Trials of zero-carbon HGVs will generate data on the best options for this sector. In the short-term, efficiency and logistics improvements are also needed.

- The Gear Change strategy<sup>13</sup> set out Government's vision for increasing active travel and using modal shift as a cost-effective way of reducing transport emissions.
  - The focus on high-quality infrastructure that would provide an attractive alternative to car use and on delivery through Local Authorities (including recognition that different solutions will be appropriate for different areas) within this strategy are important.
  - Government should reinforce the increase in walking and cycling, and positive public responses to reduced air pollution, that occurred during the COVID-19 pandemic to deliver lasting longer-term travel behaviours.
- The Bus Back Better strategy<sup>14</sup> aims to improve services across the country, including through better connectivity, simplified fares and increased use of prioritisation measures, to encourage more people to use the bus, rather than the car, as we build back from the COVID-19 pandemic.
  - This strategy included funding for UK production and purchase of zero-emission buses and was accompanied by a consultation<sup>15</sup> on phasing out new sales of diesel buses.
  - Further empowerment of, and support for, Local Authorities is likely to be needed to deliver improvements to bus services and simultaneously continue driving zero-emission bus take-up.
  - The public transport sector will require particular support to rebuild public confidence in its safety and avoid a car-led recovery. Bus and train operators may need further support as social distancing rules reduce capacity and impact profitability.
- The Scottish Government's Climate Change Plan Update<sup>16</sup> included a commitment to reduce car-kilometres by 20% by 2030. A comprehensive package of measures to support active travel, shared mobility and public transport, as well as reducing the need for some types of journey, will be needed to deliver this transformation.
- The Welsh Government launched LLwybr Newydd: the Wales Transport Strategy,<sup>17</sup> setting out its intention to improve the quality, reliability and affordability of public transport and provide better active travel and EV charging infrastructure to encourage people to switch to more sustainable modes of transport.
- The Ten Point Plan also committed £20 million in initial funding for trials of zero-emission heavy-goods vehicles (HGVs) and promised an upcoming consultation on a phase-out date for new sales of diesel HGVs.
  - This funding is being made available through two innovation competitions – one<sup>18</sup> proposing to test battery-electric trucks in real-world operation, and a second<sup>19</sup> to conduct pre-deployment planning for separate trials of an electric road system and hydrogen fuel-cell HGVs.

- Separate development and demonstration projects have also received funding this year, including Advanced Propulsion Centre grants<sup>20</sup> for development of electric HGV propulsion systems with better range and improved energy efficiency and a commitment<sup>21</sup> to establish a hydrogen transport hub in the Tees Valley.

The Transport Decarbonisation Plan will be important in setting out how the Government plans to deliver Net Zero across the whole transport system.

The upcoming **Transport Decarbonisation Plan** is expected to provide further detail on how the Government plans to deliver Net Zero for the transport sector.

Alongside this, it will be important to embed the positive behavioural changes that have been developed during the COVID-19 pandemic, but also to act decisively to mitigate those more negative consequences which could jeopardise the sector's decarbonisation pathways. Key priorities as the economy emerges from the pandemic should be:

- To restore confidence in and use of public transport. This is important not only for transport emissions, but to ensure all people have access to affordable and safe transport.
- To prioritise funding away from car use. The costs of car travel have fallen relative to both average wages and to bus and rail.<sup>22</sup> This needs to be rebalanced away from cars, the most carbon-intensive mode, and towards public transport and walking and cycling.
- To encourage behaviours that reduce travel demand such as working from home or using technology in place of business trips. Prioritisation of investment in improved digital connectivity rather than road-building would help achieve this, contributing towards a greener recovery.
- To encourage behaviours which improve efficiency of travel such as increased car sharing.

## b) Buildings

We have set out the core requirements of a policy package in buildings in the Sixth Carbon Budget policy report. UK Government's Heat and Buildings strategy, which was originally due by summer 2020, had not been published as this year's Progress Report was being finalised.

At its core, the strategy needs to set out the trajectory of standards on energy efficiency and heating emissions with policy proposals to deliver on this ambition in a way that works for households. It must signal a clear route to expanding heat pump and heat network supply chains now, while kicking off the process to clarify the role for hydrogen in any locations where it may be a viable option, as well as those where it is not. There are critical questions to resolve around who pays for buildings decarbonisation, along with considerations around how to ensure resilience measures are integrated and co-benefits (e.g. for health and fuel poverty alleviation) maximised.

## i) Key developments in the past year

### Strategy and implementation

A number of important publications have been released over the past year including the Ten Point Plan, the Energy White Paper, the Scottish Government Draft Heat in Buildings Strategy, consultations on new build standards, the Northern Irish Energy Strategy consultation and the Welsh plan on tackling fuel poverty – amongst others. Developments have included the following:

Key developments over the past year have included a commitment to phase out the installation of natural gas boilers by 2035 UK-wide, and to require zero or near zero carbon heating from as early as 2025 in Scotland.

BEIS and the Scottish Government have developed new proposals for energy efficiency standards for owner-occupied homes, with further proposals from BEIS for an in-use performance scheme for large commercial buildings.

- **Owner occupier energy efficiency.** The Scottish Government committed to consulting on detailed proposals for requiring owner-occupied private housing to meet Energy Performance Certificate (EPC) C at trigger points such as point of sale from 2023-25 onwards, with a backstop standard by 2035.\* UK Government consulted on a framework for lenders to disclose the energy performance of their portfolios, and on an associated target for all lenders to meet a portfolio average of EPC C by 2030. The Energy White Paper also announced a commitment to consult on regulatory measures to improve the energy performance of owner-occupied homes.
- **Private rented sector energy efficiency.** UK Government consulted on requiring all properties with new tenancies to meet EPC C from 2025, with properties for all tenancies required to reach the standard by 2028. The Scottish Government also committed to requiring private-rented sector properties to meet EPC C by 2028. The 2020 Energy White Paper confirmed that the future trajectory for the non-domestic minimum energy efficiency standards will be EPC B by 2030 – BEIS are now consulting on proposals to tighten enforcement and an interim target.
- **Energy efficiency in social homes.** The UK Government Social Housing White Paper commits to reviewing whether the Decent Homes Standard should be updated and how it can better support decarbonisation and energy efficiency. In Scotland, plans were announced to bring forward the review on strengthening the EPC B target. The Welsh Government launched the optimised retrofit programme to pilot approaches to retrofit.
- **Other commercial energy efficiency.** BEIS have published proposals for a new in-use performance rating for commercial and industrial buildings over 1,000 square metres, with a view to introducing standards on in-use performance based on the successful Australian NABERS scheme and in line with our advice. Success relies on absorbing lessons from the original scheme, including the role of public procurement in establishing the standard.
- **Metrics.** UK Government published the EPC action plan examining the steps needed to improve the reliability, impact, and data infrastructure of EPCs. The Scottish Government also committed to consult on proposed reforms to EPCs in 2021.
- **New buildings.** UK Government has announced an interim standards uplift for new homes to apply from 2021, and proposed to legislate in 2024 for the Future Homes Standard to be introduced in 2025. This standard will require carbon savings of 75% relative to today and the Government plans to consult on whether to end gas grid connections to new homes built from 2025. UK Government have also consulted on the Future Buildings Standard, with implementation proposed as starting in 2025. Consultations have also been undertaken in the devolved administrations, with the Scottish Government targeting new buildings consented from 2024 for zero emissions heating (and cooling).

\* A range of commitments here and elsewhere have been made around requiring homes to meet an EPC C standard, which is broadly consistent with the level of home insulation in our pathways, provided EPCs are made fit for purpose. This means that they must be designed to drive deployment of the necessary energy efficiency measures - all practicable lofts and cavities insulated alongside other low-regret measures, with solid wall insulation deployed where this supports low-carbon heat and wider benefits; to do so on a holistic basis (i.e. to address issues such as overheating and ventilation simultaneously); whilst not disincentivising low-carbon heat or treating onsite generation as a replacement for energy efficiency or low-carbon heat. See below for further discussion.

- **Low-carbon heat.** The Scottish Government have proposed regulations to require installation of zero or near zero emissions heating in existing buildings at trigger points (such as heating system replacement) from 2025, with a backstop requirement for all buildings to meet this standard no later than 2045. UK Government have set an ambition for all newly installed heating systems from the mid-2030s to be low carbon, or appliances which can be converted to a clean fuel supply. UK Government have also announced an ambition to deliver 600,000 heat pump installations per year by 2028, alongside plans for hydrogen trials from 2023 and a plan to consult on the role of hydrogen-ready appliances. The details of the Green Gas Support scheme, supporting biomethane, have also been announced.
- **Heat networks.** BEIS is finalising proposals for the £270 million Green Heat Network Fund, which will shift the focus away from gas Combined Heat and Power to lower-carbon networks. The Heat Networks Bill is going through the Scottish Parliament, including ambitious proposals for zoning.
- **Skills.** The Green Jobs Taskforce was launched, with a commitment to publishing an action plan this spring.
- **Wood in construction.** The England Trees Action Plan commits Government to developing a policy roadmap on use of timber in construction, to increase public demand for sustainably sourced timber through procurement policies and to conduct further research.

A full table of progress to date against the CCC's previous recommendations can be found in supplementary material published alongside this report. It should be noted that the ratings are assigned on the basis of UK progress, reflecting the majority position. For this reason they often do not, in isolation, reflect the pace of progress in the devolved administrations. Nevertheless, following publication of the Draft Heat in Buildings Strategy, it remains the case that Scotland demonstrates a strong example of action to develop an effective policy framework. We will comment on progress in Scotland in more detail in our Scottish Progress Report in late 2021.

While important progress on ambition has been made or is imminent, effective policy has yet to be designed or implemented in many areas.

HM Treasury committed over £3 billion of public funding in the 2020-21 financial year to buildings decarbonisation as part of the Green Recovery. This included over £1 billion for public sector decarbonisation, alongside home efficiency schemes.

### Delivery and the Green Recovery

The case for investing in buildings retrofit as part of economic recovery remains strong – there are major benefits in terms of emissions reduction, cost savings and wider benefits; it is labour-intensive and spread across the country. Fundamentally this is something that needs to happen on the path to Net Zero and supply chains are well below the levels they need to be at in order to deliver Government commitments on fuel poverty, energy efficiency and heat over the next decade.

Significant time pressure and issues with the private sector contractor led to the £1.5 billion Green Homes Vouchers scheme being scrapped prematurely with only £264 million allocated to date.

In recognition of these points, Treasury committed over £3 billion of public funding in the 2020-21 financial year, including over £2 billion grant funding for home retrofit and £1 billion funding for public sector decarbonisation.

The very significant time constraints for spending the funding have led to mixed results, with severe consequences for the Green Homes Grant voucher scheme due to the requirement to undertake the work before payment is issued:

- Where the decision was taken to commit spending by the end of the financial year but actually undertake the work in 2021/22, funds were successfully committed. This includes the £1 billion Public Sector

Decarbonisation Fund, the £500 million Local Authority Delivery programme for the Green Homes Grant, focussed on fuel poor, and the £50 million Social Housing Decarbonisation Fund Demonstrator.

- The £1.5 billion Green Homes voucher scheme was conceived as the only direct-to-household offer, with a requirement to undertake the work within the 2020/21 financial year. Major delivery issues with the private sector administrator led to the scheme cancellation in March 2021 with only £264 million allocated to date (of which £211 million to low income households).<sup>23</sup> The Government has agreed to honour existing vouchers meaning a portion of the spend will fall under the 2021/22 financial year.

It is essential that lessons are learnt. Government must now come forward with plans for a successor scheme in the next fiscal event, committing to long-term funding and taking sufficient time to develop and test a scheme so that we get one which works.

To avoid further harm to supply chains at this stage, it is essential that Government comes forward with plans for a successor to the Green Homes Grant voucher scheme in the next fiscal event— ensuring this time that it is thoroughly tested, provides a long-term funding commitment, and builds on lessons learnt (Box 4.3).

The initial success of the public sector scheme means that there is a template to build on now. Our scenarios imply funding levels of £1 billion a year through the next decade, with a growing role for low-carbon heat alongside energy efficiency. The next stages must now pivot to longer-term planning cycles, with clear roles for local authorities backed by funding, and strong integration with wider heat policy including the heat networks roll-out. The funding streams must also be designed so as to be accessible to smaller public bodies, who anecdotally have not had the resources to bid into the Public Sector Decarbonisation Scheme and who have been affected by the merging of Salix funding with this pot.\*

For the public sector, the key is moving now to longer term planning cycles, with clear roles for Local Authorities backed by funding, and strong integration with wider heat policy including the heat networks roll-out.

### Box 4.3

#### Lessons from the Green Homes Grant

The £1.5 billion Green Homes Grant voucher scheme opened for applications in September 2020, a few months after it was announced by the Treasury. It is the first publicly funded direct-to-household offer on home energy efficiency since the demise of the Green Deal scheme in 2015.

The scheme aimed to improve the energy efficiency of over 600,000 homes, with grants focussed on fabric efficiency measures and low-carbon heating primarily. Grants of up to £5,000 were issued, covering two-thirds of the cost. Households in receipt of certain benefits were eligible for grants of up to £10,000, covering 100% of the cost of improvements.

#### Lessons for the successor scheme

There are a number of important lessons to take into account in the design of a successor scheme, along with an important positive story on demand:

- **Demand for the scheme.** The scheme generated a significant amount of interest from the public, with close to 2 million views of the Simple Energy Advice GHG eligibility checker in a 4-month period and 170,000 measures applied for over seven months. By comparison, only 20,000 measures were funded through Green Deal loans between 2013 and 2015. Media reports covered people unable to apply due to the lack of local approved suppliers. The fact that it was announced by the Treasury may have helped raise the profile, along with the relative simplicity of the basic offer to consumers.
- **Timelines and the need for a policy package approach.** From the outset there were calls for the Treasury to extend the funding window beyond March 2021 to allow supply chains time to scale up and provide more certainty to businesses to invest, develop and retain skills in the sector. These calls were backed by significant

\* Salix funding provides Government funding to the public sector to improve energy efficiency, reduce carbon emissions and lower energy bills. Salix is funded by the Department for Business, Energy and Industrial Strategy, the Department for Education, the Welsh Government and the Scottish Government.

evidence of the negative impacts on home insulation markets from short-term subsidy schemes in England and Wales, including job losses of 30,000 following the end of the Green Deal. There is also evidence of poor-quality installations linked to the surge in funding in the final year of the Supplier Obligation schemes, which shows the impact of scaling up too quickly without the skills in place to deliver. Government can move forward by announcing a successor scheme in the next fiscal event alongside proposals for a timetable of standards, with funding designed to support market stability and long-term investment planning.

- **The need for testing with installers.** The timelines for getting the scheme up and running also put pressure on scheme development. In the £50 million Social Housing Decarbonisation Fund Demonstrator fund launched in parallel, market testing had already taken place through the Whole House Retrofit competition meaning there was evidence to draw on. A key learning from the Green Homes Grant voucher scheme is the need to workshop the consumer journey and practicalities with a group of installers/practitioners covering the core trades. This could have flagged a number of issues with the IT system including (but not limited to) the importance of being able to track existing applications, the difficulties with delivery around Christmas, and ways to streamline evidencing so as not to rely on consumers acting following installation.
- **Procurement and use of existing systems.** The issues with the scheme contractor are currently subject to review by the National Audit Office (NAO). There remain important questions over the procurement and contracting, as well as the decision not to make use of existing IT systems such as the one used on the ECO scheme, or to make more use of existing commercial relationships and expertise, including through local authorities.
- **Accreditation.** Households need to be confident that when they upgrade their property they will see genuine improvements and technology that works. Government has undertaken a considerable programme of work following the recommendations of the 2014 Each Home Counts review to improve standards and accreditation, notably through its support of the PAS2030 and PAS2035 standards overseen by Trustmark. The Microgeneration Certification Scheme (MCS) similarly has accredited installers of low-carbon heat under the Renewable Heat Incentive. However, there were a number of issues with the accreditation process for Trustmark, particularly for low-carbon heating measures already covered by MCS which created bottlenecks in the supply chain and meant that consumer demand remained unmet, with strong geographical variation.

It is essential that these lessons are taken into account in a successor scheme to create a long-term stable market which can deliver the major upgrade of the housing stock to EPC C over the next decade.

*Source: BEIS (2020) Press release: Greener homes, jobs and cheaper bills on the way as Government launches biggest upgrade of nation's buildings in a generation; BEIS (2021) Official Statistics - Green Homes Grant voucher release, May 2021*

## ii) Next steps for buildings decarbonisation

As part of our Sixth Carbon Budget advice we set out our view of the four necessary components of a policy package for the decarbonisation of heat in buildings: setting a clear direction, making low-carbon financially attractive, implementing enabling measures, and getting on with it.

As summarised above, a number of important commitments have been made over the past year, but important gaps also remain at a UK level in every area:

- **A clear direction.** We do not yet have a long-term trajectory of standards in place to deliver the efficiency upgrades and fossil fuel phase-out that is needed. There is not yet a sufficiently strong commitment to the role of electrification – in particular, the current Government ambition of 600,000 heat pumps a year by 2028 will almost certainly fall short of the 2030 NDC

Major gaps include a clear trajectory of standards on efficiency and heat; funding proposals and interventions to make low-carbon choices attractive; green buildings passports and a governance framework to drive decisions on heat infrastructure and zoning from the mid-2020s, including a role for area-based energy plans.

target (given the lack of any stated ambition on heat networks) as well as falling short of the Committee's pathway to meeting the Sixth Carbon Budget.

There is no support in place now for commercial heat pumps over 45kW – a key supply chain.

- **Making low-carbon financially attractive.** There is currently no plan for how price signals will be reformed to drive low-carbon choices (i.e. to correct the current distortions that work against electrification), and a number of existing funding routes are set to fall away. A multi-year programmatic funding regime is needed to replace them. In particular, there are major risks given the lack of support mechanism for commercial heat pumps over 45 kW after the Renewable Heat Incentive closed to new applications. Grants of up to £4000 are unlikely to be sufficient for medium-sized installations up to 45 kW given capital costs of £750-1550 per kW.\* Equity and consideration of the fair distribution of costs will be critical to designing the price signal reforms and funding programmes necessary.
- **Enabling measures.** While progress has been made, more is needed to ensure householders have access to high quality information and can have confidence that work will be delivered to high standards. The forward roadmap should include plans for incorporating in-use performance and transitioning to green building passports.

EPCs are not fit for purpose – further reforms are essential.

- Government plan to increase the reliance on EPCs as a key policy lever. As such it is critical they are made fit for purpose, robust and enforceable and make use of energy consumption data. The EPC action plan is a positive step forward but further action is needed to ensure EPCs and Standard Assessment Procedure (SAP) deliver the energy efficiency measures needed and do so in a holistic way which supports (rather than disincentivises) low-carbon heat deployment and actively drives measures to simultaneously address ventilation, damp and overheating (rather than simply communicating risks). Onsite generation, such as solar PV, should not be treated as a substitute for energy efficiency or low-carbon heat, and needs to be valued proportionately to its benefits (factoring in seasonality and any on-site storage). Biomass boilers must not be encouraged in areas where they will impact public air quality and biofuels in buildings should be minimised (for example, through efficient use in hybrid heat pumps rather than 'drop-in' biofuel boilers) given our assessment of economy-wide best use being elsewhere.

Other barriers need to be addressed, including poor compliance and enforcement and the risk of high connection charges.

- The reforms in the Buildings Safety Bill create a framework to improve the efficacy of building regulations, including those relating to climate change mitigation and adaptation.<sup>24</sup> This should be strengthened through an explicit responsibility for sustainability alongside buildings safety and performance. It will be important to ensure the buildings safety regulator is sufficiently equipped to monitor and enforce compliance across all building regulations and to ensure that local authorities are properly funded for enforcement activities.
- Barriers to deployment of key measures, such as the risk posed by the current connection charging regime to the uptake of low-carbon technology such as heat pumps, need to be addressed.

\* Range based on an air-to-air heat pump at the lower bound, and a low-temperature air-to-water heat pump at the upper bound, Sixth Carbon Budget published dataset, available online.

It will be difficult if not impossible to develop the full mix of heat options (i.e. low-carbon heat networks and hydrogen alongside building-scale technology) without any planning or clear roles for local authorities, networks and other actors.

- **Getting on with it.** Recognition is needed of the importance of a geographically planned approach to heat decarbonisation, with plans introduced to deliver it. Commitments are lagging in areas with potential for early progress.
  - There is an urgent need to formalise a governance framework to drive decisions on heat infrastructure and zoning from the mid-2020s, including a role for area-based energy plans. This should be underpinned by a programme of research initiated in 2021 to identify areas unlikely to be suitable for hydrogen (a key enabler to efficiently targeting early electrification and network development) alongside priority candidate areas for hydrogen.
  - Levers such as the 2021 buildings standards uplift have potential to drive early growth in heat pumps, but it remains unclear to what extent they will do so.

The priority now must be on implementing a comprehensive policy package, and enshrining the long-term standards framework in regulation and law, to finalise the roadmap for decarbonising the UK building stock.

Climate adaptation and resilience is an essential part of this, including good ventilation to manage overheating risks, green sustainable urban drainage systems and water efficiency measures.

Progress in decarbonising buildings must go hand in hand with adapting them to the changing climate. An integrated approach to housing and thermal comfort is required to manage overheating risk and ensure good ventilation.\* Programmes to improve energy efficiency of the housing stock provide an opportunity also to undertake work to adapt properties to possible heat and flood risks and improve water efficiency.

## c) Manufacturing and construction

This year has seen a substantial increase in the Government's stated ambition on decarbonisation of manufacturing. However, progress on developing and delivering policy has been slower than required with large gaps in policy remaining.

### i) Progress in the past year

In March, the Government's Industrial Decarbonisation Strategy (IDS) set out ambition to reduce emissions from manufacturing and refining by around two thirds by 2035 from 2018 levels. This represents a substantial step forward in the Government's ambition, but it is still below the CCC pathway, in which the equivalent emissions are reduced by 73% by 2035.

Underlying this ambition, the Government has made several commitments in the past year to deliver fuel switching, CCS and energy and resource efficiency, through the IDS, Waste Prevention Programme and business model updates.

- **Fuel switching.** The IDS set an ambition that at least 20 TWh of fuel use will switch to low-carbon energy by 2030, which is close to, but below, the 24.5 TWh in the CCC pathway.

The Government's Industrial Decarbonisation Strategy set out ambition to reduce emissions from manufacturing and refining by around two thirds by 2035 from 2018 levels.

\* High levels of energy efficiency measures installed in new and existing homes can increase the retention of heat and airtightness of the building. This can increase the risk of overheating and exposure to indoor air pollutants if appropriate adaptation and ventilation measures are not implemented at the same time.

Government has set out a 'minded to' business model for industrial carbon capture, but only and small commitment to 'set out initial steps to support uptake of electrification'.

- **Hydrogen.** Government has committed to consult on a hydrogen supply business model that would incentivise hydrogen use by subsidising the cost of hydrogen production.
- **Electrification.** Government has made a smaller commitment to 'set out initial steps to support uptake of electrification'. It also committed to publish a call for evidence on energy affordability and fairness, by April 2021, which may consider the distribution of energy levies and taxes.
- **Mandatory requirements.** Government has committed to explore the option of making it a mandatory requirement for upgraded equipment to be low-carbon ready in the 2020s, which is also likely relevant to CCS.

- **CCS.** The IDS set an ambition for around 3 MtCO<sub>2</sub>e of industrial CCS by 2030, which is broadly in line with the CCC pathway\*. The Government also set out a 'minded to' position for an industrial carbon capture business model, although some aspects of the model are yet to be detailed.
- **Resource and Energy Efficiency.** The Waste Prevention Programme consultation proposed policies to improve resource efficiency, although the sectoral scope of these proposals is often limited, the pace of proposals modest and the emissions impact is not estimated. Further details are set out in sub section (f) on waste. Government also agreed an updated set of Climate Change Agreements with industry to encourage energy efficiency.
- **Material Substitution.** The England Trees Action Plan commits Government to developing a policy roadmap on use of timber in construction and to increase public demand for sustainably sourced timber through procurement policies.

The Waste Prevention Programme consultation proposed policies to improve resource efficiency.

Government has also set out several plans that could provide cross-cutting support for different decarbonisation measures and maintaining industrial competitiveness:

- **Carbon and energy pricing.** The UK Emissions Trading System (UK ETS) launched at the start of the year. Government has committed to consulting by September 2021 on a cap for the UK ETS consistent with the Sixth Carbon Budget.
- **Product standards.** Government has committed to a call for evidence on low-carbon industrial product standards within a year, highlighting the potential for mandatory standards to be introduced in the mid-to-late 2020s.

Government has committed to consult on a target-consistent cap for the UK ETS and a call for evidence on product standards.

Government has made mixed progress with awarding **existing capital funding**. £170 million was awarded from the Industrial Decarbonisation Challenge, but progress awarding funding from the £315 million Industrial Energy Transformation Fund has continued to be too slow since its announcement in October 2018 and the £250 million Clean Steel Fund appears to have made no progress.

Overall, while progress has been made, development and delivery of policy to decarbonise manufacturing and construction will need to broaden and accelerate.

Overall, while progress has been made, development and delivery of policy to decarbonise manufacturing and construction will need to broaden to fill several policy gaps, and accelerate if it is to deliver abatement levels consistent with the CCC pathway.

\* Note that this 3MtCO<sub>2</sub>e of CCS includes CCS on refineries which falls within our Fuel Supply sector. We have compared to our pathway on an equivalent basis.

## ii) Next steps on manufacturing and construction policy

Our Sixth Carbon Budget policy report set out the core requirements of a policy package for decarbonising manufacturing and construction. In this subsection, we set out key near-term policy actions required to deliver the longer-term actions recommended in our Sixth Carbon Budget advice. Full details are set out in the tables of departmental policy recommendations at the end of this report. These policy actions should address the shortfalls of existing decarbonisation policy for manufacturing and construction, and ensure longer-term policy has the right ambition, delivers key measures, strengthens incentive mechanisms, maintains industrial competitiveness, and develops infrastructure and skills.

### **Ambition**

Government has stated that it will revisit its ambition for decarbonisation of manufacturing and refining in its Net Zero Strategy. It should take this opportunity to align its ambition with the CCC pathway for manufacturing or identify other areas of the economy to make up for this shortfall. The strategy must also set out the Government's ambitions and plans to decarbonise off-road mobile machinery.

It should also set out which policies will enable this ambition and quantify how much abatement Government expects to be enabled by each policy, particularly for resource and energy efficiency abatement through the 2020s.

### **Delivering specific measures**

Government should establish incentive mechanisms to support fuel switching, implementing CCS proposals and initiating the development of standards to improve energy and resource efficiency. The Government should:

- Establish funding mechanism(s) to support operational and capital costs of both electrification and hydrogen use in manufacturing, as soon as possible, with the aim of awarding funding in 2022. It should also deliver industrial carbon capture contracts to enable final investment decisions on the first industrial carbon capture projects in the first half of 2022.
- Consult on detailed proposals for product standards and extended producer responsibility to improve the resource efficiency of consumer goods' lifecycles by spring 2022. It should also implement policies to drive more resource-efficient construction and use of existing low-carbon construction materials, including a substantial increase in the use of timber in construction, on the same timetable. This should include finalising the reporting methodology for whole-life carbon standards for buildings, roads and infrastructure.

### **Cross-cutting incentives and maintaining competitiveness**

Government should also work towards strengthening its cross-measure incentive mechanisms and start to develop the crucial framework for maintaining long-term competitiveness, which will require development of measurement standards.

The Government should:

- Set a cap for the UK ETS consistent with the path through the Sixth Carbon Budget to Net Zero. It should also reform energy and carbon pricing for manufacturers not covered by the UK ETS, to provide a clear and strong incentive for decarbonisation.

Government should establish incentive mechanisms to support fuel switching, implementing CCS proposals and initiating the development of standards to improve energy and resource efficiency.

Government should also work towards strengthening its cross-measure incentive mechanisms and start to develop the crucial framework for maintaining long-term competitiveness, which will require development of measurement standards.

- Consult on reforms to electricity pricing to remove disincentives to electrification, based on consideration of the strategic and fair allocation of legacy policy costs associated with past deployment of less-mature low-carbon electricity generation. It should also consider the balance of existing taxes, such as the Climate Change Levy, on different energy sources.
- Start to develop the options of applying either border carbon tariffs or minimum standards to imports of selected emissions-intensive products. This should include developing carbon-intensity measurement standards, encouraging the international development of these (e.g. through the G7 and COP26 presidencies) and fostering international consensus around trade policies.

### Infrastructure, skills and jobs

Implementation of manufacturing decarbonisation will require development of supporting policies on infrastructure and skills, and a focus on jobs. The recommendations tables in the annex of this report detail our recommendations in full, capturing their cross-sectoral and cross-departmental nature:

- On infrastructure, Government should deliver the CCS Transport and Storage Regulatory Investment Model; develop plans for CO<sub>2</sub> transport from dispersed sites; deliver plans to ensure electricity networks can accommodate large localised increases in demand; and formalise the process for decisions on the conversion to hydrogen of (zones of) the gas networks.
- On skills and jobs, Government should develop a strategy for the development and roll-out of manufacturing training and skills and design industrial decarbonisation policies to support and create jobs, especially in regions with reliance on industrial jobs.

## d) Agriculture and land use

While the UK Government and the devolved administrations have set out elements of their ambition to reduce emissions from land, there has been limited implementation of policy in these sectors over the past year. Key announcements on peat and trees in England were published in their respective Action Plans in May 2021.<sup>25</sup>

### i) Progress in the past year

#### Trees

The UK Government has committed<sup>26</sup> to the planting of 30,000 hectares of woodland per year by 2025 across the UK, in line with the CCC pathway:

- England's share is around 7,000 hectares per year based on Defra's commitment to treble tree planting rates from the 2,340 hectares achieved in 2019/20.
- The Scottish Government intends to deliver 18,000 hectares per year by 2024/25.<sup>27</sup> The Welsh Government's current ambition remains at 2,000 hectares a year, with a commitment to increase that to 4,000 hectares by

Implementation of manufacturing decarbonisation will require development of supporting policies on infrastructure and skills and a focus on jobs.

UK Government's afforestation targets are in line with the CCC pathway for 2025.

an unspecified time. Northern Ireland's target of 18 million trees during this decade averages 900 hectares per year.<sup>28</sup>

£500 million of funding has been committed through the Nature for Climate Fund to meet England's woodland creation target. Scottish Forestry will receive £100 million to reach its afforestation target and Northern Ireland launched a £4 million Small Woodland Grant Scheme.

£500 million from the Nature for Climate Fund will be the main source of public funding to meet England's woodland creation target to 2025. This will provide grants for conventional planting in urban and rural areas (including trees on farms), as well as natural colonisation. Focus will be given to the planting of native broadleaves, and extra funding will be provided for planting that can deliver wider benefits such as riparian shading (trees planted along water courses can reduce the risks to freshwater species from higher water temperatures), biodiversity, water filtration and flood risk alleviation.

To meet the 2024/25 afforestation target in Scotland, Scottish Forestry will receive £100 million, £30 million will go to Forestry and Land Scotland and £20 million to boost tree nursery capacity. Northern Ireland launched the £4 million Small Woodland Grant Scheme at the end of 2020 to encourage the integration of trees on farmland.

### Peat

Defra's new £50 million Nature for Climate Peatland Grant Scheme funded by the Nature for Climate Fund will support the Government's target for restoring 35,000 hectares of peatland in England by 2025. Of this area, around 5,000 hectares is expected to come from the restoration of lowland agricultural land to peat habitat.

The Government's peat restoration commitments for England falls short of the CCC pathway.

This falls short of the Committee's pathway for the restoration of 56,000 hectares of peatland in England by 2025, which includes 8,000 hectares of lowland rewetted to peat habitat. Defra is expected to publish details on the options to manage sustainably the area of lowland peat that remains in agriculture in 2022.

Legislation introduced in May 2021 prevents the rotational burning of certain blanket bog sites in England with immediate effect.\* The partial ban covering an area of around 142,000 hectares accounts for around 40% of all blanket bog in England.<sup>29</sup> Of the area covered by the ban, around 52,000 hectares hold a live consent to burn, with the remainder either being subject to a consent that is not exercised or has no current relevant consent. This partial ban is less ambitious than our recommendation that all rotational burning in England and the devolved administrations should cease immediately. Data on the area of land that is burned each year is poor as the requirement to notify the authorities only covers newer consents.

The Government's partial ban on rotational burning of peat is less ambitious than the CCC's recommendation that all burning in England and the devolved administrations should cease immediately.

The sale of peat in compost is to end in England by 2024 subject to a consultation later this year on a range of measures to achieve this. The consultation will also consider extending the sales ban to the professional market, by an as yet unspecified date. These proposals are less ambitious than our recommendation that all peat extraction, along with its sale in both the amateur and professional horticultural market should end by 2023. This should also apply to imported peat, which makes up two-thirds of peat sold in the UK.

In Wales, between 600-800 hectares of peat will be restored annually between 2020 and 2025 under the Government's National Peatland Action Programme (NPAP). Launched in November 2020, around 680 hectares was directly delivered through the NPAP in 2020/21.

\* Sites of Special Scientific Interest that are also a Special Area of Conservation or a Special Protection Area.

Pilots focused on delivering eight land-based management standards are being funded through the Sustainable Farming Incentive ahead of national roll-out in 2022.

## Agriculture

Defra is funding pilots under the Sustainable Farming Incentive (SFI) this year ahead of a national roll-out in 2022. The SFI, which is part of the new Environmental Land Management Scheme (ELMS) will see farmers pilot actions focused on delivering eight land-based management standards covering arable land, grasslands, horticultural soils, hedgerows, agroforestry and water buffers. In addition to delivering emissions reduction and carbon sequestration, many of the actions will deliver other benefits such as improved wildlife habitat, reduced diffuse water pollution and improvements to air quality.

The Welsh Government introduced legislation to extend coverage of Nitrate Vulnerable Zones to all of Wales in line with our recommendation. In force since April this year, mandatory measures covering manure management and fertiliser use to reduce nitrate run-off into water courses will also deliver reductions in N<sub>2</sub>O emissions.

## Nature

Defra recently announced it will be amending the Environment Bill to require a legally-binding target for species abundance, aiming to halt the decline of nature by 2030.<sup>30</sup> This will apply to species within protected sites, the wider countryside and urban areas. The exact target level and broader details will be set in secondary legislation following consultation and further evidence gathering.

### ii) Next steps for decarbonising agriculture and land use

Existing ambition in England and the devolved administrations falls short of the trajectory needed to meet the Sixth Carbon Budget on the path to Net Zero. Ambition needs to be raised and gaps addressed quickly as delayed action now puts future targets at risk given the time profile of carbon sequestration. Policy voids should be addressed quickly (e.g. what will replace the Common Agricultural Policy in Scotland and Northern Ireland):

- Defra and the devolved administrations should set out targets for woodland creation and peat restoration beyond 2025. These bodies should work together to ensure that the combined levels are in line with the UK ambition set out in our Sixth Carbon Budget Advice (e.g. 30,000 hectares of new woodland each year from 2025, increasing to 50,000 hectares in 2035).
- Authorities should develop and implement further mechanisms to leverage private sector finance to help support woodland creation and peat restoration targets in England and the devolved administrations. This includes increasing participation in the Woodland Carbon Guarantee, and assessing the scope for and merits of including trees and peat in the UK Emissions Trading Scheme. Further development of the Peatland Code is needed to widen eligibility to a range of peatlands and enable accreditation by the UK Accreditation Service.
- The Sustainable Farming Incentive pilots are currently focused on land management actions. The pilots should be extended to include the full range of available low-carbon farming measures set out in our Sixth Carbon Budget advice, aimed at reducing other sources of emissions (e.g. enteric emissions from cattle and sheep). Future piloting of the Local Nature Recovery and Landscape Recovery schemes, which make up the other two ELM schemes should incentivise landscape-scale change such as afforestation and peat restoration.

Ambition in England and the devolved administration falls short of what is needed to achieve the Sixth Carbon Budget and Net Zero. Gaps must be addressed quickly given the time profile of carbon sequestration.

Gaps in ambition and policy include targets for woodland creation and peat restoration beyond 2025; extending the Sustainable Farming Incentive pilots to additional low-carbon farming measures; expediting legislation to ban rotational burning of all upland peat and ending the sale of peat for all horticultural use by 2023.

- Legislation to ban rotational burning of all upland peat sites in England (and elsewhere in the UK) should be expediated to come into force before the start of the burn season in October 2021. The ban on horticultural peat sales (including imports) should cover both the amateur and professional markets and be brought forward to start in 2023 – a year earlier than planned. Damaging peat extraction practices should stop for all uses by 2023. These recommendations apply to all of the UK.
- The ongoing Industrial Strategy Fund for agriculture (i.e. Transforming Food Production Challenge), and the roll-out of future productivity schemes such as Defra's Farming Investment Fund and the Innovation Research and Development Scheme must cover funding of measures to improve agricultural productivity while reducing the GHG impact of farming.
- Measures to address non-financial barriers to increase the take-up of low-carbon farming practices and land-use change need to be addressed. For example, both England and Scotland's respective Plans identified a range of barriers that could impede the planting of more trees, and work must now proceed to find solutions to address these.
- The Scottish Government should develop a new rural support scheme that builds towards its climate goals. The Northern Ireland Executive should set out the future direction of its post-CAP policy and how this will be used to deliver emissions reduction and carbon sequestration in the sector.

## e) Electricity Supply

The Sixth Carbon Budget report set out the key elements of a policy package to fully decarbonise electricity generation. That includes the need to follow the coal phase-out with phase-out of unabated gas generation while keeping pace with growing demand from electrification, by deploying variable renewable generation at scale, developing markets for dispatchable low-carbon capacity, and ensuring that the enabling infrastructure and market arrangements are in place to accommodate this.

### i) Progress in the past year

The main policy developments in the past year have been the publication of the Government's Ten Point Plan and Energy White Paper, which committed to increasing the capacity of offshore wind significantly over the coming decade. Progress was also made around the processes for delivering this, and on the longer-term future of electricity markets.

The Government has committed to increasing offshore wind capacity from 10 GW today to 40 GW by 2030, and to support power CCUS and additional nuclear investment.

- **Ten Point Plan and Energy White Paper.** These included headline commitments to increase the level of offshore wind capacity four-fold by 2030, to make onshore wind and solar eligible for low-carbon contracts once more, and to take forward carbon capture utilisation and storage (CCUS), nuclear, and demand-side flexibility.
  - **Offshore wind.** The Government committed to increasing capacity of offshore wind from 10 GW today to 40 GW by 2030. That includes 1 GW of floating offshore wind, which is likely to be increasingly important over the period to 2050.
  - **Low-carbon auctions.** The Government confirmed that the fourth round of auctions for low-carbon electricity will take in place in late 2021. These will now include onshore wind and solar, and the capacity

limit has been doubled to 12 GW compared to the last auction round in 2019.

– **Power CCUS, nuclear, and demand-side flexibility** all featured additional commitments to:

- Support at least one power CCUS project by 2030. Currently, only new power plants above 300 MW are required to be CCS-ready. The White Paper commits to removing this distorting threshold.
- Bring at least one large-scale nuclear plant to point of Final Investment Decision this Parliament, and to provide up to £385 million of funding to develop a Small Modular Reactor (SMR) design and to build an Advanced Modular Reactor (AMR) demonstrator.
- Publish a new Smart Systems Plan and a new Energy Data Strategy in 2021, to unlock more of the potential for demand-side flexibility.

The Government has commissioned a review of the regime for connecting offshore projects to the onshore network.

- **Offshore Transmission Network Review.** Following our recommendation in the 2020 Progress Report, the Government has commissioned a review of the regime for connecting offshore projects to the onshore electricity network. This will explore whether a more coordinated approach for connections would be cost-effective in the context of increased ambition for offshore wind.
- **Call for evidence on market design.** A future electricity system with high shares of variable renewable generation is likely to require a different market design compared to the current arrangements. This call for evidence aimed to understand more about how to continue to maintain deployment of renewable generation at scale while minimising costs and supporting innovation in a high-renewable system.

## ii) Next steps for decarbonising electricity generation

The Ten Point Plan and Energy White Paper made a significant step towards a low-carbon electricity system with the commitment to 40 GW of offshore wind by 2030. However, gaps remain and further policies are needed to meet the Sixth Carbon Budget. Priorities include:

- **Unabated gas phase-out.** The Government should commit to phasing-out the use of unabated gas for electricity generation by 2035, subject to ensuring security of supply. It should publish a comprehensive long-term strategy in 2021 for achieving this. That should include through developing and deploying CCUS and hydrogen in electricity generation, and by ensuring new gas plant are property CCUS- and/or hydrogen-ready as soon as possible and by 2025 at the latest.
- **Renewables delivery.** While the Government has committed to regular auctions for low-carbon electricity, it should set out a schedule and clear pathway of volumes to be procured in order to provide visibility to the supply chain. It will need to address potential barriers to deploying and using low-carbon generation at scale (e.g. the planning and consenting regime for renewables and networks).
- **Networks.** The CCC Pathway has a 50% increase in electricity demand by 2035 and a two-to-three-fold increase by 2050 as the economy increasingly electrifies. The Government will need to work with Ofgem to deliver the

The Government should commit to phasing-out the use of unabated gas for electricity generation by 2035, subject to ensuring security of supply.

Barriers to delivery will need to be addressed, and investment will be needed to ensure networks can accommodate higher demand.

The Government should start planning for the market arrangements needed for a fully decarbonised electricity system in the 2030s.

strategic investment required to ensure that electricity networks can accommodate this.

- **Market design.** Given lead times for potential changes to market arrangements, the Government will need to go beyond their recent call for evidence and develop a strategy as soon as possible on market design for the medium- to long-term for a fully decarbonised, resilient electricity system in the 2030s and onwards.

## f) Fossil fuel supply

We previously set out the core requirements of a policy package for fuel supply in the Sixth Carbon Budget Policy report.

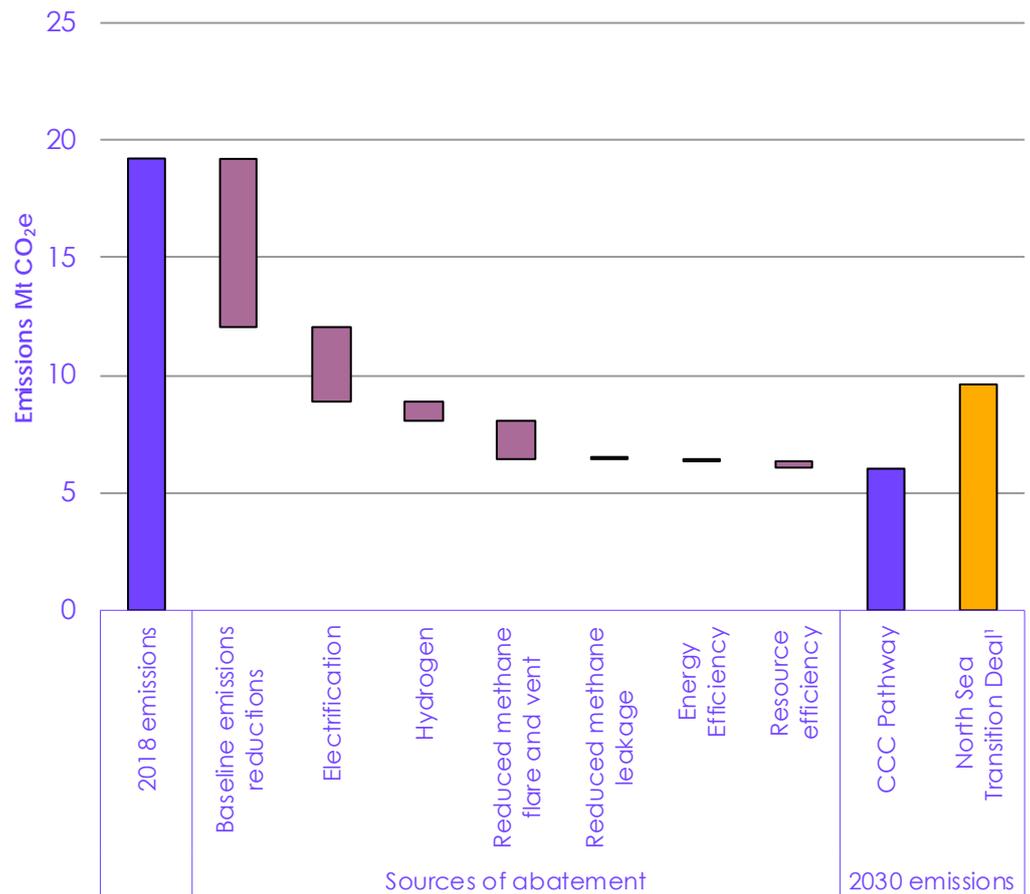
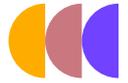
### i) Progress in the past year

The key development in the past year has been the North Sea Transition Deal (NSTD), which commits to reducing the greenhouse gas footprint of North Sea oil and gas production and processing by 50% by 2030 relative to 2018 levels. This target is less ambitious than our Sixth Carbon Budget recommendation of reducing emissions by 68% for the same period (Figure 4.4). We strongly advise that ambition on reducing emissions from North Sea fossil fuel production and processing be strengthened to be consistent with the CCC Pathway and the Sixth Carbon Budget:

The targets of the North Sea Transition Deal should be strengthened.

- The commitment for a reduction in emissions occurs in the context of declining oil and gas production in the North Sea. While it is difficult to forecast precise levels of production out to 2030, our baseline scenario – before actions to reduce the footprint of production – implies a 37% reduction in emissions by 2030 on 2018 levels.
- Electrification offers opportunities to reduce emissions from fossil combustion emissions associated with oil and gas production, by a further 17% of 2018 emissions. However, the degree of electrification assumed in the NSTD targets falls short of our estimate for cost-effective action. Stronger action is needed to reduce the emissions footprint of fossil fuels consumed in the UK.
- The CCC Pathway sets out a further 8% of emissions reductions from 2018 levels through measures to reduce flaring and venting. The NSTD also falls short of this level of ambition – by aiming to only permit flaring and venting for safety reasons by 2030. We have recommended this should be done by 2025, which would contribute to accelerating the pace of emissions reductions in the sector.
- The announcement of 'climate compatibility checkpoint' reviews prior to licensing rounds can ensure new fossil fuel production is consistent with the UK's climate commitments, including zero direct emissions from energy use by 2027. These reviews would need to present a transparent and coherent case for there to be a potential justification for proceeding with new licenses.

Figure 4.4 Emissions reductions in oil and gas production and processing in the CCC Pathway & the North Sea Transition Deal



Source: CCC analysis, BEIS (2021) *North Sea Transition Deal*.

Notes: Abatement in oil and gas production reflects emissions reduction from oil and gas platforms and processing terminals but does not include LNG terminals or compression stations. 1. North Sea Transition Deal residual emissions assume 50% emissions reductions from 2018 levels.

## ii) Next steps for fossil fuel production

Meeting Net Zero will involve transitioning almost entirely away from the unabated use of fossil fuels. Indeed, the CCC pathway set out in the Sixth Carbon Budget entails unabated fossil fuel use falling from 1,750 TWh in 2019 to 110 TWh in 2050, with use in 2050 limited predominantly to aviation.

Specifically, petroleum use in the CCC pathway decreases by 85% in 2050, by which time oil products are combusted exclusively used in aviation. In a similar vein, unabated gas is only 3 TWh by 2050, which represents less than 1% of current gas use.

As the energy system transitions towards low-carbon energy carriers such as hydrogen, low-carbon electricity and bioenergy, some fossil fuels can be used in a way that is consistent with UK targets:

- Unabated gas use and oil should decline by 62% in 2035 to be consistent with the Sixth Carbon Budget. However, some oil will still be needed,

Fossil fuel use should decrease by 95% by 2050.

In the transition towards low-carbon fuels, some fossil fuel use can be consistent with UK targets.

predominantly in surface transport (135 TWh), aviation (123 TWh) and shipping (42 TWh).

- In addition, there is uncertainty on the role of fossil gas in the UK, as some sectors are likely to use gas with carbon capture and storage (CCS) as a means to decarbonise. Our analysis found that 50 to 105 TWh could be used across the economy in 2035, with that range widening further in 2050 from 60 to 445 TWh.<sup>31</sup> As use of fossil gas with CCS only reduces emissions by up to around 85% compared to unabated fossil gas use, use of zero-carbon energy is preferable where it can feasibly be deployed.

Reducing the footprint of fossil fuel use is crucial to limit the impact on global GHG emissions.

Remaining fossil fuel use in the UK will need to consider the emissions footprint associated with oil and gas production in order to limit the impact on GHG emissions:

- The Sixth Carbon Budget requires the emissions of UK oil and gas production and processing to fall by 87% in 2035, relative to 2018 levels. For the same year, active efforts to move towards electrification and reduced methane flaring and venting should contribute to reducing emissions by 22% and 6% respectively below 2018 levels, beyond the expected decline in oil and gas production.
- However, current projections of the North Sea oil and gas production suggest it is unlikely to be sufficient to meet future UK needs. This suggests that there is likely to continue to be a need for some additional fossil fuel supply and/or imports of Liquefied Natural Gas (LNG).
- Given the demand for fossil fuels during the transition, it will be important to consider the upstream emissions from oil and gas production in the UK against those of imports in order to limit the impact on global GHG emissions. Implementation of standards on the emissions footprint of fossil fuels supplied for UK use could both drive reductions in fossil fuels supply emissions in countries supplying fuels to the UK and provide a level playing field for UK production that means more stringent standards than embodied in the NSTD can be implemented without losing market share.

Reducing demand for fossil fuels and the emissions footprint of UK oil and gas production and processing are key to limiting the impact on global GHG emissions, reinforcing the need for more ambitious targets that more closely align to a 68% emissions reductions in 2030 against 2018 levels.

## g) Waste

Our Sixth Carbon Budget advice set out the policies and measures required to get the waste sector on track to deliver the UK's pathway to Net Zero. The Government has made progress in some of these areas but there are still key gaps which must be addressed quickly.

## i) Progress in the past year

Government has made some progress in developing policies to deliver on its 2018 Resources and Waste Strategy for England, which set out its ambition to double resource efficiency and eliminate avoidable wastes by 2050, achieve 65% municipal recycling by 2035 and eliminate food waste to landfill by 2030.

Defra's Waste Prevention Programme, and BEIS' Industrial Decarbonisation Strategy set out a number of important initiatives on waste and resource efficiency.

Defra's Waste Prevention Programme, which was launched for consultation in March 2021, is central to this. It includes several measures aimed at driving more resource-efficient approaches to product design and consumer behaviour, including:

- Extended Producer Responsibility (EPR) schemes for several key waste streams so that producers bear the cost of waste disposal, incentivising more efficient and sustainable product design.
- New product standards and product information to reflect how reusable, recyclable and repairable a product is, with the aim of minimising premature obsolescence.
- A plastics tax and new charges on certain single-use plastic items.

Also, as mentioned under the section on manufacturing and construction, BEIS published their Industrial Decarbonisation Strategy which sets out a number of measures to improve resource efficiency, including:

- Exploring low-carbon product standards and labelling which will consider embodied carbon, as well as broader environmental impacts.
- A £30 million UKRI Circular Economy Research Programme aimed at working with industry to develop new approaches to resource efficiency.

Delivery timelines for waste and resource efficiency policies are too slow and important gaps remain, in particular around the landfilling of biodegradable waste, recycling and emissions from Energy from Waste plants.

However, despite this progress, delivery timelines are too slow, policy is weak in some areas and key gaps remain. For example:

- The Environment Bill, which contains key powers to deliver on the Resources and Waste Strategy and Waste Prevention Programme, has been delayed and is yet to be passed into law.
- The Waste Prevention Programme itself is only now out for consultation – over two years after the Resources and Waste Strategy was published, while specific consultations on key elements of the programme, such as some Extended Producer Responsibility schemes, are not expected for a number of years.
- A number of aspects need to be strengthened, in particular raising the level of recycling targets, increasing the plastics tax threshold and extending the commitment to end landfilling of food waste to cover all major biodegradable waste streams – and implementing this in 2025 rather than 2030.

Of particular concern is a lack of policy or guidance governing the use of, and emissions from, Energy from Waste (EfW) plants. If EfW usage is left to grow unchecked, EfW emissions will quickly exceed those of the CCC pathway while undermining recycling and re-use efforts. A recent policy statement indicating EfW plants will be eligible for CCS support is encouraging, but further action is urgently needed in this space.

## ii) Next steps on waste policy

To deliver the CCC pathway urgent action is needed to ban biodegradable waste from landfill from 2025 while improving recycling, re-use and waste prevention.

Full details of all the policies needed to get the waste sector on track to Net Zero are set out in our Sixth Carbon Budget policies report and the Departmental Recommendations tables at the end of this report. The following actions should be prioritised by Government in the next few years:

- The Environment Bill should be legislated this year and should be used to strengthen commitments on waste and resource efficiency including:
  - Raising recycling targets for England from 65% by 2035 to at least 68% by 2030. Experience in Wales has shown that this is feasible.
  - Sending a policy signal to ban the main biodegradable waste streams (i.e. paper, card, textiles, wood, food and garden waste) from landfill from 2025.
- Delivery of the Waste Prevention Programme must be accelerated so that key measures such as Extended Responsibility Schemes and product standards are in place well before 2025.
- In order to avoid unintended consequences, Government must take a whole system approach to improving waste prevention, re-use and recycling, including by:
  - Encouraging investment in recycling and re-use services and infrastructure to ensure that, as far as possible, waste is not diverted from landfill to EfW plants.
  - Ensuring a holistic policy approach to reduce waste arisings, for example by expanding measures aimed at reducing single-use plastic waste to cover other single-use items and materials.
  - Phasing out exports of waste by 2030 at the latest while strengthening tracking and enforcement, to ensure waste intended for recycling or recovery are treated as such.
- Government must urgently address rising emissions from, and use of, EfW, including by:
  - Setting out capacity and utilisation requirements for EfW which are consistent with plans to improve recycling and waste prevention, by the end of 2021.
  - Consulting on the introduction of a carbon price on EfW emissions (either as part of the UK ETS or a separate carbon tax), by the end of 2022.
  - Providing the necessary support to enable existing EfW plants to begin to be retrofitted with carbon capture, utilisation and storage (CCUS) from the late 2020s, and introducing policy to ensure that any new EfW plants are built either with CCUS or are 'CCUS ready'.

A systems approach to waste management and prevention is crucial to avoid merely shifting emissions from one source to another, for example from landfill to Energy from Waste or from the UK to overseas.

Delivering these actions requires different Departments to work closely together so Government should consider establishing new cross-Whitehall governance on waste and resource efficiency.

The formal inclusion of international aviation in the Sixth Carbon Budget is an important step towards tackling these emissions alongside other UK emissions

## h) Aviation

The Government announced that international aviation (and shipping) emissions would be formally included in carbon budgets for the first time when accepting the Committee's recommendation on the level of the Sixth Carbon Budget. We strongly welcome this significant step, which recognises that international aviation emissions need to be tackled alongside other UK emissions, and look forward to seeing legislation on the formal inclusion of international aviation and shipping laid before Parliament soon.

### i) Progress in the past year

There have been a few minor policy developments since we published the Sixth Carbon Budget, but the Net Zero Aviation Strategy is overdue:

- The new UK Emissions Trading Scheme (UK ETS, a replacement to the EU ETS), which will cover emissions from domestic UK flights and flights between the UK and the European Economic Area, was launched and ran its first auctions in May 2021.
- DfT published a consultation on implementing monitoring, reporting and verification requirements of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) as its first voluntary phase commences, including options for interaction between CORSIA and the UK ETS for flights that are covered by both schemes.<sup>32</sup>
- The Civil Aviation Authority published the Airspace Modernisation Strategy (AMS), a plan for the use of UK airspace up to 2040 which aims to deliver quicker, quieter and cleaner journeys. DfT also announced a funding support package for initiatives within the AMS that support the post-pandemic recovery of the aviation sector and decarbonisation.<sup>33</sup>
- The Ministry of Defence announced a change in RAF aviation fuel standards, allowing RAF aircraft to utilise up to 50% of sustainable aviation fuels (SAF) in the future.<sup>34</sup>
- An aviation Net Zero Consultation and Strategy were planned for 2020. At the time of finalising this report the Government's consultation on decarbonising aviation had not yet been published. The Government intends to publish a Net Zero Aviation Strategy following the consultation, ahead of COP26.

### ii) Next steps for decarbonising aviation

We have set out the core requirements of a policy package in aviation in the Sixth Carbon Budget policy report.

There remain significant gaps within the policy framework for aviation. Government support at present is focused on innovation funding and demonstration activities, but without clear long-term policy mechanisms driving SAF uptake or valuing negative emissions in the UK. These policy gaps should be addressed in the Aviation Strategy:

- The **Road Transport Fuel Obligation** development fuels sub-mandate is unlikely to drive significant development of jet fuels, as it can be met with cheaper fuels.

- There is currently no price signal for **GHG removals** in the UK.
- There is a lack of larger-scale **deployment support and policy frameworks** specifically for sustainable aviation fuel and GHG removals.

While SAF and technological innovations in aircraft provide an opportunity to reduce emissions in the aviation sector, our analysis for the Sixth Carbon Budget suggests that these measures alone are unlikely to go far enough in reducing emissions. The CCC pathway allows for some further growth in aviation demand, but below growth in a 'business as usual' case. Government must recognise the need for demand management as part of a wider strategy to decarbonise aviation, which should include:

- **An aviation decarbonisation pathway.** Although the UK aviation industry has committed to a Net Zero goal for 2050 (via the Sustainable Aviation coalition), this is not yet a policy goal for Government. A sector emissions trajectory is needed to inform demand management and airport capacity policies.
- **An assessment of airport capacity.** Several UK airports are in the process of seeking planning permission to expand, or have already sought permission to expand and are challenging planning permission rejections (see Box 4.4). Government has not made commitments to review its airport capacity strategy nor stated a clear position on this issue. Our advice from the Sixth Carbon Budget remains unchanged – there should be no net expansion of UK airport capacity unless the sector is on track to outperform its net emissions trajectory. Government needs to assess its airport capacity strategy and develop and put in place a demand management framework to assess and, if required, control sector GHG emissions and non-CO<sub>2</sub> effects.
- **Appropriate price incentives.** Reforming aviation taxation, alongside wider reform of carbon pricing, will be critical to achieving Net Zero. The Government's current proposals for air passenger duty (APD) reform<sup>35</sup> are largely going in the wrong direction:
  - Proposals include halving domestic APD to improve domestic connectivity. Current price signals mean that flights are often cheaper than lower carbon alternatives (e.g. rail). Redressing this requires both higher taxes for flights (where there is an alternative to flying) and subsidies on trains. Rather than reducing APD to incentivise domestic flights, policy to improve domestic connectivity should focus on reducing the cost and improving the service for surface transport, especially rail.
  - Where surface transport is not an option, relaxed requirements in APD could relate not to distance but to the time taken to travel by alternative routes. Favourable treatment may be justified for small islands in Scotland which would take hours to reach by other means, or for Northern Ireland, but not for example for travel from London to Newcastle or London to Edinburgh which can be done by train easily and relatively quickly.
  - Government should seek to embed positive behaviours that have emerged during COVID-19, such as a reduction in business travel, through taxation.

Managing aviation demand is a critical part of achieving the Net Zero target, future airport capacity needs must be considered alongside appropriate price incentives.

The Government is at present developing legislation on the implementation of CORSIA. These regulations should be used to maximise opportunities to tackle climate change impacts of aviation, including non-CO<sub>2</sub> effects:

CORSIA credits should only be used towards ETS obligations if and when these meet minimum eligibility criteria. Non-CO<sub>2</sub> effects of aviation must start to be measured.

- Government's CORSIA consultation includes options for interaction between CORSIA and the UK ETS. Any such interaction should ensure credits used to offset aviation emissions meet minimum credibility criteria.
- Non-CO<sub>2</sub> effects of aviation can have significant warming impacts. While it is true that further research is needed to better understand these impacts, and estimates may change as the science evolves, the data needed to enable these estimates should start to be collected now. Government should include a requirement within CORSIA regulations for monitoring and reporting of non-CO<sub>2</sub> effects.

#### Box 4.4

##### Airport capacity expansion

Several UK airports are in the process of seeking planning permission to expand or have already sought permission to expand and are challenging planning permission rejections:

- A Supreme Court ruling in December 2020 overturned a previous court decision that had blocked the plan to build a third runway at Heathrow airport on environmental grounds, although airport operators still need to apply for planning permission for the expansion to go ahead.
- Expansion plans for Leeds Bradford airport were given conditional approval by Leeds city council. Government later issued a direction preventing councillors from granting planning permission without special authorisation. In April 2021, Government postponed deciding on this request, providing no timescales for its resolution.
- London airports, as well as many other regional airports, are seeking to push ahead with expansion proposals.

The UK already has more than enough capacity to accommodate the demand increases in our Balanced Net Zero Pathway. Our advice in the Sixth Carbon Budget was therefore that there should be no net expansion of UK airport capacity, unless the sector is on track to sufficiently outperform its net emissions trajectory and can accommodate the additional demand:

- Outperforming the net emissions trajectory means making significant progress on nascent and untested technologies like hybrid electric planes, and developing and scaling up markets for sustainable aviation fuels (SAF) and greenhouse gas removals.
- It is not possible to have certainty today over the pace of development of these technologies in future. It is therefore difficult at present to justify capacity expansion on the basis of outperforming the emissions trajectory, particularly given the uncertainty around the permanence of impacts on aviation demand from COVID-19.

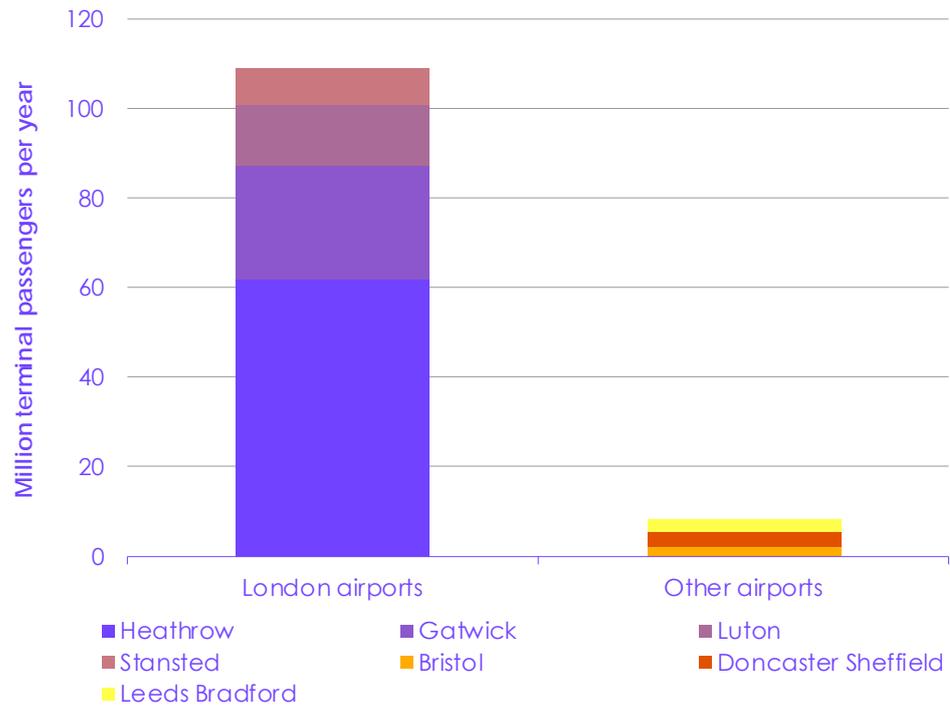
The fact that we have enough capacity in aggregate to achieve our emissions targets does not mean that capacity is always in the right place:

- Airport capacity around London far exceeds capacity elsewhere in the country, as does planned capacity expansion in London compared to regional airports' plans.
- While demand is greater in and around London, other areas see economic potential in increasing their local airport capacity and improving their connectivity. There could be some emissions savings from better allocation of capacity across the country (e.g. some emissions reduction from flying from a local airport rather driving or flying to London).
- Conversely, arguments for increasing capacity in hub airports, such as Heathrow, include reducing emissions from less holding and better air traffic management.

Further work is needed to understand how capacity can best be utilised and managed across the UK to increase efficiency and minimise emissions. A mechanism for managing

demand should be developed and put in place alongside an assessment of the Government's airport capacity strategy. This could act to control sector GHG emissions and non-CO<sub>2</sub> effects if required and could also allow Government to address issues around UK connectivity.

Figure B4.4 Airport capacity expansion plans



Source: CCC analysis based on AEF UK Airport Expansion Guide (<https://www.aef.org.uk/uk-airport-expansions/>), Heathrow Airport Expansion Consultation (<https://www.heathrow.com/company/about-heathrow/expansion/documents>), Gatwick Long Term Plans (<https://www.gatwickairport.com/business-community/future-plans/long-tem-plans/>), Doncaster Sheffield Masterplan ([https://flydsa.co.uk/dsaadmin/wp-content/uploads/2020/07/DSA\\_Masterplan.pdf](https://flydsa.co.uk/dsaadmin/wp-content/uploads/2020/07/DSA_Masterplan.pdf)). Includes airports with planning application submissions, that are challenging planning permission refusals as well as airports that have recently publicly stated that they intend to pursue expansion plans, where impacts of expansion plans on passenger numbers were available.

## i) Removals

We have set out the core requirements for ensuring the timely delivery of Greenhouse Gas Removals (GGR) in the Sixth Carbon Budget policy report.

Key developments in the past year are new funding to GGR research and development through the UK Research and Innovation's GGR demonstrators programme,<sup>36</sup> selection of phase one of the BEIS Direct Air Capture and GGR competition,<sup>37</sup> and inclusion of GGR within the Scottish Government's Emerging Energy Technologies Fund.<sup>38</sup>

Alongside, during 2020-21 BEIS carried out a call for evidence on GGR.<sup>39</sup> This invited submissions on the contribution of GGR to reaching Net Zero, on GGR governance, and on possible approaches to GGR support mechanisms.

## i) Next steps towards GGR delivery

The Net Zero Strategy should set out expected amounts and timings of land-based and engineered removals (i.e. bioenergy with CCS (BECCS) and direct air carbon capture and storage (DACCS)) in contributing to meeting the Sixth Carbon Budget and the Net Zero target. These should avoid over-reliance on these solutions.

Building on the results of the BEIS GGR consultation, policy on governance and support mechanisms should be developed over the next year in order to enable GGR scale-up during the mid-late 2020s. This should include enabling domestic engineered removals to contribute to UK carbon budgets and Net Zero, establishing GGR monitoring, verification and reporting structures that ensure that GGR is sustainable and verifiable, and setting out support mechanisms that align with the expectations for the role and timing of GGR contribution to UK emissions reductions.

More generally, as GGR by BECCS and DACCS is reliant on CCS infrastructures for the storage of the removed CO<sub>2</sub>, it is critical that CCS is established in a consistent timeframe and in a manner that allows for the usage of CO<sub>2</sub> pipeline and storage for removals.

# Endnotes

- <sup>1</sup> Scottish Government (2020) *Protecting Scotland, Renewing Scotland: The Government's Programme for Scotland 2020-2021*.
- <sup>2</sup> Scottish Government (2021) *Scottish Budget: 2021-2022*.
- <sup>3</sup> Scottish Government (2020) *Securing a green recovery on a path to net zero: climate change plan 2018 – 2032 – update*.
- <sup>4</sup> Just Transition Commission (2021) *A National Mission for a fairer, greener Scotland*.
- <sup>5</sup> Senedd Cymru | Welsh Parliament (2021) *The Climate Change (Interim Emissions Targets) (Wales) (Amendments) Regulations 2021*.
- <sup>6</sup> Welsh Government (2021) *Llwybr Newydd: the Wales Transport Strategy 2021*.
- <sup>7</sup> Welsh Government (2021) *Beyond recycling*.
- <sup>8</sup> CCC (2020) *Letter: Lord Deben, Climate Change Committee to Edwin Poots MLA*.
- <sup>9</sup> Northern Ireland Executive (2021) *Energy Strategy for Northern Ireland: consultation on policy options*.
- <sup>10</sup> Northern Ireland Executive (2021) *Future Energy Decarbonisation Scenarios*.
- <sup>11</sup> OBR (2021) *Economic and Fiscal Outlook*.
- <sup>12</sup> OBR (2021) *UK Infrastructure Bank*.
- <sup>13</sup> Department for Transport (2020) *Gear change: a bold vision for cycling and walking*.
- <sup>14</sup> Department for Transport (2021) *Bus back better: a national bus strategy for England*.
- <sup>15</sup> Department for Transport and Office for Zero-Emission Vehicles (2021) *Ending the sale of new diesel buses*.
- <sup>16</sup> Scottish Government (2020) *Securing a green recovery on a path to Net Zero: climate change plan 2018-2032 – update*.
- <sup>17</sup> Welsh Government (2021) *Llwybr newydd: the Wales transport strategy*.
- <sup>18</sup> Department for Transport and Innovate UK (2021) *SBRI zero-emission road freight, supporting uptake of battery-electric trucks*.
- <sup>19</sup> Department for Transport and Innovate UK (2021) *Zero-emission road freight strands 1-3*.
- <sup>20</sup> Department for Business, Energy and Industrial Strategy (2021) *Emissions-cutting trucks and next-gen hydrogen buses closer to hitting the road with £54 million government-led funding*.
- <sup>21</sup> Department for Transport (2021) *UK's first ever hydrogen transport hub kick-started by £3 million government investment*.
- <sup>22</sup> RAC Foundation (2021) *Transport price index*.
- <sup>23</sup> BEIS (2021) *Green Homes Grant voucher release, May 2021*.
- <sup>24</sup> HM Government (2020) *The Government Response to the Committee on Climate Change's 2020 Progress Report to Parliament*.
- <sup>25</sup> Defra (2021) *England Peat Action Plan*; Defra (2021) *The England Trees Action Plan 2021-2024*.
- <sup>26</sup> Defra (2020) *England Tree Strategy Consultation*.
- <sup>27</sup> Scottish Government (2020) *Update to the Climate Change Plan, 2018-2032*.

- <sup>28</sup> Northern Ireland Department of Agriculture, Environment and Rural Affairs (2020) *Forest for our Future Programme*.
- <sup>29</sup> Defra (2021) *England Peat Action Plan*.
- <sup>30</sup> Defra (2021) *Nature for people, wildlife and climate – policy paper*.
- <sup>31</sup> CCC (2020) *Sixth Carbon Budget – The UK’s path to Net Zero*.
- <sup>32</sup> Department for Transport (2021) *Implementing the carbon offsetting and reduction scheme for international aviation (CORSIA)*.
- <sup>33</sup> Department for Transport, Civil Aviation Authority (2021) *Airspace Modernisation Plan*.
- <sup>34</sup> Ministry of Defence (2021) *Sustainable fuels to power RAF jets*.
- <sup>35</sup> HM Treasury (2021) *Consultation on aviation tax reform*.
- <sup>36</sup> UK Research and Innovation (2021) *Greenhouse Gas Removal Demonstrators Programme*.
- <sup>37</sup> Department for Business, Energy & Industrial Strategy (2021), *Projects selected for Phase 1 of the Direct air capture and greenhouse gas removal programme*.
- <sup>38</sup> Scottish Government (2020) *Update to the Climate Change Plan 2018 – 2032*.
- <sup>39</sup> Department for Business, Energy & Industrial Strategy (2020) *Greenhouse gas removals: call for evidence*.

# Joint Departmental Recommendations

# Recommendations by Department

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## Central Government departments:

- **Table A1:** Cabinet Office and Number 10
- **Table A2:** COP Unit, the Foreign, Commonwealth and Development Office (FCDO) and the Department for International Trade (DIT)
- **Table A3:** HM Treasury (HMT)
- **Table A4:** Department for Business, Energy and Industrial Strategy (BEIS)
- **Table A5:** Department for Environment, Food and Rural Affairs (Defra)
- **Table A6:** Department for Transport (DfT)
- **Table A7:** Ministry of Housing, Communities and Local Government (MHCLG)
- **Table A8:** Department for Digital, Culture, Media and Sport (DCMS)
- **Table A9:** Department for Education (DfE)
- **Table A10:** Department for Work and Pensions (DWP)
- **Table A11:** Department of Health and Social Care (DHSC)
- **Table A12:** Home Office and the Ministry of Justice (MoJ)
- **Table A13:** Ministry of Defence (MoD)

## Regulators and the Office for National Statistics:

- **Table A14:** Office of Gas and Electricity Markets (Ofgem)
- **Table A15:** Water Services Regulation Authority (Ofwat)
- **Table A16:** Office for National Statistics (ONS)

## Devolved administrations:

- **Table A17:** The Scottish Government
- **Table A18:** The Welsh Government
- **Table A19:** The Northern Ireland Executive

**Table A1**  
Recommendations for Number 10 and Cabinet Office

Timing

Cross-cutting	Use the <b>Cabinet Committees</b> on Climate Strategy and Climate Action to drive home the need for more pace in policy development across Departments. Consider whether additional governance mechanisms such as independent delivery bodies are required in particular areas, such as heat decarbonisation.	2021-22 Priority recommendation
	Commit to a ' <b>Net Zero Test</b> ' to ensure that all Government decisions are compatible with the legislated emissions targets.	2021 Priority recommendation
	Develop (with BEIS) a <b>public engagement strategy</b> for Net Zero which builds on the findings of the UK Climate Assembly by involving people in decision-making, providing trusted information on decarbonisation choices and the need to reduce emissions and adapt to climate change. The strategy should also identify preferred policy options to empower people to contribute fully towards the path to Net Zero.	2021-22 Priority recommendation
	Support <b>local government</b> (with MHCLG) to play a full role in the Net Zero transition, including through increased resourcing, guidance, involvement in local area energy plans, statutory reporting on the emissions from their estate and reforming the planning framework to enable delivery of low-carbon and climate-resilient measures.  This is likely to require additional funding for staffing and resources for local delivery plans, alongside a 'duty to collaborate' to encourage authorities to work with local, regional and national partners to deliver their climate ambitions.	2021-23  (funding for local authorities at next Budget) Priority recommendation
	Cabinet Office should ensure that <b>adaptation</b> is integrated into major upcoming policies in the next two years related to the priority CCRA3 risk for which it has lead responsibility, coordinating work with other relevant departments as necessary:  <ul style="list-style-type: none"> <li>Multiple risks to the UK from climate change impacts overseas</li> </ul> In addition, for the coming five-year period (2023-2028), Cabinet Office should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the other risks and opportunities in the CCRA3 for which it is the lead department (see Adaptation Report Annex).	By 2023  Priority recommendation
	Review <b>guidance documents</b> used in policy and business case development (e.g. the Green Book) and ensure these are consistent with the requirements of Net Zero and account for the impacts of climate change.	2022
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Cabinet Office should build a strong <b>climate resilience capability</b> for the UK, including making use of storyline or 'what-if' scenarios to assess risks, in addition to or instead of using 'reasonable worst-case' approaches. It should develop an early warning system for global climate shocks. It should consider how more allowance and flexibility can be built into policy making and policy implementation. This could include enhancing the ability of the Government to make fast decisions by bringing in technical advice and expertise quickly when needed, and both protecting, and enhancing, monitoring and surveillance systems to enable faster reactions as events unfold.	By 2023
	Develop and implement fully-funded plans towards making all <b>public buildings and vehicle fleets</b> zero-carbon in the long term. This must include a move to multi-year programmatic funding to deliver the stated ambitions of switching to ultra-low emission vehicles by 2030 and to halve emissions from public buildings by 2032, supported by cross-government strategy (including an ambitious new set of Greening the Government commitments) and capital funding levels in the order of £1 billion/year for buildings.	2021-22
	As the public sector, lead the shift to other positive behaviours that <b>reduce travel demand</b> , for example encouraging home-working.	2021
International (With BEIS and the COP Unit)	Work towards securing more <b>climate finance commitments</b> from developed countries to get back on track for mobilising \$100 billion a year in climate finance as soon as possible.	2021
	Work to bring forward additional <b>emissions reduction ambition</b> from countries that haven't yet strengthened commitments ahead of COP26.	H2 2021
	Place aligning <b>global COVID-19 recovery plans</b> with the goals of the Paris Agreement as a core goal of the UK's G7 and COP26 presidencies.	2021-22
	Ensure that any outcome on <b>international carbon markets</b> at COP26 has high integrity and genuinely supports global ambition to tackle climate change.	H2 2021
	Develop the option of applying either <b>border carbon tariffs or minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.	2021 Priority recommendation

Table A2 Recommendations for the COP Unit, the Foreign, Commonwealth and Development Office (FCDO) and the Department for International Trade (DIT)		Timing
Cross-cutting	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
Action in the run-up to COP26	Work towards securing more <b>climate finance commitments</b> from developed countries to get back on track for mobilising \$100 billion a year in climate finance as soon as possible.	2021 (COP26)
	Work to bring forward additional <b>emissions reduction ambition</b> from countries that haven't yet strengthened commitments ahead of COP26.	H2 2021
	Provide a clear commitment prior to COP26 regarding the timescale by which the <b>UK's official development assistance (ODA) contribution</b> will return to 0.7% of GNI given the UK's commitment to align its ODA spend with Paris Agreement requirements and the need for increased finance to achieve the Paris Agreement.	H2 2021
	Place aligning <b>global COVID-19 recovery</b> plans with the goals of the Paris Agreement as a core goal of the UK's G7 and COP26 presidencies.	2021-22
	Ensure that any outcome on <b>international carbon markets</b> at COP26 has high integrity and genuinely supports global ambition to tackle climate change.	H2 2021
	Develop the option of applying either <b>border carbon tariffs or minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.	2021 Priority recommendation
Ongoing climate action	For the coming five-year period (2023-2028), FCDO should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Publish a new strategy for the UK's <b>international climate policy</b> for after COP26 - ensuring that the initiatives for the COP26 presidency have long-term benefits for global emissions over the coming decade and supports the implementation of policies to deliver on strengthened national targets.	H1 2022
	For the coming five-year period (2023-2028), DIT should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks and opportunities in the CCRA3 for which it is the lead department (see Adaptation Report Annex).	2023
	DIT should use trade policy to <b>encourage increased ambition</b> on both climate change mitigation and adaptation in other countries, including considering the role for border carbon adjustments and standards to <b>prevent carbon leakage</b> .	Spring 2022

Table A3 Recommendations for the HM Treasury (HMT)		Timing
	Complete the overdue <b>Net Zero Review</b> , which should: <ul style="list-style-type: none"> <li>Develop a plan for funding decarbonisation fairly, reviewing the distribution of costs for businesses, households and the Exchequer.</li> <li>Set approach to near-term and long-term decarbonisation funding needs.</li> <li>Consider policy implications for a just transition.</li> </ul>	2021 Priority recommendation
	The <b>spending review(s)</b> should ensure departments are fully equipped to deliver the necessary actions across climate change mitigation and adaptation, during the rest of this Parliament and beyond.	2021 Priority recommendation
	For the coming five-year period (2023-2028), outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
Funding	Increase resources for <b>local government</b> to play a full role in the Net Zero transition.	2021-23 (funding for LAs at next budget) Priority recommendation
	Fund plans towards making all <b>public buildings and vehicle fleets</b> zero-carbon in the long term. This must include a move to multi-year programmatic funding to deliver the stated ambitions of switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032, supported by cross-government strategy (including an updated set of Greening the Government commitments) and capital funding levels in the order of £1 billion/year for buildings.	2021-22
	Provide a clear commitment prior to COP26 regarding the timescale by which the <b>UK's official development assistance (ODA) contribution</b> will return to 0.7% of GNI given the UK's commitment to align its ODA spend with Paris Agreement requirements and the need for increased finance to achieve the Paris Agreement.	H2 2021
	Establish mechanisms (with BEIS) to close the substantial funding gap for <b>heat networks</b> , with a multi-year funding programme needed of sufficient scale to deliver the growth in network deployment, and transition to low-carbon heat sources.	2022
Taxation, carbon and energy pricing	Work with BEIS on the <b>Heat and Buildings Strategy</b> : to ensure that relative prices favour a shift to low-carbon technologies, consulting widely including with the Committee on Fuel Poverty; to ensure that sufficient funding is available; and to consider the role of tax incentives (e.g. Stamp Duty differentials). Work with MHCLG and the new buildings safety regulator to ensure that local authorities are properly funded to enforce buildings standards.	2021 Priority recommendation
	Consult on <b>reforms to electricity pricing</b> to remove disincentives to electrification, based on consideration of the strategic and fair allocation of legacy policy costs associated with the past deployment of less-mature low-carbon electricity generation. Also consider the balance of existing taxes, such as the Climate Change Levy, on different energy sources. These reforms in combination with wider sectoral incentives, standards and carbon pricing should remove price barriers to electrification.	H1 2022
	Consult (with BEIS) on the introduction of a <b>carbon tax</b> (either as part of the UK ETS or a separate instrument) aimed at curbing rising emissions from Energy from Waste.	2022
	Reform <b>Vehicle Excise Duty</b> , with larger differentials across all vehicle types, to provide stronger incentives to purchase zero-emission vehicles and reverse the shift towards cars that have higher lifecycle emissions. The reforms should consider the impact and design of second and subsequent year rates, to ensure they encourage the purchase of zero-emission vehicles in the second-hand market.	H1 2022
	<b>Aviation tax reform</b> should seek to address price imbalances between aviation and surface transport, encouraging the low-carbon alternative (e.g. rail) for journeys where one exists. Taxation should also be used, alongside improvements in broadband, to embed positive behaviours that have arisen during the pandemic (e.g. replacing business travel with videoconferencing and online collaboration).	2021-22
	Create a clear incentive for manufacturing facilities not currently covered by the UK ETS to switch to low-carbon energy sources by reforming the suite of energy and carbon policies, which could include rebalancing the <b>Climate Change Levy</b> rates for electricity and gas.	2023
	Set out a clear plan for ensuring that carbon prices and taxes on manufacturers, energy producers and aviation encourage emissions reductions in line with the CCC Pathway, planning for revised (and likely higher) carbon prices from 2023. This should include setting out a <b>cap for the UK ETS</b> consistent with a credible path to the Sixth Carbon Budget for consultation by Q3 2021.	2021
	Develop (with DIT) the option of applying either <b>border carbon tariffs or minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.	2021 Priority recommendation

Table A3 Recommendations for the HM Treasury (HMT)		Timing
Green finance	Develop further ways to embed Net Zero and climate risk in <b>financial decisions</b> by UK firms, building on the UK's Green Finance Strategy. This should include implementing mandatory climate disclosure, adoption of a robust green taxonomy with clear guidance on how it should be used. It should also consider the recommendations of the Committee's Finance Advisory Group, such as making Net Zero and adaptation plans mandatory for financial institutions and monitoring financial flows into climate action.	2021-25
	In the <b>green gilt framework</b> , setting out the rules on what spending green sovereign bonds can be used for, ensure that revenue is used to fund expenditure that will genuinely contribute to Net Zero and improved climate resilience.	2021

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Cross-cutting	<p>Publish the overall <b>Net Zero Strategy</b>. It should:</p> <ul style="list-style-type: none"> <li>• Provide a comprehensive plan for achieving Net Zero, the 2030 NDC and the carbon budgets, setting out ambition for sectors and key technologies and behaviours that together will meet the challenge.</li> <li>• Set out the approach to the key cross-cutting challenges of fair funding, just transition, skills, public engagement, local delivery, governance.</li> <li>• Set timelines for how policies will start to deliver decarbonisation with the required urgency, and ensure that wider policy development is consistent with the UK's climate goals.</li> <li>• Ensure adaptation is properly integrated in the plan, maximising synergies and minimising trade-offs, while recognising the risks and impacts from climate change (see Adaptation Progress Report for more details).</li> <li>• Introduce processes for monitoring progress and mechanisms to course-correct over time.</li> </ul>	2021 Priority recommendation
	<p>Ensure that <b>adaptation is integrated</b> into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the third UK Climate Change Risk Assessment (CCRA3) for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>• Risks to the supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (with Defra and DIT).</li> <li>• Risks to people and the economy from climate-related failure of the power system.</li> </ul> <p>In addition, for the coming five-year period (2023-2028), BEIS should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).</p>	By 2023 Priority recommendation
	<p>Develop a <b>public engagement</b> strategy for Net Zero which builds on the findings of the UK Climate Assembly by involving people in decision-making, providing trusted information on decarbonisation choices and the need to reduce emissions. The strategy should link to engagement on adaptation and identify preferred policy options to empower people to contribute fully towards the path to Net Zero.</p>	2021-22 Priority recommendation
	<p>Ensure <b>all departmental policy decisions</b>, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p>	Now and ongoing
International	<p>Update the UK's long-term <b>low greenhouse gas emission development strategy with the UNFCCC</b> to reflect a formulated economy-wide plan to achieve Net Zero by 2050 (expected to be the Net Zero Strategy).</p>	H2 2021
	<p>Place aligning <b>global COVID-19 recovery plans</b> with the goals of the Paris Agreement as a core goal of the UK's G7 and COP26 presidencies.</p>	H2 2022
	<p>Publish a new strategy for the UK's <b>international climate policy for after COP26</b> - ensuring that the initiatives for the COP26 presidency have long-term benefits for global emissions over the coming decade and support the implementation of policies to deliver on strengthened national targets.</p>	H1 2022
Jobs and skills	<p>Working with DWP, DfE, the Home Office and MHCLG, develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.</p>	2021 Priority recommendation
	<p>Design industrial decarbonisation policies to <b>support and create jobs</b>, especially in regions with reliance on industrial jobs.</p>	Now and ongoing

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Supporting business action	<b>Support businesses</b> to play their full role in the Net Zero transition and in adapting to climate risks and opportunities, for example by extending and expanding the role of the Net Zero Business Champion beyond COP26, building on the Race to Zero and Race to Resilience campaigns and providing sufficient resources to fully support businesses of all sizes to engage in the transition, to input to policy development and to set their own robust Net Zero and adaptation action plans.	2021-22
	Develop further ways to embed Net Zero and climate risk in <b>financial decisions</b> by UK firms, building on the UK's Green Finance Strategy. This should include implementing mandatory climate disclosure, adoption of a robust green taxonomy with clear guidance on how it should be used. It should also consider the recommendations of the Committee's Finance Advisory Group, such as making Net Zero and adaptation plans mandatory for financial institutions and monitoring financial flows into climate action.	2021-25
	Determine appropriate regulatory arrangements, rules and guidance for the use of <b>carbon offsetting by UK corporates</b> within their Net Zero strategies, recognising the growing demand for offsetting markets, the interactions with the UK ETS and currently accredited schemes (i.e. the Woodland Carbon Code and the Peatland Code), and the need to avoid double-counting or negative outcomes for non-carbon objectives.	2021-22
Research and data	Drawing on the Energy Innovation Needs Assessments ensure <b>innovation funding</b> (e.g. through UKRI, Catapults, the Industrial Strategy Challenge Funding, BEIS Innovation Programme and the Net Zero Innovation Portfolio) drives forward an extensive research and innovation package for delivering a Net Zero, climate-resilient future.	Now and ongoing
	<b>Make monitoring and data analysis</b> of climate risks more accessible, alongside better digitisation of past records. Further efforts should be taken to make the evidence on climate risks more usable for decision makers through co-design of research programmes with end users, where the user drives the research question from the beginning of the process. A major gap is the lack of projections of impacts in 2°C and 4°C scenarios; this needs addressing as an urgent priority ahead of CCRA4.	2022
	Review plan for improving <b>data collection</b> and statistical reporting for the purposes of monitoring and informing the low-carbon transition, as part of the broader work the ONS are already undertaking to improve the collection of climate-related data.	2022
	Work with ONS to put in place plans to <b>collect and report data</b> annually on low-carbon heat networks, specifically the amount of heat delivered (split by DUKES consumption sector, i.e. Residential/Public/Commercial/Industry, and where possible, by source of heat supply). This should be part of a plan for improving data collection and statistical reporting for the purposes of monitoring and informing the low-carbon transition.	2022
	Improve the collection and reporting of <b>industrial decarbonisation data</b> to allow for progress to be monitored more effectively, particularly on energy and resource efficiency.	2022
	Energy / carbon pricing and emissions trading	Set out a clear plan (with HMT) for ensuring that carbon prices and taxes on manufacturers, energy producers and aviation encourage emissions reductions in line with the CCC Pathway, planning for revised (and likely higher) carbon prices from 2023. This should include setting out a <b>cap for the UK ETS</b> consistent with a credible path to the Sixth Carbon Budget for consultation by Q3 2021.
Consult (with HMT) on <b>reforms to electricity pricing</b> to remove disincentives to electrification, based on consideration of the strategic and fair allocation of legacy policy costs associated with the past deployment of less-mature low-carbon electricity generation. It should also consider the balance of existing taxes, such as the Climate Change Levy, on different energy sources. These reforms in combination with wider sectoral incentives, standards and carbon pricing should remove price barriers to electrification.		H1 2022
Consult (with HMT) on the introduction of a <b>carbon tax</b> (either as part of the UK ETS or a separate instrument) aimed at curbing rising emissions from Energy from Waste.		2022
Commit (with DfT) not to use credits from the <b>Carbon Offsetting and Reduction Scheme for International Aviation</b> (CORSIA) for flights covered by the UK ETS unless and until they can satisfy strict eligibility criteria (equivalence, additionality, permanence, sustainability).		2021-22
Develop (with DfT) the option of applying either <b>border carbon tariffs</b> or <b>minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.		2021 Priority recommendation

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Buildings	Produce a robust, equitable and ambitious <b>heat strategy</b> to eliminate emissions from buildings through a clear direction for the next 30 years. This must include: <ul style="list-style-type: none"> <li>Standards covering all segments of the building stock, with support for consumers through the transition.</li> <li>Plans to rebalance policy costs - in consultation with the Committee on Fuel Poverty and wider stakeholders - while making low-carbon solutions more financially attractive.</li> <li>Plans to introduce Green Building Passports.</li> <li>Formalisation of a governance framework to drive decisions on heat infrastructure including a role for area-based energy plans and zoning of heat networks.</li> </ul>	2021 Priority recommendation
	Provide a stable long-term policy framework to support sustained <b>energy efficiency and heat pump</b> growth at sufficient scale (i.e. 600,000 heat pumps per year in existing homes by 2028). This must include a replacement for the Green Homes Grant voucher scheme which works, backed by standards and support for non-residential heat pump installations. Create a level-playing field for hybrid heat pumps off the gas grid and ensure hybrid heat pumps are an integral part of PAS2035 retrofit coordinator advice.	2021 Priority recommendation
	Establish mechanisms to close the substantial funding gap for <b>heat networks</b> , with a multi-year funding programme of sufficient scale to deliver the growth in network deployment, and transition to low-carbon heat sources, needed. Finalise policy on the future market framework for heat networks, including requiring new district heat schemes to utilise low-carbon sources from 2025 at the latest and setting regulations for the conversion of legacy fossil fuel schemes to low-carbon sources.	2022
	Publish proposals for standards to phase out the installation of <b>new liquid and solid fossil fuel heating</b> by 2028 at the latest. Send clear signals on the phase-out of gas heating, including the roles for area-based planning and standards in phasing out gas installations (as in Scotland).	2021
	Move to <b>multi-year programmatic funding</b> to deliver the stated ambition of halving emissions from public buildings by 2032. This must be supported with cross-government strategy (either independent or integrated with the Net Zero or Buildings Strategies) and funding levels in the order of £1 billion/year. Support mechanisms must be designed so that smaller public bodies can access them.	2022
	Set requirements for all <b>new gas boilers to be hydrogen-ready</b> by 2025 at the latest, while ensuring that all new boilers outperform current and expected future air quality standards.	2021
	Implement improvements to the <b>Energy Performance Certificate (EPC) and Standard Assessment Procedure (SAP)</b> framework, including: <ul style="list-style-type: none"> <li>Ensuring EPCs drive deployment of the necessary energy efficiency measures and do so on a holistic basis to address overheating, ventilation, and moisture-risk.</li> <li>Supporting delivery objectives across both energy efficiency and low-carbon heat, and valuing properly the benefits of low-carbon and flexible technologies.</li> <li>Formally integrating a forward trajectory for declining grid carbon-intensity, in line with Government projections.</li> <li>Addressing wider issues of quality/robustness, with a commitment to integrate in-use performance metrics from 2023.</li> <li>Plans for the future role of Green Building Passports.</li> </ul>	2022
	Improve understanding of and support action on <b>overheating in existing residential buildings</b> and encourage retrofit of passive cooling measures. The Heat and Building Strategy must consider overheating risks. The following steps are needed: <ul style="list-style-type: none"> <li>Further research to understand when overheating occurs in existing homes, including ongoing monitoring of temperatures in the housing stock, monitoring of overheating exceedances in homes, and the number of homes currently adapted.</li> <li>Guidance and information for homeowners with the steps that can be taken if their homes overheat. This should include an outline of behavioural options and the measures that can be installed to reduce internal temperatures. Green Building Passports and home retrofit plans could provide holistic guidance and help to unlock green finance.</li> <li>Overheating risk considered and mitigated against if necessary when doing energy efficiency retrofit programmes.</li> <li>Making finance available to install adaptation measures. This could be via grant schemes or green finance for private owners, with public funding targeted at low-income or vulnerable households alongside energy efficiency retrofit.</li> </ul>	2022
	Bring forward the date to reach EPC C in <b>social homes</b> to 2028, in line with the Private Rented Sector (PRS) proposals and finalise the delivery mechanism. Implement ambitious <b>PRS standards</b> for homes which drive fabric efficiency, while valuing deployment of cost-effective low-carbon heat alongside this. Implement the EPC B target for <b>PRS non-domestic buildings</b> in line with new proposals. Consult on options to cover the regulatory policy gap for <b>owner-occupied homes</b> .	2021

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Power	Publish a plan for reaching an emissions intensity of 50 gCO <sub>2</sub> /kWh by 2030, with a total of around 350 TWh of low-carbon generation. Set out a schedule for regular auctions to procure <b>low-carbon generation</b> , with a clear pathway of volumes to be procured and robust contingency for uncertainties in demand and delivery. Address potential barriers to deploying and using low-carbon generation at scale (e.g. the planning and consenting regime for renewables and networks, exposure to climate risks) and, with Ofgem, develop a framework under which sufficient supply resilience can be ensured.	2022 Priority recommendation
	Commit to phasing out <b>unabated gas generation</b> by 2035, subject to ensuring security of supply.	2021 Priority recommendation
	Publish a comprehensive long-term strategy for <b>unabated gas phase-out</b> , including ensuring new gas plant are properly CCS- and/or hydrogen-ready as soon as possible and by 2025 at the latest.	By Spring 2022 Priority recommendation
	Develop a strategy as soon as possible on <b>market design</b> for the medium to long term for a fully decarbonised, resilient electricity system in the 2030s and onwards.	2023
	Develop mechanisms for strategic investment in coordination with Ofgem to ensure that <b>electricity networks</b> can accommodate increased future demand levels, including large localised demand increases associated with electrification in manufacturing, transport and buildings, and that lack of network capacity does not cause delays in emissions reduction.	2023
	Develop a strategy to coordinate the development of <b>interconnectors</b> , connections for offshore wind farms and the enhancement of inter-area transfer capacity for the onshore network, ensuring cost-effective, timely delivery, bringing forward any legislation necessary to enable it.	H1 2022
	Work in partnership with Ofgem to publish and implement a new <b>Smart System Plan and Energy Data and Digitalisation Strategy</b> , including working with DCMS on cyber-security, in order to continue to unlock the full benefits of electricity system flexibility. Ensure that, alongside smart standards for heating, all electricity users have access to half-hourly metering and the option of tariffs that encourage flexibility in use of electric heat and electric vehicle charging.	2021
	Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for <b>electricity, digital and ICT networks</b> . As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.	Now and ongoing
Waste	Set out capacity and usage requirements for <b>Energy from Waste</b> consistent with plans to improve recycling and waste prevention. Issue guidance to align local authority waste contracts and planning policy to these targets.	2021 Priority recommendation
	Introduce the necessary planning guidance and policy to ensure any <b>new Energy from Waste</b> plants (including incineration, gasification & pyrolysis facilities) are built with carbon capture usage and storage (CCUS) or are 'CCUS-ready'.	Spring 2022 Priority recommendation
	Set out how <b>existing Energy from Waste</b> plants will be supported to be retrofitted with CCUS from late 2020s onwards, with 2050 a backstop date for full CCUS coverage.	2022

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Manufacturing and construction	Establish funding mechanism(s) to support operational and capital costs of both <b>electrification and hydrogen-use in manufacturing</b> , as soon as possible, with the aim of awarding funding in 2022. There must be mechanisms for both options, not only hydrogen, and the mechanism(s) should be designed to ensure that, in the medium term, hydrogen-use and electrification compete on a level playing field, to ensure the best value for consumers and taxpayers. Support for electrification may be combined with reforms to electricity pricing.	2022 Priority recommendation
	Continue to support <b>innovation</b> and demonstration of fuel switching and CCS technologies for decarbonising manufacturing and construction. Ensure that a full range of options is developed, filling previous gaps in support, such as encouraging electrification projects to come forward.	Spring 2022
	Set out which policies will deliver the pathway to 4 MtCO <sub>2</sub> e of <b>industrial energy efficiency</b> abatement set out in the Industrial Decarbonisation Strategy and quantify how much abatement will come from each policy: <ul style="list-style-type: none"> <li>Set out the future role of Climate Change Agreements (CCAs) and any required CCA reforms.</li> <li>Consult on mandating the use of Energy Management Systems and on Government support and incentives for implementing energy management standards.</li> <li>Set out the role of energy efficiency standards and audit programmes.</li> <li>Develop resources such as direct advice and training to address capacity and expertise gaps, and highlight available energy efficiency solutions, particularly for SMEs.</li> </ul>	Spring 2022
	Ensure the policy package for decarbonising manufacturing addresses manufacturers' low appetite for investments with long <b>payback times</b> , either using grants or favourable loans, particularly for energy efficiency.	2022
	Work with the minerals industries to develop a detailed joint plan for <b>CO<sub>2</sub> transport from dispersed sites</b> .	Spring 2022
	Commit to <b>targets</b> for ore-based steelmaking and cement production in the UK to reach near-zero emissions by 2035 and 2040, respectively.	2021
	Deliver industrial <b>carbon capture contracts (ICC)</b> to enable final investment decisions on the first ICC projects by mid-2022.	H1 2022
	Deliver the proposed <b>CCS transport and storage</b> regulatory investment model to enable final investment decisions by mid-2022 that are consistent with establishing at least two CCS transport and storage clusters in the mid-2020s.	H1 2022
	Create a clear incentive for <b>manufacturing facilities not currently covered by the UK ETS</b> to switch to low-carbon energy sources by reforming the suite of energy and carbon policies, which could include rebalancing the Climate Change Levy rates for electricity and gas.	2023
	Set out a strategy for decarbonisation of <b>off-road mobile machinery</b> and work with industry to identify potential policies to increase uptake of low-carbon off-road mobile machinery. This will require work across BEIS, MHCLG, DfT and Defra.	2021

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Resource efficiency in manufacturing and construction	<p>Step up efforts (with Defra) to deliver the <b>waste prevention and resource efficiency</b> improvements required as part of the pathway to Net Zero, including by:</p> <ul style="list-style-type: none"> <li>Accelerating delivery of the Waste Prevention Programme so that key policies, such as Extended Producer Responsibility and new product standards, are on track to be in place well before 2025.</li> <li>Setting out how levels of resource efficiency improvements identified within the Industrial Decarbonisation Strategy will be delivered.</li> <li>Beginning to develop and implement any additional policies needed to deliver these resource efficiency improvements, by the end of 2022.</li> <li>Ensure cross-departmental working, potentially through new cross-Whitehall governance focused on resource efficiency.</li> </ul>	<p>Spring 2022 <b>Priority recommendation</b></p> <p>(end 2022 for additional policies)</p>
	<p>Develop policies (with MHCLG, Defra and DfT) to drive more <b>resource-efficient construction</b> and use of existing low-carbon materials, including a substantial increase in the use of <b>wood in construction</b>. Policies should include:</p> <ul style="list-style-type: none"> <li>Reviewing and clarifying the position of structural timber in the ban on combustible materials, underpinned by further research and testing where necessary, and ensuring there are no barriers to the safe use of timber in buildings. The buildings safety regulator to play a role in overseeing this on an ongoing basis.</li> <li>The development of a fully-funded policy roadmap on the use of timber, including policies to support the development of UK wood supply chains.</li> <li>Finalising the reporting methodology for whole-life carbon standards.</li> <li>Setting out a plan for phasing in mandatory whole-life reporting followed by minimum whole-life standards for all buildings, roads and infrastructure by 2025, with differentiated targets by function, scale, and public/private construction.</li> </ul>	Spring 2022
	<p>Consult on detailed proposals (with Defra) for <b>product standards and extended producer responsibility</b> to improve the resource efficiency of consumer goods' lifecycles. The proposals should include all consumer goods with high environmental impact and cover how products are made, through indicators such as the level of recycled content and critical material content, and the reparability, durability and upgradability of a product.</p>	Spring 2022
	<p>Work with business to encourage and <b>enable consumers to share</b>, lease and use products for longer while discouraging 'disposable' business models.</p>	Spring 2022
Transport	<p>Continue to support (with DfT and Ofgem) widespread deployment of <b>EV charging infrastructure</b>:</p> <ul style="list-style-type: none"> <li>This should ensure it can support high EV uptake levels. Project Rapid has the right ambition for the strategic road network and should be developed into a full strategy for the 2020s and beyond.</li> <li>Further investment is needed to support on-street and other urban charging solutions for those without off-street parking and destination charging.</li> <li>Government should aim for there to be around 150,000 public charge points operating by 2025. These should be widely available across all regions of the UK.</li> <li>Implement the recommendations of the EV Energy Taskforce, in particular improving the consumer charging experience and making smart-charging accessible, appealing and cost-effective for as many EV users as possible.</li> </ul>	Now and ongoing <b>Priority recommendation</b>
	<p>Produce a clear assessment (with DfT) of how best to re-use and <b>recycle EV batteries</b> and fund development of competitive, large-scale battery recycling facilities in the UK.</p>	2021-22
	<p>Continue innovation and demonstration support (with DfT) for <b>zero-carbon fuel technologies</b> and their use in shipping, and ship efficiency measures. Develop incentives for zero-carbon ammonia and hydrogen supply chains.</p>	Early 2020s

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Greenhouse gas removals (GGRs)	The overall Net Zero Strategy should place <b>GGRs in context</b> of a wider strategic approach to reaching Net Zero, setting out a plan for development and deployment of removals, but also for actions elsewhere to limit the need for them.	2021 Priority recommendation
	Building on the Greenhouse Gas Removals (GGR) call for evidence, launch consultation on Government's preferred <b>GGR strategy</b> and long-term expected requirement for GHG removals, including a proposed market design, a set of governance principles and proposals that recognise the need for a long-term price signal.	H1 2022 Priority recommendation
	Support the <b>demonstration of engineered GGR</b> at scale in the 2020s, either through amending existing policies or introducing new support mechanisms.	2022 Priority recommendation
	Build on the recently commenced <b>innovation programmes</b> , the Direct Air Capture and other Greenhouse Gas Removals Competition and UK Greenhouse Gas Removal Demonstration Programme, to support both the demonstration and commercialisation of more advanced greenhouse gas removal technologies (taking these from technology readiness level 5 to 8), and alongside undertake research and development into less advanced removal approaches including through pilots and field experiments.	Now and ongoing
	Ensure that a <b>public engagement strategy</b> for Net Zero includes national, regional, and local communities to improve the public's understanding of GGR approaches and both the local and system-wide implications of different options - awareness is currently very low, and support is mixed or uncertain.	2021-22
	Align with adaptation policies to ensure long-term <b>resilience and effectiveness of GGRs</b> in the face of climate impacts and exploit potential for co-benefits (e.g. choice of tree species, protecting new infrastructure from flood risks).	Before 2025
Fuel supply	Develop a <b>Hydrogen Strategy</b> out to 2035 that determines plans and sets out pathways to appropriate hydrogen use across power, industry, transport, and buildings; low-carbon hydrogen production options; and the associated infrastructure. Ensure that large-scale hydrogen trials begin in the early 2020s.	2021 Priority recommendation
	Deliver a <b>Biomass Strategy</b> that is aligned to the UK's path to Net Zero, and which reflects recommendations on governance, monitoring and best-use from the Committee's 2018 Biomass report and 2020 Land Use report. The UK should also continue to take a global lead on further developing and improving UK and international biomass governance and sustainability criteria.	2022 Priority recommendation
	Set new requirements for CCS-readiness at <b>biofuel conversion facilities</b> of all scales. This should include dates beyond which new facilities should be built with CCS, and dates for when CCS will need to be retrofitted to biofuel facilities already in operation.	2022
	Set out policies to reduce <b>upstream emissions from oil and gas</b> production by 68% by 2030, relative to 2018 levels: <ul style="list-style-type: none"> <li>Develop policies to reduce emissions from existing oil and gas platforms, including developing carbon-intensity measurement standards for gas and oil.</li> <li>Set a requirement for new plans for offshore oil and gas platforms and associated installations to use low-carbon energy for their operations, aligning to zero direct emissions from operational energy use by 2027.</li> <li>Make plans to ensure flaring and venting is only permitted for safety reasons from 2025.</li> </ul>	2021
	Work with Ofgem to make explicit how current and future policies will reduce emissions associated with <b>methane leakage</b> from the gas networks in a way that is consistent with the Sixth Carbon Budget.	2021
	Formalise the process, governance framework and timeline for decisions on the <b>conversion to hydrogen</b> of appropriate parts of the gas pipeline networks. This should include starting a programme of research with Ofgem to identify areas which are unlikely to be suitable (such that electrification and alternatives can be prioritised), alongside priority candidate areas for hydrogen.	2021

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Cross-cutting	<p>The next <b>National Adaptation Programme</b>, due in 2023, should ramp up adaptation ambition, implementation and evaluation. It should:</p> <ul style="list-style-type: none"> <li>• Set out the Government's vision for a well-adapted UK, alongside the measurable outcomes that the Government is aiming to achieve by the end of the next NAP period (2023 – 2028).</li> <li>• Include a detailed monitoring and evaluation framework, including which indicators will be used to monitor progress in reducing risk and showing the effectiveness of different adaptation responses for each risk in CCRA3.</li> <li>• Report how departments have addressed the top eight priority risks set out in the CCRA3 Advice Report for urgent action between 2021 and 2023.</li> <li>• Set out how adaptation is being integrated into policy, and the measurable actions by department for adaptation across each of the 61 risks and opportunities set out in the CCRA3 Technical for the period 2023-2028.</li> <li>• Ensure the adaptation actions and the programme as a whole are framed around the principles for good adaptation outlined in the CCRA3 Advice Report: <ul style="list-style-type: none"> <li>– Adapt to 2°C warming, assess the risks for 4°C</li> <li>– Prepare for unpredictable extremes</li> <li>– Assess interdependencies</li> <li>– Understand threshold effects</li> <li>– Integrate adaptation into relevant policies</li> <li>– Ensure adaptation is sufficiently financed</li> <li>– Avoid lock-in</li> <li>– Address inequalities</li> <li>– Consider opportunities from climate change</li> </ul> </li> <li>• Specific actions to manage international climate risks should be included, setting out the direct response to the risks identified in CCRA3.</li> </ul>	2023 onwards Priority recommendation
	<p>Ensure that <b>adaptation is integrated</b> into major upcoming policies in the next two years related to the priority CCRA3 risks for which Defra has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>• Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards.</li> <li>• Risks to soil health from increased flooding and drought.</li> <li>• Risks to natural carbon stores and sequestration (trees, soils and wetlands) from multiple hazards.</li> <li>• Risks to crops, livestock, and commercial trees from multiple hazards.</li> </ul> <p>In addition, for the coming five-year period (2023-2028), Defra should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).</p>	By 2023 Priority recommendation
	<p>Implement a <b>public engagement programme about national adaptation objectives</b>, acceptable levels of risk, desired resilience standards, how to address inequalities, and responsibilities across society. The findings from the programme should feed into the vision and desired outcomes of the next National Adaptation Programme.</p>	2021 Priority recommendation
	<p>Implement measures to address <b>non-financial barriers to tackling emissions from land use and agriculture</b>, including awareness and improving skills in sustainable forestry and peatland management; scaling up supply chains; streamlining application processes and addressing contractual and tax issues where they are acting as barriers. Delivery plans should also set out measures to:</p> <ul style="list-style-type: none"> <li>• Improve knowledge exchange of low-carbon farming practices to provide confidence to farmers to take up measures to reduce on-farm GHGs.</li> <li>• Improve the science and evidence base for woodlands and peatlands, to deliver GHG reductions and multiple other benefits, ensure the right tree is planted in the right place and that they are resilient to future climate impacts.</li> </ul>	2021-25 Priority recommendation

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Cross-cutting	Legislate the <b>Environment Bill</b> this year, using it to strengthen commitments on waste, resource efficiency, agriculture and land-use.	2021
	Develop (with DIT) the option of applying either <b>border carbon tariffs or minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.	2021 Priority recommendation
	Ensure <b>all departmental policy decisions</b> , and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.	Now and ongoing
Research and data	Fund a programme of work to design and populate the appropriate new <b>priority adaptation indicators</b> for England. These should complement other environmental and social indicators collated by Government. The CCC could be tasked to coordinate this activity in partnership with other relevant organisations such as the Office for Environmental Protection and Environment Agency.	2021
	Continue to monitor <b>consumption emissions</b> . These are important to ensure that action to decarbonise UK-based activities does not result in emissions moving offshore, and to track progress in decarbonisation of imports to the UK, which in turn can inform future policy (e.g. border carbon adjustments).	Now and ongoing
	Improve the collection and reporting of <b>industrial decarbonisation data</b> to allow for progress to be monitored more effectively, particularly on energy and resource efficiency.	2022
Nature and land use	Extend current ambition set out by the UK government and the devolved administrations to implement a comprehensive delivery mechanism to address <b>degraded peatland</b> : <ul style="list-style-type: none"> <li>17% of upland peat is restored, equivalent to 200,000 hectares (and where this is not possible, stabilise the peat) by 2025; 58% by 2035 (700,000 hectares) and the remaining area by 2045.</li> <li>Rewet and sustainably manage 12% of lowland peat used for crops by 2025 (24,000 hectares), rising to 38% by 2035 (72,000 hectares).</li> <li>Rewet 8% of lowland grassland area by 2025 (18,000 hectares), rising to 25% by 2035 (54,000 hectares).</li> <li>Remove all low-productive trees (i.e. less than YC8) from peatland (equivalent to 16,000 hectares by 2025), and restore all peat extraction sites by 2035 (equivalent to 50,000 hectares by 2025).</li> </ul>	2021-25 Priority recommendation
	Extend current ambition set out by the UK government and the devolved administrations to implement a comprehensive <b>delivery mechanism for new woodland</b> to create at least 30,000 hectares per year across the UK by 2025 (in line with the Government's commitment) and an average of 40,000 hectares per year in the 2030s.	2021-25 Priority recommendation
	Introduce legislation to: <ul style="list-style-type: none"> <li>Extend the <b>ban on rotational burning of peat</b> from certain protected upland bog sites to all peatland before the start of the burn season in 2021</li> <li>End peat extraction, and ban its sale for all horticultural uses including in the professional sectors and apply this to imports by 2023.</li> <li>Mandate water companies to restore peatland under their ownership.</li> <li>Ensure lowland peat soils are not left bare.</li> </ul>	2021-23 Priority recommendation
	Publish an overarching strategy that clearly outlines the relationships and <b>interactions between the multiple action plans</b> in development for the natural environment, including those for peat, trees, nature and plant biosecurity. This must clearly outline how the different strategies will combine to support the Government's climate change goals on both Net Zero and adaptation, along with the wider environment and other goals.	2021
	Make <b>long-term targets for biodiversity</b> , set out under the Environment Bill, and associated timeframes outcome-based and linked directly to the goals set out in the Government's 25-Year Environment Plan.	H1 2022
	Make <b>interim targets for biodiversity</b> statutory and link them clearly to the long-term targets set out in the Environment Bill.	H1 2022
	The commitment in the 25 Year Environment Plan to achieve 75% <b>restoration for terrestrial and freshwater</b> protected sites should be extended to include all priority habitat sites.	2021
	Set out a clear mechanism to account for the consequences of <b>higher water temperatures and low flows</b> (including drying up) in water bodies for freshwater habitats and species, and for meeting the Water Framework Directive (WFD) targets. This is lacking in current plans to revise the River Basin Management Plans (RBMPs).	H1 2022
	Extend the statutory requirements of <b>marine plan policies</b> to the decisions of public and private organisations. At present only public authorities are duty bound under law to apply the plan policies to their decisions meaning there is a significant gap in the protections they are designed to provide.	Now

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Agriculture and food	<p>Provide <b>incentives and address non-financial barriers</b> across all of the UK to:</p> <ul style="list-style-type: none"> <li>Plant <b>trees</b> on 2% of farmland by 2025 while maintaining their primary use, rising to 5% by 2035.</li> <li>Extend <b>hedgerows</b> by 20% by 2035 and better manage existing hedgerows.</li> <li>Increase the area growing <b>energy crops</b> across the UK to 6,000 hectares per year by 2025, and 30,000 hectares per year by 2035.</li> </ul>	2021-25 Priority recommendation
	<p>Implement measures to encourage consumers to <b>shift diets and reduce food waste</b> across the supply chain, including:</p> <ul style="list-style-type: none"> <li>Low-cost, low-regret actions to encourage a 20% shift away from all meat by 2030, rising to 35% by 2050, and a 20% shift from dairy products by 2030. Develop an evidence-based strategy to establish options for successful behaviour shifts and demonstrate public sector leadership.</li> <li>Policy to reduce food waste by 50% by 2030 and 60% by 2050, with the public sector taking a lead through measures such as target setting and effective product labelling.</li> </ul>	Start now and review mid-2020s for diet change Priority recommendation
	<p>Introduce a strong <b>post-CAP regulatory baseline</b>, and adopt and retain existing EU rules that benefit GHG mitigation into UK legislation. These include low-cost, low-regret on-farm measures to reduce emissions; extending coverage of Nitrate Vulnerable Zones across all of the UK; including measures that reduce enteric methane emissions in the Clean Air Strategy, specifically under the proposal to extend environmental permitting to the dairy and intensive beef sectors; and mandating UK feed producers to incorporate methane inhibiting additives in compound feed and mineral supplements.</p>	2021-23
	<p>Set out measures to ensure the resilience of the <b>food supply chain</b>, including to the risks of extreme weather in England and internationally, as part of its white paper responding to the independent review of the National Food Strategy for England.</p>	2022
	<p>Introduce a comprehensive plan and incentives to deliver <b>emissions reduction across all UK farms</b> through:</p> <ul style="list-style-type: none"> <li>High take-up of low-carbon agricultural measures (60-75% by 2050) covering livestock (diets, breeding, and health), soils (cover crops and grass-legume mix) &amp; waste management (anaerobic digestion and slurry covers).</li> <li>Measures to incentivise the take-up of near-zero-emissions options for agricultural machinery and vehicles from the mid-2020s, and develop options where they are not currently available.</li> </ul>	2021-25
	<p>The landscape-level and on-farm measures set out above should:</p> <ul style="list-style-type: none"> <li><b>Leverage private and public finance</b> (e.g. a trading scheme or auctioned contracts). New and existing funding streams should continue during the transition period to this system to avoid a hiatus in deployment.</li> <li>Be accompanied by a strong <b>monitoring, reporting and verification</b> system that uses the latest monitoring tools and technologies to create a strong institutional framework to verify actions across the UK.</li> </ul>	2021-25
	<p>Set out a strategy for decarbonisation of <b>off-road mobile machinery</b> and work with industry to identify potential policies to increase uptake of low-carbon off-road mobile machinery. This will require work across BEIS, MHCLG, DfT and Defra.</p>	2021

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Waste	Introduce the necessary planning guidance and policy to ensure any new <b>Energy from Waste</b> plants (including incineration, gasification & pyrolysis facilities) are built with carbon capture usage and storage (CCUS) or are 'CCUS ready'.	Spring 2022 Priority recommendation
	Set out how existing <b>Energy from Waste</b> plants will be supported to be retrofitted with CCUS from late 2020s onwards, with 2050 a backstop date for full CCUS coverage.	2022 Priority recommendation
	Set out capacity and usage requirements for <b>Energy from Waste</b> consistent with plans to improve recycling and waste prevention. Issue guidance to align local authority waste contracts and planning policy to these targets.	2021 Priority recommendation
	Set out <b>funding arrangements for local authorities</b> to provide the recycling, composting and waste management services and infrastructure required to deliver at least the commitments in the Environment Bill, Waste Prevention Programme and Resources and Waste Strategy, by 2022.	2022-25
	Consult on the introduction of a <b>carbon tax</b> (either as part of the UK ETS or a separate instrument) aimed at curbing rising emissions from Energy from Waste.	2022
	Set a target for a 68% <b>recycling rate</b> by 2030 covering all wastes in England via the Environment Bill and announce new policies to meet this target. Northern Ireland to set a 70% target for 2030. Scotland and Wales to set new targets for 2030 that go beyond their 70% targets for 2025.	2021
	<b>Composting facilities</b> should be incentivised to install forced aeration as a method of reducing on-site emissions.	From 2022
	Mandatory <b>business food waste</b> reporting to be introduced by 2022, building on WRAP's existing voluntary scheme.	2022
	Legislate for (in England via the Environment Bill, and in Wales, Scotland, and Northern Ireland via new legislation) and implement a <b>ban on landfilling of the main biodegradable waste</b> streams from 2025 (both municipal and non-municipal). There must be sufficient recycling/composting/AD treatment capacity made available before the ban comes into force, so that significant increases in energy-from-waste are avoided.	2021
	Long-term plans should be announced for eventual <b>diversion of all wastes from landfill</b> (except for where no alternative treatment or disposal method exists) but with a date conditional on sufficient action on reduction, re-use and recycling, and installation of CCS at energy-from-waste plants, to avoid a surge in fossil emissions when the ban comes into force.	Mid-2020s
	Introduce policies and funding for increased <b>methane capture and oxidation at landfill sites</b> , to decrease fugitive landfill methane emissions significantly.	2022
Phase out <b>exports of waste</b> by 2030 at the latest, through improvements in waste prevention and domestic recycling and recovery, while strengthening tracking and enforcement to ensure that any exports intended for recycling are being treated appropriately.	2020s	
Greenhouse gas removals and offsets	Build on the recently commenced innovation programmes (with BEIS), the Direct Air Capture and other Greenhouse Gas Removals Competition and UK Greenhouse Gas Removal Demonstration Programme, to support both the <b>demonstration and commercialisation of more advanced greenhouse gas removal</b> technologies (taking these from technology readiness level 5 to 8), and alongside undertake research and development into less advanced removal approaches including through pilots and field experiments.	Now and ongoing
	Align with adaptation policies to ensure long-term <b>resilience and effectiveness of GGRs</b> in the face of climate impacts and exploit potential for co-benefits (e.g. choice of tree species, protecting new infrastructure from flood risks).	Before 2025
	Consider (with BEIS) the appropriate regulatory arrangements, rules and guidance for the use of <b>carbon offsetting by UK corporates</b> within their Net Zero strategies, recognising the growing demand for offsetting markets, the interactions with the UK ETS and currently accredited schemes (i.e. the Woodland Carbon Code and the Peatland Code), and the need to avoid double-counting or negative outcomes for non-carbon objectives.	2021-22

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Resource efficiency	<p>Step up efforts to deliver the <b>waste prevention and resource efficiency</b> improvements required as part of the pathway to Net Zero, including by:*</p> <ul style="list-style-type: none"> <li>Accelerating delivery of the Waste Prevention Programme so that key policies, such as Extended Producer Responsibility and new product standards, are on track to be in place well before 2025.</li> <li>Setting out how levels of resource efficiency improvements identified within the Industrial Decarbonisation Strategy will be delivered.</li> <li>Beginning to develop and implement any additional policies needed to deliver these resource efficiency improvements, by the end of 2022.</li> <li>Ensure cross-departmental working, potentially through new cross-Whitehall governance focused on resource efficiency.</li> </ul>	<p>Spring 2022 Priority recommendation</p> <p>(end 2022 for additional policies)</p>
	<p>Consult on detailed proposals for <b>product standards and extended producer responsibility</b> to improve the resource efficiency of consumer goods' lifecycles. The proposals should include all consumer goods with high environmental impact and cover how products are made, through indicators such as the level of recycled content and critical material content, and the reparability, durability and upgradability of a product.</p>	Spring 2022
	<p>Develop policies (with BEIS, MHCLG and DfT) to drive more <b>resource-efficient construction</b> and use of existing low-carbon materials, including a substantial increase in the use of <b>wood in construction</b>. Policies should include:</p> <ul style="list-style-type: none"> <li>Reviewing and clarifying the position of structural timber in the ban on combustible materials, underpinned by further research and testing where necessary, and ensuring there are no barriers to the safe use of timber in buildings. Buildings safety regulator to play a role in overseeing this on an ongoing basis.</li> <li>The development of a fully funded policy roadmap on the use of timber, including policies to support the development of UK wood supply chains.</li> <li>Finalising the reporting methodology for whole-life carbon standards.</li> <li>Setting out a plan for phasing in mandatory whole-life reporting followed by minimum whole-life standards for all buildings, roads and infrastructure by 2025, with differentiated targets by function, scale, and public/private construction.</li> </ul>	Spring 2022
	<p>Work with business to encourage and enable consumers to share, lease and use products for longer whilst <b>discouraging 'disposable' business models</b>.</p>	Spring 2022
Buildings and infrastructure	<p>Make changes ahead of the next round of reporting under the <b>Adaptation Reporting Power (ARP)</b>. When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies. In particular:</p> <ul style="list-style-type: none"> <li>The next round of reporting must be mandatory.</li> <li>The deadline for reporting must allow sufficient time for consideration of all the reports in the fourth UK Climate Change Risk Assessment, and the CCC's statutory assessment of progress on adaptation.</li> <li>The list of organisations reporting should be expanded to ensure comprehensive coverage of critical infrastructure and services, such as canals and food supply chains, as recommended by the ARP3 consultation.</li> </ul>	2023
	<p>Work with the Environment Agency to set out the measures being taken to improve the uptake of <b>property-level flood resilience (PFR)</b> following stakeholder responses to its PFR call for evidence and consultation. This should include improved data collection to monitor progress. Plans for the new national flood risk assessment and 2025 long-term investment scenarios must ensure that the evidence they provide can be used to identify the most effective locations for PFR, and smart targets for their installation with timescales.</p>	2022
	<p>Work with <b>Port Operators and the British Ports Association</b> to ensure the format of reporting under the Adaptation Reporting Power is appropriate for port operators and that the right operators are being asked to report, as well as to identify what further support could be offered to enable more comprehensive reporting on adaptation by the ports sector.</p>	2023
	<p>Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for <b>electricity, digital and ICT networks</b>. As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital &amp; ICT.</p>	Now and ongoing

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Waste and wastewater	Work with the Environment Agency, Ofwat and other stakeholders to set out targets and supporting measures for <b>reducing water use by business</b> . This could be through ensuring that any water reduction targets linked to the Environment Bill include business as well as household water use, and responding to advice and recommendations from Defra's new Senior Water Demand Reduction Group.	2022
	Commit innovation funding to development and demonstration of novel <b>wastewater treatment</b> process that achieve a step change improvement in direct process emissions.	2022
	Outside of the municipal wastewater sector, incentivise <b>industrial wastewater plants</b> to reduce their process emissions.	From 2022

Table A6 Recommendations for the Department for Transport (DfT)		Timing
Cross-cutting	For the coming five-year period (2023–2028), DfT should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Decisions on <b>investment in roads</b> should be contingent on analysis justifying how they contribute to the UK's pathway to Net Zero. This analysis should demonstrate that the proposals would not lead to increases in overall emissions. Wherever possible, investment in roads should be accompanied by proportionate investment in EV charging infrastructure and in active travel and public transport.	2021-22
	Develop policies (with BEIS, Defra and MHCLG) to drive more <b>resource-efficient construction</b> and use of existing low-carbon materials. DfT's focus should be on: <ul style="list-style-type: none"> <li>Finalising the reporting methodology for whole-life carbon standards</li> <li>Contributing to a plan for phasing in mandatory whole-life reporting followed by minimum whole-life standards for all roads and infrastructure by 2025, with differentiated targets by function, scale, and public/private construction.</li> </ul>	Spring 2022
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
Electric vehicles	Develop a comprehensive policy package to <b>support the supply and uptake of EVs</b> to enable delivery of the 2030 phase-out of new petrol and diesel cars and vans. This will require: <ul style="list-style-type: none"> <li>Strong consumer incentives to purchase zero-emission vehicles, whether in the form of purchase subsidies or preferential tax rates and duties. These should be fair across consumer groups and scaled back as costs of EVs fall.</li> <li>Introducing a zero-emission vehicle mandate requiring car manufacturers to sell a rising proportion of zero-emission vehicles (specifically, fully battery-electric vehicles), reaching nearly 50% by 2025 and 100% by 2030, with only a very small proportion of hybrids allowed alongside until 2035. This will benefit air quality and consumers, as well as greenhouse gas emissions.</li> <li>Setting out ambitious UK regulations on new car and van CO<sub>2</sub> intensities to 2030, with more regular intervals than the EU's five years, requiring around a 55% reduction by 2025 and 97% by 2030.</li> </ul>	Policy package: 2021 Support: Now and ongoing  Priority recommendation
	Continue to support widespread deployment of <b>EV charging infrastructure</b> : <ul style="list-style-type: none"> <li>This should ensure it can support high EV uptake levels. Project Rapid has the right ambition for the strategic road network and should be developed into a full strategy for the 2020s and beyond.</li> <li>Further investment is needed to support on-street and other urban charging solutions for those without off-street parking and destination charging.</li> <li>Government should aim for there to be around 150,000 public charge points operating by 2025. These should be widely available across all regions of the UK.</li> <li>Implement the recommendations of the EV Energy Taskforce, in particular improving the consumer charging experience and making smart-charging accessible, appealing and cost-effective for as many EV users as possible.</li> </ul>	Now and ongoing Priority recommendation
	Produce a clear assessment of how best to re-use and <b>recycle EV batteries</b> and fund development of competitive, large-scale battery recycling facilities in the UK.	2021-22

Table A6 Recommendations for the Department for Transport (DfT)		Timing
Public transport and active travel	Strengthen support for, and provision of, schemes to support <b>walking, cycling and public transport</b> to reduce demand for higher-carbon travel: <ul style="list-style-type: none"> <li>Provision of infrastructure for active travel and other support schemes, as well as measures to make it less attractive to drive, are needed.</li> <li>This should include maintaining positive behaviour shifts and addressing risks resulting from the COVID-19 pandemic.</li> <li>Working across delivery bodies (e.g. local authorities) is critical.</li> </ul>	2021-22 Priority recommendation
	Government should support the <b>public transport and shared mobility</b> sectors to recover from the COVID-19 pandemic: <ul style="list-style-type: none"> <li>Positive communications and messaging will be required to rebuild public confidence in the safety of public transport.</li> <li>Financial support for the sector should be maintained while confidence and demand are rebuilt, to avoid the risk of operators cutting service provision.</li> <li>Government should seek to reverse the increasing relative price advantage of car travel over public transport.</li> </ul>	2021-22
	Set out a clear vision to deliver Net Zero in <b>rail</b> , and support Network Rail and other bodies in delivering the target to remove all passenger diesel trains by 2040. This should cover a mix of zero-emission technologies (e.g. track electrification, battery-electric, hydrogen and hybrid trains). The strategy should be published by 2021 as recommended by the National Infrastructure Commission.	2021
	Mandate a <b>phase-out</b> of new sales of all <b>diesel buses and coaches</b> by 2040 at the latest. <ul style="list-style-type: none"> <li>This should include a requirement for new sales of diesel vehicles operating on shorter, urban routes to end considerably sooner.</li> <li>Local authorities should be empowered to continue driving zero-emission bus take-up and to deliver improvements to bus services.</li> </ul>	2021-22
	Implement large-scale <b>trials of zero-emission HGVs</b> in the early-2020s to demonstrate the commercial feasibility of these technologies and establish the most suitable and cost-effective technology mix.	Early 2020s
Freight and off-road mobile machinery	Set out and implement a <b>strategy to transition to zero-carbon freight</b> , including: <ul style="list-style-type: none"> <li>Ending sales of new diesel HGVs by 2040 at the latest.</li> <li>Stronger purchase and other incentives for zero-emission HGVs.</li> <li>Infrastructure plans and support (e.g. ultra-rapid chargers for battery-electric HGVs and hydrogen refuelling stations for hydrogen HGVs).</li> <li>Clean air zones.</li> </ul>	2021
	Implement schemes to <b>reduce HGV and van use</b> in urban areas (e.g. e-cargo bikes and use of urban consolidation centres), to reduce traffic and improve the safety of active travel.	2021
	Set out a strategy for decarbonisation of <b>off-road mobile machinery</b> and work with industry to identify potential policies to increase uptake of low-carbon off-road mobile machinery. This will require work across BEIS, MHCLG, DfT and Defra.	2021
	Build on the <b>Clean Maritime Plan</b> and formal inclusion of international shipping in CB6 and Net Zero to set a Net Zero 2050 goal for UK shipping (including international shipping) and a pathway to get there.	2021
Shipping	Take a leadership role in working with the <b>International Maritime Organisation (IMO)</b> and other willing partners on global shipping policies, research funding, tighter efficiency targets and other initiatives to reduce shipping emissions. Work to strengthen the IMO 2050 global target.	2021-22
	Commit to the UK's first <b>clean maritime cluster(s)</b> operating at commercial scale (supplying at least 2 TWh/year of zero-carbon fuels) by 2030 at the latest, with zero-carbon fuels expanding to 33% of UK shipping fuel use by 2035.	2021-22
	Continue <b>innovation and demonstration support for zero-carbon fuel</b> technologies and their use in shipping, and ship efficiency measures. Develop incentives for zero-carbon ammonia and hydrogen supply chains.	Early 2020s
	Provide support for ports' investment in <b>shore power</b> and electric recharging infrastructure.	Early 2020s
	Start monitoring <b>non-CO<sub>2</sub> effects</b> of shipping and decide on how best to tackle them alongside UK climate targets.	2021

Table A6 Recommendations for the Department for Transport (DfT)		Timing
Aviation	Commit to a Net Zero goal and pathway for UK aviation as part of the forthcoming <b>Aviation Decarbonisation Strategy</b> , with UK international aviation reaching Net Zero emissions by 2050 at the latest, and domestic aviation potentially earlier. Plan for residual emissions (after efficiency, low-carbon fuels, and demand-side measures) to be offset by verifiable greenhouse gas removals, on a sector net emissions trajectory to Net Zero.	2021 Priority recommendation
	Assess the Government's <b>airport capacity strategy</b> in the context of Net Zero and any lasting impacts on demand from COVID-19, as part of the aviation strategy. There should be no net expansion of UK airport capacity unless the sector is on track to sufficiently outperform its net emissions trajectory and can accommodate the additional demand. A demand management framework will need to be developed (by 2022) and be in place by the mid-2020s to annually assess and, if required, control sector GHG emissions and non-CO <sub>2</sub> effects.	2021-22 Priority recommendation
	Take a leadership role within the <b>International Civil Aviation Organisation (ICAO)</b> , and work with other high-ambition nations, to set a long-term goal for aviation consistent with the Paris Agreement, strengthen the CORSIA scheme and align CORSIA to this long-term goal.	2021-22
	Continue innovation and demonstration support for <b>sustainable aviation fuel (SAF)</b> technologies, aircraft efficiency measures, hybrid, full electric and hydrogen aircraft development and airspace modernisation. Set out a policy package for supporting the near-term deployment of commercial SAF facilities in the UK (with carbon capture and storage where applicable).  Longer-term, support for SAF should transition to a more bespoke, enduring policy to drive uptake.	Now and ongoing Policy package in 2021
	Use <b>aviation tax reform</b> to address price imbalances between aviation and surface transport, encouraging the low-carbon alternative (e.g. rail) for journeys where one exists. Taxation should also be used, alongside improvements in broadband, to embed positive behaviours that have arisen during the pandemic (e.g. replacing business travel with online networking).	2021-22
	Commit to not use credits from the <b>Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)</b> for flights covered by the UK ETS unless and until they can satisfy strict eligibility criteria (equivalence, additionality, permanence, sustainability).	2021-22
	Start monitoring <b>non-CO<sub>2</sub> effects</b> of aviation (including through CORSIA for eligible aeroplane operators), set a minimum goal of no further warming after 2050, research mitigation options, and consider how best to tackle non-CO <sub>2</sub> effects alongside UK climate targets without increasing CO <sub>2</sub> emissions.	2021-22

Table A7 Recommendations for the Ministry of Housing, Communities and Local Government (MHCLG)		Timing
Cross-cutting	<p>Support <b>local government</b> to play a full role in the Net Zero transition, including through increased resourcing, guidance, involvement in local area energy plans, statutory reporting on the emissions from their estate and reforming the planning framework to enable delivery of low-carbon and climate resilient measures.</p> <p>This is likely to require additional funding for staffing and resources for local delivery plans, alongside a 'duty to collaborate' to encourage authorities to work with local, regional and national partners to deliver their climate ambitions.</p>	<p>2021-23 <b>Priority recommendation</b></p> <p>(funding for local areas at next budget)</p>
	<p>Ensure that <b>adaptation is integrated</b> into major upcoming policies in the next two years related to the priority CCRA3 risks for which MHCLG has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>Risks to human health, wellbeing and productivity from increased exposure to heat in homes and buildings (with DHSC).</li> <li>In addition, for the coming five-year period (2023-2028), MHCLG should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).</li> </ul>	<p>By 2023 <b>Priority recommendation</b></p>
	<p>Working with BEIS, DWP, DfE and the Home Office, develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.</p>	<p>2021 <b>Priority recommendation</b></p>
	<p>Ensure that developments and infrastructure are compliant with <b>Net Zero</b> and appropriately <b>resilient to climate change</b> through proposed amendments to the Planning Bill.</p>	<p>2021-22</p>
	<p>Introduce an <b>urban greenspace</b> target to reverse the decline and ensure towns and cities are adapted to more frequent heatwaves in the future and that the 25-Year Plan goals are met.</p>	<p>2022</p>
	<p>Ensure all departmental policy decisions, planning decisions and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b>.</p>	<p>Now and ongoing</p>
Flooding	<p>Ensure that all types of current and future <b>flood risk</b> are included in policies to assess flood risk to new developments. Housing targets for local authorities should take account of flood risk, amongst other environmental issues. Assessments and management of flood risk in new developments must as a minimum:</p> <ul style="list-style-type: none"> <li>Include evidence that the development will be safe over its full lifetime, with a consideration of the downstream interactions and impacts of new developments (i.e. it should not increase flooding in other areas).</li> <li>Include an assessment of current and future flood risk under both 2°C and 4°C global climate scenarios.</li> <li>Assess and manage the risk of flooding to local infrastructure as well as housing.</li> <li>Include a consideration of better preparedness as set out in the Government's recent FCERM Policy Statement.</li> <li>Ensure there are properly funded and trained staff in local authorities.</li> </ul>	<p>2022</p>
	<p>To help improve the <b>information on SuDS and surface water flood risk</b>, urgently begin collecting data on sewer capacity and SuDS location, type and capacity. This would bring the level of information in line with that for river and coastal flood risk defences.</p>	<p>2021</p>
	<p>To address the issue of increased risk of <b>surface water flooding</b> in new developments, commit to ensuring that new developments do not put more water into the public sewers than what was there before, taking into account climate change. To incentivise this, end the automatic right to connect to the public sewer; planning reforms should enact Schedule 3 of the Flood and Water Management Act (2010); and technical SuDS standards should be made mandatory and be updated to deliver SuDS that provide multiple economic, social and environmental benefits.</p>	<p>2022</p>
	<p>The <b>consultation process for surface water flood risk</b> must be improved. This should be done by adding statutory consultees for all development type and sizes. Consultees must have the appropriate skills to provide advice on surface water flood mitigation. Ensure that Local Authorities fully justify planning decisions where applications can proceed either without or going against formal flood risk mitigation advice.</p>	<p>2022</p>

Table A7 Recommendations for the Ministry of Housing, Communities and Local Government (MHCLG)		Timing
Buildings	<p>Implement a <b>strong set of standards – with robust enforcement</b> – that ensure both new and existing buildings are designed for a changing climate and deliver high levels of energy efficiency and low-carbon heat. Including:</p> <ul style="list-style-type: none"> <li>Publish robust definitions of the Future Homes Standard and Future Buildings Standard which are legislated in advance of 2023 and ensure no fossil fuels are burnt in new buildings. This must include coordination with DfE, MoJ, DHSC as well as BEIS and HMT.</li> <li>Regulate the overheating requirement as set out in the Future Buildings Standard consultation. Expand the requirement to cover refurbishments of existing buildings and conversions of non-residential buildings to residential.</li> <li>Work with BEIS on the Heat and Buildings Strategy and use standards to set a clear direction for retrofit across the buildings stock.</li> <li>Ensure that the remit of the new buildings safety regulator covers climate change mitigation and adaptation, strengthened through an explicit responsibility for sustainability; and is fully equipped to monitor and enforce compliance with buildings standards.</li> <li>Work with HM Treasury to ensure that local authorities are properly funded to enforce buildings standards.</li> <li>Close loopholes allowing homes to be built which do not meet the current minimum standards for new dwellings. This includes provisions around the expiry of planning permission and permitted development rights relating to change of use. Make accurate performance testing and reporting widespread, committing developers to the standards they advertise.</li> </ul>	2021-22 <b>Priority recommendation</b>
	<p>Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.</p>	2021-22
	<p>Implement improvements to the <b>Energy Performance Certificate (EPC) and Standard Assessment Procedure (SAP)</b> framework, including:</p> <ul style="list-style-type: none"> <li>Ensuring EPCs drive deployment of the necessary energy efficiency measures and do so on a holistic basis to address overheating, ventilation, and moisture-risk.</li> <li>Supporting delivery objectives across both energy efficiency and low-carbon heat, and valuing properly the benefits of low-carbon and flexible technologies.</li> <li>Formally integrating a forward trajectory for declining grid carbon-intensity, in line with Government projections.</li> <li>Addressing wider issues of quality/robustness, with a commitment to integrate in-use performance metrics from 2023.</li> <li>Plans for the future role of Green Building Passports.</li> </ul>	2022
Construction	<p>Step up efforts to deliver the <b>waste prevention and resource efficiency</b> improvements required as part of the pathway to Net Zero, including by:</p> <ul style="list-style-type: none"> <li>Setting out how levels of resource efficiency improvements in construction identified within the Industrial Decarbonisation Strategy will be delivered.</li> <li>Beginning to develop and implement any additional policies needed to deliver these resource efficiency improvements, by the end of 2022.</li> <li>Ensure cross-departmental working, potentially through new cross-Whitehall governance focused on resource efficiency.</li> </ul>	Spring 2022 <b>Priority recommendation</b>  (end 2022 for additional policies)
	<p>Develop policies (with BEIS, Defra and DfT) to drive more <b>resource-efficient construction</b> and use of existing low-carbon materials, including a substantial increase in the use of <b>wood in construction</b>. Policies should include:</p> <ul style="list-style-type: none"> <li>Reviewing and clarifying the position of structural timber in the ban on combustible materials, underpinned by further research and testing where necessary, and ensuring there are no barriers to the safe use of timber in buildings. Buildings safety regulator to play a role in overseeing this on an ongoing basis.</li> <li>The development of a fully funded policy roadmap on the use of timber, including policies to support the development of UK wood supply chains.</li> <li>Finalising the reporting methodology for whole-life carbon standards.</li> <li>Setting out a plan for phasing in mandatory whole-life reporting followed by minimum whole-life standards for all buildings, roads and infrastructure by 2025, with differentiated targets by function, scale, and public/private construction.</li> </ul>	Spring 2022
	<p>Set out a strategy for decarbonisation of <b>off-road mobile machinery</b> and work with industry to identify potential policies to increase uptake of low-carbon off-road mobile machinery. This will require work across BEIS, MHCLG, DfT and Defra.</p>	2021

Table A8 Recommendations for the Department for Digital, Culture, Media and Sport (DCMS)		Timing
Cross-cutting	Support BEIS in developing a <b>public engagement strategy</b> for Net Zero which builds on the findings of the UK Climate Assembly by involving people in decision-making, providing trusted information on decarbonisation choices and the need to reduce emissions and adapt to climate change. The strategy should also identify preferred policy options to empower people to contribute fully towards the path to Net Zero.	2021-22 Priority recommendation
	For the coming five-year period (2023-2028), outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Work in partnership with Ofgem to publish and implement a new <b>Smart System Plan and Energy Data and Digitalisation Strategy</b> , including on cyber-security, in order to continue to unlock the full benefits of electricity system flexibility. Ensure that, alongside smart standards for heating, all electricity users have access to half-hourly metering and the option of tariffs that encourage flexibility in use of electric heat and electric vehicle charging.	2021
	Ensure <b>sport and culture strategies</b> align to other departments' plans for lower-carbon buildings, more active travel and improved public health.	2021
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
Digital infrastructure	Ensure plans for a <b>digital transition and fibre roll-out</b> can complement changing work patterns and travel behaviours, leading to lower-carbon working. Co-ordinate with DfT to invest in digital infrastructure to lock in positive behaviours that reduce travel demand (e.g. home-working).	2021
	<b>Resilience standards for the digital sector</b> must include requirements pertaining to climate change risks. In addressing the National Infrastructure Commission recommendations from the Resilience Study, Government should incorporate consideration of climate change risks and adaptation actions into any new standards being developed. Standards for digital infrastructure operators should include requirements to: <ul style="list-style-type: none"> <li>Assess climate risks under both 2°C and 4°C global climate scenarios.</li> <li>Consider interdependencies with other critical infrastructure, and</li> <li>Set out actions to reduce risk and monitor progress.</li> </ul>	2022
	Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for <b>electricity, digital and ICT networks</b> . As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.	Now and ongoing

Table A9 Recommendations for the Department for Education (DfE)		Timing
	Working with BEIS, DWP, MHCLG and the Home Office, develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.	2021 Priority recommendation
	Support BEIS in developing a <b>public engagement strategy</b> for Net Zero which builds on the findings of the UK Climate Assembly by involving people in decision-making, providing trusted information on decarbonisation choices and the need to reduce emissions and adapt to climate change. The strategy should also identify preferred policy options to empower people to contribute fully towards the path to Net Zero.	2021-22 Priority recommendation
	For the coming five-year period (2023-2028), DfE should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the one risk in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	2021-22
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing

Table A10 Recommendations for the Department for Work and Pensions (DWP)		Timing
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Working with BEIS, DfE, MHCLG and the Home Office, develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.	2021 Priority recommendation
	Design industrial decarbonisation policies to <b>support and create jobs</b> , especially in regions with reliance on industrial jobs.	Now and ongoing
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	2021-22

Table A11 Recommendations for the Department of Health and Social Care (DHSC)		Timing
	For the coming five-year period (2023–2028), DHSC should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Assess <b>health sector vulnerability</b> to existing and future climate risks, particularly for care homes and home-based care. Following this, develop a cross-sector approach to address risks. This cross-sector approach should include input from DHSC, CQC, PHE, NHS, MHCLG and local level public health bodies.	2022
	Fund the strengthening and widening of vector and pathogen surveillance and early-warning mechanisms, due to the increasing risk of <b>disease spread</b> as a result of climate change and other factors.	Now and ongoing
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	Now and ongoing
	Support the NHS in delivering on its Net Zero plan.	Now and ongoing
	Take an active role in climate policy development that also has <b>health benefits</b> , such as active travel, access to green space, air quality, better buildings and healthier diets.	Now and ongoing
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing

Table A12 Recommendations for the Home Office and the Ministry of Justice (MoJ)		Timing
	For the coming five-year period (2023–2028), MoJ should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Home Office, BEIS, DWP, DfE and MHCLG, should develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.	2021 Priority recommendation
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	2021-22
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing

Table A13 Recommendations for the Ministry of Defence (MoD)		Timing
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	2021-22
	Assess the potential for <b>alternative fuels</b> (such as low-carbon electricity, hydrogen or bioenergy) to be used for land vehicles, ships and aircraft, and consider opportunities to support wider use of low-carbon technologies in civil applications (e.g. through research or demonstration).	Now and ongoing



Table A14 Recommendations for the Office of Gas and Electricity Markets (Ofgem)		Timing
	<p>Continue to support widespread deployment of <b>EV charging infrastructure</b>:</p> <ul style="list-style-type: none"> <li>This should ensure it can support high EV uptake levels. Project Rapid has the right ambition for the strategic road network and should be developed into a full strategy for the 2020s and beyond.</li> <li>Further investment is needed to support on-street and other urban charging solutions for those without off-street parking and destination charging.</li> <li>Around 150,000 public charge points will need to be operating by 2025. These should be widely available across all regions of the UK.</li> <li>Implement the recommendations of the EV Energy Taskforce, in particular improving the consumer charging experience and making smart-charging accessible, appealing and cost-effective for as many EV users as possible.</li> </ul>	Now and ongoing <b>Priority recommendation</b>
	Ensure all regulatory decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Develop mechanisms for strategic investment in coordination with BEIS to ensure that <b>electricity networks</b> can accommodate increased future demand levels, including large localised demand increases associated with electrification in manufacturing, transport and buildings, and that lack of network capacity does not cause delays in emissions reduction.	2023
	Start a programme of research with BEIS to identify <b>areas which are unlikely to be suitable for hydrogen</b> (such that electrification and alternatives can be prioritised), <b>alongside priority candidate areas for hydrogen</b> . Distribution Network Operators should gather and share detailed information on network capacity (at least to substation level) to feed into this.	2021
	Set out reforms to encourage the <b>utilisation of existing network capacity</b> and ensure that costs of local network upgrades are shared fairly and do not disincentivise the roll-out of low-carbon technologies.	2021
	Work in partnership with BEIS to publish and implement a new <b>Smart System Plan and Energy Data and Digitalisation Strategy</b> , including working with DCMS on cyber-security, in order to continue to unlock the full benefits of electricity system flexibility. Ensure that, alongside smart standards for heating, all electricity users have access to half-hourly metering and the option of tariffs that encourage flexibility in use of electric heat and electric vehicle charging.	2021
	Develop (with BEIS) a strategy to coordinate the development of <b>interconnectors</b> , connections for offshore wind farms and the enhancement of inter-area transfer capacity for the onshore network, ensuring cost-effective, timely delivery, bringing forward any legislation necessary to enable it.	H1 2022
	Work with BEIS to make explicit how current and future policies will reduce emissions associated with <b>methane leakage</b> from the gas networks in a way that is consistent with the Sixth Carbon Budget.	2021

Table A15 Recommendations for the Water Services Regulation Authority (Ofwat)		Timing
	Ensure all regulatory decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Include <b>decarbonisation</b> as one of Ofwat's core principles, to assist the water industry's goal of decarbonising by 2030, and the need to roll out advanced anaerobic digestion systems.	2021
	Work with Defra, the Environment Agency and other stakeholders to set out targets and supporting measures for <b>reducing water use by business</b> . This could be through ensuring that any water reduction targets linked to the Environment Bill include business as well as household water use as well as responding to advice and recommendations from Defra's new Senior Water Demand Reduction Group.	2022

Table A16 Recommendations for the Office for National Statistics (ONS)		Timing
	Review plan for improving <b>data collection</b> and statistical reporting for the purposes of monitoring and informing the low-carbon transition, as part of the broader work the ONS are already undertaking to improve the collection of climate-related data.	2022
	Work with BEIS to put in place plans to collect and report data annually on <b>low-carbon heat networks</b> , specifically, the amount of heat delivered (split by DUKES consumption sector, i.e. Residential/Public/Commercial/Industry, and where possible, by source of heat supply).	2022
	Improve the collection and reporting of <b>industrial decarbonisation data</b> to allow for progress to be monitored more effectively, particularly on energy and resource efficiency.	2022



**Table A17**  
Recommendations for the Scottish Government

Timing

Scale up delivery across all sectors in line with the ambition set out in the recent <b>Climate Change Plan Update</b> .	Now and ongoing
<p>Publish the finalised <b>Heat in Buildings strategy</b>.</p> <ul style="list-style-type: none"> <li>This must include finalising the regulatory framework and role of different trigger points (including area-based plans), and setting in train the legislation needed to underpin these.</li> <li>Consult on the trajectory of reform for metrics such as EPCs, to ensure they are robust and enforceable, fit for purpose to deliver the measures needed on a holistic basis, do not disincentivise low-carbon heat, integrate in-use performance metrics from 2023, and include plans for the future role of Green Building Passports.</li> <li>Provide further detail on the ambition for heat networks and heat pumps over the coming decade, and determine how funding for energy efficiency and low-carbon heat will be allocated to meet strategic priorities.</li> </ul>	2021
Proposals in Scotland's Updated Climate Change Plan 2018-32 to set out a <b>route map for agricultural transformation</b> should be scaled up, with the development of environmental conditionality that incentivises emission reduction and carbon sequestration measures in the land sector that build towards Scotland's climate goals. It is essential that appropriate incentives are in place to drive early action, given the time (often decadal) needed for some measures to reduce and sequester carbon (e.g. afforestation and peat restoration).	2021
<p>Renew efforts to improve <b>recycling and resource efficiency</b>, including by:</p> <p>Bringing forward the planned circular economy package for legislating within the forthcoming Programme for Government.</p> <p>Putting in place the policy and support to ensure the 2025 targets (including the 70% recycling target) within the package are delivered, and setting new ambitious targets for 2030.</p> <p>Legislating to ban key biodegradable waste streams going to landfill from 2025, and ensuring this is delivered through increased resource efficiency and recycling.</p>	2021
<p>Publish a strategy setting out how the Scottish Government will achieve a 20% reduction in <b>car-kilometres</b> by 2030 and deliver 20-minute neighbourhoods. This should be supported by:</p> <p>Continuing to strengthen schemes to support walking, cycling, and public transport.</p> <p>Investment in infrastructure connectivity to lock in positive behavioural changes that reduce travel demand (e.g. home-working).</p> <p>Supporting the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.</p>	2021
Continue to support the expansion of Scotland's <b>public EV charge point network</b> , to ensure the EV transition works for all road users in Scotland.	Now and ongoing
Maintain the provision of <b>interest-free loans</b> for EVs (now including second-hand EVs) on top of existing UK government grants. Plan for a transition to fiscally-neutral incentives as EV costs fall.	2021-22
Taxation should be used, alongside improvements in broadband, to <b>embed positive behaviours</b> that have arisen during the pandemic, replacing business travel with videoconferencing and online collaboration.	2021-22
Seek to address price imbalances between aviation and surface transport, once <b>aviation taxation</b> is devolved to Scotland, encouraging the low-carbon alternative (e.g. rail) for journeys where one exists.	2021-22
Play a leading role in decarbonising the <b>shipping</b> sector by exploring opportunities to transition ferries operated by Transport Scotland to low-carbon energy and establishing appropriate business models to encourage their adoption.	Now and ongoing

Table A18 Recommendations for the Welsh Government	Timing
Publish a new <b>Net Zero Delivery Plan</b> that sets out a long-term vision for meeting the Net Zero goal in 2050, with a particular focus on the Third Carbon Budget and beyond.	2021
Publish a coherent, <b>long-term strategy for heat and energy</b> efficiency in Welsh homes and other buildings, setting a framework for progress in areas of devolved responsibility.  As part of this, energy efficiency policy should be designed so as to ensure that funds go as far as possible in reducing the fuel poverty gap and improving the energy efficiency of homes, by focusing on the most cost-effective interventions (including upgrading homes to EPC B and EPC C where applicable).	2021
Deliver on the priorities set out in Llbwyr Newydd to <b>reduce demand for higher-carbon travel</b> . This includes: <ul style="list-style-type: none"> <li>• Delivering a better, more integrated, decarbonised bus system.</li> <li>• Developing a network of connected local routes for walking and cycling.</li> <li>• Investing in infrastructure connectivity to enable delivery of the ambition for 30% of the workforce to work remotely on a regular basis.</li> <li>• Supporting the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.</li> </ul>	2021-22
Support delivery of a <b>charging network</b> that meets the ambition set out in the Electric Vehicle Charging Strategy, to ensure the EV transition works for all road users in Wales.	Now and ongoing
The Welsh Government's second statutory decarbonisation plan (LCDP2), due out later this year, should set out policies to <b>accelerate afforestation rates</b> to deliver its share of the UK target to plant 30,000 hectares in 2025.	2021
Build on strong progress made on <b>recycling and resource efficiency</b> , including by: <ul style="list-style-type: none"> <li>• Implementing the policies set out in the recent 'Beyond Recycling' strategy.</li> <li>• Legislating and progressing towards the existing 70% recycling target, and set new ambitious targets for 2030.</li> <li>• Legislating to ban key biodegradable waste streams going to landfill from 2025, and ensuring this is delivered through increased resource efficiency and recycling.</li> </ul>	2021

Table A19 Recommendations for the Northern Ireland Executive	Timing
Legislate a credible <b>long-term emissions reduction target</b> that is backed up by evidence on its deliverability and a clear plan for how it can be achieved in a way that is fair for Northern Ireland's citizens – the Committee previously advised that an 82% reduction on 1990 levels by 2050 is Northern Ireland's appropriate contribution to the Paris Agreement and the UK Net Zero goal.	2021-22
Publish a final energy strategy that sets out how Northern Ireland will achieve a <b>net-zero-carbon energy system</b> by 2050, in line with the pathways recommended in our December 2020 advice.	2021
<p>Publish a coherent, <b>long-term strategy for heat and energy efficiency</b> in Northern Ireland's homes and other buildings; encompassing regulatory, policy and funding commitments to facilitate delivery.</p> <ul style="list-style-type: none"> <li>• The strategy should include a trajectory of regulatory standards for energy efficiency, supported by reforms to relevant metrics (such as EPCs) to ensure they drive the measures needed on a holistic basis and do not disincentivise low-carbon heat. Reforms should ensure metrics are robust and enforceable such that standards targeted are achieved in practice.</li> <li>• Publish proposals on the phase-out of fossil fuel heating, including standards to phase out the installation of new liquid and solid fossil fuel heating. Proposals should recognise the critical role of heat pumps and hybrid heat pumps in these homes, minimising the use of biofuels to reflect economy-wide needs.</li> </ul>	2022
Consult on an ambitious trajectory of <b>new-build standards</b> uplifts, including ensuring all new homes are designed for a changing climate, are ultra-efficient and use low-carbon heating from 2025.	2021
Set out provisions to integrate a <b>post-CAP framework</b> that helps the land sector contribute to Northern Ireland's climate goals as soon as the climate legislation is introduced. This should include providing incentives for landowners and tenants to deliver low-carbon farming practices and change the use of land to reduce emissions and increase carbon sequestration.	2022
<p>The Northern Ireland Executive should bring forward a <b>resource efficiency package</b> which matches the ambition of Wales and Scotland, including by:</p> <ul style="list-style-type: none"> <li>• Setting a target for 70% recycling across all wastes by 2030.</li> <li>• Policies to deliver such a target, as well as improving waste prevention and re-use.</li> <li>• Legislating to ban key biodegradable waste streams going to landfill from 2025, and ensuring this is delivered through increased resource efficiency and recycling.</li> </ul>	2022
<p>Strengthen support for and provision of schemes to support <b>walking, cycling and public transport</b> to reduce Northern Ireland's high levels of car-dependence:</p> <ul style="list-style-type: none"> <li>• Strengthen schemes to ensure access to local amenities without dependency on cars.</li> <li>• Invest in infrastructure connectivity to lock in positive behavioural changes that reduce travel demand, e.g. home-working.</li> <li>• Support the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.</li> </ul>	2021-22
Support the deployment of <b>public charge points</b> across Northern Ireland, to address the issue that Northern Ireland currently has the fewest EV charge points per capita of any of the UK nations.	Now and ongoing
Resume collecting and publishing <b>data on vehicle-kilometres</b> travelled by mode in Northern Ireland. This will help identify which actions are effective in encouraging modal shift away from car travel.	2021-22
<b>Long-haul air passenger duty</b> , which is devolved to Northern Ireland, should be increased at least in line with UK-wide long-distance APD, to better reflect the climate change impact of flying.	2021-22

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# June 2021

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Progress in reducing emissions – 2021 Report to Parliament  
Climate Change Committee

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London SW1H 0ET

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June 2021

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# Progress in adapting to climate change

## 2021 Report to Parliament



Progress in adapting to climate change  
2021 Report to Parliament

Climate Change Committee  
June 2021

Presented to Parliament pursuant to Section 36(1) and Section 59 (1) of the Climate Change Act 2008. This report is published in two volumes. Volume 1 (Progress in reducing emissions – 2021 Report to Parliament) and Volume 2 (Progress in adapting to climate change – 2021 Report to Parliament).

Both volumes were laid before Parliament on 24 June 2021 and are available online at:  
[www.theccc.org.uk/publications](http://www.theccc.org.uk/publications)

Book 2 of 2

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# Joint Foreword

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The UK's Climate Change Act had extraordinary foresight. It laid the groundwork for the nation's escalating climate ambition. It anticipated, correctly, the need to cajole governments into climate plans that would not otherwise fit the political cycle. It has kept UK climate policies rooted in the scientific realities and the technical feasibilities.

That framework now faces its sternest test, as demand grows to see Net Zero delivered; as the urgency becomes more obvious; and as the inadequacies of our planning for the impacts of climate change become clear.

The rigour of the Climate Change Act helped bring COP26 to the UK, but it is not enough for Ministers to point to the Glasgow summit and hope that this will carry the day with the public. Leadership is required, detail on the steps the UK will take in the coming years, clarity on tax changes and public spending commitments, active engagement with people and businesses across the country. These steps are essential, so people can see opportunity in climate-positive choices. We cannot rely on good will alone.

This demands a step change in Government action, but it is hard to discern any comprehensive strategy in the climate plans we have seen in the last 12 months. There are gaps and ambiguities. Climate resilience remains a second-order issue, if it is considered at all. We continue to blunder into high-carbon choices. Our Planning system and other fundamental structures have not been recast to meet our legal and international climate commitments.

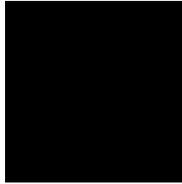
We commend Ministers for accepting our advice on the future path for UK emissions. The setting of the UK's 2030 NDC, the passing into law of the Sixth Carbon Budget, the decision to bring international aviation and shipping emissions within the UK carbon budgets; all were made on the Committee's recommendation. But the Committee's advice to step-up the ambition and resourcing of adaptation continues to go unheeded. And the willingness to set emissions targets of genuine ambition contrasts with a reluctance to implement the realistic policies necessary to achieve them.

It has therefore been a year of climate contradictions. Important statements of ambition, like the agreement to phase out the sale of petrol and diesel cars and vans, have been undermined by delays to essential legislation and much-needed plans to decarbonise buildings and improve their climate resilience. We await a Treasury Net Zero Review, once promised in autumn 2020. The transport decarbonisation plan is still slated, somewhat optimistically, for spring 2021. A pattern has emerged of Government strategies that are later than planned and, when they do emerge, short of the required policy ambition.

There is still time to address this. This Progress Report offers more than 200 policy recommendations, covering every part of Government. The opportunity to implement them is there. Before COP26, a Net Zero Strategy is promised, which will carry the greatest weight if it is accompanied by Treasury's review of funding. The Government's climate change risk assessment, due in early 2022, can change the tone on adaptation and climate risk management. But it is time for the Government to implement these changes with the urgency that the science demands.

COVID-19 casts a long shadow, but there are three broad lessons from the pandemic: first, we have seen the critical importance of effective planning for high-impact eventualities; second, we have experienced the ability of government to act with pace and scale when it is required; and third, we have learned that people are willing to support change when they have the information before them.

These lessons can shape a successful COP26 summit in November. With strong climate plans at home, the UK Presidency can have global influence. Our message to Government is simple: act quickly – be bold and decisive. Your moment has arrived.



Lord Deben  
Chairman, Climate Change Committee



Baroness Brown  
Chair, Adaptation Committee

# Overall progress in climate policy: Net Zero and adaptation

The 2020s must be a decisive decade for climate action.

We are in the decisive decade for tackling climate change. Global emissions of greenhouse gases are as high as they have ever been. Nevertheless, green shoots of progress suggest this can change. And it must. The 2010s was the hottest decade on record globally, driving dangerous weather patterns and affecting societies and ecosystems around the world. Without a much stronger and urgent effort, we will breach 1.5°C of warming in the early 2030s and remain ill-prepared for the future.

The world needs to cut emissions and adapt to climate risks.

Global emissions must be cut rapidly to Net Zero, integrated with actions to adapt to the climate risks and impacts. Action must occur across the world, with richer countries acting earliest, while offering support for poorer countries. As host of the upcoming UN climate talks ('COP26') the UK has a particular responsibility to implement effective climate action and drive global efforts.

The UK's record to date is strong in parts, but it has fallen behind on adapting to the changing climate and has not yet provided a coherent plan to reduce emissions in the critical decade ahead:

The UK has a strong track record on climate action, but it is incomplete.

- **Statutory framework for climate.** The UK has a strong climate framework under the Climate Change Act (2008), with legally-binding emissions targets, a process to integrate climate risks into policy, and a central role for independent evidence-based advice and monitoring. This model has inspired similar climate legislation across the world.
- **Emissions targets.** The UK has adopted ambitious territorial emissions targets aligned to the Paris Agreement: the Sixth Carbon Budget requires an emissions reduction of 63% from 2019 to 2035, on the way to Net Zero by 2050. These are comprehensive targets covering all greenhouse gases and all sectors, including international aviation and shipping.
- **Emissions reduction.** The UK has a leading record in reducing its own emissions: down by 40% from 1990 to 2019, the largest reduction in the G20, while growing the economy (GDP increased by 78% from 1990 to 2019). The rate of reductions since 2012 (of around 20 MtCO<sub>2</sub>e annually) is comparable to that needed in the future.
- **Climate Risk and Adaptation.** The UK has undertaken three comprehensive assessments of the climate risks it faces, and the Government has published plans for adapting to those risks. There have been some actions in response, notably in tackling flooding and water scarcity, but overall progress in planning and delivering adaptation is not keeping up with increasing risk. The UK is less prepared for the changing climate now than it was when the previous risk assessment was published five years ago.
- **Climate finance.** The UK has been a strong contributor to international climate finance, having recently doubled its commitment to £11.6 billion in aggregate over 2021/22 to 2025/26. This spend is split between support for cutting emissions and support for adaptation, which is important given significant underfunding of adaptation globally. However, recent cuts to the UK's overseas aid are undermining these commitments.

The UK's record on climate change compares well with that of other countries. But despite the recent willingness of the Government to raise ambition to cut emissions, delays in policy and implementation continue. Much greater urgency is now required from Ministers:

Delivery must accelerate and broaden.

- **The ambition of the last year must be turned into policy and real-world delivery.** The UK has begun to reinforce its new emissions targets with clear ambition for specific sectors in line with the required path (e.g. 40 GW offshore wind by 2030, phase-out of petrol and diesel cars and vans by 2030, 30,000 hectares annual afforestation by 2025). However, some commitments fall short and key strategies have been delayed, leaving holes in ambition. Policies to deliver on the commitments are mostly still to be developed.
- **Progress must extend across the economy.** The relative success of reducing emissions in the electricity sector to date has not been matched in transport, buildings, industry, or agriculture. Only a few sectors have strong plans to adapt to the current and future climate, leaving key risks to the UK's infrastructure and natural environment. Some government departments are not sufficiently prioritising climate change, and none are yet moving at the pace required.
- **A robust plan is needed for adaptation.** The UK does not yet have a vision for successful adaptation to climate change, nor measurable targets to assess progress. Not one of the 34 priority areas assessed in this year's progress report on adaptation is yet demonstrating strong progress in adapting to climate risk. Policies are being developed without sufficient recognition of the need to adapt to the changing climate. This undermines their goals, locks in climate risks, and stores up costs for the future.
- **The climate challenge must be reflected throughout policy and planning.** Climate risks affect all aspects of society, while any new source of emissions could put the Net Zero path at risk. Climate change must therefore be integrated throughout policy and planning decisions, and must be a key consideration in the Government's proposed planning reforms.

Adaptation policy needs a step change in ambition and action.

As the UK rebuilds after the COVID-19 pandemic, there is an opportunity to make systemic changes that will fill the gaps in the UK's climate response. Now is the time to invest in the UK's future through accelerated action to cut emissions and adapt to the changing climate, while supporting the global transition.

The Net Zero Strategy, due ahead of COP26, should complete the picture on how the UK will cut its emissions.

- **Delivering Net Zero.** The Government has promised a Net Zero Strategy before COP26. It must set clear and integrated ambitions across the economy that will meet the Sixth Carbon Budget, and indicate how they will be funded fairly. Efforts must then shift quickly to focus on implementation and delivery. The pace of policy development must accelerate. Credible policies should be fully functioning and properly funded by the end of the current Parliament (i.e. by 2024) to ensure that almost all investments and purchases are low-carbon by the end of the decade or soon after.
- **Adapting to climate risks.** The Government should set out its vision for a UK that is well-prepared for climate change. It should include clear quantified targets, supported by policies and regulations. Climate adaptation must be embedded in core policies if they are to succeed. Key current and upcoming policies include: the Plan for Growth, the National Infrastructure Strategy, the Environment Bill, the Environmental Land Management

Scheme, the Tree and Peat Action Plans, the Net Zero Strategy, the Planning Bill and developments in energy, housing and health policy.\*

Adaptation is vital to achieving society's goals and must be embedded throughout government policies.

- **Integrating climate policy.** Achieving Net Zero will require effective adaptation. The programmes must be properly integrated. For example, as the energy efficiency of buildings is improved, they must also be protected from overheating. The vast carbon stores of the UK's peatlands and soils must be protected. Trees planted to draw CO<sub>2</sub> from the atmosphere and/or to provide timber should be suited to the future climate and, where possible, provide services such as flood defences, enhancing ecosystems, urban cooling, and accessible green space.
- **Embedding climate action across society.** Reducing emissions and adapting to climate change will require a whole-of-society endeavour. Success will require the public to be engaged in the challenge, building public consent for the changes with a broader understanding of what is required and why. Workers will need help to develop the required skills and to fill the jobs created during the transition. Businesses must be encouraged, and in some cases required, to invest in solutions and make low-carbon, climate-resilient choices.
- **Reinstating overseas aid commitments.** Climate challenges are fundamentally integrated with wider challenges for ecosystems and economies. This means climate finance and climate action are not fully isolated from cuts to the UK's Official Development Assistance (ODA) in practice. The Government has said the cut to ODA is temporary; now that the UK's economic recovery is underway, the Government should provide a firm timeline for reinstating its previous commitment.

Government must lead the change. Reducing emissions and adapting to climate change must be embedded throughout policy. All parts of government have a role, requiring strong coordination and an effective devolution of powers and responsibilities to drive delivery. We set out detailed recommendations for each government department and the national Governments of Scotland, Wales and Northern Ireland in an annex of Tables at the end of this report. We will revisit progress against them at our next annual progress report in a year's time. Our next major report will be a thorough appraisal of the UK's Net Zero Strategy.

Reaching Net Zero and addressing climate risks can help to build a better UK.

The transition to Net Zero and the climate adaptation programme offer a positive vision for the UK's future and for the world. They involve an investment boost that can support the economic recovery. This investment will be rewarded with reduced running costs and reduced costs of adapting to climate change in the future. It will support good-quality new jobs across the country, and bring opportunities to enhance our natural environment, our health and our well-being.

The UK can and should be a global leader on climate change.

The challenge of responding to climate change will not end with COP26 in the autumn or with the completion of the UK Presidency a year later. Global commitments are increasingly moving into line with the Paris Agreement, but we have entered a critical decade of action to consolidate and to deliver them. UK action must continue to provide an attractive model of success to maintain our climate leadership in support of a global response that meets the global challenge.

\* Some of these UK policies only cover England. Equivalent devolved policies must also reflect climate change.

# The Committee



**Baroness Brown of Cambridge DBE FRS**  
Chair, Adaptation Committee

Baroness Brown of Cambridge DBE FREng FRS (Julia King) is an engineer, with a career spanning senior engineering and leadership roles in industry and academia. She currently serves as Chair of the CCC's Adaptation Committee; non-executive director of the Offshore Renewable Energy Catapult; and Chair of the Carbon Trust.



**Professor Michael Davies**

Michael Davies is Professor of Building Physics and Environment at the UCL Institute for Environmental Design and Engineering (IEDE). At UCL his research interests relate to the complex relationship between the built environment and human wellbeing. He is also Director of the Complex Built Environment Systems Group at UCL and a member of the Scientific Advisory Committee of 'Healthy Polis'.



**Professor Richard Dawson**

Richard Dawson is Professor of Earth Systems Engineering and Head of Water in the School of Engineering at Newcastle University. Over the last two decades his research has focused on the analysis and management of climatic risks to civil engineering systems, including the development of systems modelling of risks to cities, catchments and infrastructure networks.



**Ece Ozdemiroglu**

Ece Özdemiroğlu is an environmental economist and the founding director of eftec (Economics for the Environment Consultancy). Her work uses economic value evidence for natural capital and applies this evidence in accounting and appraisal. Ece is also the convenor of the British Standards Institution's Assessing and Valuing Natural Capital Committee who wrote the BSI8632 on Natural Capital Accounting for Organizations. She is Associate Editor of the Journal for Environmental Economics and Policy and a Fellow of the RSA.



**Rosalyn Schofield LLB**

Rosalyn Schofield is a solicitor. She was Director of Company Secretariat at Associated British Foods plc, where she had global responsibility for the environmental sustainability and impact of the business. Rosalyn is also a Council Member of the University of Hull and Chair of the Audit and Risk Committee there as well as at the CCC. She has previously worked as Legal Director at JD Wetherspoon plc and was a commercial property lawyer in private practice.

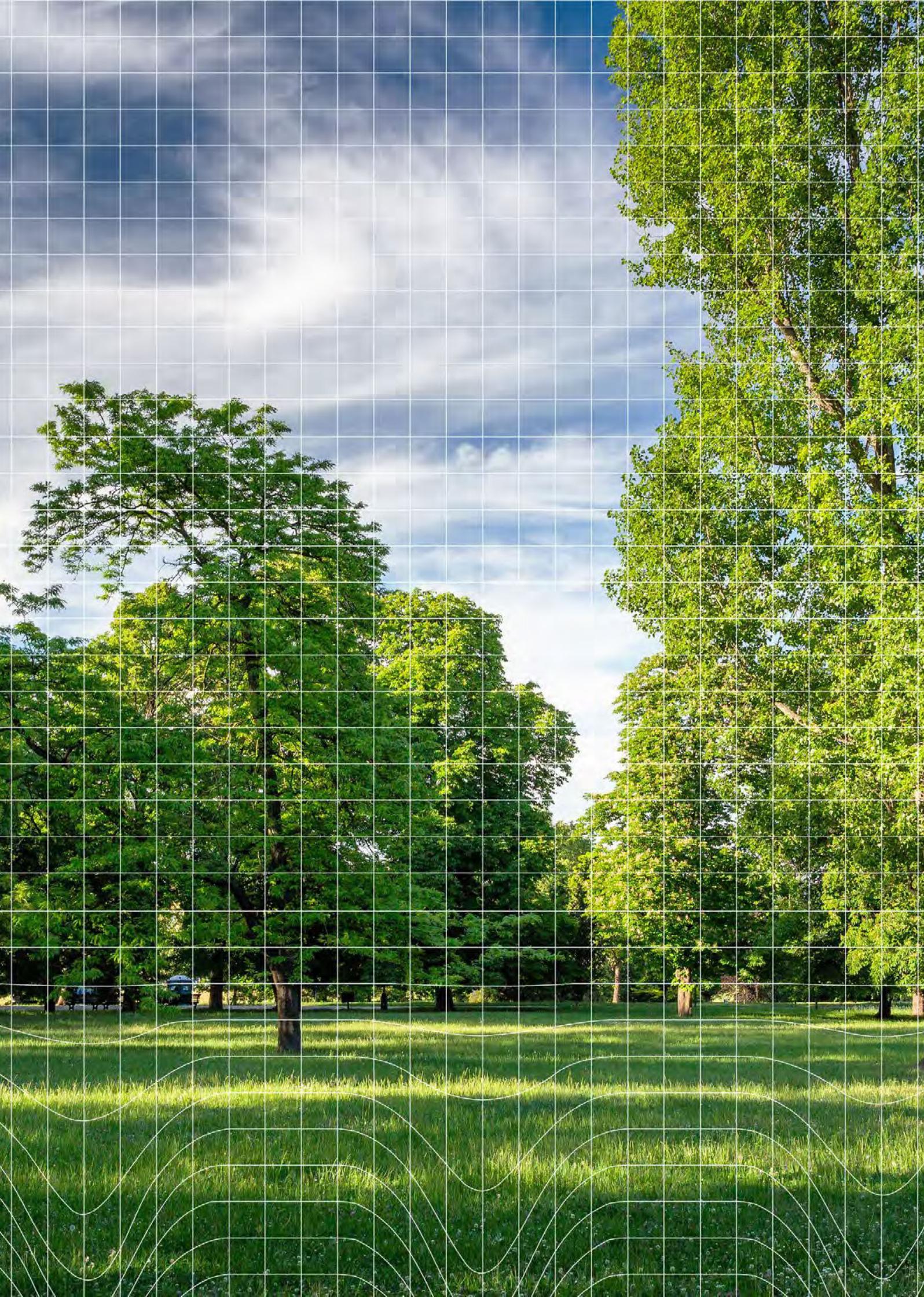


**Professor Kate Jones**  
Expert Adviser to the Adaptation Committee

Kate is Professor of Ecology and Biodiversity at University College London. Her work focuses on crossing disciplinary boundaries to address critical global challenges, especially at the interface of ecological and human health. Professor Jones has made key advances in monitoring the status and trends in biodiversity and particularly in modelling and forecasting zoonotic disease outbreaks in humans (Ebola, SARS), breaking down traditional barriers between ecology, climate change and public health to inform global policy.

# Executive Summary

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**Climate change impacts are increasing, but the UK Government's National Adaptation Programme has not delivered the necessary improved resilience to the changing climate as was intended under the UK Climate Change Act.**

As the UK enters its third statutory cycle of national risk assessment and adaptation planning, it is essential that the Government is more ambitious in the forthcoming 3<sup>rd</sup> National Adaptation Programme, with a comprehensive set of actions linked to the efforts for economic recovery from the Covid-19 pandemic and to the levelling up agenda. This is critical if country is to realise a resilient recovery from coronavirus and deliver on key policies including Net Zero.

The Government should set a clear vision for a well-prepared UK, and back that with quantifiable targets to embed adaptation in policies across the natural environment, planning, infrastructure, homes and transport as they advance in the coming 12 months and beyond.

This report follows our advice on the CCRA3 Independent Risk Assessment and focusses on adaptation implementation in England. We set out eight key messages (Box ES.1), and make 50 specific recommendations to improve progress, ten of which are joint adaptation/ mitigation recommendations that are also included in the Mitigation Progress Report.

**Box ES.1**

**The Committee's key messages on adaptation progress**

- The global and UK climate will continue to change out to mid-century at least.
- Warming at much higher levels than a 2°C increase in global temperature remain possible in the second half of the century.
- The National Adaptation Programme has not developed national preparedness for a 2°C rise in global temperature, let alone higher levels of warming.
- Our assessment shows limited changes in progress scores since 2019. Adaptation needs to be integrated into a range of key policies before the next National Adaptation Programme is published in 2023. There are signs of improvement across a number of sectors that if continued, could help to achieve this.
- The Government needs to reinstate support services and resourcing for local adaptation action.
- There are no actions in the National Adaptation Programme to respond to the risks to the UK from climate change overseas. As we stated in our last report and in our advice on the CCRA, these risks need to be included in the next Programme due in 2023.
- The next 12 months will be important for making improvements to how we measure and monitor adaptation in the UK. Global interest in monitoring and evaluation is growing in the run up to COP26 - with a focus on the UK's approach. To be world-leading, Government needs to resource new work to improve existing datasets and identify and create new ones.
- The UK is entering its third cycle of risk assessments and National Adaptation Plans. The third iteration of the National Adaptation Programme must be more ambitious; more comprehensive; and better focussed on implementation than its predecessors, in order to improve national resilience to climate change.

Below, we set out our eight key messages in more detail, drawing on the analysis in this report.

## The global and UK climate will continue to change out to mid-century at least

**Global temperatures are now around 1.2°C above pre-industrial levels, with the UK showing a similar change.** The world is currently warming by around 0.25°C per decade due to human emissions of greenhouse gases. Globally, the six most recent years (2015 to 2020) have been the hottest years on record. In England, episodes of extreme heat are becoming more common, rainfall patterns are changing, and sea level is rising.

**Even with ambitious global efforts to reduce greenhouse gas emissions, further climate change is inevitable.** With these changes will come increasing climate impacts from a wide range of weather hazards: more and stronger heatwaves, flooding, drought, wildfire, and potential changes to storms and wind patterns. The following changes are expected by 2050 relative to a 1981-2000 baseline:

- Warmer and wetter winters. Average winter temperatures are projected to increase by around 1°C and rainfall by +5% (central estimates), with an uncertainty range of up to 2.5°C warmer and 20% wetter. Increasing winter rainfall intensity will increase the risks of flash flooding.
- Drier and hotter summers. Average summer temperatures are projected to increase by 1.5°C and rainfall to decrease by 10% with an uncertainty range of up to 3°C hotter and 30% drier. Summer rainfall, when it occurs, will be more intense increasing the risk of flooding; and hotter summers will increase the risk of excess deaths and affect productivity.
- Continuing sea level rise, of around 10-30 cm with possible rises extending up to 30 – 40 cm across the UK. Depending on the location in the UK, this will increase the risks of coastal flooding under extreme high tides, and affect the functioning of coastal infrastructure.

## Warming at much higher levels than a 2°C increase in global temperature remain possible in the second half of the century

**Climate commitments are strengthening but global warming of up to 4°C above pre-industrial levels by 2100 cannot yet be ruled out.** The Paris Agreement aims to keep global temperature increase to well below 2°C above pre-industrial levels, and ideally to 1.5°C. Recent pledges from national governments to reduce greenhouse gas emissions are closing the gap to the Paris goal but are not yet ambitious enough to meet it. Furthermore, policies are generally not yet in place to meet the pledges that have been set and are expected to only hold global emissions approximately flat over the next decade. This level of ambition, if not strengthened would imply reaching around 3°C of global warming above pre-industrial levels by 2100, with a warming of around 4°C above pre-industrial levels by 2100 still possible due to climate response uncertainty.

## The National Adaptation Programme has not developed national preparedness for a 2°C rise in global temperature, let alone higher levels of warming

**Government action has been inadequate to drive progress in most areas.** This report highlights some areas where there has been progress.

These areas tend to be where Government has intervened and taken a leading role, such as producing a National Floods Strategy, mandating reporting under the Taskforce on Climate-Related Financial Disclosure (TCFD) or setting clear planning requirements for the water sector. However, in most areas there has not been equivalent action, both from Government and other stakeholders like business and the third sector. There are various barriers preventing adaptation in these sectors such as gaps in awareness about the risks, the presence of externalities and missing markets, financial constraints and various behavioural barriers.

**The gap between future levels of risk and planned adaptation has widened in the last 5 years.** Neither the first nor second iteration of the National Adaptation Programme (published in 2013 and 2018 respectively) has delivered a minimum level of resilience to current and inevitable climate change. The Committee's recent advice to Government on the third UK Climate Change Risk Assessment highlights that over half (56%) of the risks have been given the highest urgency score, signalling that more action is needed than is currently planned for. In contrast, only around one third (36%) of the risks were given the highest urgency score in the 2016 assessment.

**Planning for 2°C and consideration of 4°C warming is still not happening.** Our detailed assessment of progress in England presented in this report shows that planning for 2°C and consideration of 4°C warming is still not happening in 27 of the 34 adaptation priorities considered; the exceptions being the infrastructure sectors with high plan scores shown in Figure ES.1 below (flood and water management, road, rail, energy and the design of new critical infrastructure).

**The UK is leading in diagnosis but lagging in policy and action.** The UK has world-leading climate science expertise. But this record is not matched in policy ambition and implementation. We have good evidence on future climate risks, good evidence on the importance of prudent risk planning and good evidence on the benefits of UK adaptation. In the wake of the Covid-19 pandemic, it has never been clearer that we need robust, well-resourced plans for known risks, however small or distant they seem and even if the decision is not to act at the end.

## Our assessment shows limited change in progress scores since 2019

**Improved assessment scores have been given to only five out of 34 adaptation priorities (Figure ES.1).** The Committee has updated its assessment of the quality of adaptation plans, and actions to reduce risk, using the same framework as our 2019 report and taking into account evidence provided by government and stakeholders.

**No sector achieves the highest risk management score.** We have still been unable to award any sector a high score for risk management which means that vulnerability and exposure to climate change are not being managed appropriately nor in line to meet relevant government goals, such as public health protection or enhancing biodiversity. This remains unchanged from 2019.

Five areas have improved plan scores:

### River and coastal flood alleviation

- The Government published a new, major flood and coastal erosion Policy Statement in 2020 which sits alongside the Environment Agency's updated Flood and Coastal Erosion Risk Management (FCERM) Strategy.

The FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperature for flood and coastal erosion risk.

- Alongside the new plans, significant announcements have also been made to boost investment in flood defence schemes and supporting projects, including £5.2 billion to create around 2,000 new flood and coastal defences for 336,000 properties. There is still a gap in developing a national monitoring and evaluation strategy, but work is underway to consider which metrics should be used to measure progress.

#### **Surface water flood alleviation**

- The new FCERM Strategy has several commitments for the Environment Agency to work with Ofwat, water companies and other Risk Management Authorities to improve resilience to surface water and drainage flood risks and encourage long-term adaptive planning. All Lead Local Flood Authorities (LLFAs) now have published surface water flood management strategies, a key recommendation from our earlier progress reports.

#### **Extreme weather impacts on business**

- There has been significant progress by government in the last two years to help businesses better prepare for the impacts of climate change. There is a new plan for mandatory disclosures for physical risk under the Taskforce on Climate-related Financial Disclosure (TCFD), which will apply to listed and UK-registered companies, banks and building societies, insurers, and some pension schemes.
- In 2022, a further refresh of the Government's Green Finance Strategy is expected, along with the next Bank of England Stress Test which is focussed on climate change risks. The Taskforce on Nature-related Financial Disclosures (TNFD) has launched since our last progress report and aims to serve the same strategic role as TCFD.

#### **Supply chain interruptions**

- The first part of the National Food Strategy has been published and Government has made further commitments to report and develop a better understanding of issues related to food supply chains, including climate change. However, despite an improvement in the plan score, the risk management score for supply chains has dropped (see below).

#### **Commercial fisheries**

- Climate change adaptation was included as one of eight priorities under the Fisheries Act (2020) and requires the Marine Management Organisation (MMO) to set out how this objective will be met. There are currently no specific plans for adapting to a minimum 2°C rise in global temperature, which if/when such plans are published by the MMO could improve the plan score further in the future.

In three cases, scores have become worse since 2019:

#### **Supply chain interruptions**

- Despite some improvements in planning, the score for managing risk has dropped due to the increased evidence since 2019 of greater vulnerability in supply chains than previously estimated. This reflects both the experience of the Covid-19 pandemic and survey evidence showing the high costs of disruptions. The level of adaptation underway has remained roughly the same. Further work on building resilience into supply chains was highlighted as one of the UK's top national priorities in our recent advice to Government on the third UK Climate Change Risk Assessment.

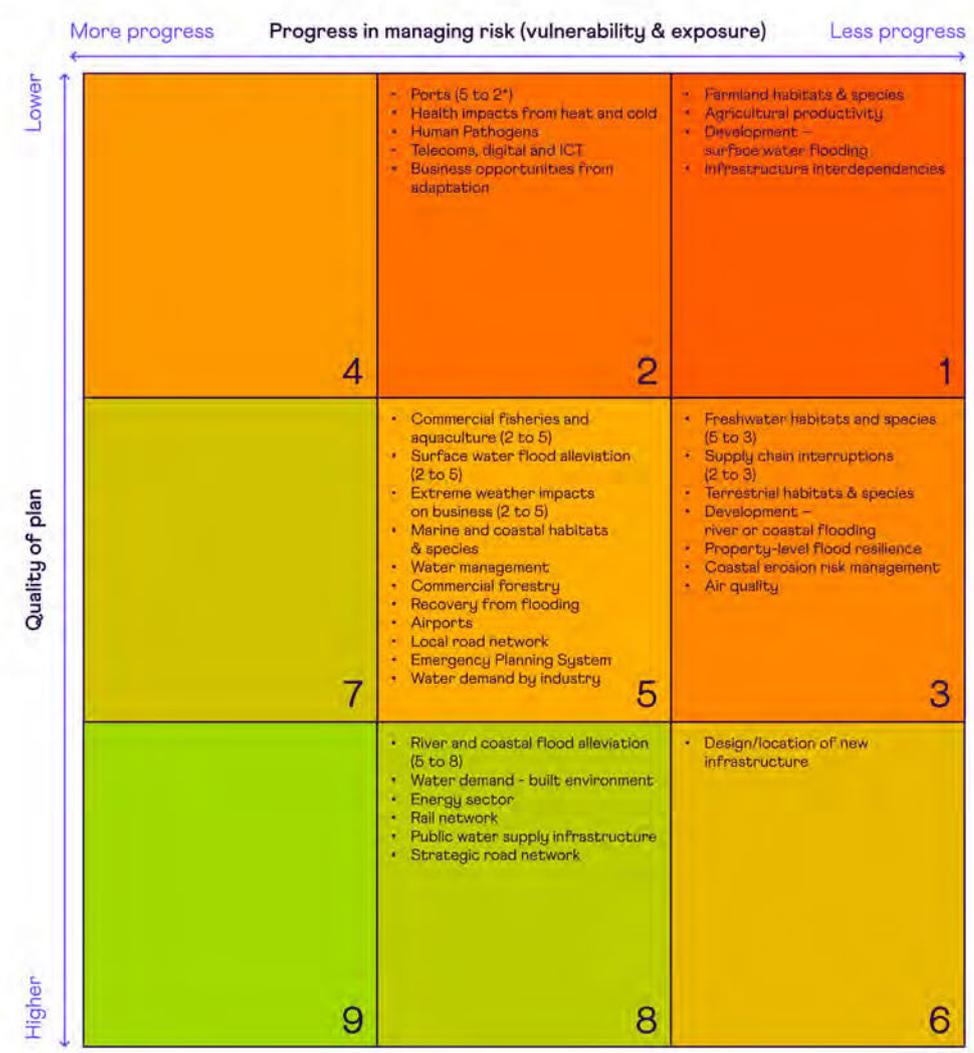
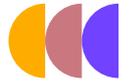
#### **Ports**

- In this assessment we have split out our assessment of airports from ports. This has resulted in a lower plan score for ports. Resilience standards for ports are left to individual operators and due to their commercial nature, there is limited information available on the extent of planning for climate change impacts, and the resulting impacts on the movement of goods. Several ports declined to participate in the last round of the Adaptation Reporting Power and expected participation in the current round is unclear.

#### **Freshwater habitats**

- While general plans to build the resilience of freshwater habitats to climate change are in place, they have had only limited impact on managing pressures on biodiversity to date. Available species metrics indicate that populations are remaining stable, but the long-term declines in the ecological status of water bodies in England persist. Surface water temperatures across England have consistently exceeded their long-term mean in recent decades, yet details on the ongoing revisions to River Basin Management Plans suggest risks from higher water temperatures are still not given sufficient consideration.

Figure ES.1 The Adaptation Committee's scoring of adaptation priorities (2021)



Source: CCC

Notes: Definitions for each of the score boxes are given in Chapter 1. Adaptation priorities where scores have changed since 2019 are highlighted with the change in score provided in brackets.

\*The score for ports has dropped from 5 to 2, but this is due to the splitting of a joint airports/ports priority in 2019 into separate priorities for this report. The level of planning has not changed for ports since 2019.

**The lack of change in scores hides some signs of progress that present opportunities to drive adaptation forward, if adaptation is integrated effectively into policies.**

There are key opportunities for new policies to integrate adaptation over the coming 12 months, in the run up to COP26 and the publication of the Government's next adaptation programme.

In our advice on the Third UK Climate Change Risk Assessment we set out eight risk areas where there are major upcoming policy announcements, and in this report we have highlighted specific policy opportunities for England in more detail:

### Natural environment

- The current overhaul of policies and plans for protecting the natural environment has not yet adequately integrated adaptation. Without this integration, the aims of the Government's 25-Year Environment Plan are unlikely to be met because climate change will reduce habitat condition, soil and water quality and quantity, threatening further the health of ecosystems and the natural environment, which are already in serious decline.
- The Government needs to set outcome-based, long-term targets for widespread habitat restoration, with statutory interim targets to drive the early action that is needed now to improve resilience.
- Actions that reduce vulnerability and exposure to climate change across all environmental public good outcomes\* should be rewarded under the forthcoming Environmental Land Management scheme (ELM). We made a series of recommendations to this effect in 2019. None have been implemented, but it is not too late to do so as policies are still under development.

### Infrastructure

- The National Infrastructure Commission has identified climate change as one of three key challenges for infrastructure resilience. The 2020 National Infrastructure Strategy states that climate change should be fully considered at the design stage and cost-effective adaptation actions should be built in over the whole life cycle of the asset.
- In our advice to Government on CCRA3, we point to the vulnerability of the power system as a key priority for further action now.
- The new UK National Infrastructure Bank, launching in interim form in 2021, is a key component of the National Infrastructure Strategy and can support adaptation through stimulating investment in green infrastructure.
- The Treasury's Supplementary Green Book Guidance (*Accounting for the Effects of Climate Change*) supports analysts and policymakers to identify if and how their proposals could be affected by climate risks and how to design adaptation measures in response.
- The Infrastructure and Projects Authority is working in collaboration with the CCC to incorporate tests for climate change into assurance processes for all projects on the Government's Major Project Portfolio.
- In the water sector, the next round of water company plans will incorporate the latest UK climate projections, and set stricter targets for leakage, aiming for a 50% reduction by 2050.
- In aviation, a new 2050 strategy, consulted on in 2019 but not yet published, is expected to include actions for improving resilience.

\* Environmental public good outcomes refer to the Government's objectives to protect, improve and expand the natural environment to ensure it continues to provide the market and non-market goods and services that are essential to society.

## Health and the built environment

- New housing developments continue to be built without resilience to heat, or a focus on water efficiency and in some cases to flooding, especially from surface water. This is despite the Committee's consistent advice, which has highlighted fundamental gaps in policy since it began to assess these issues ten years ago.
- More information is required to understand the Government's intentions with planning reform and the forthcoming Planning Bill. Some draft proposals (such as the extension of permitted development rights, moving to a single sustainability test that may not adequately take account of climate change mitigation and adaptation, and removing the duty to cooperate) may make adaptation more difficult to achieve.
- A more forward-looking outlook on flood risk is required for new developments. There may be no material increase in present day flood risk from some limited building in the floodplain, but these developments increase exposure in the event of defence breaches and future climate and population changes. If building on the floodplain continues at the current level, the funding required to build and maintain new defences, will continue to rise.
- The planning system is not designed to incentivise 'green' Sustainable Drainage Systems, and some homes are being built in areas at risk of surface water flooding without any expert flood mitigation advice.
- Potential progress on taking steps to manage overheating risk in new residential buildings should come through MHCLG's proposed overheating standard. This proposal is strongly welcomed by the Committee, and now needs to become reality.
- There remains a substantial gap in addressing overheating in existing homes and health and care facilities. There has been better planning for 2°C and 4°C in schools and prisons.
- There are opportunities across multiple policies to improve urban greening including the Environment Bill, updates to National Planning Policy including implementation of biodiversity net gain (if gains are real) and the forthcoming Net Zero Strategy.
- The outcome of the 2019 consultation on measures to reduce personal water use, expected in 2021, presents a key opportunity to introduce more stretching water efficiency targets.

## Business

- Consultations on pension scheme regulations, the future of audit and criteria for public procurement have set out proposals for greater consideration of climate change, which now need to be enacted.
- The new SME Climate Hub offers tools and resources to help small businesses develop their climate strategy and contribute to efforts to reduce UK emissions to Net Zero. There is an opportunity improve promotion and integration of adaptation through this or a similar initiative.
- Stronger assurance is required for the resilience of supply chains, particularly key supply chains such as for food and medical supplies, as part of the Government's new Plan for Growth.

- More should be done to explore how current uses of green finance for adaptation could be replicated or scaled up across regions in England.
- There has been progress in planning for a green recovery in response to the economic impacts from COVID-19. However, the measures announced, such as the Ten Point Plan for a Green Industrial Revolution and the Green Jobs Taskforce, focus almost exclusively on achieving Net Zero and miss out on the opportunities for climate change adaptation. There are good examples to draw on, such as exploring potential revenue streams in areas such as natural capital and resilience, new financial products such as green and sustainability bonds and regional initiatives such as the Greater Manchester IGNITION project. Again, there are still opportunities in the next 12 months to integrate adaptation more fully into these policies.

This list is not comprehensive, but it emphasises the urgency of integrating adaptation into current policy to avoid lock-in and unnecessary future expenditure.

### The Government needs to reinstate support services and resourcing for local adaptation

**Support services need to respond to the needs of business and promote the importance of adaptation alongside achieving Net Zero.** The UK Climate Impacts Programme and subsequently Climate Ready was the lead national adaptation support service for businesses, as well as other sectors, and was responsible for developing tools and guidance before its closure in 2016. This created a gap and lack of assurance that smaller businesses and organisations in particular would be aware of and able to access resources and the latest expertise on climate risk and adaptation. As mentioned above, the new SME Climate Hub aims to provide a 'one-stop-shop' for SMEs to make a climate commitment and access 'best-in-class' tools and resources. It already offers several resources for physical risk and understanding climate impacts, though it should aim to improve integration and promotion of adaptation alongside reducing emissions to Net Zero. It will be important to monitor feedback for the SME Climate Hub and whether action from Government is required to develop resources to ensure the needs of different types of business and organisations are met.

**The Government should ensure that local authorities are properly funded with resources and training available to tackle climate change.** This includes ensuring that local authorities have the capacity to respond to extreme weather events such as flooding; provide clear guidance for how adaptation should be included in development plans; ensure local authorities are properly resourced and have trained personnel to enforce building regulations; and ensure long-term resource budgets are in line with capital investments in flood risk management. Local authorities should have powers to require enhanced building standards in areas where climate impacts are particularly significant – for example higher water efficiency standards in areas with growing populations which will be increasingly drought-prone.

### There are no actions in the National Adaptation Programme in response to the risks to the UK from climate change overseas

**As we stated in our last report and in our advice on the CCRA, the risks to the UK from climate change overseas need to be included in the next National Adaptation Programme due in 2023.**

The urgency of UK action for some overseas climate risks is greater than previously assessed as there is now more evidence on the scale and number of risks as shown in the CCRA3 Technical Report. The majority of these are scored as 'more action needed', including risks to UK food availability, international supply chains, public health and systemic risks from multiple impacts that will cascade across the globe. The Covid-19 pandemic, while not a climate-driven risk, has shown how quickly systemic risks can propagate and affect all aspects of society and the economy.

**The Government needs to include specific actions to manage international climate risks to the UK in the next National Adaptation Programme. These should include:**

- Reviewing the environmental governance and exposure to climate risks in emerging free trade agreements.
- Addressing food access inequality and informing dietary choices, given that the UK imports over 50% of its food. This action would reduce vulnerability to the risk of decreasing nutritional quality of food produced due to climate change
- Increasing the resilience of international trade systems, reducing reliance on long, just-in-time supply chains which are susceptible to shocks
- Real-time monitoring of transmission pathways for emerging diseases, alongside increased surveillance of wildlife, people and other imports; and improvement of public and professional level information
- Planning for increasing unpredictability and the potential for sudden shifts in the climate, which are possible even at lower levels of warming.

**The next 12 months will be important in improving how adaptation is measured and monitored in the UK**

**Global interest in monitoring and evaluation is growing in the run up to COP26 - with a focus on the UK's approach.** Measuring progress is fundamental to understanding whether adaptation is working. The Committee published a set of recommended adaptation indicators in 2019 for Defra to populate, but little has happened to progress this. We have highlighted the following key issues related to metrics in this report:

- The use of habitat condition and species abundance as proxy indicators for the vulnerability of biodiversity to climate change only offers a simplistic assessment of progress. Development of more sophisticated metrics is needed to help inform how ecosystems and biodiversity are responding to climate change, and the components or functions that are most vulnerable, so that adaptation responses can be better focussed. For instance, the use of remote sensing tools will provide new data to improve our understanding of changes in water flow, fractional vegetation cover, impervious surface area mapping and drought predictions based on soil water index.
- For flooding and coastal change, the Government must deliver a well-established monitoring and evaluation framework and national set of indicators to monitor trends and policy impact effectively. Improved indicators need to include data on the uptake and type of sustainable drainage systems being installed both in new build and retrofit.

- While surveillance programmes exist in England for disease vectors such as ticks and mosquitoes, the current level of surveillance should be improved and expanded. The new Health Security Agency provides an opportunity for climate change to be considered in the context of disease spread, expand current surveillance across the UK, and provide suitable indicators to measure vector abundance.
- There is a continuing lack of data on the vulnerability of infrastructure to extreme weather and the steps being taken to manage interdependencies between sectors. When used effectively, the Adaptation Reporting Power (ARP) can present updated risks and adaptation actions, allowing an assessment of preparedness of all infrastructure sectors and their interdependencies. Very few ARP3 reports have been available for this assessment due to a misalignment of timeframes with the CCC's mandatory reporting schedule, and the voluntary nature of the ARP reporting means there is no guarantee of sector-wide coverage. These reports are intended to be a key input to the development of the NAP and the CCRA; but to date it has not been possible to use them effectively in this way.

The Government should resource new work to improve existing datasets and identify and create new ones. Improved understanding of how adaptation actions lead to better outcomes is needed, following the approach set out in the Government's Magenta Book (Guidance for Evaluation). Funding is also needed to support the sustained measurement of relevant indicators like soil health, and to consider how to bring together different organisations and groups that collect data to streamline and share data. In the coming months, prior to COP 26, the CCC would be willing to coordinate this work if requested to do so by Defra, in collaboration with other relevant organisations such as the Office for Environmental Protection.

### **The third iteration of the National Adaptation Programme must be more ambitious; more comprehensive; and better focussed on implementation**

**In this report, we have prioritised what needs to be done by Government in England – and brigaded our climate recommendations by Government Department as an aid to better policy (Table 1).** We stated in 2019 that the country was at risk of becoming complacent on climate change adaptation. Since then, there have been some signs that Government is taking climate change risks more seriously. Adaptation is one of the key themes for COP26, and the Government has appointed a dedicated Adaptation Champion. Some policy milestones have been met, such as spelling out the need for adapting to 2°C and planning for 4°C in the updated Treasury Green Book guidance on appraising policies, projects and programmes; which all departments are expected to follow. But the specific actions that need to be delivered have not taken place in many sectors. Adaptation is not being sufficiently resourced, and must not continue to be the poor relation to climate change mitigation as the Government prepares for the spending review later this year.

Our recommendations for the key actions needed before the publication on the next National Adaptation Programme are shown in below by department.\*

**Table 1**  
The Adaptation Committee's Recommendations for Adaptation

No.	Department	Sector	Recommendation	Timing
1	All (Joint adaptation/mitigation recommendation)	All	Ensure all policy decisions , and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.	Now and ongoing
2	All (Joint adaptation/mitigation recommendation)	All	Review guidance documents used in policy and business case development (e.g. the Green Book) and ensure these are consistent with the requirements of Net Zero and account for the impacts of climate change. Consider options for introducing a Net Zero Test to ensure that all policies and decisions are compliant with Net Zero.	2022
3	All (Joint adaptation/mitigation recommendation)	All	Work towards securing more climate finance commitments from developed countries to get back on track for mobilising \$100 billion a year in climate finance as soon as possible.	2021 (COP26)
4	COP Unit, FCDO, DIT	All	Provide a clear commitment prior to COP26 regarding the timescale by which the UK's official development assistance (ODA) contribution will return to 0.7% of GNI given the UK's commitment to align its ODA spend with Paris Agreement requirements and the need for increased finance to achieve the Paris Agreement.	2021
5	Defra	All	The next National Adaptation Programme, due in 2023, should ramp up adaptation ambition, implementation and evaluation. It should: <ul style="list-style-type: none"> <li>• Set out the Government's vision for a well-adapted UK, alongside the measurable outcomes that the Government is aiming to achieve by the end of the next NAP period (2023 – 2028).</li> <li>• Include a detailed monitoring and evaluation framework, including which indicators will be used to monitor progress in reducing risk and showing the effectiveness of different adaptation responses for each risk in CCRA3.</li> <li>• Report how departments have addressed the top eight priority risks set out in the CCRA3 Advice Report for urgent action between 2021 and 2023 (see recommendations by department below).</li> <li>• Set out how adaptation is being integrated into policy, and the measurable actions by department for adaptation across each of the 61 risks and opportunities set out in the</li> </ul>	2023 onwards

\* Recommendations that are joint with the Mitigation Progress Report are highlighted as such.

			<p>CCRA3 Technical for the period 2023 – 2028 (see recommendations by department below).</p> <ul style="list-style-type: none"> <li>• Ensure the adaptation actions and the programme as a whole are framed around the principles for good adaptation outlined in the CCRA3 Advice Report: <ul style="list-style-type: none"> <li>– Adapt to 2°C warming, assess the risks for 4°C</li> <li>– Prepare for unpredictable extremes</li> <li>– Assess interdependencies</li> <li>– Understand threshold effects</li> <li>– Integrate adaptation into relevant policies</li> <li>– Ensure adaptation is sufficiently financed</li> <li>– Avoid lock-in</li> <li>– Address inequalities</li> <li>– Consider opportunities from climate change</li> </ul> </li> <li>• Specific actions to manage international climate risks should be included, setting out the direct response to the risks identified in CCRA3.</li> </ul>	
6	Defra	All	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority CCRA3 risks for which it has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>• Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards</li> <li>• Risks to soil health from increased flooding and drought</li> <li>• Risks to natural carbon stores and sequestration from multiple hazards</li> <li>• Risks to crops, livestock, and commercial trees from multiple hazards</li> </ul> <p>In addition, for the coming five year period 2023-2028, Defra should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Annex).</p>	By 2023
7	Defra	All	<p>Implement a public engagement programme about national adaptation objectives, acceptable levels of risk, desired resilience standards, how to address inequalities, and responsibilities across society. The findings from the programme should feed into the vision and desired outcomes of the next National Adaptation Programme.</p>	2021

8	Defra	All	Fund a programme of work to design and populate the appropriate new priority adaptation indicators for England. These should complement other environmental and social indicators collated by Government. The CCC could be tasked to coordinate this activity in partnership with other relevant organisations such as the Office for Environmental Protection and Environment Agency.	2021
9	Defra (joint adaptation/ mitigation recommendation)	Natural environment	Publish an overarching strategy that clearly outlines the relationships and interactions between the multiple action plans in development for the natural environment, including those for peat, trees, nature and plant biosecurity. This must clearly outline how the different strategies will combine to support the Government's climate change goals on both Net Zero and adaptation, along with the wider environment and other goals.	2021
10	Defra	Natural environment	The commitment in the 25 Year Environment Plan to achieve 75% restoration for terrestrial and freshwater protected sites should be extended to include all priority habitat sites.	2021
11	Defra	Natural environment	Make long-term targets for biodiversity, set out under the Environment Bill, and associated timeframes outcome-based and linked directly to the goals set out in the Government's 25-YEP.	June 2022
12	Defra	Natural environment	Make interim targets for biodiversity statutory and link them clearly to the long-term targets set out in the Environment Bill.	June 2022
13	Defra (joint adaptation/ mitigation recommendation)	Natural environment	Introduce legislation to extend the ban on rotational burning of peat from certain protected upland bog sites to all peatland before the start of the burn season in 2021; end peat extraction, and ban its sale for all horticultural uses including in the professional sectors and apply this to imports by 2023; mandate water companies to restore peatland under their ownership; and ensure lowland peat soils are not left bare.	2021-2023
14	Defra (joint adaptation/mitigation recommendation)	Natural environment	Extend current ambition set out by the UK government and the devolved administrations to implement a comprehensive delivery mechanism to address degraded peatland (hectares given are for the UK): <ul style="list-style-type: none"> <li>• 17% of upland peat is restored, equivalent to 200,000 hectares (and where this is not possible, stabilise the peat) by 2025; 58% by 2035 (700,000 hectares) and the remaining area by 2045;</li> <li>• Rewet and sustainably manage 12% of lowland peat used for crops by 2025 (24,000 hectares), rising to 38% by 2035 (72,000 hectares);</li> <li>• Rewet 8% of lowland grassland area by 2025 (18,000 hectares), rising to 25% by 2035 (54,000 hectares);</li> <li>• Remove all low-productive trees of less than YC8 from peatland (equivalent to 16,000 hectares by</li> </ul>	2021-2025

			2025), and restore all peat extraction sites by 2035 (equivalent to 50,000 hectares by 2025).	
15	Defra	Natural environment	Set out a clear mechanism to account for the consequences of higher water temperatures and low flows (including drying up) in water bodies for freshwater habitats and species, and for meeting the Water Framework Directive (WFD) targets. This is lacking in current plans to revise the River Basin Management Plans (RBMPs).	June 2022
16	Defra	Marine	Extend the statutory requirements of marine plan policies to the decisions of public and private organisations. At present only public authorities are duty bound under law to apply the plan policies to their decisions meaning there is a significant gap in the protections they are designed to provide.	Now
17	Defra	Infrastructure	Make changes ahead of the next round of reporting under the Adaptation Reporting Power (ARP). When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies. In particular: <ul style="list-style-type: none"> <li>• The next round of reporting must be mandatory.</li> <li>• The deadline for reporting must allow sufficient time for consideration of all the reports in the fourth UK Climate Change Risk Assessment, and the CCC's statutory assessment of progress on adaptation.</li> <li>• The list of organisations reporting should be expanded to ensure comprehensive coverage of critical infrastructure and services, such as canals and food supply chains, as recommended by the ARP3 consultation.</li> </ul>	2023
18	Defra	Infrastructure	Work with Port Operators and the British Ports Association to ensure the format of reporting under the Adaptation Reporting Power is appropriate for port operators and that the right operators are being asked to report. Defra should work with these organisations to identify what further support could be offered to enable more comprehensive reporting on adaptation by the ports sector.	2023
19	Defra; BEIS; DCMS	Infrastructure	Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for electricity, digital and ICT networks. As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.	Now and ongoing

20	Defra	Flooding	Work with the Environment Agency to set out the measures being taken to improve the uptake of property-level flood resilience (PFR) following stakeholder responses to its PFR call for evidence and consultation. This should include improved data collection to monitor progress. Plans for the new national flood risk assessment and 2025 long-term investment scenarios must ensure that the evidence they provide can be used to identify the most effective locations for PFR, and smart targets for their installation with timescales.	2022
21	Defra	Food security	Set out measures to ensure the resilience of the food supply chain, including to the risks of extreme weather in England and internationally, as part of its white paper responding to the independent review of the National Food Strategy for England.	2022
22	Defra	Water	Work with the Environment Agency, Ofwat and other stakeholders to set out targets and supporting measures for reducing water use by business. This could be through ensuring that any water reduction targets linked to the Environment Bill include business as well as household water use, as well as responding to advice and recommendations from Defra's new Senior Water Demand Reduction Group.	2022
23	MHCLG	All	<p>MHCLG should ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority CCRA3 risks for which it has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>Risks to human health, wellbeing and productivity from increased exposure to heat in homes and buildings (with DHSC)</li> </ul> <p>In addition, for the coming five year period 2023-2028, MHCLG should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Annex).</p>	By 2023
24	MHCLG (joint adaptation/mitigation recommendation)	Planning	Ensure that developments and infrastructure are compliant with Net Zero and appropriately resilient to climate change through proposed amendments to The Town and Country Planning Order.	2021-22
25	MHCLG	Flooding (Planning reform)	<p>Ensure that all types of current and future flood risk are included in policies to assess flood risk to new developments. Housing targets for local authorities should take account of flood risk, amongst other environmental issues. Assessments and management of flood risk in new developments must include as a minimum:</p> <ul style="list-style-type: none"> <li>Evidence that the development will be safe over its full lifetime, with a consideration of the downstream interactions and impacts of new developments i.e. not increase flooding in any other areas</li> </ul>	2022

			<ul style="list-style-type: none"> <li>• An assessment of current and future flood risk under both a 2°C and 4°C global climate scenarios.</li> <li>• Assess and manage the risk of flooding to local infrastructure as well as housing.</li> <li>• A consideration of better preparedness as set out in the Government's recent FCERM Policy Statement.</li> <li>• Ensure there are properly funded and trained staff in local authorities.</li> </ul>	
26	MHCLG	Flooding	To address the issue of increased risk of surface water flooding in new developments, commit to ensuring that new developments do not put more water into the public sewers than what was there before, taking account of climate change. To incentivise this, end the automatic right to connect to the public sewer; planning reforms should enact Schedule 3 of the Flood and Water Management Act (2010); and technical SuDS standards should be made mandatory and be updated to deliver SuDS that provide multiple economic, social and environmental benefits.	2022
27	MHCLG	Flooding	To help improve the information on SuDS and surface water flood risk, urgently begin collecting data on sewer capacity and SuDS location, type and capacity. This would bring the level of information in line with that for river and coastal flood risk defences.	2021
28	MHCLG	Flooding	The consultation process for surface water flood risk must be improved. This should be done by adding statutory consultees for all development type and sizes. Consultees must have the appropriate skills to provide advice on surface water flood mitigation. Ensure that Local Authorities fully justify planning decisions where applications can proceed either without or going against formal flood risk mitigation advice.	2022
29	MHCLG	Building safety (overheating)	<p>Implement a strong set of standards - with robust enforcement - that ensure both new and existing buildings are designed for a changing climate and deliver high levels of energy efficiency and low-carbon heat. Including:</p> <ul style="list-style-type: none"> <li>• Publish robust definitions of the Future Homes Standard and Future Buildings Standard which are legislated in advance of 2023 and ensure no fossil fuels are burnt in new buildings. This must include coordination with DfE, MoJ, DHSC as well as BEIS and HMT.</li> <li>• Regulate the overheating requirement as set out in the Future Buildings Standard consultation. Expand the requirement to cover refurbishments of existing buildings and conversions of non-domestic buildings to residential.</li> <li>• Work with BEIS on the Heat and Buildings Strategy and use standards to set a clear direction for retrofit across the buildings stock.</li> </ul>	2021-22

			<ul style="list-style-type: none"> <li>• Ensure that the remit of the new building safety regulator covers climate change mitigation and adaptation, strengthened through an explicit responsibility for sustainability; and is fully equipped to monitor and enforce compliance with buildings standards.</li> <li>• Work with HM Treasury to ensure that local authorities are properly funded to enforce buildings standards.</li> <li>• Close loopholes allowing homes to be built which do not meet the current minimum standards for new dwellings. This includes provisions around the expiry of planning permission and permitted development rights relating to change of use. Make accurate performance testing and reporting widespread, committing developers to the standards they advertise.</li> </ul>	
30	MHCLG	Planning reform	Introduce an urban greenspace target to reverse the decline and ensure towns and cities are adapted to more frequent heatwaves in the future and that the 25-Year Environment Plan goals are met.	2022
31	BEIS	All	<p>Ensure that adaptation is integrated into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the third UK Climate Change Risk Assessment (CCRA3) for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>• Risks to the supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (with Defra and DIT)</li> <li>• Risks to people and the economy from climate-related failure of the power system</li> </ul> <p>In addition, for the coming five-year period 2023-2028, BEIS should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Annex).</p>	By 2023
32	BEIS	All	BEIS should ensure that Net Zero and adaptation are considered together in the forthcoming Net Zero Strategy. There should be a focus on maximising synergies and minimising trade-offs between mitigation and adaptation actions and the risks from climate change to achieving Net Zero. Actions that have multiple benefits across climate change mitigation, adaptation, biodiversity and health should be high on the Government's agenda for action over the next five-year period.	2021
33	BEIS and MHCLG	Building safety (overheating)	Improve understanding of and support action on overheating in existing residential buildings and encourage retrofit of passive cooling measures. The	2022

			<p>Heat and Building Strategy must consider overheating risks. The following steps are needed:</p> <ul style="list-style-type: none"> <li>• Further research to understand when overheating occurs in existing homes, including: ongoing monitoring of temperatures in the housing stock, monitoring of overheating exceedances in homes, and number of homes currently adapted</li> <li>• Guidance and information for homeowners with the steps that can be taken if their homes overheat. This should include an outline of behaviour options and the measures that can be installed to reduce internal temperatures. Green Building Passports and home retrofit plans could provide holistic guidance and help to unlock green finance.</li> <li>• Overheating risk considered and mitigated against if necessary when doing energy efficiency retrofit programmes.</li> <li>• Making finance available to install adaptation measures. This could be via grant schemes or green finance for private owners, with public funding targeted at low-income or vulnerable households alongside energy efficiency retrofit.</li> </ul>	
34	BEIS (joint adaptation/mitigation recommendation)	Businesses	Support businesses to play their full role in the Net Zero transition and in adapting to climate risks and opportunities, for example by extending and expanding the role of the Net Zero Business Champion beyond COP26, building on the Race to Zero and Race to Resilience campaigns and providing sufficient resources to fully support businesses of all sizes to engage in the transition, to input to policy development and to set their own robust Net Zero and adaptation action plans.	2021-22
35	BEIS and HM Treasury (joint adaptation/mitigation recommendation)	Businesses	Develop further ways to embed Net Zero and climate risk in financial decisions by UK firms, building on the UK's Green Finance Strategy. This should include implementing mandatory climate disclosure, adoption of a robust green taxonomy with clear guidance on how it should be used. It should also consider the recommendations of the Committee's Finance Advisory Group, such as making Net Zero and adaptation plans mandatory for financial institutions and monitoring financial flows into climate action.	2021-25
36	BEIS	Research	Make monitoring and data analysis of climate risks more accessible, alongside better digitisation of past records. Further efforts should be taken to make the evidence on climate risks more usable for decision makers through co-design of research programmes with end users, where the user drives the research question from the beginning of the process. A major gap is the lack of projections of impacts in 2°C and 4°C scenarios; this needs addressing as an urgent priority ahead of CCRA4.	2022

37	Cabinet Office	All	<p>Cabinet Office should ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority CCRA3 risk for which it has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>Multiple risks to the UK from climate change impacts overseas</li> </ul> <p>In addition, for the coming five year period 2023-2028, Cabinet Office should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA3 for which it is the lead department (see Annex).</p>	By 2023
38	Cabinet Office	All	<p>Cabinet Office should build a strong climate resilience capability for the UK, including making use of storyline or 'what-if' scenarios to assess risks, in addition to or instead of using 'reasonable worst-case' approaches. It should develop an early warning system for global climate shocks. It should consider how more allowance and flexibility can be built into policy making and policy implementation. This could include enhancing the ability of the Government to make fast decisions by bringing in technical advice and expertise quickly when needed, and both protecting, and enhancing, monitoring and surveillance systems to enable faster reactions as events unfold.</p>	By 2023
39	DHSC	All	<p>For the coming five year period 2023-2028, DHSC should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the four risks and opportunities in the CCRA for which it is the lead department (see Annex).</p>	2023
40	DHSC	Building safety	<p>Assess health sector vulnerability to existing and future climate risks, particularly, for care homes and home-based care. Following this, develop a cross-sector approach to address risks. This cross-sector approach should include input from CQC, PHE, NHS, MHCLG and local level public health bodies.</p>	2022
41	DHSC	Public health - vector-borne diseases	<p>Fund the strengthening and widening of vector and pathogen surveillance and early warning mechanisms, due to the increasing risk of disease spread as a result of climate change and other factors.</p>	Now and ongoing
42	HM Treasury	All	<p>For the coming five year period 2023-2028, HMT should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the CCRA3 for which it is the lead department (see Annex).</p>	2023
43	HM Treasury (Joint adaptation/mitigation recommendation)	All	<p>The spending review(s) should ensure departments are fully equipped to deliver the necessary actions across climate change mitigation and adaptation, during the rest of this Parliament and beyond.</p>	2021

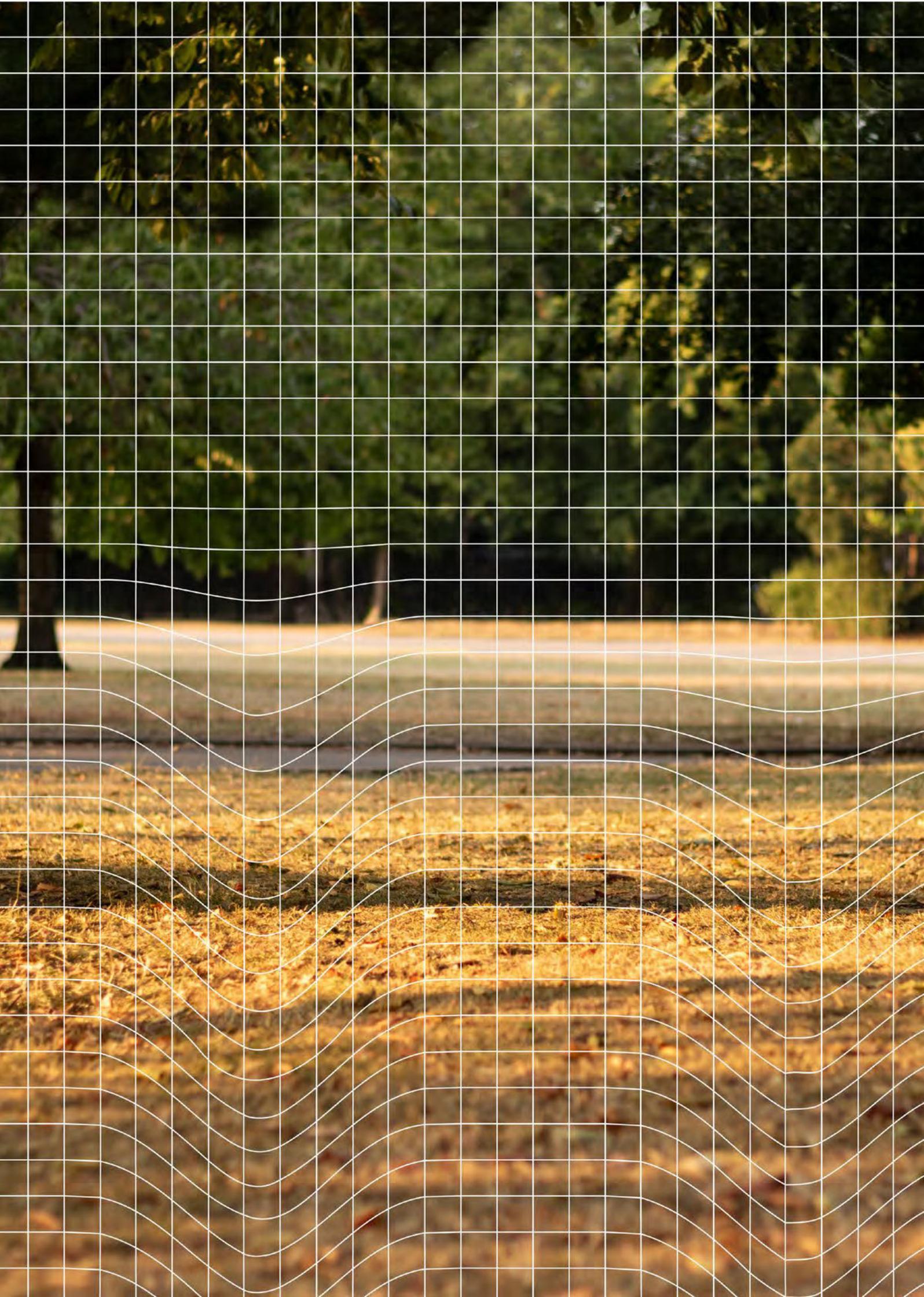
44	DCMS	All	For the coming five year period 2023-2028, DCMS should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Annex).	2023
45	DCMS	Infrastructure	Resilience standards for the digital sector must include requirements pertaining to climate change risks. In addressing the National Infrastructure Commission recommendations from the Resilience Study, Government should incorporate consideration of climate change risks and adaptation actions into any new standards being developed. Standards for digital infrastructure operators should include requirements to: <ul style="list-style-type: none"> <li>• assess climate risks under both 2°C and 4°C global climate scenarios,</li> <li>• consider interdependencies with other critical infrastructure, and</li> <li>• set out actions to reduce risk and monitor progress.</li> </ul>	2022
46	FCDO	All	For the coming five year period 2023-2028, FCDO should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Annex).	2023
47	DfT	All	For the coming five year period 2023-2028, DfT should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA3 for which it is the lead department (see Annex).	2023
48	DIT	All	For the coming five year period 2023-2028, DIT should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA3 for which it is the lead department (see Annex).	2023
49	MoJ	All	For the coming five year period 2023-2028, MoJ should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Annex).	2023
50	DfE	All	For the coming five year period 2023-2028, DfE should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Annex).	2023

# Chapter 1

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## Introduction

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# 1.1 Observed and projected climate change

This section summarises observed and possible future changes in the UK's weather and climate.

This section covers the most up-to-date evidence regarding observed and projected changes in the UK's weather and climate. It highlights that several recent trends in UK's weather and climate can be linked to human-induced climate change – with further changes expected over coming decades.

## Global climate change

Global temperatures continue to rise rapidly – with human influence the driver.

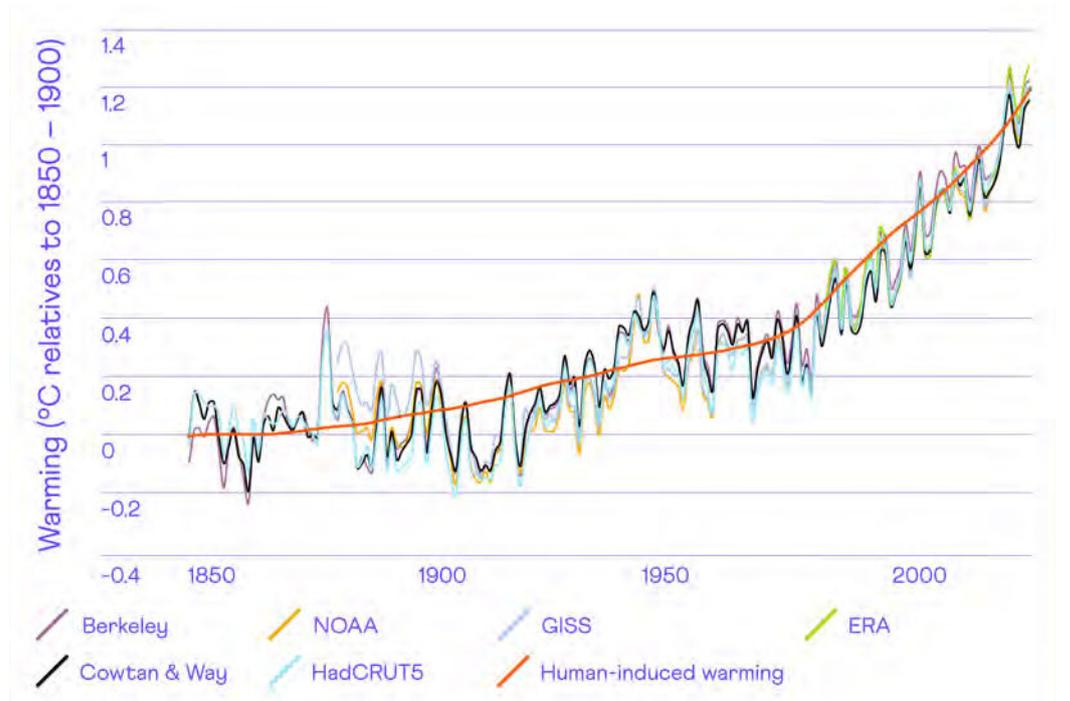
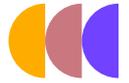
Global temperature observations over recent years are fully consistent with those expected from continuing long-term global warming resulting from human activity:

- Annual global mean surface temperature in 2020 was the joint warmest or second warmest on record across all prominent global temperature datasets (Figure 1.1). 2020 global temperature was similar to that in 2016, in which global temperature was boosted by a very strong El Niño. The six most recent years were the six warmest years globally in the observational record.
- Estimated human-induced warming has now reached around 1.2°C above 1850-1900 (an approximation for preindustrial levels). Human-induced warming is estimated to explain 100% ( $\pm 20\%$  uncertainty) of the observed warming since 1850 – 1900.
- Human-induced warming is increasing at around 0.25°C per decade leading to further increases in global and UK climate hazards in the future. At this present rate of increase, human-induced warming would exceed 1.5°C above preindustrial levels (the lowest level referred to in the Paris Agreement long-term temperature goal) by the early 2030s.

COVID-19 related impacts on emissions will not have a long-term effect on climate risks.

In 2020 the impact of measures to address the COVID-19 pandemic on global energy demand caused global annual energy-related CO<sub>2</sub> emissions to fall by around 6% relative to 2019 levels.<sup>1</sup> Global emissions rates have since recovered to be closer to 2019 levels. This temporary fall in global CO<sub>2</sub> emissions did not significantly affect atmospheric CO<sub>2</sub> concentrations, global temperature or climate impacts, as these are primarily determined by cumulative global CO<sub>2</sub> emissions over time. Changes in the global climate, and climate hazards, will continue until global emissions fall to close to zero.

Figure 1.1 Global average surface air temperature change



Source: CCC analysis

Notes: Each thin line represents a different global temperature dataset. The NOAA, GISS and ERA datasets are expressed relative to 1850 - 1900 using the offset over the 1981-2000 period from the HadCRUT5 dataset. Human-induced warming is taken from [globalwarmingindex.org](http://globalwarmingindex.org).

## Observed climate change in the UK

Changes in aspects of the UK's weather and climate are already being seen.

The latest observations of UK weather and climate continue to document several clear recent trends<sup>2</sup> in aspects of UK climate (Figure 1.2):

- **Warmer average temperature.** The UK's annual average temperature has risen by around 0.6°C above the average of the 1981 - 2000 period, consistent with a trend of nearly 0.3°C per decade since the 1980s. Human-induced climate change in the UK is estimated to have raised UK average temperature above preindustrial levels by a similar amount to the global average.
- **Higher average sea levels.** The level of the seas around the UK has risen by around 6.5 cm since 1981 - 2000. They are currently estimated to be rising at around 2.5 cm per decade.\*
- **Changed temperature extremes.** The shifting UK climate is having a clear effect on observed temperature extremes.<sup>3</sup>

\* Based on a linear trend over the past 20 years.

- The warmest temperature recorded each year has increased over time. Averaged across the UK, the warmest temperature of the year has increased to around 27°C today from around 25°C in the 1960s, with much more rapid rates of increase in the South East of England. The average duration of heatwaves (periods in which there are more than three days in excess of 25°C) has increased over time. For the UK as a whole, summers as hot as in 2018 (the joint warmest summer on record) are expected to occur in up to 25% of years, compared to less than 10% of years a few decades ago.
- The coldest temperature of the year has also increased over time. Averaged across the UK, the coldest temperature of the year is now around -7.5°C today. In the 1960s it was around -9°C.
- The number of icing days (days in which the maximum temperature remains below 0°C) across the UK was around six per year in the 1960s but has fallen to around three per year today. Individual years with a significantly greater number of icing days remains possible, such as in 2010.
- **Sunshine.** The most recent decade has been the sunniest on record in the UK (around 5% sunnier than over 1981 - 2000, with increases largely confined to winter and spring), however the causal link between this trend and human-induced climate change currently remains under investigation, with possible links to changes in aerosol emissions.<sup>4</sup>

In some aspects of the UK's weather and climate clear signals of global climate change have yet to emerge.

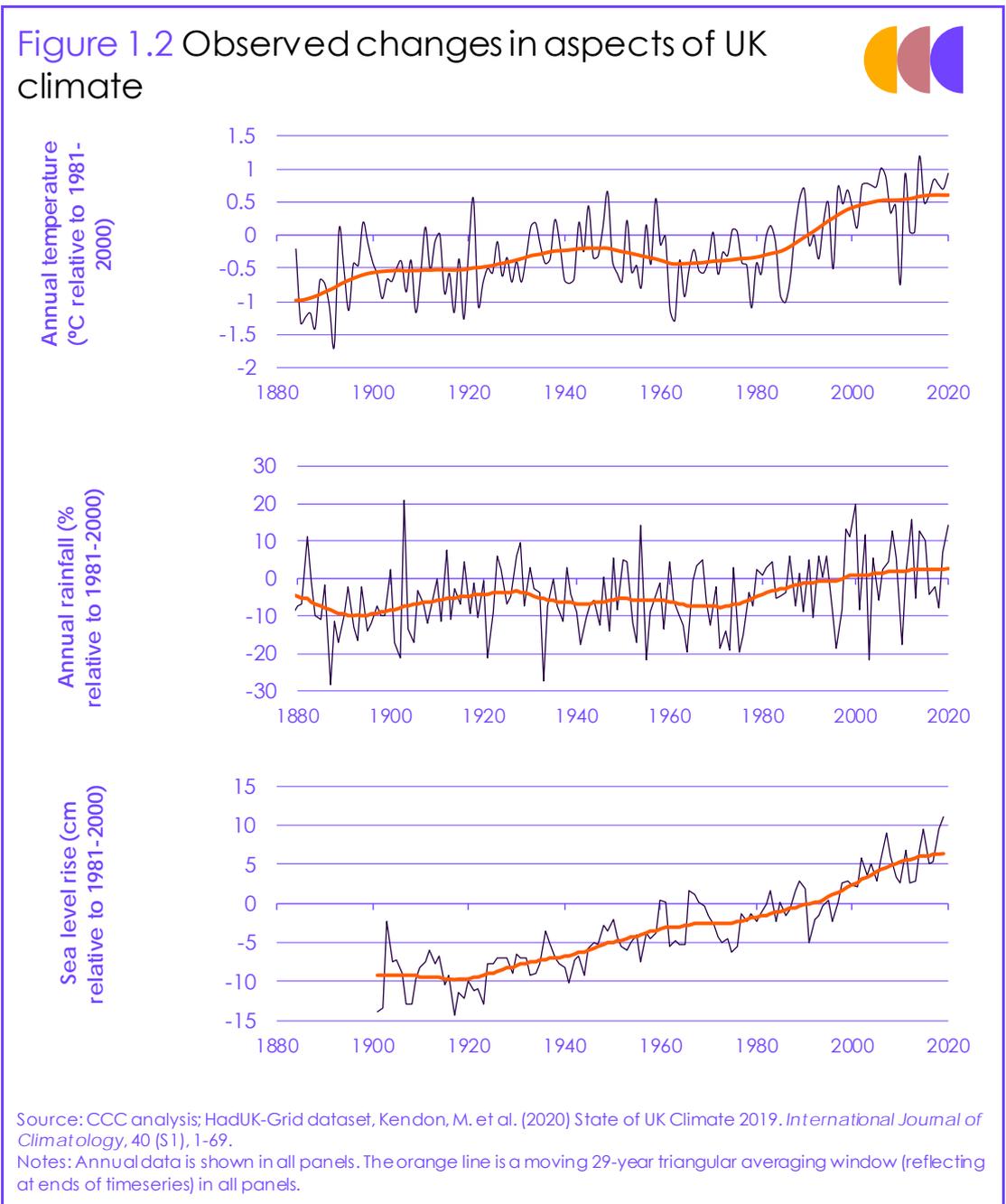
Signals of climate change may be emerging in other climate variables, but the strong annual and decadal variability in the UK's weather and climate still prevents their clear detection despite this being possible in other regions of the world:

- **Annual and seasonal precipitation.** Since the 1980s there has been an overall increase in the annual average amount of UK rainfall. The most recent decade was around 3% wetter than over 1981 - 2000, but interannual variability remains strong with both significantly wetter and drier years being observed. Western Scotland is the part of the UK with the most statistically significant trends to wetter years.<sup>5</sup> For the UK, winter and spring shows trends to being wetter and drier respectively, consistent with expected long-term trends due to climate change, but the statistical significance of these trends remains limited. The recent run of wet summers means that summers over the last decade have been around 20% wetter than over 1981 - 2000, despite projections for drier summers on average in the future. This highlights the continued impacts that annual and decadal variability have on near-term changes in some aspects of the UK's weather and climate.
- **Precipitation extremes.** Heavy rainfall metrics generally show an increase in very wet days across the UK, but the expected signal from climate change remains hard to distinguish from the large interannual variability in the observational record. Extreme event attribution studies have found robust signals that human-induced climate change has increased the likelihood of some observed UK precipitation extremes.<sup>6</sup>
- **Storminess.** Storms can bring heavy rainfall and strong winds to the UK (particularly in winter), with risks of flooding and wind damage.

There are no clear trends in UK storminess over the observed record.\* As UK storminess is strongly linked to the Jetstream improving understanding of how Jetstream variability may change in the future is an important area of research to better understand future UK climate hazards.†

Further changes in aspects of the UK's climate are expected.

The absence of clearly distinguishable observed trends in these aspects of UK weather and climate does not mean that there is no effect of climate change. For many variables (e.g. rainfall) there are good physical reasons to expect human-induced global warming to drive changes. Detectable changes in other aspects of UK climate are expected to emerge from natural climate variability as human-induced global warming continues to increase.



\* Storminess is here defined in terms of maximum wind gust speed.

† Evidence from the latest generation of climate models produced by the UK Met Office, which have improved representation of Jetstream variability, suggests a possible shift to more stormy winters on average in the future.

In the UK the year 2020 was the third warmest year on record and the fifth wettest. There were several notable extreme weather events in the UK over 2020, some of which have been demonstrated to have been made more likely by human-induced climate change (Box 1.1).

### Box 1.1

#### Extreme weather and climate events in the UK during 2020

Extreme weather and climate events occurred throughout 2020, across a range of different climate variables. Research over the last year has helped to provide insights into the relative role of human-induced climate change and natural climate variability as drivers:

- **Rainfall and storms in February.** A series of storms crossing the UK made February more than twice as wet as would be expected on average. This was the wettest February on record and the fifth wettest month ever recorded. This contributed to extensive flooding, particularly across Northern England and Wales, with peak flow rates recorded on many rivers.
- **Record sunshine in spring.** Following the wet end to the winter, the spring was exceptionally dry and sunny. Overall, the spring was the UK's sunniest spring on record (sunnier than most UK summers) and May was the driest May on record for England. This was largely driven by stable conditions in the North Atlantic Jetstream that brought repeated periods of high pressure over the UK. The spring sunshine in 2020 would still be a very sunny spring by the end of the century under all plausible future scenarios for global greenhouse gas emissions.
- **Heatwaves in August.** August saw a long-lasting heatwave affecting (primarily) southern England. Night-time temperatures were particularly affected with temperatures remaining above 20°C at some location in the UK for five nights. This heatwave was linked to a rise in the death rate above the average rate for the time of year. Summer heatwaves are becoming more common and hotter in the UK.
- **Record daily rainfall in October.** October saw the UK's wettest day on record. Robust trends in the UK's wettest day of the year have not yet emerged in the observational record, but a trend towards more intense rainfall extremes is expected as the atmosphere holds more water when it is warmer.

These events highlight that the combination of rare instances of natural climate variability and the background of continued human-induced climate change can combine to create highly unprecedented weather and climate events in today's climate. This emphasises the value of preparing for unprecedented climate impacts today, not just in the future, and that climate variability will remain a key driver of UK climate impacts in the future under all future climate scenarios.

Source: Parry, S. et al. (2020) *Briefing Note: Severity of the February 2020 floods - preliminary analysis*; Kendon, M. & McCarthy, M. (2021) *The United Kingdom's wettest day on record – so far – 3 October 2020*. *Weather*.

## Projected changes in UK climate and weather

The Committee recently published its advice on the Third UK Climate Change Risk Assessment (CCRA3). This advice, supported by an extensive Technical Report, provides a detailed assessment of the changes in UK weather and climate that might be expected in the future.

The changes in UK weather and climate expected out to 2050 are:

- **Warmer and wetter winters.** By 2050 the UK's average winter could be around 1°C warmer (0.5°C cooler – 2.5°C warmer uncertainty range) than it was on average over 1981-2000 and around 5% wetter (10% drier – 20%

Further changes are expected in UK weather and climate over the next few decades.

wetter uncertainty range). An increase in both the intensity of winter rainfall and the number of wet days is expected.

- **Drier and hotter summers.** By 2050 the UK's average summer could be around 1.5°C warmer (0°C – 3°C uncertainty range) than it was on average over 1981-2000 and around 10% drier (30% drier – 5% wetter uncertainty range). A summer as hot as in 2018 (the joint hottest summer on record) for the UK as whole could be normal summer conditions by 2050. The temperature of the hottest days each year are expected to increase more than the average summer temperature increase. The intensity of summer rainfall (when it occurs) is expected to increase.
- **Continued sea-level rises.** The seas around the UK will continue to rise over the three decades to 2050. By 2050 sea levels could be around 10 – 30 cm higher than over 1981-2000, depending on the specific location in the UK.\*

These additional changes in the UK's climate to 2050 are largely insensitive to the pathway of global greenhouse gas (GHG) emissions over coming decades.

Beyond mid-century, the different possible future trajectories in global GHG emissions become the main source of uncertainty in global and UK climate changes. If global emissions continue at a high level through to mid-century and beyond, global temperature will continue to rise beyond 2050 and associated climate changes in the UK and elsewhere will continue in the second half of the century. If, however, global emissions have been significantly reduced by mid-century and are brought to Net Zero soon after, then many aspects of global and UK climate in the second half of the century can be kept close to that experienced at mid-century.†

Long-term UK climate risks therefore depend on both the ambition and implementation of global emissions reductions:

- Recent trends in costs of key technologies (e.g. renewable electricity) are helping the world move away from the futures with ever increasing global emissions. This means that exceeding 4°C of warming above preindustrial levels by 2100 is no longer the most likely estimate of current climate trajectory outcomes.
- Current ambition for global emissions reduction is expected to be consistent with a central estimate of around 3°C of warming above preindustrial levels by 2100.<sup>7</sup> Climate response uncertainty means that exceeding 4°C by 2100 (or keeping warming below 2°C) remains within the envelope of possibilities and cannot yet be ruled out as a possible outcome.
- Recent commitments to achieve Net Zero emissions by large emitters (including China and the USA) by around mid-century would, if delivered, move the central estimate for 2100 warming close to keeping below 2°C above preindustrial levels. There would remain a non-negligible chance of warming exceeding 2°C even if this scenario for global emissions were delivered.

\* Range (in 50<sup>th</sup> percentile) outcomes across UK capital cities is given here. Climate uncertainties means that changes could range from 30 – 40 cm above 1981 – 2000 levels across capital cities under a high climate response (95<sup>th</sup> percentile).

† Some aspects of the climate (e.g. sea level) will continue to change in the second half of the century regardless of global emissions trajectories continuing to increase hazards such as coastal flooding.

In the long-term, UK climate changes depend strongly on efforts to reduce global greenhouse gas emissions.

Keeping central estimates of warming 'well-below' 2°C, the Paris Agreement long-term temperature goal, would require significant strengthening of near-term commitments to emissions reductions by 2030 in addition to reaching Net Zero around mid-century.

It remains prudent to plan for a range of possible longer-term climate outcomes given the uncertainty in both the climate response and future trajectories of global GHG emissions when considering UK climate risks in the second half of the century.

## 1.2 The CCC adaptation assessment framework

### Purpose of this report

**This is the Adaptation Committee's second assessment of progress in delivering the current National Adaptation Programme, required under the UK Climate Change Act (2008).**

The UK Climate Act requires the CCC's Adaptation Committee to report on progress in adapting to climate change through the National Adaptation Programme, covering England and reserved matters, every two years. The Committee's first assessment in 2019 of the latest National Adaptation Programme (NAP2, published in 2018), considered how the National Adaptation Programme and other actions were changing vulnerability and exposure to climate risks in England.<sup>8</sup> That report concluded that:

- On the basis of the evidence available, England is not prepared for even a best-case scenario of a 1.5 - 2°C rise in global temperature (see above), let alone more extreme levels of warming that remain likely on the basis of current pledges to reduce greenhouse gas emissions.
- The National Adaptation Programme does not address all the risks and opportunities set out in the second UK Climate Change Risk Assessment (CCRA) in 2017, despite this being a requirement of the UK Climate Change Act.
- The institutional and support framework for adaptation in England has been eroded over the past ten years.
- Vulnerability and exposure to climate change continue to increase across a range of sectors that are classed in the CCRA as needing urgent action.
- There are pockets of excellence in adaptation planning and action across England, that need to be supported and scaled up over the next ten years.

The 2019 report concluded that the Government must raise the profile and strengthen governance for adaptation over the coming decade to prepare for the impacts of climate change. The Committee offered 12 recommendations, which the Government responded to in autumn 2019.<sup>9</sup> A further set of recommendations on adaptation was also included in the CCC's subsequent Mitigation Progress Report in 2020, to which the Government also responded.<sup>10,11</sup>

This report re-assesses progress for the same set of 'adaptation priorities' or sectors that were covered in 2019. Each chapter considers changes in relevant policy, and shows updated indicators of vulnerability, exposure, adaptation action and impact. We have provided an updated set of conclusions in the Executive Summary.

## The CCC's assessment framework and structure of this report

### The Adaptation Committee revised its assessment framework for its 2019 Progress Report, and we use the same framework here.

The 2019 report explains in detail the rationale and context for the assessment framework used by the Committee for adaptation. It is based on two questions:

- **Is there a good quality plan?** The Committee has reviewed whether plans are in place that include adaptation actions to prepare for inevitable change (approximately a 2°C rise in global temperature above pre-industrial levels), and a consideration the risks for that sector in a 4°C scenario. We also assess whether plans are SMART – specific, measurable, attainable, relevant and time-bound. A good plan will have clearly stated outcomes that are appropriate in the context of climate change, have considered the short-term and long-term effects of climate change, have an effective monitoring and evaluation framework and demonstrate clear links between the outcomes and corresponding actions. A weaker plan might have vague or unclear outcomes, make weaker links to the current and future effects of climate change, and may only include guidance but not require specific action.
- **Is progress being made in managing risk?** The Committee assesses indicators of vulnerability, exposure, adaptation action, and climate change impacts to assess how risk is changing, and whether goals remain on track to be met where this is relevant. For this step, we also consider how the actions set out in the National Adaptation Programme, and other relevant actions, are addressing risk. In this context, the Committee has considered to what extent the actions taking place relate to the risks identified in the Climate Change Risk Assessment and whether they are being implemented in accordance with NAP2. The assessment seeks evidence of what impact the actions are having on risk, wherever possible.

For each adaptation priority, an assessment score of high, medium or low is given for plans and managing risk using a set of defined criteria (Table 1.2). Those scores then place each adaptation priority on a 9-box grid.

### Across the chapters, each section includes a progress summary table explaining the differences in plan and risk scores between 2019 and now.

These are included as signposts for the reader. The analysis is then expanded below with a narrative on changes in the plan score, changes in the risk score, and an overall conclusion. The Committee's full set of indicators is provided in an annex to this report, but some of the key indicators that support the scores are highlighted in the chapters.

Recommendations related to each adaptation priority are provided in the relevant places in the text in this report. The complete set of adaptation recommendations is provided, by department, in the Executive Summary.

**Table 1.2**  
Adaptation Committee Assessment Criteria

Score	High	Medium	Low
<b>Plan Score</b>	<p><b>Good quality plan:</b></p> <p>Considers climate change, including a range of scenarios (adaptation planning for inevitable change i.e. a 2°C scenario, consideration of risks for a 4°C scenario)</p> <p><b>Sets out specific action – not just guidance</b></p> <p>SMART – specific, measurable goals with timescales</p> <p>Has effective monitoring and evaluation built in</p> <p>Can see links from the plan down to the actions</p> <p>Plans up to date</p>	<p><b>Medium quality plan:</b></p> <p>Considers climate change, though possibly vague on what scenarios are included</p> <p><b>Requires general action – not just guidance</b></p> <p>Some aspects of being SMART</p> <p>Some monitoring and evaluation</p> <p>Some links to action</p>	<p><b>Low quality plan:</b></p> <p><b>Minimal or no consideration of climate change</b></p> <p><b>No firm actions, not SMART</b></p> <p>No monitoring and evaluation</p> <p>No firm link through to actions</p> <p>Plans not up to date</p>
<b>Risk Management Score</b>	<p><b>Evidence that risk (vulnerability and exposure) is reducing at an appropriate rate, and/or is in line to meet goals</b></p> <p><b>Good evidence of impact of actions on risks</b></p>	<p><b>Mixed picture – some evidence of risk being managed, but other areas where progress is lacking</b></p> <p><b>Some evidence of impact of actions on risks</b></p>	<p><b>Evidence that risk is not reducing or is increasing, or lack of evidence to judge what is happening to risk</b></p> <p><b>No evidence that actions are having an impact on risk</b></p>

Source: Bold criteria are considered as key to that score; other criteria are also assessed but are of lesser importance.

International climate risks are important for a full understand of the possible impacts of climate change in the UK and actions to avoid them.

**The National Adaptation Programme does not include any actions on addressing the risks to the UK from climate change overseas. We include a joint section on international dimensions of risk in our accompanying mitigation Progress Report.** Both the CCRA2 Evidence Report and the recently published CCRA3 Evidence Report consider how international climate risks would directly and indirectly impact the UK. The elements of international risks that are especially relevant to the UK, identified by CCRA2 (and so relevant for NAP2), fall into the following categories: (1) global trade and supply chains, especially for food; (2) migration and displacement; and (3) broader geopolitical and macroeconomic issues. There are also risks specific to particular Government departments, such as risks to overseas military operations.

In particular, the CCRA2 Evidence Report assessed that extreme weather events have the potential to affect global food production, trade and supply chains, making prices more volatile and/or altering productivity in the long-term. Furthermore, weather-related events were identified as potential drivers of increased international human displacement with subsequent impacts on overseas development efforts. These risks were assigned to the ‘more action needed’ category.

However, the formal NAP2 actions do not cover any of the international risks from CCRA2. We have not, therefore, included an International Dimensions chapter in this Progress Report as there are no NAP actions against which to assess progress. A summary of our latest assessment of the importance of international dimensions of risk is provided in a joint section considering mitigation and adaptation in the accompanying report to this one on reducing UK emissions.

## Adaptation indicators

Better indicators and data are needed to understand more clearly the effectiveness of adaptation actions.

Measurement is fundamental to understanding if adaptation is working. Relevant measurement indicators are needed which effectively monitor progress in reducing climate change risk and show the effectiveness of different adaptation responses.

### **Current indicators for measuring progress and the effectiveness of adaptation actions are inadequate.**

Most currently available indicators measure progress towards policy targets or legal requirements. They are not necessarily aligned with the measurements needed to identify tangible reductions in climate risk or improvement of resilience. For example, for the natural environment sector, peatland condition and species abundance indicators can be used as proxy indicators for the vulnerability of the habitat to climate change; better condition and higher abundance can be interpreted as higher resilience. However, they do not confidently link how restoration activities can improve resilience of peatland and its services to reduce specific climate impacts. In addition, such indicators are only available for protected sites, not all peatlands.

By improving the ability to monitor the impact of adaptation interventions, the Government can plan more effective and cost-efficient adaptation actions. However, without appropriate indicators it is not possible to accurately determine whether sufficient funding is allocated towards the right actions in the right places. This is vital if the Government is to achieve its long-term policy aims, including delivering Defra's Environmental Land Management scheme outcomes, the 25-year Environment Plan (25 YEP) goals, and the objectives outlined in the Flood and Coastal Erosion Risk Management (FCERM) strategy.

As more countries are expected to come forward with National Adaptation Plans or Adaptation Communications in advance of COP26, attention will turn to measuring progress against these commitments. There is a window of opportunity for the Government to drive improvements in measuring progress on adaptation.

### **The Committee has reviewed its previous indicator framework following the 2019 Progress Report and identified key gaps.**

As part of its biennial review of progress in adapting to climate change in England, the Committee collects indicators to assess trends in risk factors: hazard, vulnerability and exposure. We also collect indicators to assess trends in adaptation actions, and climate impacts.

In order to assess the suitability of existing adaptation indicators with the increasing challenge of measuring adaptation progress, the Committee has conducted work to align its existing adaptation indicator framework with a theory of change (ToC) approach. A ToC is a methodology that helps establish links between inputs, outputs, outcomes and impacts. These can be defined as: inputs - specific actions implemented to bring about outputs or outcomes (e.g. funding levels, capacity building activities); outputs - products or events produced that result from the

completion of adaptation actions (e.g. area of peatland restored, energy efficient boilers installed in homes); outcomes – an intermediate prerequisite for meeting the Government’s overarching policy goals (e.g. meeting good ecological status benchmarks for water bodies); impacts – the contribution of outcomes to the achievement of goals that can be attributed to a particular intervention. (e.g. change in the number of properties flooded each year resulting from increased expenditure on flood risk management).

**A review of the Committee’s current set of adaptation indicators has identified significant gaps.**

The Committee’s work has included a rapid review of existing indicators against this ToC framework and producing an indicator wish-list for all sectors (see accompanying standalone annex to this report for more details). The results from the review show a high proportion of indicators within the Committee’s adaptation indicator framework measure the level of inputs to and outputs from given adaptation activities, however, there is a gap in metrics to measure progress towards outcomes (i.e. the effectiveness of adaptation actions). Furthermore, many indicators within the current set were originally designed for other purposes, and not to measure changes in risk vulnerability, so they can therefore be used only as proxy indicators at best.

The exercise has enabled the Committee to identify areas where the assessment process would benefit from future work to design and populate additional adaptation indicators. These include:

- **Natural environment** – a shortage of impact indicators that enable the assessment of: a) the effectiveness of adaptation actions in reducing climate risk; and b) changes in the natural environment that can be directly attributable to climate change.
- **People and the built environment** – a significant lack of data on sewer capacity and sustainable urban drainage (SuDS) uptake which makes it difficult to assess progress in surface water flood alleviation; and lack of monitoring of internal temperatures in homes and other buildings.
- **Infrastructure** – indicators that enable the assessment of impacts from disruption due to severe weather events on key infrastructure; indicators on the condition of slopes and embankments supporting the strategic and local road network; data on interdependent risks and resilience actions by infrastructure providers; data on the extent to which climate risk is being considered in the design and location of new infrastructure.
- **Business** – many of the current set of indicators are based on self-reported or survey evidence which may not be representative for businesses of different sizes or sectors; a shortage of impact indicators that enable a consistent assessment of the effectiveness of adaptation interventions over time.

**Defra should bring together relevant stakeholders to share data and knowledge.**

There are many UK organisations who recognise the challenges of measuring adaptation progress and are in the process of developing indicators. For example, within government, Defra is developing a range of adaptation metrics within its 25-YEP indicators framework, while the Environment Agency is exploring the design and use of indicators to measure progress towards the adaptation objectives set out in its FCERM strategy.

The CCC has been approached by the Interim Environmental Governance Secretariat to provide guidance around the adaptation indicators required for the proposed Office for Environmental Projection (OEP) to conduct its independent scrutiny of the Government's progress towards meeting the 25-YEP goals. Following a special interest group workshop, the British Ecological Society (BES) is also coordinating the production of a peer-reviewed manuscript investigating how a suite of indicators may be developed to track the effectiveness of adaptations actions in the natural environment, within a monitoring and evaluation framework.

Defra should consider how it can help to streamline these various processes and requirements, and bring together the different expertise available on developing and populating indicators.

**There is an urgent need for Government to fund work to develop new indicators to support the comprehensive assessment of adaptation progress.**

The next six months, in the run up to COP 26, would be a key time for the CCC to lead this work if requested by Government. In addition to a comprehensive framework for adaptation indicators, alignment of indicators across organisations and sectors will require coordination. The Committee is well placed to play a key role in harmonising indicators currently in development, drawing on expertise from different sectors and ensuring a consistent approach across organisations.

The CCC would work together with Defra, the Office for Environmental Protection, the Environment Agency, MHCLG, the British Ecological Society and others to identify, develop and source data for new indicators, create a framework for using them and coordinate ongoing work to ensure indicators remain appropriate and relevant. There is also a role for the Chief Scientific Advisers to coordinate action across all Government departments and to consider how to better resource monitoring and evaluation.

# Endnotes

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- <sup>1</sup> International Energy Agency (2021) *Global Energy Review: CO<sub>2</sub> Emissions in 2020*.
- <sup>2</sup> Kendon, M. et al. (2020) *State of the UK Climate 2019*. 40, S1, 1-69.
- <sup>3</sup> Met Office (2018) *State of the UK Climate 2017: Supplementary report on Climate Extremes*.
- <sup>4</sup> Sanchez-Romero, A. et al. (2014) The signal of aerosol-induced changes in sunshine duration records: A review of the evidence. *J. Geophys. Res. Atmos.*, 119, 4657–4673; Christidis N. et al. (2016) Human Contribution to the Record Sunshine of Winter 2014/15 in the United Kingdom. *Bulletin of the American Meteorological Society*, 97, 12, S47-S50.
- <sup>5</sup> Hawkins, E. et al. (2020) Observed Emergence of the Climate Change Signal: From the Familiar to the Unknown. *Geophysical Research Letters*, 47, 6.
- <sup>6</sup> Schaller, N. et al. (2016) Human influence on climate in the 2014 southern England winter floods and their impacts. *Nature Climate Change*, 6, 627–634; Otto, F. et al. (2018) Climate change increases the probability of heavy rains in Northern England/Southern Scotland like those of storm Desmond—a real-time event attribution revisited. *Environ. Res. Lett.*, 13, 024006.
- <sup>7</sup> Climate Action Tracker Initiative.
- <sup>8</sup> CCC (2019) Progress in preparing for climate change: 2019 report to Parliament
- <sup>9</sup> HM Government (2019) Government response to the Committee on Climate Change: 2019 report to Parliament, Progress in preparing for climate change
- <sup>10</sup> CCC (2020) Reducing UK emissions: Progress Report to Parliament
- <sup>11</sup> HM Government (2020) Government Response to the Committee on Climate Change's 2020 Progress Report to Parliament: Reducing UK emissions

# Chapter 2

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## Natural Environment

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## 2.1 Introduction

**This chapter considers progress in adapting the natural environment to climate change including both natural capital assets, and the ecosystem services they provide.**

The structure of this chapter follows the Natural environment and natural assets chapter in the Evidence Report for the 2021 UK Climate Change Risk Assessment. Its focus is the protection of the natural environment and goods and services that are provided directly from land, water and sea. Some of these services are covered in other chapters. For example, the business chapter covers a range of other provisioning services (minerals, energy); flood regulatory services are also covered in the infrastructure chapter; while water appears in several chapters across the report. Supporting services such as biodiversity and soil quality cut across all priorities so are not separately identified. Cultural services are not included in this discussion. The natural environment priorities covered in this chapter and their place in a natural capital framework are set out in Table 2.1.

**Table 2.1**  
Natural environment chapter priorities

Natural capital assets including biodiversity	Regulating services	Provisioning services
Terrestrial habitats and species Farmland habitats and species Freshwater habitats and species Marine and coastal habitats and species	Water management	Agricultural productivity Commercial forestry Commercial fisheries and aquaculture

Source: CCRA3 Technical Report

**The natural environment is critical for adaptation because all other sectors ultimately depend upon it.**

Many of the services that the natural environment provides not only underpin human well-being and economic activity, but are also key to societal resilience to climate change. They support livelihoods and economies, help to moderate the climate itself, and offer protection from climate-related impacts such as storms, landslides and flooding. This was recognised in the UK National Ecosystem Assessment<sup>1</sup>, which noted that appreciation of the full value of ecosystem services requires recognition of values that are shared.<sup>2</sup> For instance, the annual non-market benefits (e.g. recreation, carbon sequestration, pollution removal, urban cooling) of UK woodland were found to exceed the market benefits of timber by approximately 12 times.<sup>3</sup>

The type and scale of ecosystem services vary across contexts and scales. Provisioning services deliver resources (e.g. food, fibre) for economic activities such as agricultural production, fishing, timber and water supply.

Many of the services that the natural environment provides not only underpin human well-being and economic activity, but are also key to societal resilience to climate change.

<sup>1</sup> Estimate should be interpreted as the minimum value of the habitat, as a number of 'non-market' ecosystem services that support the valuation are not currently measured.

At local to catchment scales, ecosystems contribute to regulating water flow and flooding, water quality, soil quality and retention, the spread of pests and diseases, and help to moderate direct climate-related impacts. At the regional to global landscape scales, ecosystems provide climate regulation through carbon sequestration.

Supporting services, such as biodiversity and nutrient cycling, contribute to well-being and resilience by underpinning ecosystem function. Cultural services such as recreation are central to health and human well-being and contribute to economic activities like tourism. The Covid-19 pandemic has increased awareness of the value of cultural services, such as access to the natural environment and the benefits it provides for mental and physical well-being.

There remains only limited evidence of natural capital being considered in Government policy design, incentives for better environmental management and appraisal.

There are a growing number of practical tools that support this approach. For example, the Enabling a Natural Capital Approach (ENCA) online tool<sup>4</sup> provides practical advice, and easy access to data and references to better understand natural capital and how to take it into account. Accounting for natural capital has also influenced the long term thinking behind the 25 Year Environment Plan for England, and other advice from the Natural Capital Committee. However, there remains only limited evidence of natural capital being considered in Government policy design, incentives for better environmental management and appraisal.

### **Integrated, ecosystem-based approaches or nature-based solutions can contribute to adaptation for the natural environment and other sectors.**

Nature-based solutions (NbS) can help build the resilience of the natural environment to climate change impacts through delivering actions to protect, sustainably manage and restore natural or modified ecosystems in both urban and rural areas. For example, green and blue infrastructure are an increasingly important adaptation measure and generate a range of benefits both for wildlife (e.g., through habitat creation) and human health (e.g., reducing the Urban Heat Island effect, providing shading and surface water flood resilience; providing recreational opportunities; as well as potentially improving air quality).

### **Effective planning for Net Zero can also deliver climate change adaptation and wider environmental goals.**

There are both risks and opportunities from the effects of a changing climate for the natural environment and its contribution to Net Zero. It is vital that the impacts of climate change risks on the natural environment and its ability to contribute to mitigation are incorporated in the delivery of mitigation measures. For instance, peatlands are critical for carbon storage and water regulation. If peatlands are not in good condition, they are at much higher risk of degradation and carbon loss as the climate changes, as well as not delivering its other benefits.

It is vital that the impacts of climate change risks on the natural environment and its ability to contribute to mitigation are incorporated in the delivery of mitigation measures.

In addition, mitigation measures such as new tree and hedgerow planting, catchment-sensitive farming and peatland restoration have important benefits for building climate resilience. However, careful planning about species mix, location and management actions is necessary for such measures to deliver planned greenhouse gas removals as the climate changes. The Government must therefore ensure the future local climatic and ecological context is considered when implementing the measures. The changes that are needed will vary across the country because climate change impacts will vary spatially, as well as the quantity and condition of natural capital assets, local needs and demands.

### **The Government should leverage private sector financing to support climate adaptation and resilience activities.**

Government alone will not be able to finance the costs of addressing the adverse impacts of climate change, as well as fund the innovations needed to capitalise on any potential opportunities.

Environmental restoration and management to build climate resilience at the landscape level will result in private benefits as well as public goods. For many of these, specifically in the areas of flood risk management, carbon sequestration and water quality improvements, it is critical to encourage private investment alongside Government funding (e.g. such as through the Environmental Land Management schemes), in order to deliver the scale of transformation in land use and management that is required. Combining public sector funds with private sector capital (blended finance) could offer the potential to scale up the deployment of projects that deliver multiple environmental benefits, including climate change adaptation. The Government's Green Finance Strategy also looks to address this through aligning private sector financial flows with clean, sustainable and resilient economic growth.

However, further work in this area is needed if the scale of the challenges from climate change in England are to be met. The Government should encourage private sector participation in climate change adaptation activities through expanding its portfolio of blended, innovative funds and facilitating risk-sharing.

### **Monitoring the effectiveness of actions in the face of changing climate risks will be vital to assess how the extent and condition of the natural environment and the services it provides change over time.**

Research into developing more sophisticated metrics for the natural environment is urgently needed to help inform on how ecosystems and biodiversity are changing due to climate change, and the components or functions that are most vulnerable to climate change, so that adaptation responses can be better focussed.

Some of the indicators used in this chapter to assess changes in risk and effectiveness of adaptation plans are based around the Lawton principles, established in 2010, for improving the resilience of the natural environment by making habitats 'bigger, better, more numerous and more joined up'. Habitat condition and species abundance (whether impacted by climate change or not) are used as proxy indicators for the vulnerability of biodiversity as a whole, as they give a sense of how 'under pressure' different systems already are. However, this enables only a simplistic assessment of progress. As noted in chapter 1, research into developing more sophisticated metrics for the natural environment is urgently needed to help inform on how ecosystems and biodiversity are changing due to climate change, and the components or functions that are most vulnerable to climate change, so that adaptation responses can be better focussed.

### **There must be no regression in existing environmental protections.**

Any changes to existing environmental regulations must only proceed after consultation with experts such as Natural England and the new Office for Environmental Protection.

Our 2019 report identified a range of legislation designed to help protect the natural environment in England, several of which contain key mechanisms for reducing climate risks. The current lack of a non-regression commitment within the Environment Bill increases the danger of backsliding on environmental standards. The Government has tabled amendments to the Environment Bill to re-focus the habitats regulations to domestic priorities, including new secretary of state powers to amend the existing EU regulations. Ensuring the condition of all conservation areas, the wider countryside and urban environment are maintained is an important adaptation goal as set out in the Lawton Review noted above. Any changes to existing regulations must only proceed after consultation with experts such as Natural England and the new Office for Environmental Protection. Furthermore, to ensure that environmental protections are maintained in the future, the government should reaffirm in law its commitment to international nature conventions.

## 2.2 Terrestrial habitats and species

Progress summary – Terrestrial habitats and species		
2019 score:	What has changed since 2019:	2021 score:
3	<p><b>Plan score: medium</b></p> <ul style="list-style-type: none"> <li>The Government has published England action plans for peat and trees, while a range of other plans are in development (nature, soil health, plant health biosecurity). These should both individually and collectively help improve resilience of terrestrial habitats, but each must include careful consideration of future climate change.</li> <li>The Government has increased spending in biodiversity and climate change, however, it is unclear if funding levels will be sufficient to meet all commitments. Environment Improvements plans (EIPs) mandated under the Environment Bill still need to clearly outline measures to ensure plans meet the 25-year Environment Plan goals. EIPs must integrate climate risks into the delivery of all plan outcomes, and include actions that reduce vulnerability and exposure to climate change.</li> <li>Without statutory interim targets, linked to long-term targets, future EIPs risk becoming aspirational.</li> </ul> <p><b>Risk management score – low</b></p> <ul style="list-style-type: none"> <li>Metrics to monitor the vulnerability of terrestrial habitats and species continue to show slow progress or a decline. The majority of targets set out in the Government's Biodiversity 2020 strategy have not been met, with many falling well short.</li> </ul>	3
<p>Notes: See annex for full datasets            Key Indicators: Terrestrial SSSIs in England, by condition, Peatland SSSIs in England, by condition, Measure of woodland resilience to climate change, Woodland species indices: breeding birds in woodland in England, Number of Wildfire incidents</p>		

This adaptation priority covers semi-natural habitats classed by Natural England as terrestrial - woodlands, grasslands, heath, montane habitats and bogs, which together represent just over a quarter of total land cover in England.\* It excludes enclosed farmland and extensive grassland used for farming, which is covered in section 2.3. We consider trees in terms of woodland habitats here, but their provisioning services in section 2.6.

As with our previous progress reports, we have measured the vulnerability of biodiversity to climate change based on the principles set out in the Lawton Review (2010).† The high-level findings of the review suggested that habitats need to be in good condition, bigger, better and more joined up in order to have a greater chance of allowing the species they support to adapt naturally as the climate changes.

\* Based on ONS UK Natural Capital Land Cover in the UK, 2015. Total semi-natural terrestrial habitats comprise semi-natural grassland; broadleaf and conifer woodland; shrubland, bushland, heathland, barren; and sparsely vegetated areas.

† See a fuller description of the Lawton principles in CCC (2013) *Managing the land in a changing climate*.

We assess progress in adaptation as related to the changing condition and size of the habitats, but condition data is only available for Sites of Special Scientific Interest (SSSIs), which are a small percentage (ca.20%\*) of the overall area of terrestrial habitats covered in this chapter.

## Summary of 2019 report score

### **Terrestrial habitats and species scored a 3 rating in our 2019 report (medium plan score, low risk management score).**

Our 2019 report noted that whilst plans are in place, the measures outlined in them were not specific, with the effectiveness of many actions difficult to assess, especially for climate change adaptation. Furthermore, targets contained in the plans were narrow in scope and did not include all priority terrestrial habitats. There was evidence of actions being taken to restore species, habitats and ecosystems, but most were in the early stages of development.

## Has the plan score changed?

### **No. The plan score remains medium.**

### **It is as yet unclear how risks from climate change and actions to address them will be incorporated into plans for improving the condition of terrestrial habitats and species.**

A new range of separate action plans including those for peat and trees were recently published, or are being developed by Government, which should help build the resilience of terrestrial habitats. However, more detail is needed on how the different strategies will combine to support the Government's climate change adaptation goals.

### **There are several plans for the natural environment that should individually and collectively help to improve the resilience of terrestrial habitats and species.**

Restoration of peatlands, alongside woodland planting, was identified as a priority climate action measure in the CCC's Sixth Carbon Budget report.<sup>5</sup> The Government has now published separate actions plans for peat and trees in England.

#### **England Peat action plan**

Unless addressed in advance, some of the downside risks of climate change could result in irreversible loss of upland peat areas in England.<sup>6</sup>

The England Peat Action Plan reiterates the 25-Year Environment Plan (25-YEP) commitment for all of England's soils to be managed sustainably by 2030. Under the plan, a new Nature for Climate Peatland Grant Scheme (part of a broader £640m Nature for Climate Fund) will support the restoration of 35,000 hectares of degraded peatland in England, backed by over £50 million in funding between 2021 and 2025. While this is a step in the right direction, the scale of restoration targeted relates to only around 5% of total peatland area in England. Of this, 15% of the area restored by 2025 will involve the restoration of lowland agricultural land to peat habitat. It is not clear what the target will be beyond 2025.

\* 20% England figure calculated as semi-natural terrestrial SSSIs published by Natural England (<https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx>) as a proportion of the total area of semi-natural habitats published in ONS UK Natural Capital Land Cover in the UK, 2015.

As outlined in the Plan, the sale of peat in compost for the amateur horticultural market will be banned in England by 2024, subject to a consultation later in 2021 on a range of legislative measures to achieve this. The consultation will also consider the ban on peat for the professional market. There are no new actions in relation to ending peat extraction in England. The Plan also does not contain any new actions to prevent the rotational burning of upland peat areas, in addition to the partial ban legislated with effect in 1st May 2021, which relates only to certain protected blanket bog sites. However, the government will keep under review the environmental and economic case for extending the approach to additional areas of blanket bog after assessing how the new regime works in practice (see below).

#### Recommendation (see CCC 2021 Joint Progress Report)

Extend current ambition set out by the UK government and the devolved administrations to implement a comprehensive delivery mechanism to address degraded peatland (hectares given are for the UK):

- 17% of upland peat is restored, equivalent to 200,000 hectares (and where this is not possible, stabilise the peat) by 2025; 58% by 2035 (700,000 hectares) and the remaining area by 2045;
- Rewet and sustainably manage 12% of lowland peat used for crops by 2025 (24,000 hectares), rising to 38% by 2035 (72,000 hectares);
- Rewet 8% of lowland grassland area by 2025 (18,000 hectares), rising to 25% by 2035 (54,000 hectares);
- Remove all low-productive trees of less than YC8 off peatland (equivalent to 16,000 hectares by 2025), and restore all peat extraction sites by 2035 (equivalent to 50,000 hectares by 2025).

Department: Defra, Timing: 2021-2025

#### Soil Health action plan

To help achieve the Government's commitment for all of England's soils to be managed sustainably by 2030, Defra are considering the potential scope for a soil health action plan as an appropriate means of supporting land managers and farmers. While broader in scope, since it will cover all soils in England, the draft Plan would be complementary to the England Peat Action Plan.

The draft plan will include developing and implementing a number of actions that support sustainable soil management and implementing new measuring and monitoring schemes for soil health. For example, the Sustainable Farming Incentive (SFI) will support sustainable approaches to farm husbandry to deliver for the environment. Plans also include developing a new Soil Health Monitoring Scheme (SHMS) for England to produce a new robust data baseline. A healthy soils indicator will be developed to feed into the SHMS and will inform a future target for soil health under the Environment Bill. Separately, a new Soil Structure Measuring and Monitoring Scheme is being developed to enable visual assessments to be carried out by farmers and land managers across all land use/soil types.

#### England Tree action plan

The CCC's land use report (2018) showed that woodland planting is a key measure for improving climate resilience; though much depends on ensuring that the right species are planted in the right location to ensure the delivery of multiple ecosystem services, in addition to carbon sequestration and storage.

Under the England Tree Action Plan, the Government will spend over £500 million of the £640 million Nature for Climate Fund on trees and woodlands between 2020 and 2025. The funding will support a trebling of current woodland creation rates, equating to ca. 7,000 ha per annum out to 2025. According to the Forestry Commission, this is broadly consistent with the Government's aspiration to increase woodland cover in England from 10% presently to 12% of total land area by 2060, but the expansion rate would need to be maintained to mid-century. Woodland expansion will include conventional planting in urban and rural areas (including trees on farms), as well as natural colonisation. To incentivise more biodiverse woodlands, higher payment rates will be offered to landowners creating predominantly native broadleaf woodland. Under the Woodland Creation Offer grant, a range of ecosystem services provided by woodlands will be recognised, and extra funding will be provided for planting that can deliver wider benefits such as riparian shading, biodiversity, water filtration and flood risk alleviation (see section 2.6).

The Government's new Environmental Land Management schemes will provide the main mechanism for publicly funded woodland creation after 2024. Work is being undertaken by Defra to determine the specific actions the ELM schemes will pay for, and quantify their contribution to climate adaptation. It is understood this work is being informed by detailed modelling, which will also test the resilience of these actions to climate uncertainty (see section 2.3).

### Plant Biosecurity Strategy

The 25-YEP includes a commitment to revise the 2014 Plant Health Biosecurity Strategy, which will set out the strategic framework to protect plant health in order to protect natural capital in England from invasive non-native species. The strategy was delayed due to the national election in 2019 and Covid-19 pressures, with plans now for it to be published in Autumn 2021.<sup>7</sup>

### Nature Strategy

The Government committed to a strategy for nature in England to implement commitments under the Convention on Biological Diversity (CBD). Government has already announced key elements of its strategy (e.g. on targets, legislative reform and new funding for nature based solutions) and will continue to develop its approach, including developing legally the binding biodiversity targets (see below) and updating its plans and strategies in response to the 15th Conference of the Parties to the CBD in October of this year.

### **An overarching 'wrapper strategy' would be useful to clearly outline the relationships and interactions between the multiple action plans both published and in development for the natural environment.**

This wrapper strategy should set out how the different strategies listed above will interact and combine to support meeting the Government's climate change adaptation goals, alongside broader objectives for the natural environment.

An overarching 'wrapper strategy' would be useful to clearly outline the relationships and interactions between the Government's various new action plans for the natural environment.

### Recommendation

Publish an overarching strategy that clearly outlines the relationships and interactions between the multiple action plans either published or in development for the natural environment, including those for peat, soil health, trees, nature and plant biosecurity. This must clearly outline how the different strategies will combine to support the Government's climate change adaptation goals.

Department: Defra, Timing: 2021.

**The Nature Recovery Network (NRN) is a key Government policy that will underpin the Nature strategy.**

As outlined in the 25-YEP, the NRN will aim to deliver on the recommendations of the Lawton Report that recovering biodiversity will require habitats in better condition; in bigger patches and that are more closely connected. Goals for the NRN set out in the 25-YEP include restoring 75% of terrestrial (and freshwater) protected sites to favourable condition, and creating or restoring 500,000 hectares of wildlife-rich habitat outside the protected site network, focusing on priority habitats. However, as noted in our 2019 progress report, in its current form, the 75% restoration target falls well short of the recognition in the Government's response to the CCC's 2017 report\* that much wider action is needed, in that it only applies to terrestrial protected sites. As noted above, protected sites cover only around one-fifth of the total area of semi-natural terrestrial habitats - the target should be extended to include all priority terrestrial sites.

Natural England is leading work to explore how climate change considerations can be incorporated into the NRN's design, both spatially and as a core principle. A NAP ecosystems and biodiversity group has been established to support this, which includes major landowners such as CLA, RSPB and National Trust. The group is used as a platform to discuss with a wider group of partners, issues including potential impacts under 2°C and 4°C degree global temperature scenarios.

**Recommendation**

Defra must extend its commitments outlined in the 25-Year Environment Plan. The commitment to achieve 75% restoration for terrestrial and freshwater protected sites should be extended to include all priority habitat sites.

Department: Defra, Timing: 2021.

**Legislation has been introduced to prevent the rotational burning of certain blanket bog sites in England with immediate effect.**

The partial ban applies only to protected sites† that are also a Special Area of Conservation or a Special Protection Area covering a total area of around 142,000 hectares, representing around 40% of all blanket bog in England. The England Peat Action Plan notes that the Government will continue to review the environmental and economic case for extending the approach to additional areas of blanket bog after assessing how the new regime works in practice. However, this ban is less ambitious than the recommendation set out in the CCC's Sixth Carbon Budget Advice<sup>8</sup> that all rotational burning in England should cease immediately.

**Recommendation (see CCC 2021 Joint Progress Report)**

Introduce legislation to extend the ban on rotational burning of peat from certain protected upland bog sites to all peatland before the start of the burn season in 2021; end peat extraction, and ban its sale for all horticultural uses including in the professional sectors and apply this to imports by 2023; mandate water companies to restore peatland under their ownership; and ensure lowland peat soils are not left bare.

Department: Defra, Timing: 2021-2023

\* In its response to recommendation 6 of the CCC's 2017 report to parliament, the Government recognised the need for action to be 'taken to enhance the condition of priority habitats and the abundance and range of priority species, both on protected sites and in the wider countryside'.

† Also referred to as Sites of Specific Scientific Interest (SSSIs)

### **Natural England and the RSPB have updated their joint Climate Change Adaptation Manual.**

The manual is a resource to support practical and pragmatic decision-making, by bringing together recent science, experience and case studies, and is intended to be an accessible entry point to a range of available resources and tools. Climate impacts and associated adaptation actions are presented by habitat. The guidance emphasises the importance of considering 2°C and 4°C warming scenarios.

### **Environment Improvements Plans (EIPs) mandated under the Environment Bill will need to clearly outline measures to ensure they meet Defra's 25-year environment plan goals.**

Delivering significant improvements across the whole of the natural environment is vital to building the ecosystem resilience required to adapt to climate change. The Environment Bill creates a new statutory cycle of monitoring, planning and reporting progress, including a duty on the Government to prepare rolling Environmental Improvement Plans (EIPs)\* and set requirements for what the plans must contain. The EIPs are necessary to provide the comprehensive and long-term vision that will guide legislation and policy to deliver better protection and enhancement of the natural environment.

However, the EIPs need to be strengthened to ensure that they include time bound, specific measures, which are more explicitly linked to the delivery of the environmental outcomes outlined in the 25-YEP. Furthermore, adaptation is a necessary pre-requisite to meeting the 25-YEP goals, because climate change will prevent the goals from being met without additional adaptation.<sup>9</sup> It is vital that climate change risks are considered in the delivery of all outcomes, and actions that reduce vulnerability and exposure to climate change must also be clearly identified and incorporated into the EIPs.

### **The government has committed to increase the amount of protected land in the UK to 30% by 2030.**

The Government has suggested that 26% of land in England is already protected for nature. However, the majority of this area is not specifically designated for nature's protection. Even where there are environmental designations in place, many are poorly-managed sites that are not in a good condition for nature and have not been regularly monitored.<sup>10</sup> This suggests significantly more resources will be required than that currently estimated by Government if the target is to be delivered effectively. To help achieve the 30% commitment, all sites contributing to the target must be monitored and in favourable condition or showing demonstrable signs of ecological recovery.

### **Action-based long-term targets will not be sufficient to ensure the Government's goals for biodiversity are met.**

The Environment Bill will mandate the government to set at least one long-term target in four priority areas (air quality, resource efficiency and waste reduction, water, and biodiversity) with each required to have a minimum duration of 15-years. The ability to set more than one long-term target within a given priority area will be particularly beneficial for biodiversity where a single measure will not be sufficient; different ecosystems, habitats and species are changing in different ways.

\* The 25-year Environment Plan is the Government's current Environmental Improvement Plan

In addition to the long-term targets, Defra confirmed in May 2021 it will also introduce a separate 2030 target for species abundance. The details will be set in secondary legislation following consultation and further evidence gathering.

It is vital that a range of outcome-based long-term targets, determined through an independent, evidence-led process of expert advice, stakeholder engagement, and public consultation, are set for biodiversity.

Proposals outlined in Defra's environmental targets policy paper suggest that for biodiversity, its long-term "outcome" targets may be limited to goals concerning the restoration of protected sites, whilst relying on "actions" targets for other important habitats. As noted above, protected sites represent around ca. 20% of the area of semi-natural terrestrial habitats in England. It is vital that a range of outcome-based long-term targets, determined through an independent, evidence-led process of expert advice, stakeholder engagement, and public consultation, are set for biodiversity. Furthermore, meaningful biodiversity measures to assess progress in meeting the targets need to be agreed with standardised methods. Failure to do so risks setting arbitrary targets, which meet legal requirements but do not lead to progress towards the 25-YEP outcomes.

**The Government will be required to periodically review its long-term targets, by carrying out a Significant Improvement Test at least every five years.**

This means that the Government must consider whether meeting its long-term targets, alongside any other relevant statutory environmental targets, would significantly improve the natural environment in England. The first test will be conducted by January 2023, three months after the October 2022 deadline for the long-term priority targets to be laid before parliament.

**Recommendation**

Long-term targets for biodiversity, set out under the Environment Bill, and associated timeframes must be outcome-based and linked directly to the goals set out in the Government's 25-YEP.

Department: Defra, Timing: June 2022.

Without legally binding interim targets which are linked to clear legally binding long-term targets, it is likely that the ten 25 YEP goals and future EIPs will become aspirational.

**Interim targets should be placed on a statutory footing to compel action now.**

Interim targets will also be included in the EIPs, which will set out government's five-year trajectory, progress of which will be updated annually. However, the interim milestones are non-mandatory meaning there is nothing to compel the Government to act now to meet targets, or to take future remedial action where targets are missed. Without legally binding interim targets which are linked to clear legally binding long-term targets, it is likely that the ten 25 YEP goals and future EIPs will become aspirational.

**Recommendation**

Interim targets for biodiversity must be made statutory and linked clearly to the long-term targets set out in the Environment Bill.

Department: Defra, Timing: June 2022.

Has the risk management score changed?

**No, the score remains low.**

**Indicators available to monitor the vulnerability of priority terrestrial habitats and species show no progress, or a decline. The majority of targets set out in the Government's Biodiversity 2020 strategy have not been met, with many falling well short.**

Indicators available to monitor the vulnerability of priority terrestrial habitats and species show no progress, or a decline.

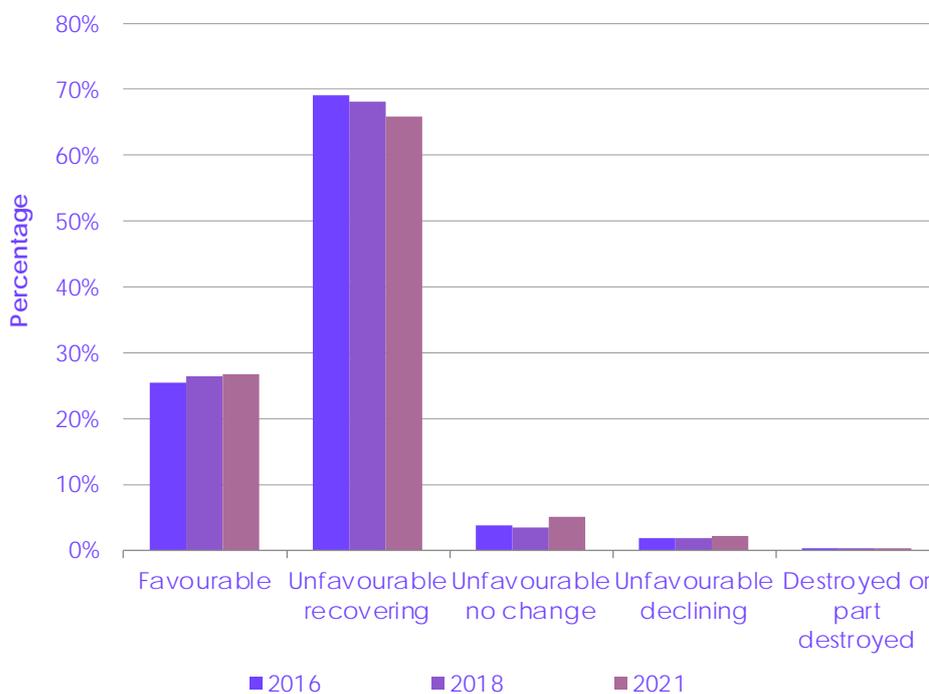
Changes in habitat condition and species abundance (whether impacted by climate change or not) act as proxy indicators for the vulnerability of biodiversity as a whole, as they give a sense of how 'under pressure' different systems already are. This aligns to the idea in the Lawton Review that ecosystems will withstand the risks from climate change more effectively if other pressures on them are reduced.

The Biodiversity 2020 strategy<sup>11</sup> contained a goal to achieve at least 50% of sites of special scientific importance (SSSIs) in favourable condition, while maintaining at least 95% in favourable or recovering condition.

**There has been little change in the condition of terrestrial SSSIs.**

The proportion of terrestrial SSSIs\* in England classed as in either 'favourable' or 'unfavourable recovering' condition declined from around 94% in 2016 to around 93% in 2021 (see figure 2.1). Within that, protected sites classed as in 'favourable' condition increased by 2% over the same period, although these represent only 27% of total terrestrial sites.

**Figure 2.1 Terrestrial SSSIs in England, by condition**



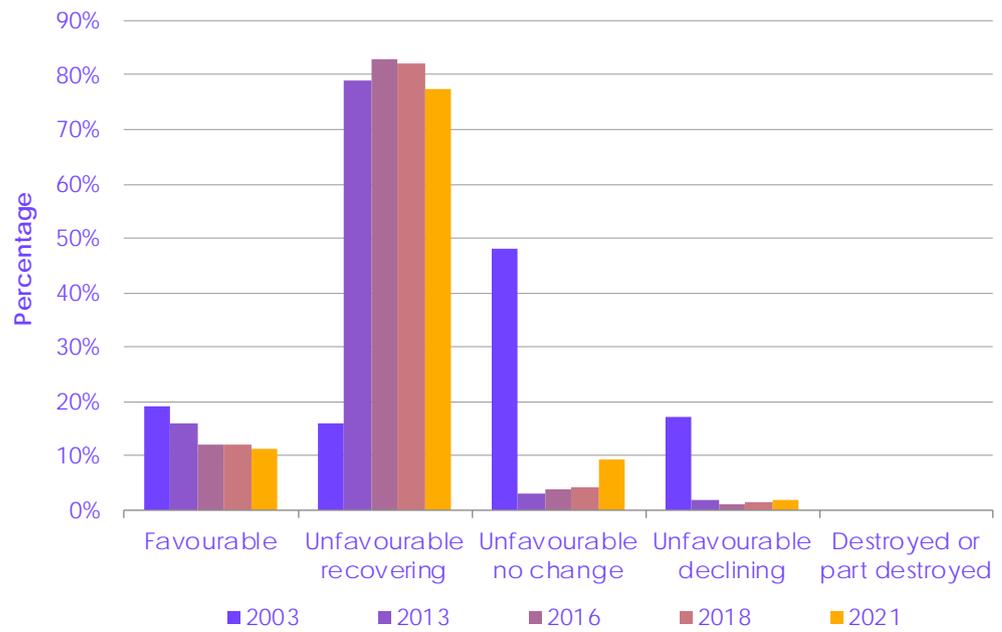
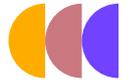
Source: Natural England, <https://designatedsites.naturalengland.org.uk/NE/interimReports/ConditionByHabitat.aspx>

**The percentage of upland peat SSSIs in favourable or unfavourable recovering condition has dropped since 2016.**

Approximately half of upland peatland in England are designated as SSSIs (51% as at 2018).<sup>12</sup> Since 2016, there has been a decrease in the area of upland peat blanket bog SSSI sites classed as in 'unfavourable recovering', down from 83% to 78% in 2021 (figure 2.2). This has coincided with an increase in sites classed as 'unfavourable no change', up from 4% in 2016 to 9% in 2021.

\* Also referred to as protected sites.

Figure 2.2 Upland blanket bog SSSIs in England, by condition



Source: For 2016 to 2021 data see Natural England: <https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx>  
 For 2003 and 2013 data, see ECI (2013) for the CCC, Assessing preparedness of England's natural resources for a changing climate

**Without routine national monitoring of soil condition in England, it is difficult robustly assess the progress being made in managing vulnerability to climate change.**

The last national assessment of soil condition in England was published as part of the 2007 Countryside Survey, while the National Soil Inventory, which also covers soil condition, was last conducted 2003. As noted above, draft proposals for the soil health action plan indicate it will include a number of actions that support sustainable soil management and implementing new measuring and monitoring schemes for soil health

Without routine national monitoring of soil condition in England, it is difficult robustly assess the progress being made in managing vulnerability to climate change.

As part of the Nature for Climate Fund (see above) initiative Defra has commissioned a project to deliver an updated peatland map. The project's aim is to map England's peatlands by determining peat location, depth, condition and extent to improve spatial prioritisation of restoration work and more accurately estimate greenhouse gas emissions. The peatland map is scheduled to be delivered by 2024 and will form a part of the England Peat Action Plan.

UK CEH also started a scaled down version of the Countryside Survey in 2019, using a UKRI-NERC- funded research platform with an annual rolling program to measure soils and vegetation repeated every five years.

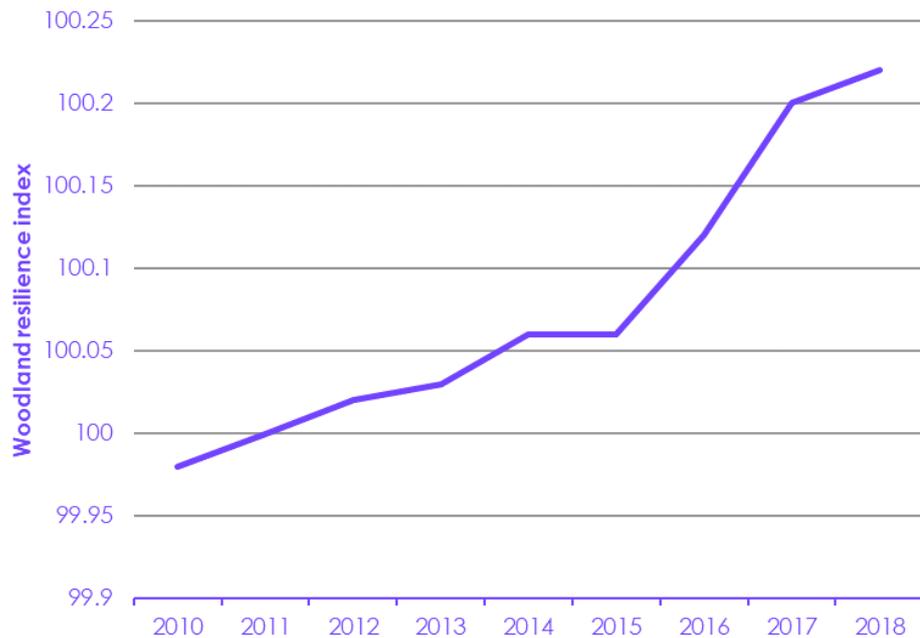
The aim is to revisit all the grid squares surveyed in 2007 survey, but with a reduced set of measurements, focusing on plant monitoring and soil sampling for basic soil chemistry. The impact of Covid-19 has caused delays to the survey since 2020, although it is understood it has recommenced.

**Some progress appears to have been made in improving woodland connectivity.**

Maintaining and improving connectivity is important in promoting biodiversity in a fragmented landscape, especially under a changing climate. However, it is very challenging to measure at the national scale.

The Forestry Commission has made some progress in this area, through its woodland resilience indicator, measured as the size and spatial configuration (i.e. connectivity) of patches of forests and woodlands, relative to 2011 values (assigned as 100). This indicator shows a consistent year-to-year increase in connectivity for forests and woodlands in England between 2011 and 2018 (figure 2.3).

Figure 2.3 Measure of woodland resilience to climate change



Source: Forestry Commission

Notes: Area of woodland created with support from the Rural Development Programme for England: both the English Woodland Grant Scheme (EWGS) and the Countryside Stewardship incentives. Areas of private-sector funded planting or planting supported by other Government funding streams are relatively small and not included.

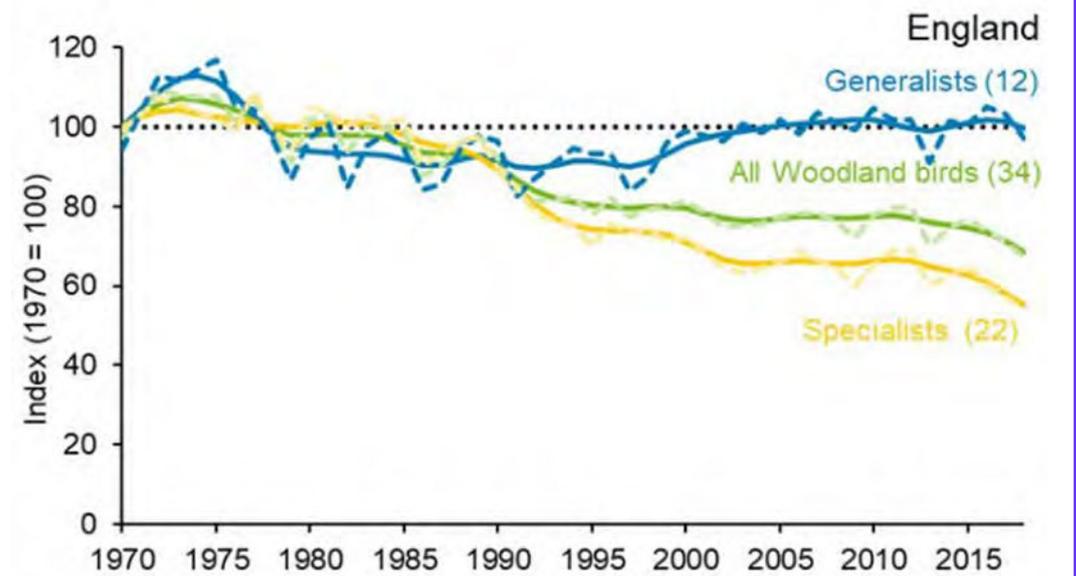
### Woodland bird species diversity is still declining.

Woodland ecosystems that are less diverse are less resilient to changes in climate, and indeed, other pressures. Species groups such as birds and butterflies provide a good indication of the broad state of the natural environment

Woodland species indicators suggest declining trends for both the long-and short-term.

Woodland species indicators suggest declining trends for both the long-and short-term. Between 1970 and 2018, the index for woodland bird specialists declined by 45% while the index for woodland bird generalist species increased by 3% (see figure 2.4). The long-term decline of the woodland bird indicator in England has been mostly driven by the decline of specialist woodland birds such as willow tit, spotted flycatcher and lesser redpoll (species restricted to or highly dependent on particular woodland habitats). A recent report by the Woodland Trust<sup>13</sup> also found just 7% of Britain's native woodlands are currently in good ecological condition.

Figure 2.4 Specialist and generalist woodland birds in England



Source: Defra biodiversity indicators 2020 update.

Notes: 1. The line graph shows the unsmoothed trends (dashed lines) and smoothed trends (solid lines). 2. The figures in brackets show the number of species in each index.

**There has been an increase in the number of wildfires and area burnt between 2015 and 2019.**

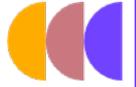
Wildfire is an emerging risk that requires more attention in adaptation planning, so we include it as an impact indicator here.<sup>14</sup>

The number of recorded wildfires in the natural environment have increased significantly since 2015.

Delays due to COVID-19 mean Forestry Commission has not been able to produce an update on wildfire statistics since the 2016-17 reference period. However, UK-wide data from the European Forest Fire Information System (EFFIS) suggest that the number of recorded wildfires have increased over the last few years, from less than 20 during 2015 to 2017, increasing to 79 in 2018 and 137 in 2019.<sup>15</sup> These data concur with analyses of Forestry Commission wildfire statistics data for England published in our 2019 progress report. In terms of the UK area burnt by wildfires, this has increased significantly in the last few years, from around 2,000 hectares in 2015 to 18,000 hectares in 2018 and 29,000 hectares in 2019 (figure 2.5).

The majority of the area burnt each year was classified as 'other natural land' and accounted for around 95% across each of the five years (2015-2019). This suggests that the majority of large wildfires over 30 hectares in size occur in natural habitats, rather than e.g. agricultural land.

Figure 2.5 Total UK wildfire area burnt, per annum, split by land cover class.



Source: ADAS for the CCC (2021) *Research to update indicators of climate-related risks and actions in England*.  
Notes: Area burnt (hectares) by wildfires larger than 30 hectares in size.

## 2.3 Farmland habitats and species

Progress summary – Farmland habitats and species		
2019 score:	What has changed since 2019:	2021 score:
1	<p><b>Plan score - low</b></p> <ul style="list-style-type: none"> <li>The forthcoming Environmental Land Management scheme has the potential to form a comprehensive plan to improve the resilience of the farmed countryside to climate change. The scheme's three-level design and the focus on 'payments by results' should support this. However, plans to date indicate adaptation is still not given sufficient consideration: it is not clear how climate risks will be incorporated in the delivery of private and public good outcomes, while explicit payments for actions that reduce vulnerability to climate change are still limited to flood risk.</li> </ul> <p><b>Risk management score – low</b></p> <ul style="list-style-type: none"> <li>Long-term downward trends in abundance indicators for key farmland species suggest agri-environment schemes have had only limited impact on managing pressures on biodiversity to date. Habitat condition indicators show the proportion of protected farmland habitats in favourable/ improving condition remains relatively high, but they only represent ca.1% of total farmland areas.</li> </ul>	1
<p>Notes: See annex for full datasets            Key Indicators: SSSIs in the farmed countryside, by condition, Changes in abundance of species (birds, butterflies) in the farmed landscapes (England), Changes in abundance of plant species in arable farmland habitat types (UK) –Experimental</p>		

The farmed countryside is the largest land use class across the UK, occupying around 70% of land area.<sup>16</sup> It is exposed similarly to the current and future pressures from climate change as those facing the terrestrial habitats and species priority. However, farmland areas are also exposed to significant other pressures from agricultural practices meaning they are likely to be highly vulnerable to climate change, hence we assess them separately.

### Summary of 2019 report score

**In our last report, Farmland habitats and species scored a 1 (low plan score, low risk management score).**

Our 2019 progress report highlighted that the adaptation plans in place for the farmed countryside would not be sufficient to address the risks identified in the Second UK Climate Change Risk Assessment. On progress in managing risk, we highlighted that the decline in abundance for key species in the farmed countryside suggest Agri-Environment schemes had had limited impact on managing pressures on biodiversity.

### Has the plan score changed?

**No, the plan score remains low.**

**While the Environmental Land Management scheme (ELM) has the potential to foster a sustained improvement in the condition of farmland habitats and species, plans to date indicate climate change adaptation is still not given sufficient consideration.**

Plans to date for the Government's proposed Environmental Land Management scheme indicate climate change adaptation is still not given sufficient consideration.

As outlined in the Government's second national adaptation programme (NAP2), the Government is currently working to develop a new long-term land management payments strategy to replace the former Common Agricultural Policy (CAP). The Environmental Land Management (ELM) scheme set out in the Agriculture Act 2020 will be a key mechanism in supporting the Government to improve the condition of the farmed countryside. Under current plans, the ELM scheme aims to deliver outcomes under six categories of public goods as identified in the 25-YEP: clean air, clean and plentiful water, thriving plants and wildlife, reducing risk from environmental hazards, mitigating and adapting to climate change, and enhanced beauty, heritage and engagement with the natural environment. Activities to improve and protect soil health will be central to delivering on these goals, although current plans do not include it as an outcome in itself. Existing plans for the scheme propose a three-scheme payment structure, with each one targeting a different geographic scale: These comprise:

- Sustainable Farming Incentive Scheme; pays farmers and land managers for actions taken (beyond regulatory requirements) to manage land in an environmentally sustainable way.
- Local Nature Recovery Scheme; pays for actions that support local nature recovery and deliver local environmental priorities. The focus is ensuring the right things are delivered in the right places.
- Landscape Recovery Scheme; supports the delivery of landscape and ecosystem recovery through long-term, land use change projects. This includes projects to restore wilder landscapes in places where that is appropriate, large-scale tree planting, peatland and salt marsh restoration projects.

The piloting and implementation of the three future schemes will be funded by gradual reductions in current Basic Payment Scheme\* payments between 2021 to 2027.

**ELM has the potential to form a comprehensive plan to improve the resilience of biodiversity in the farmed countryside to climate change.**

The three-level scheme design and the focus on 'payments for outcomes' (e.g. clean water) should support this. In particular, the Local Nature Recovery and Landscape Recovery schemes have the potential to drive systemic change, while the broader landscape focus of the latter could help deliver mitigation and adaptation co-benefits.

**The Government must build adaptive capacity through ensuring the local context is considered in ELM.**

The best use of land to support the delivery of public goods will vary depending on the local ecological and geographical context. The changes that are needed will differ across the UK because the effects from climate change will vary spatially, as well as the quantity and condition of natural capital assets, local needs and demands. For instance, as noted in section 2.1, carefully considered tree planting that ensures the right trees are planted in the right places can help deliver the Government's objectives for adaptation and mitigation. However, it is not yet clear how this spatial element of ELM will work.

The Government must build adaptive capacity through ensuring the local context is considered in its Environmental Land Management Scheme.

\* The Basic Payment Scheme (BPS) is the European Union's rural grants and payments to help the farming industry under the Common Agricultural Policy (CAP)

**It is vital that ELM design recognises adaptation as a necessary pre-requisite to meeting the scheme's other public good outcomes, and this is reflected in actions the schemes will pay for.**

Mitigating and adapting to climate change is one of the six environmental public goods that will be rewarded under the ELM schemes to contribute to delivering the 25-Year Environment Plan (25-YEP). Work is being undertaken to determine the specific actions the schemes will pay for, and quantify their contribution to mitigating and adapting to climate change alongside other policy levers. Defra has confirmed that this is being informed by detailed modelling, which will also test the resilience of these actions to climate uncertainty. Previous analysis by the CCC<sup>17</sup> has shown how difficult this is to do at a national level and that providing the right tools for local decision making may be a better approach from an adaptation perspective. Further details on the schemes will be published later in 2021.

**An integrated response to climate change, agriculture and the environment is needed.**

ELM must sit within a wider suite of climate and environmental policies. Defra has yet to set out how ELM, the Environment Bill, the 25-YEP and various policies planned for trees, peatlands and biodiversity will fit together. As noted in section 2.2, it is unclear how the different strategies together will support the Government's climate change adaptation goals.

**Defra has reported ongoing targeting of Agri-Environment Schemes (AES), such as Countryside Stewardship, on the maintenance and restoration of special sites of scientific interest (SSSIs) to deliver favourable condition of farmed habitats.**

Several research projects have been completed to evaluate and clarify the extent to which different factors may be inhibiting or masking the progress towards shifting SSSIs in AES to favourable condition, with a view to improving the implementation of current schemes and informing the development of future AES.<sup>18</sup> NAP2 also includes an action to conduct research on the resilience of AES to climate change, which has been completed. While there is evidence to suggest the range of activities incentivised through AES are making some contribution to improving the resilience of the farmed countryside,<sup>19</sup> biodiversity indicators for Farmland species show continuing declines in populations (see below). With the farmed countryside representing over two-thirds of land cover in England, analysis of progress is hindered by the same issues around monitoring as terrestrial habitats and species (section 2.2).

**The England Peat Action Plan includes activities to restore over 5,000 hectares of lowland agricultural land.**

Under the Plan, the Government has committed to restoring 35,000 hectares of degraded peatland in England by 2025. Of this, the Government's aim is for 15% of the area restored by 2025 to involve the restoration of lowland agricultural land to peat habitat. This compares to the CCC's recommendation in its Sixth Carbon Budget report for the restoration of 8,000 hectares of lowland peat by 2025.

Has the risk management score changed?

**No, the risk management score remains low.**

**Indicators show there has been no reversal in the long-term downward trend in abundance indicators for key farmland species, suggesting AESs have had only limited impact on managing pressures on biodiversity to date.**

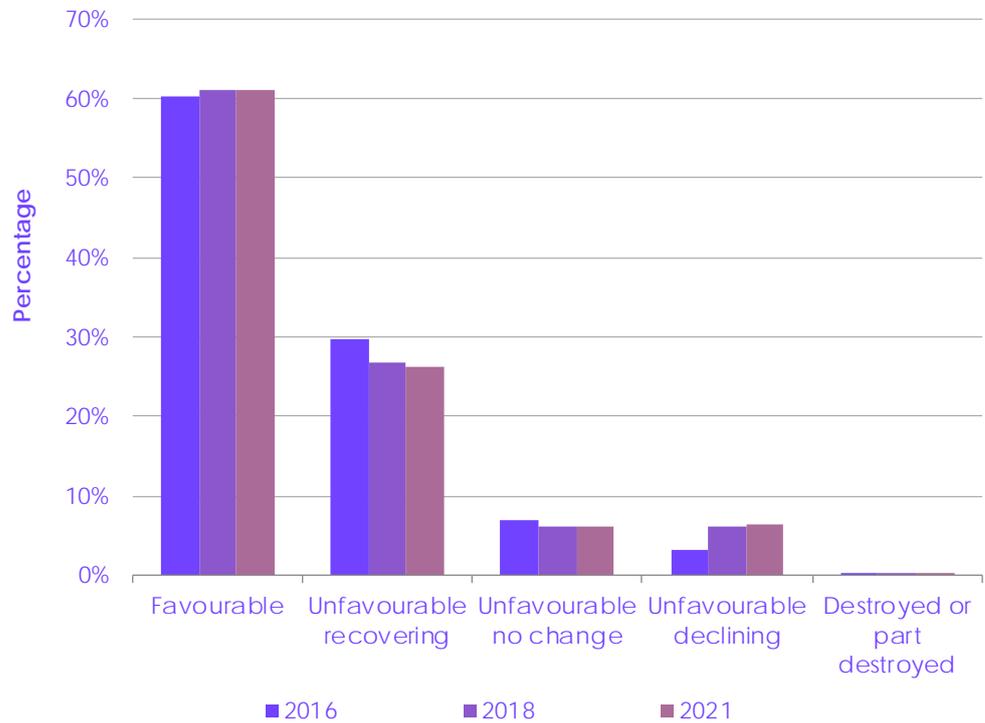
As noted above, the vast majority of land in England is farmed in some way<sup>20</sup> – so how this land is managed has a big impact on its condition and resilience to climate change.

It is vital that ELM design recognises adaptation as a necessary pre-requisite to meeting the scheme's other public good outcomes, and this is reflected in actions the schemes will pay for.

Data available on the percentage of SSSIs in the farmed countryside that are in favourable or unfavourable recovering condition remains relatively high (87%). However, designated sites such as these represent a very small proportion (less than 1%)<sup>21</sup> of the total area of farmed habitats (figure 2.6).

Indicators show there has been no reversal in the long-term downward trend in abundance indicators for key farmland species.

**Figure 2.6 Farmland SSSIs in England, by condition**

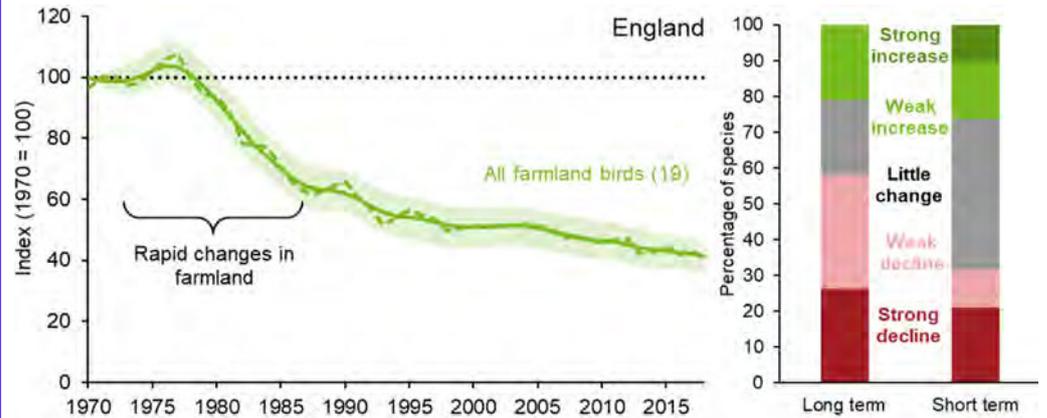


Source: Natural England, <https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx>

**Breeding bird numbers on farmland in England are less than half the levels recorded in 1970.**

According to the Lawton principles, habitats need to be in good condition, bigger, and more joined up in order to have a greater chance of allowing the species they support to adapt naturally as the climate changes. Species groups such as birds and butterflies provide a good indication of the broad state of the farmed environment. In 2018, the England farmland bird index was less than half (43%) of its 1970 value (see figure 2.7). The majority of the decline occurred between the late 1970s and early 1980s at a time of rapid changes in many farmland management practices. Declines have continued in recent years, albeit at a slower rate.

Figure 2.7 Breeding birds on farmland in England



Source: Defra biodiversity indicators 2020 update.

Notes. 1. The line graph shows the unsmoothed trend (dashed line) and the smoothed trend (solid line) together with its 95% confidence interval (shaded). 2. The figure in brackets shows the number of species in the index. 3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change, based on set thresholds of annual change.

**Hedgerow habitats support resilience of the farmed countryside to climate change, but the absence of current data mean it is not possible to assess recent trends in their condition.**

Hedgerows are an important feature of agricultural landscapes. They deliver a range of biodiversity benefits by providing food and shelter for a range of birds, insects and mammals. They also facilitate movement through the landscape by providing respite for organisms such as flying insects.<sup>22</sup> Hedgerows also provide wider environmental benefits and regulatory services such as increasing water quality and regulation, increasing air quality, reducing flood risk, reducing soil erosion, maintaining climate regulation through carbon sequestration, and promoting pollination and pest control by providing habitat for pollinators and predators of crop pests. By acting as a physical barrier at a field edge, hedgerows are able to reduce the amount of fertiliser, pesticides and sediment, which may be included in surface water run-off, from reaching watercourses. They can also contribute to managing the flow of water run-off, which can support in reducing peak flows and the risk of flooding across the catchment.

Managed hedgerows provide significant value, both to farmers and wildlife, however, if these are neglected the value can greatly reduce or become negligible.<sup>23</sup> Similarly, where hedgerows are lost, the benefits associated with the hedgerows are lost alongside this, which can have negative impacts for biodiversity and regulatory services, and also result in an increase in carbon emissions.

In 2006, it was estimated that only 22% of the UK’s hedgerows were in a favourable state.<sup>24</sup> Furthermore, between 1984 and 2007, there was a 24% decrease in the length of ‘managed’ hedgerows in Great Britain. However, the absence of recent data on the condition and extent of hedgerows in England means that it is currently difficult to determine whether progress is being made in managing the vulnerability to climate change of this vital farmland habitat.

## 2.4 Freshwater habitats and species

Progress summary – Freshwater habitats and species		
2019 score:	What has changed since 2019:	2021 score:
5	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The score has remained at medium. The Environment Agency has incorporated findings from national level risk assessments that consider climate impacts under 2°C &amp; 4°C scenarios into the River Basin Management Plan revisions process. However, current plans still do not give adequate consideration of risks to freshwater habitats from higher water temperatures and there is still no clear mechanism that accounts for the consequences of reductions in quality or flows due to climate change in meeting Government targets.</li> </ul> <p><b>Risk management score – low</b></p> <ul style="list-style-type: none"> <li>The score has changed to low from medium. Available freshwater species metrics indicate populations remain stable. However, there has been a recent decrease in the proportion of protected freshwater sites in ‘favourable’ or ‘unfavourable recovering’ condition, while broader measures of the health of all surface water bodies indicate persistent long-term declines in ecological status. New evidence shows water temperatures in freshwater environments have consistently exceeded their long-term mean in recent decades.</li> </ul>	3
<p>Notes: See annex for full datasets            Key Indicators: Protected freshwater sites in England, by condition, Proportion of water bodies in England meeting good status, Breeding wetland birds in England, England water temperature index - Annual variance from long-term mean</p>		

This adaptation priority covers all semi-natural freshwater habitats and the species they contain as classified by Natural England; rivers, streams, standing open water and canals. At a UK level, freshwater habitats cover around 12% of land.<sup>25</sup>

Freshwater habitats provide a wide array of important ecosystem services, including water supply (see section 2.8) pollution removal, and recreation (e.g. fishing and tourism). The annual value of these services, to the UK, has been estimated at approximately £1.3 billion per annum.<sup>26</sup> Though this estimate does not include all relevant ecosystem services, it will likely represent an undervaluation.

### Summary of 2019 report score

**In our last report, freshwater habitats and species scored a 5 (medium plan score, medium risk score).**

Our 2019 assessment found that while plans were in place to incorporate evidence on climate impacts under a range of future warming scenarios into the third cycle of the River Basin Management Plan, the revisions lacked adequate consideration of risks to the freshwater environment from higher water temperatures. On progress in managing risk, we highlighted that while the percentage of designated freshwater sites in favourable condition was improving, broader measures of the ecological condition of all surface water bodies assessed as part of the Water Framework Directive (WFD) indicated a worsening trend.

Has the plan score changed?

**No. The score remains the medium.**

**EU protections for the water environment in England have been fully transposed into UK law and thus have remained in place following EU exit.**

Historically, the European Union Water Framework Directive (EU WFD) has provided the framework for the management of freshwater resources in England. The EU legislation, and accompanying environmental standards and targets, were translated into UK law prior to the UK leaving the EU. They will continue to operate under the policy of “roll-over”. The UK Government’s Environment Bill also includes provision for water resources management now that the UK has left the EU.

**Plans are in place that consider the impact of reduced water availability as a result of climate change, contain clear outcomes and align to the goals for freshwater habitats outlined in the 25-Year Environment Plan (25-YEP).**

River Basin Management Plans (RBMPs) are a requirement of the UK Water Framework Directive (WFD) regulations and alongside national and river basin district activity, adopt a catchment-based approach, setting out how organisations, stakeholders and communities will collaborate to improve the environmental quality of fresh and saline water bodies. The RBMPs set out the actions that will be taken in England to improve the water environment (quality, quantity and habitat) and achieve statutory water body objectives by specified timescales. The Environment Agency are continuing the statutory process of reviewing and updating the third cycle of the RBMPs originally scheduled for publication in 2021, although it is understood the timetable may be revised in light of challenges due to the Covid-19 pandemic (e.g. obtaining stakeholder participation in the process).

The need to adapt to changing climatic conditions has been identified as integral to the RBMPs, which represent one of the Government’s key mechanisms to achieving its goals for water habitats set out in the 25-YEP. To support this, the Environment Agency has completed a programme of work to ensure that climate change projections of temperature, precipitation and sea level rise are in the RBMP revisions process. An early stage of the RBMP review process is to undertake a public consultation on significant water management issues (the challenges and choices consultation). As part of this stakeholders were encouraged to consider the impact of a changing climate on water, including considering environmental impacts from 2°C and 4°C warming scenarios through tools such as the Environment Agency’s climate change impact tool. Within the RBMPs, catchment partnerships have also been given the opportunity to outline the priorities for their catchments. To help them do this they have been given high level risk assessments to help consider challenges such as climate change. The ambition is next to develop the assessments at a more local level so as to build a better understanding of local impacts from climate change.

**More detail is needed on how freshwater habitats will support the Government’s strategy to build resilience to flood risk in England.**

The Environment Agency’s 2020 Flood and Coastal Erosion Risk Management (FCERM) strategy, outlines plans to make greater use of nature-based solutions (NbS) that take a catchment led approach to managing the flow of water to improve resilience to floods. Natural flood risk management (NFM) measures, such as restoring rivers and improving soil structure will build climate resilience through enhancing freshwater habitats’ ability to slow the flow of or store flood waters.

There is currently no clear mechanism in place that accounts for the consequences of changes in water temperature for meeting the WFD targets.

However, it is not clear currently clear which NFM measures are being considered to support the strategy.

**Guidance to inform land managers and advisors on actions to mitigate risks from higher water temperatures do not make sufficient consideration of impacts under different warming scenarios.**

In order to address the risks to freshwater species from higher water temperatures, more research is needed to refine further the strategic approach to riparian tree planting to provide cooling for species that are sensitive to higher temperatures.<sup>27</sup>

At present, however, there is no clear mechanism in place that accounts for the consequences of changes in water temperature for meeting the WFD targets. Risks from increasing water temperatures, combined with changes to flow, will make meeting and maintaining the WFD targets even more challenging.

NAP2 includes an action to develop guidance and tools to help practitioners address risks to freshwater habitats and species from high water temperatures. The rivers and streams section of the 2020 update to the Natural England and RSPB Adaptation Manual (see also section 2.2) highlights risks posed by warming temperatures to freshwater species; the role of riparian trees in addressing them; and the wider role of the restoration of natural function and processes in providing resilience. The guidance emphasises the importance of considering 2°C and 4°C warming, but does not outline how to assess actions under different warming scenarios.

The document also signposts the Woodland Trust's 'Keeping Rivers Cool: A Guidance Manual' for more detailed information. Tree planting is supported by Countryside Stewardship, targeting of which is informed by spatial data layers, including the Keeping Rivers Cool layer that Natural England and Forestry Commission advisors can access internally, and applicants can access via the Forestry Commission's web-browser. Forest Research will also publish a Riparian Woodland Practice Guide (see section 2.6) over the coming months to support implementation of the UK Forestry Standard.

#### Recommendation

Set out a clear mechanism to account for the consequences of higher water temperatures and low flows (including drying up) in water bodies for freshwater habitats and species, and for meeting the WFD targets. This is lacking in current plans to revise the River Basin Management Plans (RBMPs).

Department: Environment Agency, Timing: June 2022.

Has the risk management score changed?

**Yes, the risk management score has decreased from medium to low.**

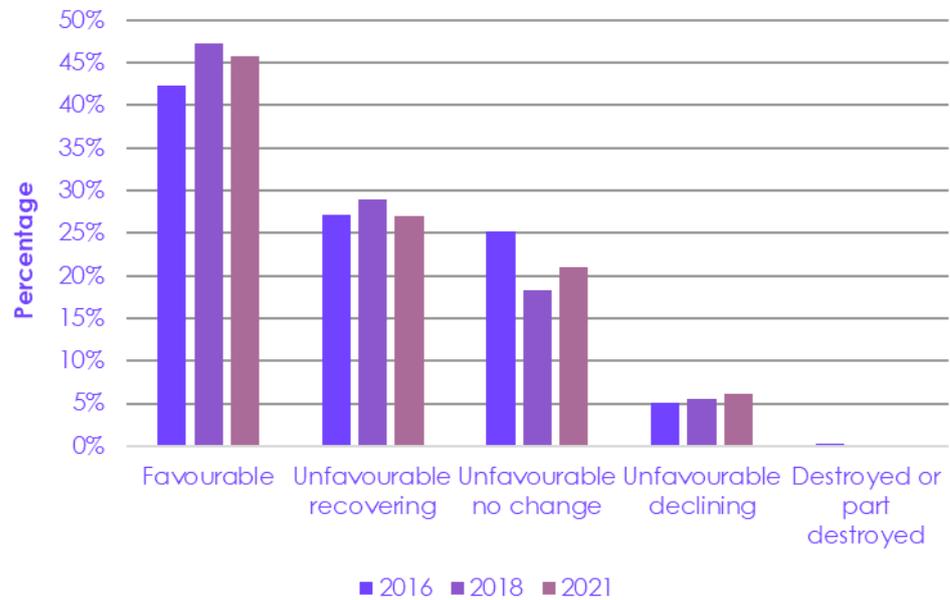
**Data on the percentage of protected freshwater sites in 'favourable' or unfavourable recovering' condition suggest a recent decline, while the ecological condition of all surface water bodies assessed as part of the WFD continues to worsen.**

Protected freshwater sites of special scientific interest (SSSIs) represent only around 8% of the total area of freshwater habitats in England, but are the only habitats for

which condition data is available.\* The latest data from Natural England on the condition of freshwater SSSIs show a slight decrease in proportion of sites in 'favourable' condition from 47% in 2018 to 46% in 2021, although they remain higher than 2016 (42%) (see figure 2.8). There has also been a decline in freshwater habitats classed as 'unfavourable recovering', down to 27% in 2021 from 29% in 2018.

There has been a recent decrease in the proportion of protected freshwater sites in 'favourable' or 'unfavourable recovering' condition, while broader measures of the health of all surface water bodies indicate persistent long-term declines in ecological status.

Figure 2.8 Freshwater SSSIs in England, by condition



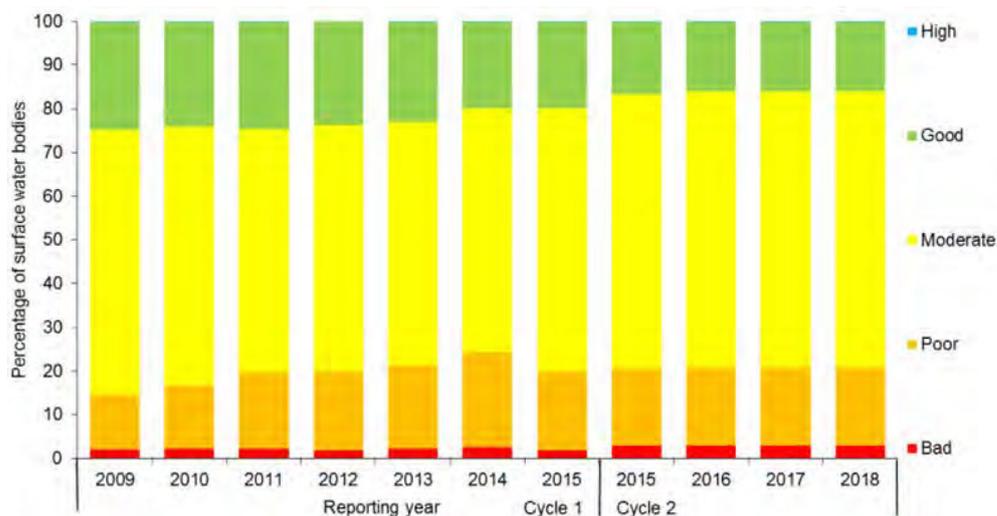
Source: Natural England, <https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx>

In England, the Environment Agency has responsibility for monitoring and reporting on the status of surface water bodies and the reasons why good ecological status has not been achieved. There has been a decrease in the proportion of surface water bodies in England awarded high or good ecological status classification under the WFD since the indicator was first prepared in 2009 (figure 2.9). In 2018, only 16% of surface water bodies assessed under the WFD were in high or good status compared with 25% in 2009 and 23% in 2013. Declines have continued in recent years, albeit at a slower rate.

\* 8% calculated by comparing area of designated rivers and streams, and standing open waters and canals according to Natural England designated sites data, with data on total area of freshwater habitats published in the ONS Land Cover Account as at 2007

In 2018, only 16% of surface water bodies assessed under the WFD were in high or good status compared with 25% in 2009.

**Figure 2.9** Status classifications of surface water bodies in England under the Water Framework Directive



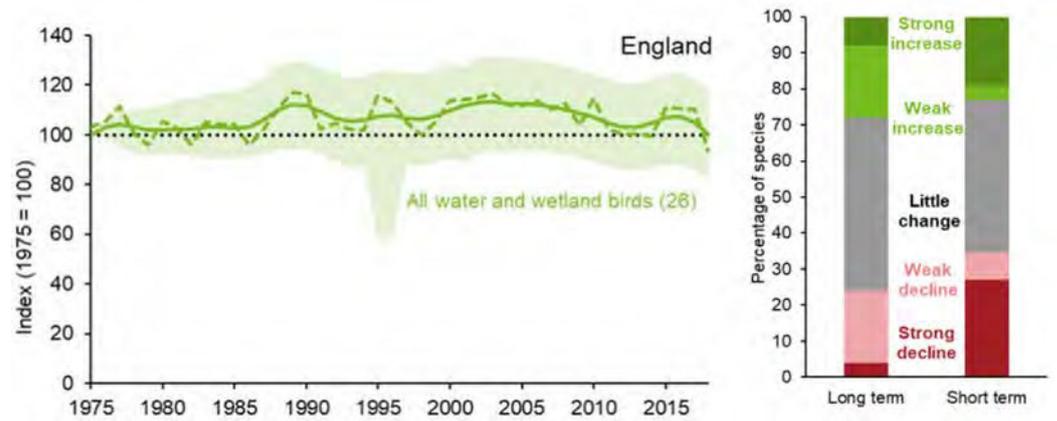
Source: Source: Defra biodiversity indicators 2020 update.

Notes. 1. Based on the numbers of surface water bodies classified under the Water Framework Directive (WFD) in England. 2. Surface water status is a composite measure that looks at both the chemical status and the ecological (including biological and habitat condition) status of a water body. The classification scheme for surface water ecological status includes five categories: high, good, moderate, poor and bad. 'High status' means no or very low human pressure. 'Good status' means a 'slight' deviation from this condition, 'moderate status' means 'moderate' deviation, and so on. Around 5,000 water bodies are assessed each year, including rivers, canals, lakes, estuaries and coastal waters.

Species abundance (whether impacted by climate change or not) is used as a proxy indicator for the vulnerability of biodiversity as a whole, as they give a sense of how 'under pressure' different systems already are.\* Wetlands, including rivers, lakes, ponds, reedbeds, grazing marshes and lowland raised bogs provide important habitats for breeding wetland birds. The water and wetland bird index has remained relatively stable for most of the period since data collection started in 1975. In 2018 the index was 9% lower than in 1975 (Figure 2.10). Numbers rose slightly in the early 2000s with the smoothed index showing a non-significant 2% increase between 2012 and 2017.

\* This is based on the idea in the review that ecosystems will withstand the risks from climate change more effectively if other pressures on them are reduced.

Figure 2.10 Breeding wetland birds in England



Source: Defra biodiversity indicators 2020 update.

Notes: 1. The line graph shows the unsmoothed trend (dashed line) and the smoothed trend (solid line) together with its 95% confidence interval (shaded). 2. The figure in brackets shows the number of species in the index. 3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change, based on set thresholds of annual change.

Higher water temperatures will increase the degradation of freshwater habitats, and compromise the viability of some freshwater species.<sup>28</sup> A recent assessment of climate-driven thresholds in UK freshwater habitats<sup>29</sup> looked at potential risks from temperature driven incidents of harmful algal blooms (HAB) in lakes. Such blooms can have wide ranging economic impacts, including on property values, water treatment costs, tourism and fisheries revenue. The study found present impact costs per annum from HAB in England under a 4°C warming scenario were predicted to increase by around 70% by the 2050s and almost triple by the 2080s.

**Water temperatures across England have been consistently above their long-term average in recent decades.**

Average annual water temperatures across England have been consistently above their long-term mean over the 2000-2019 period; 16 out of last 20 years for southern England, and 13 out of last 20 years for northern England (figure 2.11a and figure 2.11b).

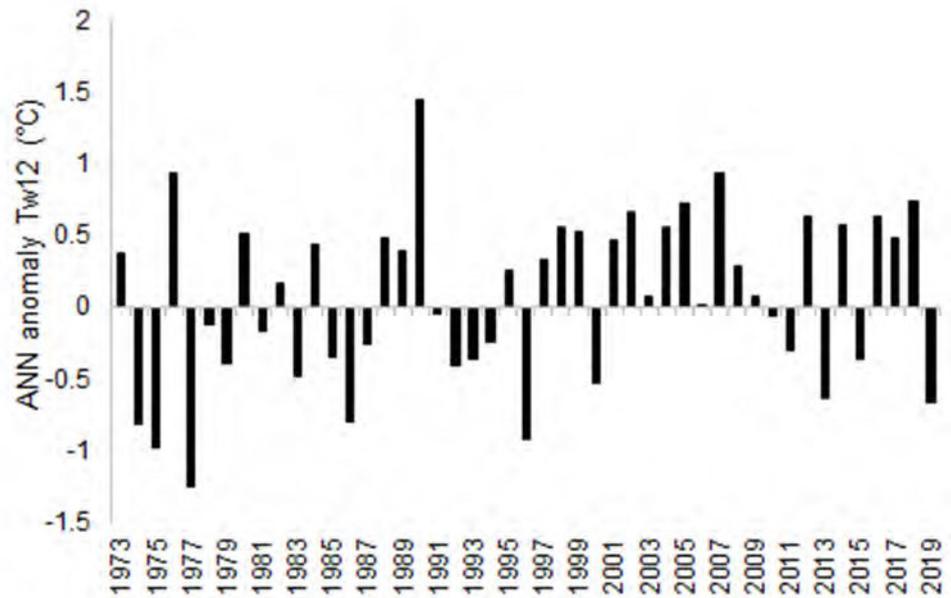
Figure 2.11a Southern England water temperature index - annual variance from long-term mean



Source: Wilby, R.L. and Johnson, M.F. (2021). National water temperature indicators for England. In preparation.

Water temperatures across England have been consistently above their long-term average in recent decades.

Figure 2.11b Northern England water temperature index - annual variance from long-term mean



Source: Wilby, R.L. and Johnson, M.F. (2021). National water temperature indicators for England. In preparation.

## 2.5 Coastal and marine habitats and species

Progress summary – Coastal and marine habitats and species		
2019 score:	What has changed since 2019:	2021 score:
5	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The adoption of a further seven regional marine plans by summer 2021, taking the total to 11, will cover the whole of the marine environment in England. This meets the Government's 25-YEP commitment to complete the full series of England Marine Plans by 2021.</li> <li>The plans use UKCP18 projections to evaluate the potential longer-term risks and opportunities from climate change. However, only public authorities are duty bound under law to apply the plan policies to their decisions, meaning there is significant gap in the protections they are designed to provide to marine habitats.</li> <li>The English component of the UK's contribution to a network of protected areas in the north east Atlantic is now complete, following the addition of 41 marine conservation zones in the third phase of designations, and taking the total to 91.</li> <li>The non-statutory status of Shoreline Management Plans limits their effectiveness as a long-term strategy.</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>Condition indicators for protected marine and coastal habitat areas in England suggest a stable to improving situation, however, for the former these cover only around 40% of the total marine area. New research suggests climate change is already affecting UK coasts and seas.</li> </ul>	5
<p>Notes: See annex for full datasets            Key Indicators: MCCIP report cards, Coastal SSSIs in England, by condition - Extent of marine protected areas, Breeding seabirds in England, Combined input of hazardous substances to the UK marine environment.</p>		

This adaptation priority covers all coastal and marine habitats and the species they contain around England.

The analysis of changes in risk vulnerability focuses on coastal and marine sites identified as being of nature conservation importance, as these are areas for which data is most available. For coastal habitats, this comprises sites which are designated under the Wildlife & Countryside Act 1981 as supporting habitats and/or species of national importance.<sup>\*</sup> A relatively high proportion of coastal priority habitats in England (between ca. 80% to 95% dependent on habitat type) fall within protected areas.<sup>30</sup>

For marine habitats, we assess sites classified as being Marine Protected Areas (MPAs), which cover around 40% (92,633 km<sup>2</sup>) of English inshore and offshore waters combined.<sup>†</sup> The total extent of MPAs is the combined area of: Nationally designated sites; National Nature Reserves (NNR), and Marine Conservation Zones (MCZ)); Internationally designated sites (Special Protection Areas (SPA) and Special Areas of Conservation (SAC)) under the European Union's Birds and Habitats

<sup>\*</sup> Also referred to as Sites of Specific Scientific Importance (SSSIs)

<sup>†</sup> English inshore waters contain 157 MPAs covering 51% of this region (26,126 km<sup>2</sup>). English offshore waters contain 40 MPAs covering 37% of this region (66,507 km<sup>2</sup>): <https://jncc.gov.uk/our-work/uk-marine-protected-area-network-statistics/>

Directives respectively; and Ramsar sites under the Convention on Wetlands of International Importance.

## Summary of 2019 report score

**In our 2019 report, Coastal and marine habitats and species scored a 5 (medium plan score, medium risk score).**

The assessment highlighted that plans are in place to conserve and improve marine and coastal habitats, which include requirements to consider how marine planning can take climate change into account. However, none included specific proposals to adapt to the key climate risks facing the marine environment. On progress in managing risk, available indicators suggested some improvement, although it was noted that more research was needed to assess the extent to which adaptive actions could increase the resilience of marine habitats and species to impacts from changes in acidity, dissolved oxygen content, temperature and ocean stratification.

## Has the plan score changed?

**No – score remains the same.**

**Marine Plans for the whole of the English area use UKCP18 projections to evaluate the longer-term risks and opportunities from climate change to marine habitats and species. Marine Protected Areas (MPAs) including Marine Conservation Zones (MCZs) are one of many factors considered within marine plans.**

The UK Marine Strategy (UKMS) provides a three-part regulatory framework for delivering marine policy at the UK level and sets out how the Government will achieve the vision of clean, healthy, safe, productive and biodiverse seas. The strategy includes overall ambitions for the marine environment, the targets to be achieved and the method to achieve those targets. Defra is currently investigating the possibility of incorporating climate considerations in UKMS assessments going forward.<sup>31</sup>

**The imminent adoption of an additional seven marine plans will meet the Government's 25-Year Environment Plan (25-YEP) commitment to complete the full series of England Marine Plans by 2021.**

Marine plans are developed by the Marine Management Organisation (MMO) and are agreed and adopted by Government under requirements laid out in the Marine and Coastal Act 2009. The plans set out statutory government policy to inform decision-making in the marine area. The environmental objectives and specific policies within the marine plans are informed by the high-level objectives, targets and indicators within the Marine Strategy. There are 11 Marine plans for the whole of the English marine environment in different stages of development.

Four Marine Plans have been officially adopted in England (see Table 2.2). Draft proposals for the remaining seven contain a number of policies to build the resilience of marine habitats to climate change. These include requiring plans to: demonstrate resilience to the impacts of climate change; ensure resilience to the impacts of climate change on the marine protected area network; protect adaptation measures already in place; protect habitats that provide carbon sequestration ecosystem services; not have significant adverse impacts on coastal change.

The adoption of a further seven regional marine plans by summer 2021, taking the total to 11, meets the Government's 25 Year Environment Plan commitment to complete the full series of England Marine Plans by 2021.

**Table 2.2**  
Status of English Marine Plans in England

Plan	Status	Review
Marine Plan for East inshore and East offshore areas inshore and East offshore areas	Adopted 2014	Decision taken by government in 2020 to update. Update scoping begins in 2021.
Marine Plan for South inshore and South offshore areas	Adopted 2018	First 3-year review to be completed in 2021, includes a recommendation to government on whether to amend or replace.
Draft Marine Plan for the North East inshore and North East offshore areas Draft Marine Plan for the North West inshore and North West offshore areas Draft Marine Plan for the South West inshore and South West offshore areas	Published for consultation 2020 – plans are a material consideration in decision making at this stage. Final adoption expected Spring 2021 - this will complete the first round of marine plans for all English seas.	1st review will be complete 3 years after adoption, including a recommendation on whether to amend or replace.

Source: MMO

**The Marine and Coastal Access Act (2009) sets out requirements for Marine Plans to take into account risks from climate change.**

While marine plans do not outline actions, and are not therefore SMART (see Chapter 1), the policies they contain are targeted as they relate to specific environmental concerns, and set out clear policy outcomes. The MMO considers a range of climate change scenarios, including UKCP18, when developing options to address the issues identified as relevant for marine planning. Under provisions set out in the Marine and Coastal Access (MCA) Act 2009, there is a statutory three-yearly review and reporting cycle, while the twenty-year lifetime of each plan makes them timebound.

**The statutory requirements of marine plan policies apply to decisions taken by public authorities only, meaning plans have a limited reach for managing activities of private organisations or other sea users that are not subject to public authority regulation.**

Section 58(1) of the MCA Act states that public authorities must take authorisation or enforcement decisions in accordance with the relevant marine plan policies. Furthermore, public authorities must have regard to relevant marine plan policies when exercising functions capable of affecting the marine area (Section 58(3)). However, only public authorities are duty bound under law to apply the policies. The plans only influence private organisations and other sea users if their activities require a public authority consent or authorisation, or if their activity is regulated and managed through other public authority functions, for example byelaw making powers, at which time marine plan policies will be taken into account by the relevant public authority. Furthermore, even at current levels, there is not enough evidence that sufficient financial and other resources are allocated for enforcement.

## Recommendation

The statutory requirements of marine plan policies must be extended to the decisions of public and private organisations. At present only public authorities are duty bound under law to apply the plan policies to their decisions meaning there is significant gap in the protections they are designed to provide.

Department: Environment Agency, Timing: June 2022.

### **The Fisheries Act 2020 and forthcoming Environment Bill should both create added protections for coastal and marine habitats and species.**

The Fisheries Act extends the powers of national authorities with regard to marine conservation in the UK. Under the Act, the Government will implement an ecosystem-based approach to fisheries management to make sure that negative impacts of fishing activities on the marine ecosystem are minimised, and to avoid degradation of the marine environment. Climate change is one of the eight objectives under the Act (see section 2.8 for further details).

Through the Environment Bill, the Government is setting the ambitious target of having all Marine Protected Areas (MPAs) in England in favourable condition by 2043. A legally binding target for MPAs will complement and bolster on-going work and existing legal obligation under the MCA Act and Conservation of Habitats and Species Regulations 2017 to meet established conservation objectives, by providing focus for the ambitions with clear aims and deadlines.<sup>32</sup>

### **The English component of the UK's contribution to a network of marine protected areas (MPAs) in the north east Atlantic is now complete.**

MPAs are designated by government under the Marine and Coastal Access Act 2009 to conserve the diversity of nationally rare, threatened and representative habitats and species. The second national Adaptation Programme (NAP2) includes an action to 'establish MCZs to contribute to an ecologically coherent network of Marine Protected Areas around England'. A third tranche of 41 sites was designated in May 2019 taking the total to 91.

Marine plan authorities are required to take account of the regime for MPAs and comply with obligations imposed in respect of them. This includes the obligation to ensure that the exercise of certain functions contribute to, or at least do not hinder, the achievement of the objectives of MCZs.

### **Government has completed analysis on controlling invasive non-native species (INNS) in the marine environment.**

In May 2019, the Government published a pathway analysis (as required then by EU Regulations) which identified three priority pathways for controlling INNS in the marine environment: (i) hull fouling, (ii) ballast water and (iii) contaminants of aquaculture animals. Further measures to provide increased prevention have been identified including: (i) ensuring vessels arriving or leaving UK waters have stringent hull cleaning and (ii) all ships to have a ballast water management plan.

### **The Committee's view is that the policy decisions within Shoreline Management Plans must be made statutory to ensure they are implemented.**

Shoreline Management Plans (SMPs) provide a framework to plan for coastal adaptation, investment and spatial planning over a 100-year time horizon (see also section 3.3). The Flood and Coastal Erosion Risk Management (FCERM) strategy notes the Environment Agency is working with coastal groups to refresh the SMPs in England to ensure they consider a range of future climate scenarios and are informed by the best available evidence, including the latest climate change projections. At present, it is not clear how this will be factored into revised plan

The non-statutory status of Shoreline Management Plans limits their effectiveness as a long-term strategy.

outcomes (including for both climate change responses and protecting habitats and species). The non-statutory status of SMPs severely undermines their effectiveness as the main vehicle that coastal authorities have to outline and implement their long-term strategy to prepare for the impact of climate change on coastal habitats and species.

Has the risk management score changed?

**No. The 'medium' score remains unchanged from 2019.**

**The proportion of protected coastal habitats in 'favourable' or 'unfavourable recovering' condition remains relatively high, while the extent of marine protected sites continues to increase.**

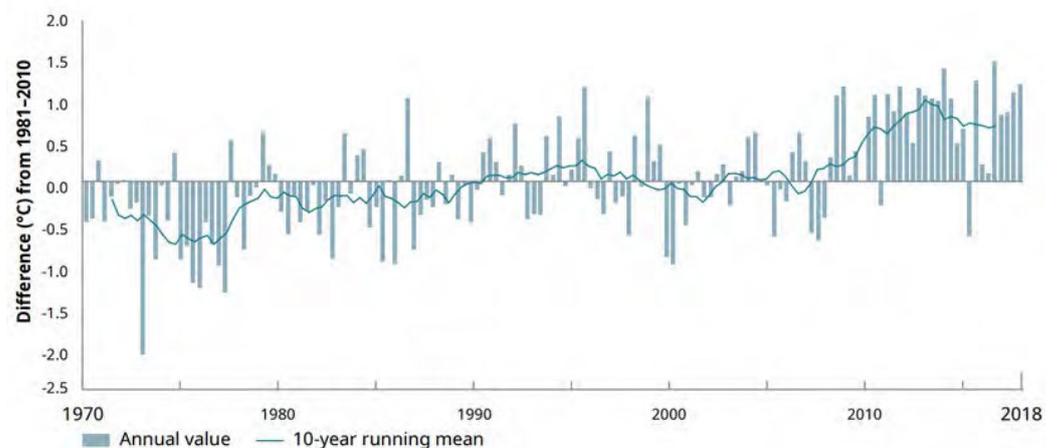
The indicators we have available to measure progress in adaptation of the coastal and marine environment include the condition of coastal sites of special scientific interest (SSSIs), and the area (but not condition) of marine protected sites. Indicators showing inputs of hazardous materials into the marine environment are also used as a proxy indicator of wider pressures that would reduce resilience to climate change overall. Unlike for terrestrial and freshwater habitats, the underlying hazard metrics that will affect marine biodiversity are also more straightforward to identify and so we include changes in these; sea surface temperature, and pH levels.

**Coastal sea surface temperatures have consistently been above their long-term average in recent decades.**

Changes in temperature of the seas around England can significantly influence the functioning of marine ecosystems. Long-term records show a warming trend in UK waters, despite short-term natural variability. On average, coastal sea surface temperatures have been 0.6°C warmer in the most recent decade compared to the 1961–1990 average (figure 2.12). Furthermore, eight of the 10 warmest years for UK sea surface temperature have occurred since 2002.

On average, coastal sea surface temperatures have been 0.6°C warmer in the most recent decade compared to the 1961–1990 average.

**Figure 2.12** Average annual sea surface temperatures for UK coastal waters, expressed as anomalies relative to the 1981 to 2010 average



Source: State of nature report, 2019

Notes: The blue bars show the annual anomalies relative to the 1981–2010 average, shown as the grey horizontal line, and the blue line shows the 10-year running mean.

**Adaptation plans outlined in NAP2 include the publication of climate impact evidence report cards by the Marine Climate Change Impacts Partnership.**

The UK Marine Climate Change Impacts Partnership (MCCIP) is a partnership between scientists, government, governmental agencies, non-governmental organisations (NGOs) and industry. Its 2020 report card covered 26 marine and coastal topics, supported by detailed peer reviewed topic reports which showed that:

- There is clear evidence that warming seas, reduced oxygen, ocean acidification and sea-level rise are already affecting UK coasts and seas. Increasingly, these changes are having an impact on food webs, with effects seen in seabed-dwelling species, as well as plankton, fish, birds and mammals.
- The upper range for the latest UK sea-level rise projections is higher than previous estimates, implying increased coastal-flood risk. The likelihood of compound effects from tidal flooding and extreme rainfall is increasing, which can greatly exacerbate flood impacts.
- Oxygen concentrations in UK seas are projected to decline more than the global average, especially in the North Sea.
- Impacts of climate change have already been observed at a range of heritage sites. Coastal assets will be subjected to enhanced rates of erosion, inundation and weathering or decay.

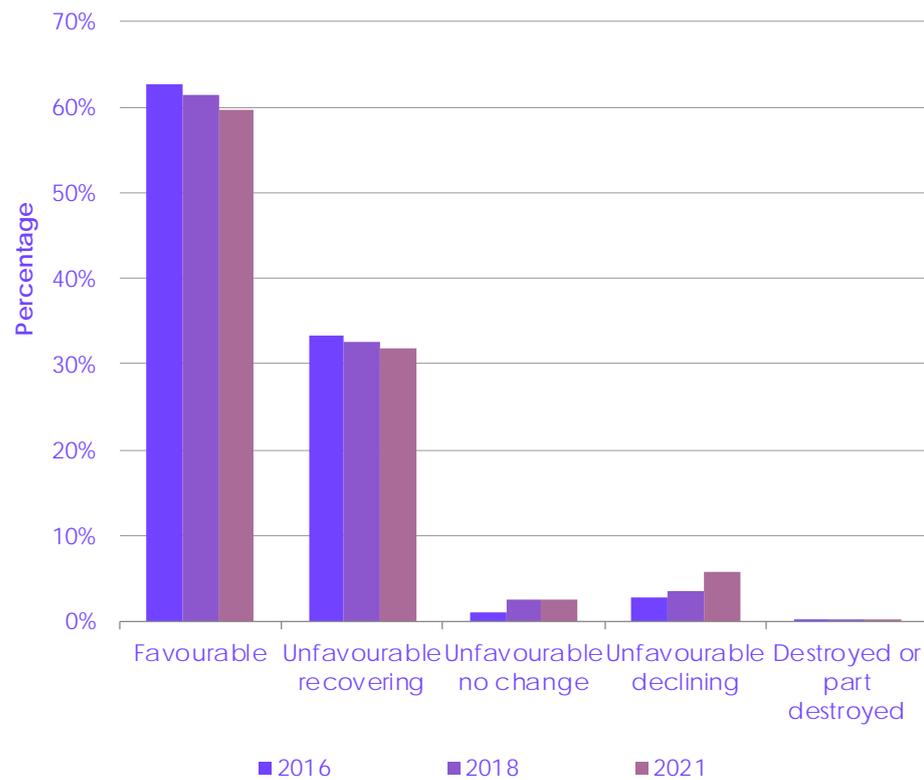
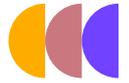
New research suggests climate change is already affecting UK coasts and seas.

The MCCIP have a new 5-year programme (2020-2025) currently underway. From 2021 onwards, the report cards will be replaced by rolling updates of marine climate evidence.

**There has been a decline in the overall condition of protected coastal sites.**

The proportion of coastal sites of special scientific interest (SSSIs) classed as in 'favourable' or 'unfavourable recovering' condition, declined from 96% in 2016 to 92% 2021 (see figure 2.13), but remains relatively high compared to terrestrial and freshwater habitats (see section 2.2 and section 2.4).

Figure 2.13 Coastal SSSIs in England, by condition



Source: Natural England, <https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx>

**The area of marine protected sites around England have more than doubled since 2015.**

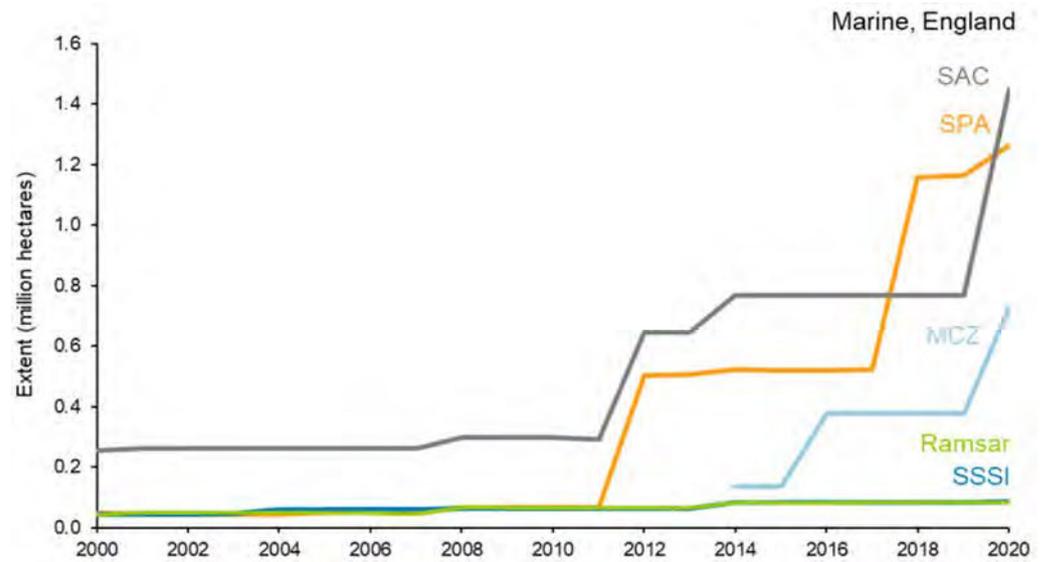
A well-designed and effectively managed network of marine protected areas (MPAs) is not just important for wildlife: it supports key sectors like tourism and recreation, safeguards habitats that store carbon, and enables fish stocks to replenish.<sup>33</sup> Increasing the area of MPAs is deemed to enhance the ability of marine habitats to manage vulnerability by reducing pressures through improving its condition. However, as noted above, without comprehensive powers to legally enforce marine plan policies, there is significant gap in the protections MPAs are designed to provide.

In the five years to 2020, the area of marine protected sites around the coast in England has more than doubled to 2.4 million hectares (Figure 2.14). A large contributor to this has been the designation of inshore marine sites under the European Birds and Habitats Directives.

As noted above, MCZ have also contributed substantially to the increase in the area of inshore marine sites around England, with the third phase of designations in May 2019 resulting in an increase of over 726,000 hectares.

In the five years to 2020, the area of marine protected sites around the coast in England has more than doubled to 2.4 million hectares.

**Figure 2.14** Extent of national and European protected sites at sea in England, by designation



Source: England biodiversity indicators 2020

Notes: 1. The extent of protected sites is the cumulative area assessed in March of each year shown. 2. Marine sites between mean low water and the 12 nautical mile limit are included; sites beyond 12 nautical miles, in UK waters, are excluded. These are included in the UK indicator on protected sites.

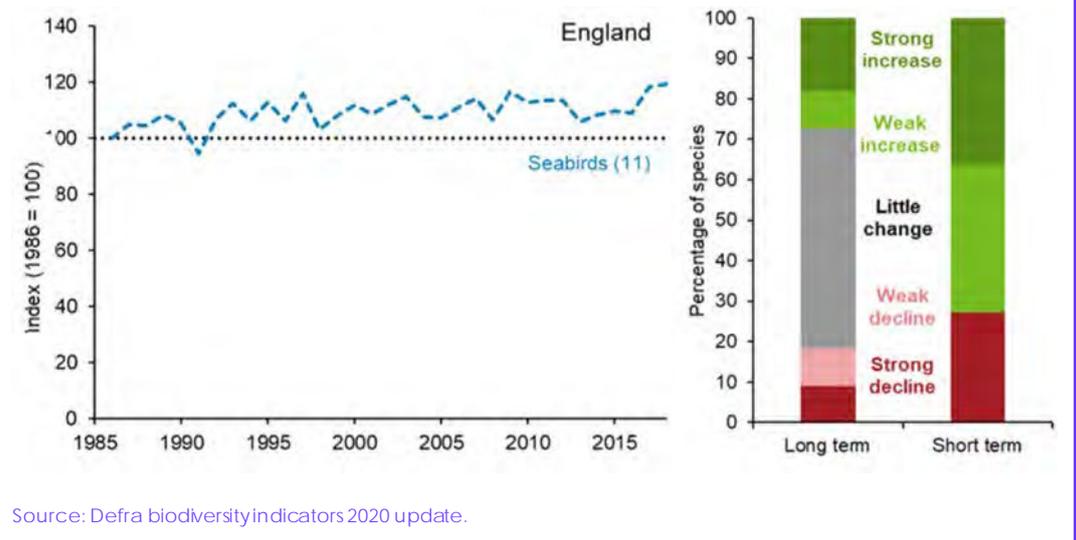
It should be noted that no data is currently available on the condition of non-protected sites.

**There have been some improvements in the abundance of breeding seabirds in England (although this trend is not seen when looking UK-wide).**

As top predators, seabirds are key indicators as to the magnitude of climate-induced changes in the marine realm; specialist seabirds in particular are known to also be very vulnerable to its impacts.<sup>34</sup> Generally, seabirds have highly specialised diets, being reliant on just a few prey species, the abundance and distribution of which can alter dramatically in response to abrupt environmental changes.

England’s coastline and offshore islands provide nesting sites for around seven million seabirds. Although fluctuating, the relative abundance of a suite of breeding seabird species has increased steadily since the late 1990s (Figure 2.15), recorded at the highest level in 2018, 19% higher than in 1986. Also, since 1986, a greater percentage of species show short term rather than the longer-term increase in abundance. However, this pattern is not reflective of the broader trend for breeding seabirds at the UK level, which has shown a 22% decline over the 1986 to 2015 period.<sup>35</sup> The difference could be due to the higher proportion of breeding seabirds being located outside of English marine waters.

Figure 2.15 Abundance of breeding seabirds in England



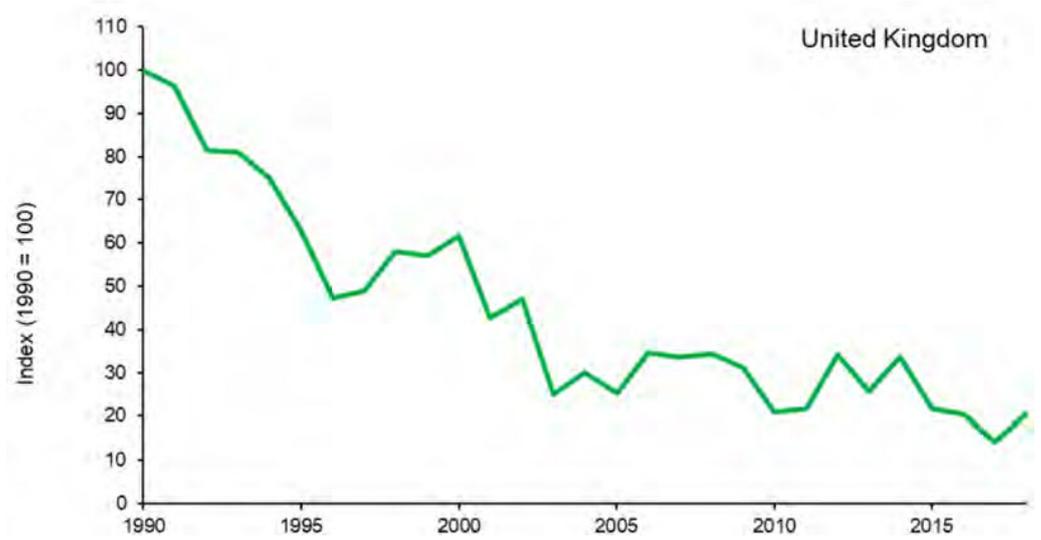
It is essential that regulatory protections around the emission of hazardous substances into marine environment be maintained and strengthened.

**Regulations on the emission of hazardous substances into the marine environment must not be relaxed if recent gains are to be retained.**

Reducing human stressors, such as pollution, on the marine environment helps strengthen its resilience to other pressures, including climate change and supports continued provision of ecosystem services. Trend data from the combined input of six of the most hazardous substances to the UK marine environment indicate a long-term decrease (-79% since 1990) (Figure 2.16). The introduction in 2018 of a new set of rules (as outlined in NAP2) for farmers and land managers to prevent pollutant emissions, protect water quality and improve soil health,<sup>36</sup> should continue to support the downward trend in emissions to the marine environment\*. However, it is essential that such regulatory protections around the emission of hazardous substances into marine (and broader) environment be maintained and strengthened if the gains achieved over recent decades are to be retained.

\* The rules set out what farmers must do or, consider to, manage risks posed by manures, manufactured fertilisers and soils through runoff, erosion and leaching.

Figure 2.16 Input of hazardous substances to the marine environment



Source: Defra biodiversity indicators 2020 update.

Notes: This indicator provides the combined input of six of the most hazardous substances to the UK marine environment: five heavy metals (cadmium, mercury, copper, lead and zinc) and one organic compound (lindane).

## 2.6 Commercial forestry

Progress summary – Commercial forestry		
2019 score:	What has changed since 2019:	2021 score:
5	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>Several medium quality adaptation plans are in place, although none directly consider climate impacts under different warming scenarios, supported by a set of actions. A guide to help forest managers and owners meet the adaptation requirements of the UK Forestry Standard will be published later in 2021.</li> <li>The Forest Industry still lacks a measurable goal for managing and reducing the impact of pest and diseases on trees in England.</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>There is mixed progress with the percentage of woodland under active forest management still below the target, while the number of high priority forest pests in UK Plant Health Risk Register is up 72% since 2015. However, the diversity of trees planted across the forests in England continues to increase.</li> </ul>	5
<p>Notes: See annex for full datasets            Key Indicators: Percentage of woodland in England under active management, Percentage of conifer and broadleaf species planted on the Nation's Forests, Total number of wildfire incidents in woodlands in England, Number of high priority forest pests in the UK Plant Health Risk Register.</p>		

### Summary of 2019 report score

**In our 2019 report, Commercial forestry scored a 5 (medium plan score, medium risk score).**

Our 2019 report found that climate change adaptation plans, which contain clear actions and outcomes, exist for the forestry sector, however, these lack clear targets and are near-term in risk outlook. Progress towards managing risk was mixed, with the Forestry Commission's target for increasing the area of forest under active management missed, although the diversity of tree planting continued to increase.

Has the plan score changed?

**No. The score is unchanged from 2019.**

**Adaptation plans are in place but these do not directly consider climate impacts under different warming scenarios, supported by a set of actions.**

The Forestry Commission has produced adaptation guidance for woodland management ('Managing England's woodlands in a Climate Emergency'), providing practical advice to landowners to manage climate change impacts on woodland. This document presents a summary of key climate change impacts covering different combinations of climatic drivers, and possible adaptation strategies for England's woodlands and forests including diversification of species, genetics, and stand structure.

While some consideration is given to possible impacts under future climate change in the guidance, these are more generic and not directly based on a range of warming scenarios.

**A UK Forestry Standard (UKFS) Practice Guide on adaptation is expected to be published during 2021.**

The guide aims to help forest managers and owners meet the adaptation requirements of the UKFS. The guide has been drafted and is undergoing Government review at time of writing. However, there is still limited information on how much of this adaptation guidance is actually being implemented, especially in the private forestry sector.

**There are online tools available to support practitioners select suitable tree species under climate change.**

The Climate Matching Tool provided by Forest Research shows regions in Europe with a similar current climate to the climate projection for any UK location. It is designed to help practitioners to consider the selection of better suited tree species from environments that England may experience in the future.

Underpinning the tool is UKCP18 climate data at 12km resolution using the RCP8.5 pathway in future projections. The climate matching tool should be seen as complementary to the Forest Commission's Ecological Site Classification tree selection tool, which shows how trees will perform in a future climate but does not take into account adaptation.

**The Forestry sector has developed a set of outcome-based actions, linked to specific climate threats, however, current plans lack timebound targets and do not take sufficient consideration of future climate impacts under different warming scenarios.**

The Government's Tree Health Resilience (THR) Strategy aims to improve the capacity of woodlands to adapt under climate change through minimising the impact of pests and diseases, as well as building resilience through selection of species and provenance. However, at present the 25-YEP and NAP2 do not include a measurable goal for managing and reducing the impact of existing plant and animal diseases including for forestry, and a clear deadline for achieving them.

The Forestry Climate Change Working Group (FCCWG), a cross-sector initiative, has developed a well-planned set of outcome-based actions to enhance the protection against pests and diseases over the next 5 years (published in 2018 as the Action Plan for Climate Change Adaptation of forests, woods and trees in England). The plan is integrated into the activities associated with the THR strategy. While the Plan contains a range of outcomes (24 in total) aligned, in varying degrees, to each of the priority actions, the outcomes do not include specific targets and timeframes over which to meet them. The FCCWG published its progress report in late 2019, which highlighted that despite progress in research and ongoing policy discussions, insufficient progress has been made in implementing adaptive actions.<sup>37</sup>

**Defra has published an England Tree Action Plan.**

Under the Plan, the Government has committed to supporting the FCCWG in implementing its adaptation plan. It will also launch a climate change competition to highlight best forestry practice, and the need to adapt new and existing woodlands to the effects of climate change (see also section 2.2). The Plan indicates the Government will develop a Woodland Resilience Implementation Plan to improve the ecological condition of woodlands in England and increase their resilience to climate change, including pests and diseases. It is understood there will also be requirements associated with choosing resilient species under the English Woodland Creation Grant.

At present there is no measurable goal for managing and reducing the impact of pest and diseases for forestry, and a clear deadline for achieving them.

The England Tree Action Plan indicates the Government will develop a Woodland Resilience Implementation Plan to improve the ecological condition of woodlands in England.

Has the risk management score changed?

**No. The risk management score remains medium.**

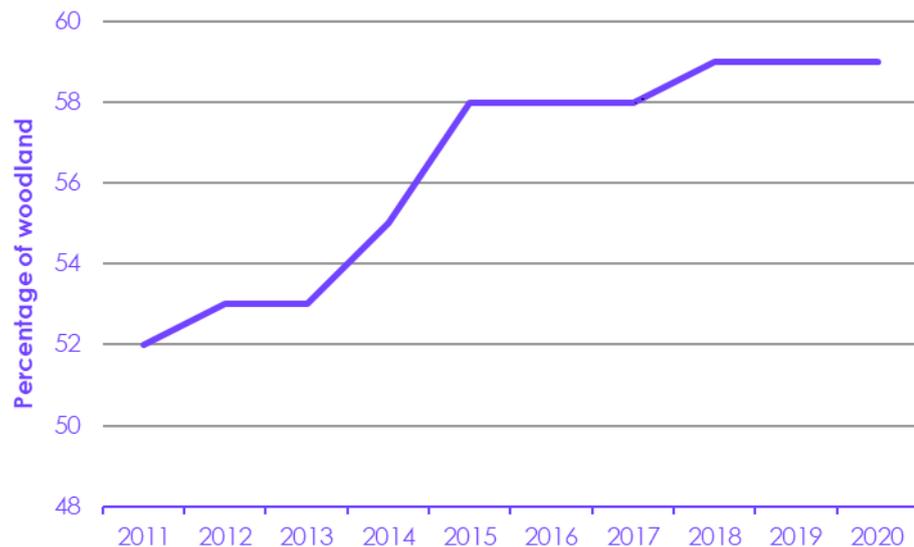
**The proportion of woodland under active management has remained largely unchanged since 2015.**

The percentage of woodland under active management has increase from 52% in 2011 to 59% in 2020, although it has remained largely unchanged since 2015.

Active woodland management for climate change adaptation involves anticipating future changes in temperature, rainfall, wildfire, and other extreme events to reduce risk exposure to both forestry and other ecosystem services and to thereby increase forest resilience. Immediate adaptation of forests and woodland to the changing climate is critical if society is to continue to benefit from the range of services they provide to wildlife, people and continue to produce timber for future generations. Active management, therefore, is an essential pre-requisite to proactively adapting commercial and other forests to climate change.

The percentage of woodland under active management has increase from 52% in 2011 to 59% in 2020, although there has only been a 1% increase since 2015 (Figure 2.17). The Government announced new funding to bring woodlands into management and increase sector capacity in the March 2020 budget as part of the Nature for Climate Fund (see Section 2.2).

**Figure 2.17** Percentage of woodland in England under active management, by area size (hectares)



Source: Forestry England.

Notes: As of 2020, 59 out of every 100 hectares of English woodland are actively managed, totalling 764,000 hectares of woodland in management.

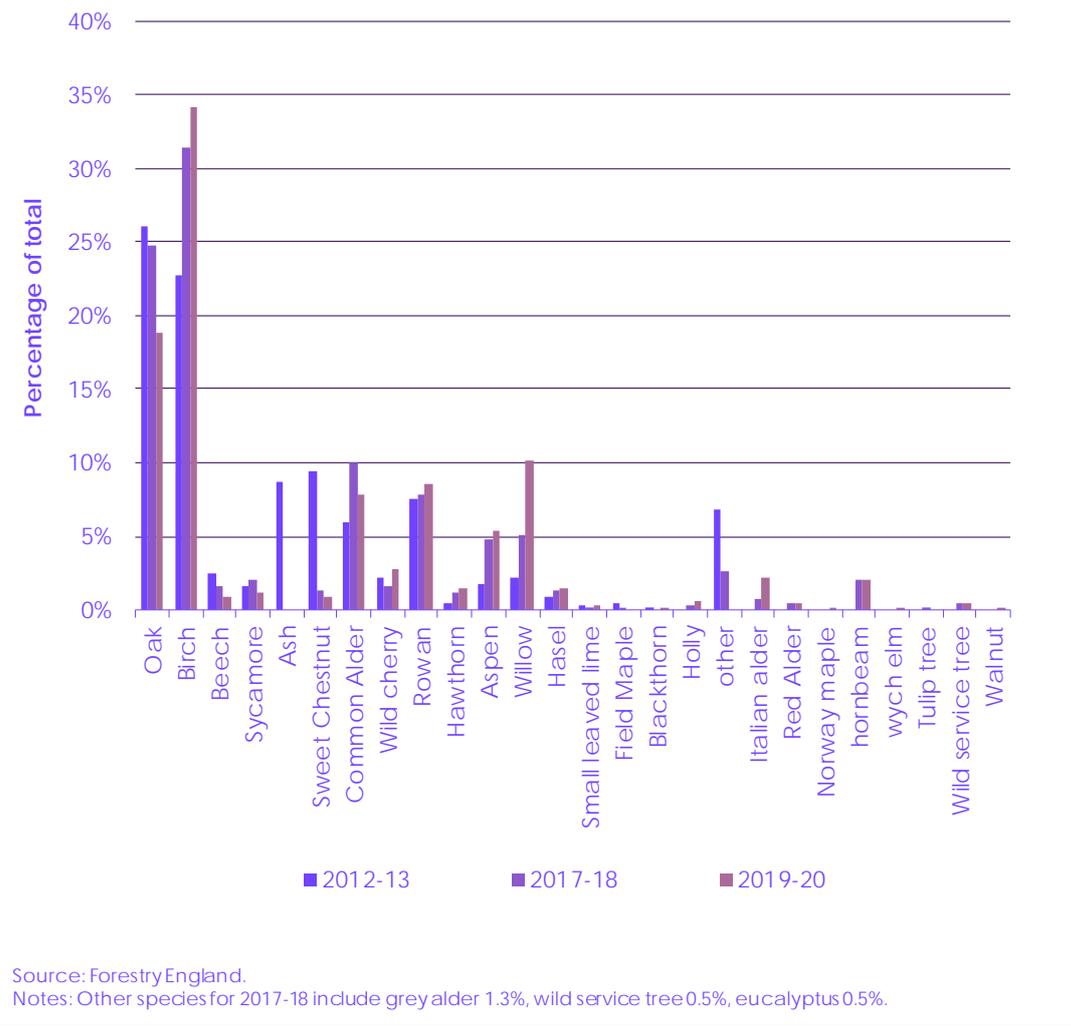
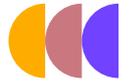
**There has been a consistent increase in the diversity of conifer and broadleaved species being planted each year.**

The number of different broadleaf species planted continues to rise; 23 major broadleaf species were planted in England's forests in 2019-20, up from 22 in 2017-18, and up from 17 in 2010-11 (see figure 2.18).

Increasing the diversity of tree species in new planting schemes is an important adaptation strategy designed to reduce threats from pests and diseases, and to help manage uncertainties around the suitability of particular species to future climate conditions.

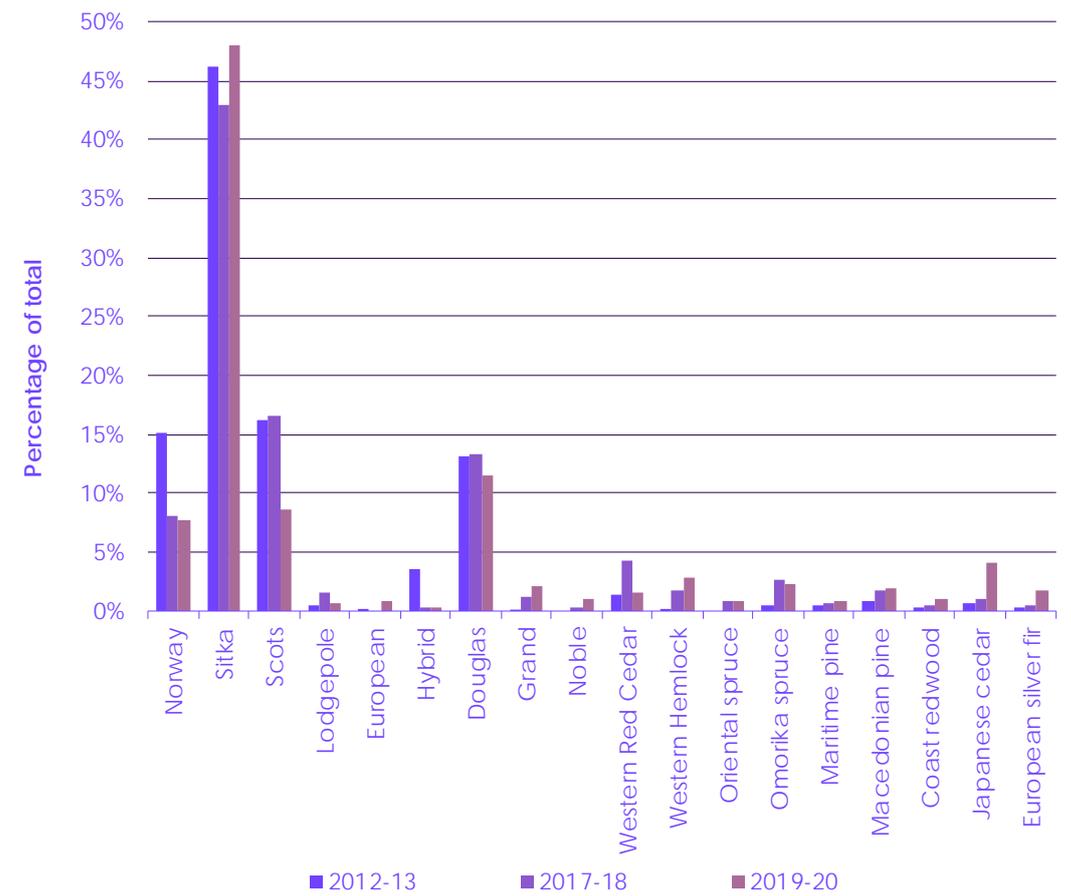
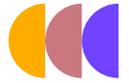
There has been a consistent increase in the diversity of conifer and broadleaved species being planted each year.

Figure 2.18 Percentage of broadleaf species planted in England's forests



The trend has also been positive for the diversity of conifer species. In 2019-20, 17 different major species of conifer tree were planted by Forestry England in the Nation's forests, up from 14 in 2017-18, and up from 8 in 2010-11 (Figure 2.19).

Figure 2.19 Percentage of conifer species planted in England's Forests



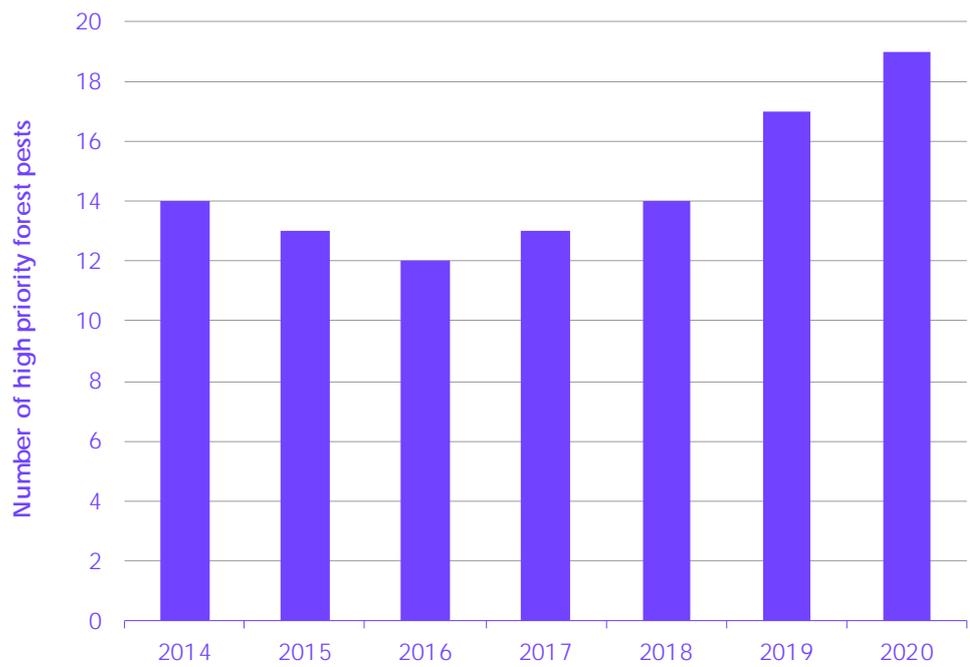
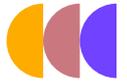
Source: Forestry England.

**Data on the number of high priority forest pests indicates a rise over the short-term.**

Pests, pathogens and invasive non-native species present serious risks to forest productivity, with consequences for livelihoods and businesses, as well as for the multiple ecosystem services that forests provide. The relationship of this risk with climate change is complex. Each problem species or micro-organism has its own specific climatic and ecological sensitivities that can favour their increased incidence. This includes parameters related to maximum and minimum temperature, moisture (both precipitation and specific/relative humidity can have an influence), and potentially wind (notably direction); these typically act in combination and are also related to duration or frequency of outbreaks.<sup>38</sup>

Despite evidence of actions to build resilience of England's forests to pests and diseases, the number of high priority forest pests in the UK Plant Health Risk Register (UKPHRR) has increased sharply in recent years, rising from 12 in 2016 to 19 in 2020. Although the data presented in figure 2.20 are for the UK, the UKPHRR report that nearly all listed forest pests present in the UK will also be present in England.

Figure 2.20 Number of high priority forest pests in the UK Plant Health Risk Register (UKPHRR)



Source: Forestry England.

## 2.7 Agricultural productivity

Progress summary – Agricultural productivity		
2019 score:	What has changed since 2019:	2021 score:
1	<p><b>Plan score - low</b></p> <ul style="list-style-type: none"> <li>Defra still lacks a strategy to ensure the agricultural sector remains productive as the climate changes. ELM plans to date are still limited largely to flood risk management, and do not consider the broader range of climate impacts (e.g. drought, pests and diseases) on agricultural productivity.</li> <li>There is some evidence of sector-led activity, although plans to date are narrow in scope (e.g. focusing only on drought and flood risks) and do not account for the effects of climate change under a range of future warming scenarios.</li> </ul> <p><b>Risk management score – low</b></p> <ul style="list-style-type: none"> <li>Although there have been declines in water abstraction by farmers, it is not clear if this represents any reduction in vulnerability to water scarcity. Additionally, while there is evidence of actions taking place to build the resilience of the sector, there are few appropriate indicators (e.g. soil health, agricultural R&amp;D) to support effective assessment.</li> </ul>	1
<p>Notes: See annex for full datasets Key Indicators: Wine Production - Area planted (ha) per year in England.</p>		

The agricultural productivity adaptation priority considers how climate change could affect the ability of the land to support domestic food production in the future as the climate changes. This priority considers the degree of innovation and flexibility in agriculture, the resilience of crops and livestock to climate change impacts including pests and diseases, and the resilience of the underpinning natural assets as they are needed to support agriculture – soil and water. If climate change degrades land capability overall, agricultural production will not be able to take advantage of any potential benefits from longer growing seasons.

### Summary of 2019 report score

**In our last report, agricultural productivity scored a 1 (low plan score, low risk management score).**

Analysis presented in the last report indicated there was a concerning absence of robust plans that considered the range of risks to and opportunities for the agricultural sector in England from climate change. Furthermore, a lack of effective indicators to monitor changes in the capability of agriculture in relation to climate change, meant that it was difficult to assess how the sector is managing current and future risk. As noted in the CCC's Sixth Carbon Budget report<sup>39</sup>, measures involving technological and land use changes in agriculture (e.g. improvements in crop productivity) will play an increasingly important role in achieving Net Zero. Building the resilience of the sector to climate change will be vital for the successful delivery of such measures.

### Has the plan score changed?

**No – the score remains unchanged from 2019.**

Defra still lacks a strategy to ensure the agricultural sector remains productive as the climate changes.

### **The agriculture sector still lacks a coherent strategy to ensure it remains productive under changing climatic conditions.**

A long-term strategy is required to prepare the agricultural sector in England for the range of risks to and opportunities from climate change, particularly with regard to water and soil management, and improving the technological capability of the sector to respond to threats such as changing pest and disease risks.

As set out above, the Government's proposed Environmental Land Management (ELM) scheme includes climate change adaptation in the defined list of public goods but content on threats to agricultural productivity is limited largely to building resilience with regard to flood risk management. There is no detail (as yet) on what will be required in terms of adaptation to the full range of risks to agriculture identified within the second UK Climate Change Risk Assessment (CCRA2-2017), including higher temperatures, drought, and increases in the spread of pests and diseases.

### **There are partial plans in place for protecting against the ongoing loss of lowland peat soils, although most plans are still in development.**

Lowland peat soils form part of the most productive agricultural land in England, but they are at high risk of loss as the climate changes.<sup>40</sup> Defra has created a new Lowland Agricultural Peat Taskforce with a remit to reduce the loss of lowland peat soils in England. The taskforce will help deliver the policy objectives outlined in the England Peat Action Plan (see section 2.2). Defra also concluded an internal evidence review of management practices with the potential to reduce soil loss and greenhouse gas emissions from lowland agricultural peatlands in England. The evidence will be presented as an input to the Task Force which is currently scheduled to report in July 2022.

### **Sector led plans indicate an increasing recognition of the need to adapt farming practices to the challenges of climate change, but gaps remain.**

Agriculture shows generally low levels of proactive planned adaptation, with most actions driven mainly by reactive and short-term adjustments rather than long-term decisions.<sup>41</sup>

A 2021 report by the National Farmers Union (NFU) lays out a blueprint for an Integrated Water Management strategy. The document aims to promote the implementation of contingency planning on farms to tackle the dual risks of flooding and water supply disruption.

There is some evidence of long-term adaptation planning by the Agriculture sector, although plans to date focus on drought and flood risks, and do not as yet account for the effects of climate change under a range of future warming scenarios.

Case study examples are presented in the report of on-farm planning for impacts of drought and flood on specific agri-product lines, and the policies needed to build resilience of agri-water infrastructure to climate change are outlined. The report also profiles a range of actions farmers and growers can take, and in many cases are already taking, to build the resilience of their businesses to the impacts related to flood and drought risk. These include: increasing water storage capacity and the use of water-saving techniques; adopting improved soil cultivation techniques to lock moisture into soils; implementing on-farm flood and drought risk management and contingency planning; and incorporating best practice in crop management.

While the report includes information on impacts to agricultural productivity from flood and drought risks, it does not consider the potential impacts and associated actions under 2°C and 4°C global warming scenarios. It is understood similar plans for the broader range of climate impacts (e.g. higher temperatures) are in the early stages of development by the NFU.

The Agriculture sector does not have a comprehensive plan to address the potential risks facing the agriculture sector from pests, pathogens and invasive non-native species.

**There is still no comprehensive plan to address the potential risks facing the agriculture sector from pests, pathogens and invasive non-native species.**

NAP2 includes actions to manage existing plant and animal diseases and lower the risk of new ones (see also section 2.2 Terrestrial habitats and species). As noted in CCRA3<sup>42</sup>, climate driven increases in the spread of pests, pathogens and invasive non-native species (INNS) present serious risks to agricultural productivity. Large-scale outbreaks or invasions may have serious ramifications for food security. Adaptation actions can include research into building the resilience of crops grown through diversifying their genetic composition, and measures to improve control for pests and diseases. However, the agricultural sector in England currently lacks a strategic-level plan, which includes coordinated surveillance and monitoring, and improved risk assessments with space and time dimensions to evaluate changing dynamics of individual pests, pathogens and INNS.

The Government has provided some funding to support long-term research into the genetic improvement of arable crops and fresh produce via the development of Genetic Improvement Networks (GINS). Defra allocated £5.5 million in 2018 over a five-year period. The research includes work to identify crop varieties which have better levels of resistance to pest and disease. The GINs are required to report on research annually, to 2023.

**Initiatives to develop research and improve agriculture efficiency should help boost the industry's resilience to climate change and reduce emissions.**

Recent research initiatives relevant to improving resilience include:

- The Countryside Productivity Small Grant (CPSG) scheme provides funding for farmers to purchase equipment to improve the productivity of their farm. Eligible activities under the scheme include more efficient use of water for irrigation, and to secure water supplies for crop irrigation by the construction of on-farm reservoirs. The Government is providing a further £21m in 2021 bringing the total investment to £60m.
- A Farming Investment Fund to support innovation and productivity is being established where grants will be available for farmers to invest in equipment, technology and infrastructure with an aim to build the efficiency of farm businesses, including on-farm water storage. The fund was announced by Defra as part of a package of measures to support the transition from the Basic Payment Scheme towards the new ELM scheme. It is understood the fund is scheduled to launch in autumn 2021.

Has the risk management score changed?

**No – the risk management score remains low.**

**Indicators to measure how the capability of the agricultural sector is changing in relation to climate change remain very limited (e.g. lack soil health metrics). It is, therefore, not possible to conduct a robust assessment of changes in the vulnerability of agricultural production to climate change.**

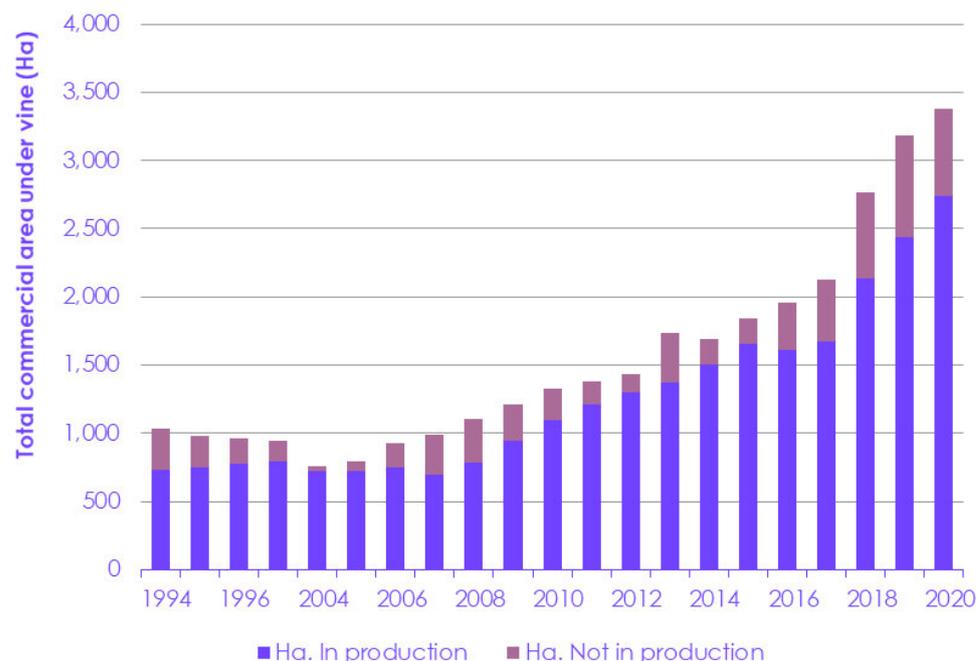
**There is presently limited information on the establishment and spread of new crops.**

Crops that are likely to become more viable commercially in the UK as the climate changes include peaches, apricots, tea, sunflowers, sweet potatoes, watermelons, walnuts, and truffles.<sup>43</sup>

While there is some evidence of actions taking place to build the resilience of the Agriculture sector, there are few appropriate indicators currently available (e.g. soil health, agricultural R&D in adaptation) to support effective assessment.

Commercial wine production is becoming viable over larger areas in England. The total commercial area under vine in England and Wales has more than doubled in the last decade from 1,384 hectares in 2011, to an estimated 3,380 hectares in 2020 (Figure 2.21). These values are for commercial vineyards only and do not include 'hobby vineyards' and 'abandoned vineyards\*'.<sup>1</sup>

**Figure 2.21 Wine Production - Area planted (ha) per year in England**



Source: ADAS for the CCC (2021) *Research to update indicators of climate-related risks and actions in England.*

There is no indication in the datasets as to whether this increase in area is being driven by improving climatic conditions for the vines, or whether there are other economic reasons for the increase in area. However, it is anticipated that the climate is becoming more suitable for vine production and thus opening up an opportunity for growers interested in wine production.

**Adaptation actions to improve monitoring and measuring of water (to ensure optimal use) and the identification of innovative techniques to reduce demand and reuse water are required both at a farm and catchment scale.**

Long-term declines are evident in the volume of water abstractions from non-tidal sources for both agricultural and fish farming sectors (see section 2.8 and section 2.9). However, the reasons for this are not clear and on its own it does not suggest whether the vulnerability of the agriculture sector to water scarcity is changing.

\* In 2020, 'hobby vineyards' and 'abandoned vineyards' accounted for an estimated additional 66 hectares and 54 hectares respectively.

**Better Indicators are needed to measure changes in the level of agricultural expenditure on adaptation.**

The amount of investment in agricultural research and development (R&D) on climate-specific issues is a useful indicator of action. The Office for National Statistics (ONS) publishes annual data on R&D investment for agriculture, forestry, fisheries and hunting. At present, however, sub-industry data for this indicator are not available, meaning we are unable to assess changes specific to the agriculture portion of R&D investment.

**Indicators are urgently needed to measure the ability of agricultural soils to support food production.**

Better Indicators are needed to measure changes in the level of agricultural expenditure on adaptation, and the ability of agricultural soils to support food production.

Soil degradation, through erosion and reduced organic matter, could cause an irreversible decline in the productive capacity of the land. In the case of agriculture, soils are being degraded by intensive farming practices in some areas (such as the Fens), with deep ploughing, short rotation periods and exposed ground leading to soil erosion from wind and heavy rain.

Defra are considering the potential scope for a soil health action plan (see section 2.2). Draft plans include developing a new Soil Health Monitoring Scheme (SHMS) for England to produce a new robust data baseline. A healthy soils indicator will be developed to feed into the SHMS and will inform a future target for soil health under the Environment Bill. Separately, a new Soil Structure Measuring and Monitoring Scheme is being developed to enable visual assessments to be carried by farmers and land managers across all land use/soil types.

## 2.8 Water management

Progress summary – Water management		
2019 score:	What has changed since 2019:	2021 score:
5	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>Revisions to the river basin management plans consider potential climate impacts under a range of warming scenarios. However, there is insufficient consideration of risks to water quality from higher temperatures in the current plans.</li> <li>The Environment Agency's second Flood and Coastal Erosion Risks strategy also considers adaptation for a range of climate scenarios and emphasises the potential for nature-based solutions to manage risks of flooding, including to agricultural land.</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>There is a lack of appropriate indicators to show how the vulnerability of the freshwater environment for providing water for human use is changing.</li> <li>Progress has been made in supporting sustainable abstraction of water from the environment through the Environment Agency's Restoring Sustainable Abstraction Programme.</li> <li>The use of land for natural flood management remains poorly recorded.</li> </ul>	5
<p>Notes: See annex for full datasets Key Indicators: Progress made by Restoring Sustainable Abstraction Programme.</p>		

This adaptation priority considers the regulating services related to the availability and quality of water in the environment, and flood risk management provided by the natural environment. Freshwater biodiversity is covered in Section 2.3.

### Summary of 2019 report score

**In our last report, water management scored a 5 (medium plan score, medium risk management score).**

Our 2019 report highlighted that while plans are in place and actions are being implemented to address increased risks of water scarcity in vulnerable locations, there was insufficient consideration of risks from higher water temperatures. Furthermore, there were no goals set out in current policies for how land should be used to manage flood risk as the climate changes.

On progress in managing risk, the downward trend in abstraction of water for agriculture suggested a decline in vulnerability to future water deficits, although on its own it is a very limited indicator as change is influenced highly by demand. A lack of information on the use of land for natural flood management in England meant we were not able to assess progress in this area accurately.

Has the plan score changed?

**No. The score remains the same.**

Revisions to the river basin management plans lack sufficient consideration of risks to water quality from higher temperatures across the impacts identified.

**Revisions to the river basin management plans (RBMPs) that consider the potential climate impacts under a range of warming scenarios will support adaptation decisions on the use of water to address future risk. However, there is insufficient consideration of risks to water quality from higher temperatures in current plans.**

As part of the process of reviewing the RBMPs (see section 2.4), in 2020 the Environment Agency completed a 'Challenges and Choices' consultation. The consultation was used to raise awareness of the impact of climate change on water management in England and gather views from stakeholders on how to mitigate these risks. Climate related changes identified included: climate and biodiversity crisis, changes in water levels and flows, and invasive non-native species. This work has started a conversation around the challenges stakeholders and the communities they represent face in the future. The discussions have led to some initiatives to prepare for warmer water temperatures (e.g. keeping rivers cool project). However, there is still insufficient consideration of risks to water quality from higher temperatures across the impacts identified.

The Environment Agency has produced current and future pressure assessments for each of the RBMP challenges identified. The futures analysis component builds on current understanding by incorporating projections for climate change, population growth and land use change, and aims to improve such tools to inform future water planning.

**The Government's water abstraction plan provides a framework to manage risks of water scarcity, but does not give adequate consideration to risks to water quality as outlined in CCRA3.<sup>44</sup>**

The 25-Year Environmental Plan identifies the Water Abstraction Plan (WAP) 2017 as the Government's key tool to help meet its 'Clean and plentiful water' goal, and to meet the challenges of climate change both now and in the future. The plan has three main elements: addressing unsustainable abstraction; stronger catchment focus; and modernisation. The WAP refers to the link between climate change and sustainably abstracted water bodies and the benefits of a stronger catchment focus in delivering greater sustainability and access to water. It is understood outputs from the RBMP risk scenario assessments (see above and section 2.4) will feed into the WAP, but it is not clear how results will support appropriate actions.

**The second Flood and Coastal Erosion Risk Management (FCERM) strategy emphasises the potential for nature-based solutions (NbS) to manage the risks of flooding.**

Natural flood management (NFM) is a central feature in the Environment Agency's national FCERM Strategy, which makes several commitments to mainstream NbS citing the benefits of working with natural processes to manage current and future flood risk. The Environment Agency has also been developing evidence and knowledge sharing concerning NFM<sup>45</sup>, including case studies on different NFM approaches, as well collaborating internationally with the US Army Corps 'Atlas' work on 'engineering with nature'.

**Funding has been allocated to natural flood management projects, but early lessons are only just emerging and further evidence of the success of projects is needed.**

In 2017, the Environment Agency began a £15 million pilot programme to learn more about NFM, working with communities, land managers, catchment partnerships and coastal groups around England. The programme completed in April 2021, with 56 NFM projects across the country delivered with local community groups, and improving 4,000 hectares of habitat. Currently, the Environment Agency identifies 40 projects as part of their FCERM investment programme that

The Environment Agency has allocated funding to natural flood management projects, but early lessons are only just emerging and further evidence of the success of projects is needed.

include NFM measures, but recognise that further learning about NFM is needed to increase confidence in its use.

**As noted in NAP2, the Environment Agency has committed to producing a Natural Flood Management design manual by 2020.**

The manual will assist practitioners in selecting appropriate NFM measures. CIRIA\* has been commissioned to lead a project to develop the design manual on behalf of the Environment Agency. The project is scheduled to complete in winter 2021/22.

Has the risk management score changed?

**No, the score has remained medium.**

**There is a lack of indicators to show how the vulnerability of the natural environment for providing water for human use is changing.**

Effective water management is a fundamental function of agricultural production, whether it be through water storage or sustainable abstraction for irrigation used to water crops. A changing climate is likely to bring greater variability in rainfall and higher temperatures. This could result in less groundwater recharge and larger seasonal variations in river flow as well as changes to when and how extended dry periods occur. Sustainably abstracted water bodies will be more resilient to changes in climate and drought pressures so addressing unsustainable abstraction will help improve resilience to climate change. As noted above, through the WAP, the Environment Agency is looking to reduce the amount of water that can be abstracted under a licence based on historical long-term average use.

**Progress has been made in supporting the sustainable abstraction of water from the environment through the EA's Restoring Sustainable Abstraction Programme.**

Through the Restoring Sustainable Abstraction (RSA) programme, launched in 2008, the Environment Agency has been investigating and changing permanent abstraction licences that have caused environmental damage, reduced biodiversity and undermined ecosystem resilience to climate change. The RSA programme identifies abstraction licences for which there were concerns about an impact on the environment and, where possible, identifies options to make the abstraction sustainable. This is either through voluntary agreement with licence holders or using compulsory legal powers. As of March 2020, 85% of the RSA Programme had been delivered, equating to changes to 320 abstraction licences.

**Data to support the assessment of changes in the level of on-farm water storage capacity in England is no longer collected.**

In our 2019 assessment, we presented information taken from Defra's Farm Business Survey on the percentage of farms sourcing water from various water sources, including from on-farm water infrastructure. Data on this ceased to be collected as part of the survey beyond the 2015-16 financial year, so we are unable to assess recent progress in developing on-farm water storage capacity for this report.

Some progress has been made in supporting sustainable abstraction of water from the natural environment.

\* Construction Industry Research and Information Association

## 2.9 Commercial fisheries and aquaculture

Progress summary – Commercial fisheries and aquaculture		
2019 score:	What has changed since 2019:	2021 score:
2	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The Fisheries Act 2020 includes a requirement for authorities in England to report on how objectives will be met to improve the ability of the Fisheries and Aquaculture industries to adapt to climate change. While adaptation plans for both sectors have now been published, neither plan considers climate impacts under a range of warming scenarios.</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>Overall, there are a greater proportion of marine stocks fished sustainably and within safe biological limits, both in the long and short term. However, existing metrics only include fish stocks covered by quota management.</li> </ul>	5
<p>Notes: See annex for full datasets            Key Indicators: Marine fish (quota) stocks of UK interest harvested sustainably, Marine fish (quota) stocks with biomass at levels that maintain reproductive capacity.</p>		

### Summary of 2019 report score

#### **Commercial fisheries and aquaculture scored a 2 in the 2019 report (low plan score, medium risk score).**

Our 2019 report highlighted that without an adequate plan for aquaculture, existing plans for the sector did not represent a sufficient strategy for adapting the industry to climate change. Available indicators suggested some progress has been made under the EU Common Fisheries Policy in introducing sustainable fisheries measures, while substantial research into the effect of climate change was underway.

#### Has the plan score changed?

#### **Yes. Medium levels plans are now in place for the sector.**

The UK marine fishing industry was worth ca. £1.5 billion in 2017 (total catches were worth £980.1 million) and employed 23,000 people, although this is rather unevenly distributed between sectors and around the UK.<sup>46</sup>

#### **The Fisheries Act. 2020 contains provisions to improve the ability of the Fisheries and Aquaculture industries to adapt to climate change, including a requirement for authorities to report triennially on how objectives will be met.**

The Fisheries Act (2020) replaces the EU's Common Fisheries Policy (CFP) in providing a framework for domestic fisheries policy governing foreign access to British fishing grounds, the licensing of fishing boats, and grants connected to fishing. The Act also extends the powers of national authorities with regard to marine conservation to the whole of the UK Economic Exclusion Zone (EEZ).

Climate change is listed as one of the eight objectives under the Act, notably reducing the impact of fisheries (e.g. through lowering emissions), and to fisheries (e.g. through improving its ability to adapt to the effects of climate change).

Climate change is listed as one of the eight objectives under the Fisheries Act. 2020.

The Act itself does not set out the specifics of how climate change objectives will be achieved. Rather, it creates a legal requirement for the UK's four national fisheries policy authorities (e.g. Marine Management Organisation (MMO) for England) to produce a Joint Fisheries Statement (JFS) that will lay out how these objectives will be met. The Act requires these authorities to produce the JFS within two years of the Fisheries Act being passed (November 2022). The Act also includes provisions to report on the JFS policies every three years, and to review the JFS every six years. This aims to ensure the policies will be responsive, and remain fit for purpose in order to achieve the fisheries' objectives. It is not clear at this stage the extent to which the impacts of climate under different warming scenarios will be included in the JFS.

**Policies to replace former EU protections must ensure gains made under the Common Fisheries Policy are maintained and built on.**

To support adaptation, policies for fisheries and aquaculture need to achieve at least two key aims: sustainable yields for populations; and flexibility through time in what species are caught, to mirror the changing species diversity and abundance in UK waters as the climate changes. Previously under the CFP, a number of tools were used to manage UK fisheries including: minimum landing sizes; mesh sizes; effort control (limiting days at sea, or power of vessels); area closures; technical measures specifying aspects of the design of the gear; and landing restrictions. The setting of a Total Allowable Catch was the primary means of controlling the number of fish removed from a stock. It is likely that EU-exit will have major implications for these fisheries, most notably in terms of changes in fisheries policy (quota arrangements, regulations etc.). It is vital that the policies implemented under the Fisheries Act ensure the gains made in improving the sustainability of the UK fishing industry are both maintained and increased.

**NAP2 includes the release of several reports by Seafish, the industry body with a remit to support the profitability and sustainability of the seafood industry.**

Seafish has produced a climate change adaptation report for the aquaculture side of the sector. The report considers the major impacts on the industry, from production to processing, that arise from five principal climate change drivers (sea level rise; changes in storms and waves; temperature change; ocean acidification; and changes in terrestrial rainfall) and sets out key areas for adaptation action. The report compliments a previous Seafish climate change adaptation report for the UK wild capture seafood side of the industry. The document also considered the major industry impacts arising from key climate change drivers and sets out major areas of adaptation action, and was produced in collaboration with key partners, for the UK Government under the first Climate Change Adaptation Reporting Power. However, while both reports comprehensively cover impacts from key climate threats, the assessments lack explicit consideration of 2°C and 4°C global temperature scenarios.

It is anticipated that evidence on climate change to inform potential responses will be collected on an ongoing basis for aquaculture in the form of an annual 'watching brief' as is currently the case for the wild capture seafood report.

Has the risk score changed?

**No, the risk score remains medium.**

Climate change drives modifications in marine ecosystems that affect fisheries' productivity and food security. Fish are an integral component of marine biodiversity. They are an important element of the food chain for seabirds, seals and cetaceans (e.g. whales) and are a source of food and employment for people.<sup>47</sup>

Adaptation plans have been produced for the aquaculture and wild capture sides of the fisheries sector, but as yet neither plan considers climate impacts under a range of warming scenarios.

There is increasing evidence of climate impacting on the off-shore fishing industry.

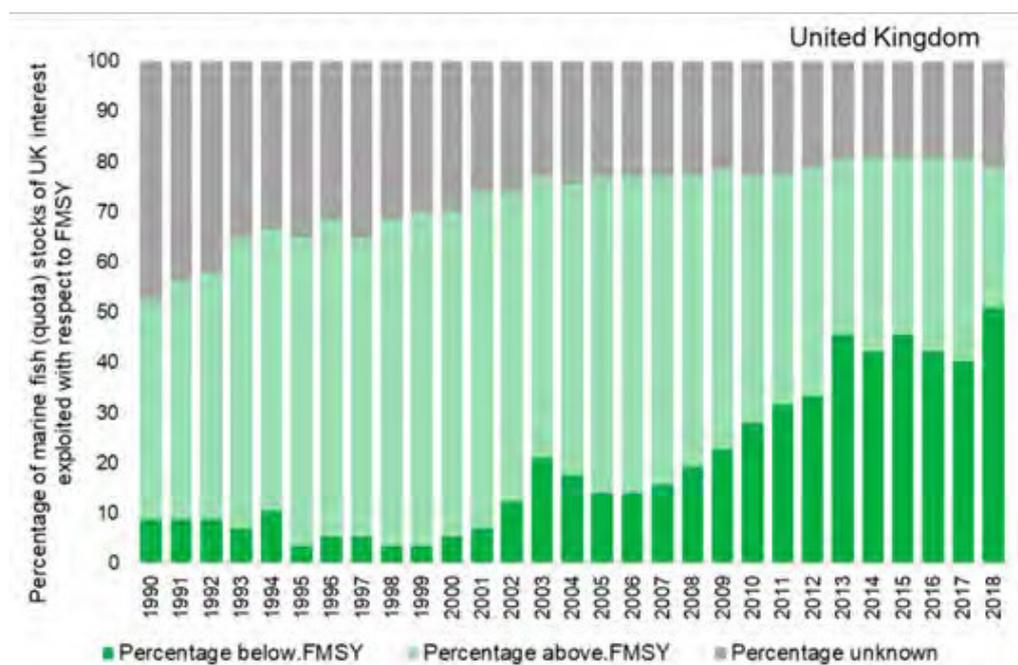
**The Marine Climate Change Impacts Partnership 2020 Report Card 2020 showed increasing evidence of climate impacting on the off-shore fishing industry.**

The report card states that fisheries productivity in some UK waters has been negatively impacted by ocean warming, including impacts to the timing of spawning among species, as well as substantial changes in fish communities in UK waters, linked to the appearance of warm-water species. There is also evidence to suggest warming, and associated oxygen solubility, appears also to be affecting the age at maturation, growth rates, and the maximum size fish can attain.

**Indicators of the extent and condition of recorded fish stocks suggest long-term improvement, however, it is not possible to assess fish species that are not under quota management.**

Maintaining sustainable fisheries helps to ensure marine ecosystems remain diverse and resilient, providing a long-term and viable fishing industry. The percentage of fish stocks at or below levels capable of producing maximum sustainable yield (MSY) has increased from 9% in 1990 to 51% in 2018 (Figure 2.22).

**Figure 2.22** Percentage of marine fish (quota) stocks of UK interest harvested sustainably

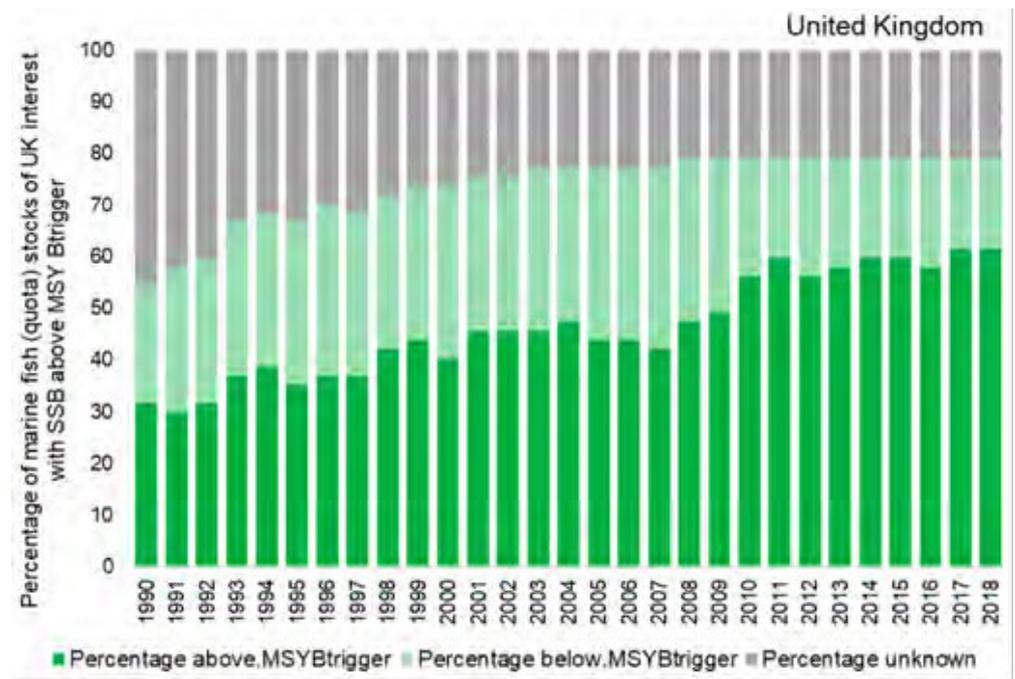


Source: Defra biodiversity indicators 2020 update.

Notes: 1. The list of stocks used within the indicator was expanded in 2017, so publications of the indicator using data prior to 2017 are not directly comparable. Note that Defra first published this indicator using the expanded list of stocks in 2019. 2. Also, not directly comparable with previous publication; As data are added to time-series and stock assessment models are refit, small changes can occur in past estimates even if the model structure is not itself revised.

The spawning biomass (SSB) of each respective fish stock should be at or above a level capable of producing maximum sustainable yield if the reproductive capacity of stocks is to be maintained. The percentage of stocks achieving this goal has also increased, from 32% in 1990 to 61% in 2018 (see figure 2.23). For 2020, the UK will have 67% of its Total Allowable Catches set at Maximum Sustainable Yield (MSY) out of the total stocks with MSY assessments.<sup>48</sup>

**Figure 2.23** Percentage of marine fish (quota) stocks of UK interest with biomass at levels that maintain full reproductive capacity



Source: Defra biodiversity indicators 2020 update.

Indicators show there are a greater proportion of marine stocks fished sustainably and within safe biological limits, both in the long and short term. However, existing metrics only include fish stocks covered by quota management.

The indicators presented in figure 2.22 and figure 2.23 only include UK fish stocks that are subject to quota management. Both are based on a group of 20 species in 57 stocks for which there are reliable estimates of fishing mortality and spawning biomass, together with MSY reference points for fishing mortality and biomass that allow the sustainability of the stocks to be evaluated. The indicator stocks include a range of local and widely distributed species of major importance to the UK fishing industry. Data limitations, however, mean it is not possible to assess the extent and condition UK fish stocks that are not subject to quota management.

**The absence of long-term monitoring datasets mean we are not able to assess the status of seafloor marine species.**

The use of bottom trawling by the fishing industry can have widespread impacts on the condition, and therefore vulnerability to climate change, of marine habitats and species. Physical disturbance can affect seafloor habitats adversely, with shifts in sea floor community composition being reported.<sup>49</sup> These shifts are driven by the replacement of larger, long-lived, slow-reproducing species with small, fast-growing species.<sup>50</sup> Data limitations mean changes in the status of seafloor marine species are not included in the assessment.

# Endnotes

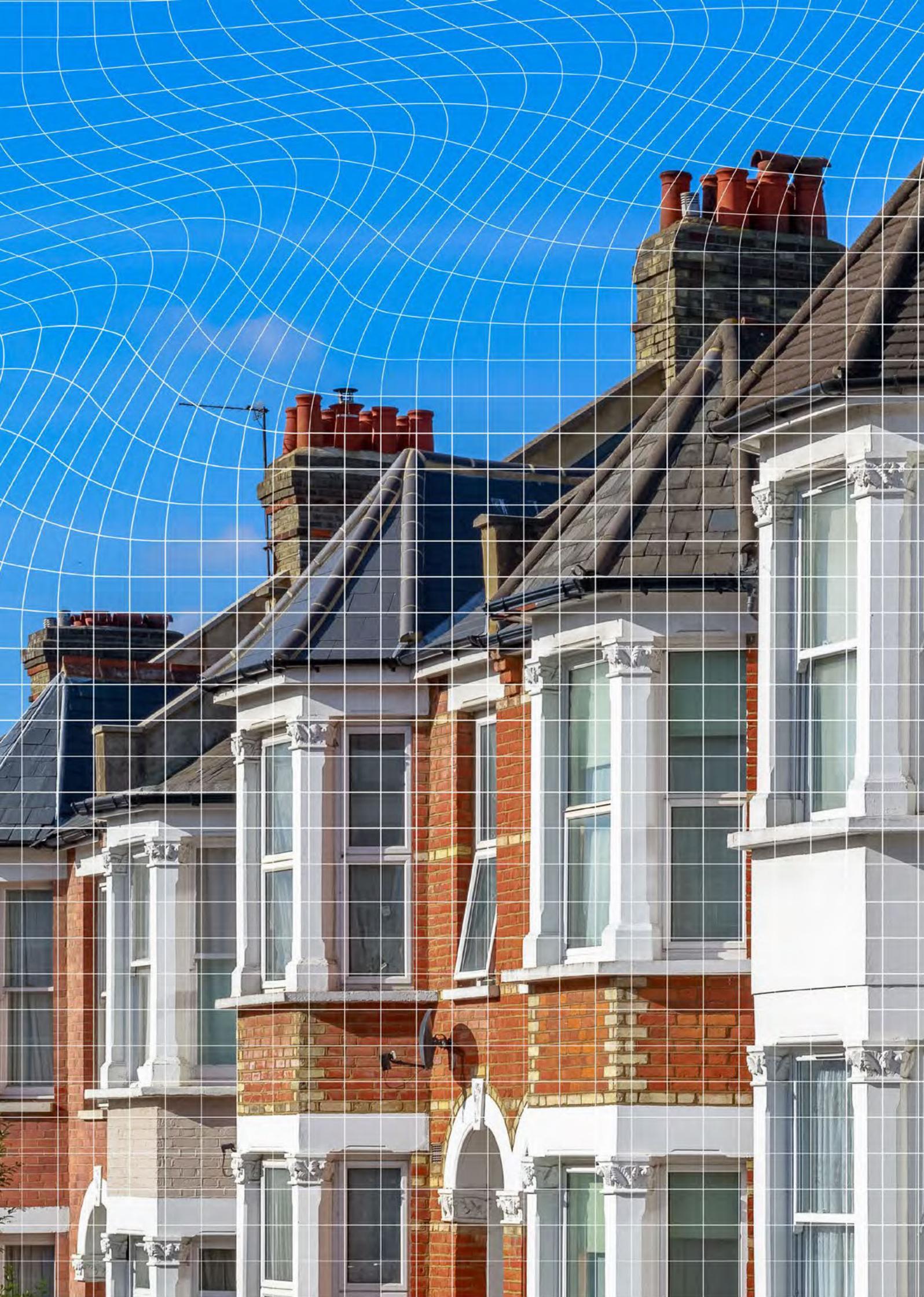
- <sup>1</sup> UK National Ecosystem Assessment report (2011)
- <sup>2</sup> Irvine. K. N, O'Brien. L, Ravenscroft. N., Cooper. N., Everard. M., Fazey. I., Reed. M. S., Kenter. J. O., (2016), Ecosystem Services Volume 21, Part B, Pages 184-193
- <sup>3</sup> ONS (2021) Woodland natural capital accounts, UK.
- <sup>4</sup> Defra (2020) Enabling a Natural Capital Approach. <https://www.gov.uk/guidance/enabling-a-naturalcapital-approach-enca>
- <sup>5</sup> CCC (2020). *The Sixth Carbon Budget, The UK's path to Net Zero.*
- <sup>6</sup> CCC (2018) *Land use: Reducing emissions and preparing for climate change*
- <sup>7</sup> NAP2 (2021) Actions update
- <sup>8</sup> CCC (2020). *The Sixth Carbon Budget, The UK's path to Net Zero.*
- <sup>9</sup> Berry. P. and Brown. I. (2021) UK Climate Change Risk Assessment Evidence Report: Chapter 3, Natural Environment and Assets
- <sup>10</sup> Wildlife and Countryside Link (2020), 30 by 30: Land for Nature's recovery.
- <sup>11</sup> Biodiversity 2020: A strategy for England's wildlife and ecosystem services
- <sup>12</sup> RSPB (2015) *England's upland peatlands – turning around a crisis.*
- <sup>13</sup> Woodland Trust (2021) State of the UK's Woods and Trees
- <sup>14</sup> Berry. P. and Brown. I. (2021) UK Climate Change Risk Assessment Evidence Report: Chapter 3, Natural Environment and Assets.
- <sup>15</sup> ADAS for the CCC (2021) *Research to update indicators of climate-related risks and actions in England.*
- <sup>16</sup> CCC (2018) *Land use: Reducing emissions and preparing for climate change*
- <sup>17</sup> ECI for the CCC (2017) *Land use modelling project:* <https://www.theccc.org.uk/publication/land-use-modelling-project-eci/>
- <sup>18</sup> NAP2 2021 Actions update
- <sup>19</sup> Natural England (2018) *Assessing the contribution of agri-environment schemes to climate change adaptation*, a report by Atkins Ltd for Government.
- <sup>20</sup> CCC (2018) *Land use: Reducing emissions and preparing for climate change.*
- <sup>21</sup> CCC (2019) *Progress in preparing for climate change.*
- <sup>22</sup> (Wolton R (2012) *What hedges do for us.* Available at: [http://www.hedgelinek.org.uk/cms/cms\\_content/files/45\\_what\\_hedges\\_do\\_for\\_us%2C\\_v2%2C\\_20\\_mar\\_2012%2C\\_rob\\_wolton%2C\\_hedgelinek.pdf](http://www.hedgelinek.org.uk/cms/cms_content/files/45_what_hedges_do_for_us%2C_v2%2C_20_mar_2012%2C_rob_wolton%2C_hedgelinek.pdf) [Accessed 21 Jan. 2021]
- <sup>23</sup> Countryside Survey: England Results from 2007 (published September 2009). NERC/Centre for Ecology & Hydrology, Department for Environment, Food and Rural Affairs, Natural England, 119pp
- <sup>24</sup> Defra (2007) Hedgerow Survey Handbook. *A standard procedure for local surveys in the UK.* Defra, London. Available at: <https://www.gov.uk/government/publications/hedgerow-survey-handbook> [Accessed 23 Mar. 2021]
- <sup>25</sup> ONS (2017) UK natural capital: ecosystem accounts for freshwater, farmland and woodland

- <sup>26</sup> ONS (2017) UK natural capital: ecosystem accounts for freshwater, farmland and woodland
- <sup>27</sup> Berry. P. and Brown. I. (2021) UK Climate Change Risk Assessment Evidence Report: Chapter 3, Natural Environment and Assets
- <sup>28</sup> Berry. P. and Brown. I. (2021) UK Climate Change Risk Assessment Evidence Report: Chapter 3, Natural Environment and Assets
- <sup>29</sup> Jones, L.; Gorst, A.; Elliott, J.; Fitch, A.; Illman, H.; Evans, C.; Thackeray, S.; Spears, B., Gunn, I.; Carvalho, L.; May, L.; Schonrogge, K.; Clilverd, H.; Mitchell, Z.; Garbutt, A.; Taylor, P.; Fletcher, D.; Giam, G.; Aron, J.; Ray, D.; Berenice-Wilmes, S.; King, N.; Malham, S.; Fung, F.; Tinker, J.; Wright, P.; Smale, R. . (2020). *Climate driven threshold effects in the natural environment*. Retrieved from [https://www.ukclimaterisk.org/wp-content/uploads/2020/07/Thresholds-in-the-natural-environment\\_CEH.pdf](https://www.ukclimaterisk.org/wp-content/uploads/2020/07/Thresholds-in-the-natural-environment_CEH.pdf)
- <sup>30</sup> Defra biodiversity indicators 2020 update
- <sup>31</sup> NAP2 (2021) Actions update
- <sup>32</sup> NAP2 (2021) Actions update
- <sup>33</sup> WWF (2020) *Value of UK restored seas*
- <sup>34</sup> Grémillet, D. and Boulinier, T. (2009) *Spatial ecology and conservation of seabirds facing global climate change: a review*. Mar. Ecol. Prog. Ser. 391: 121–137
- <sup>35</sup> UK State of Nature report, 2019.
- <sup>36</sup> CCC (2019) *Progress in preparing for climate change*.
- <sup>37</sup> NAP2 (2021) Actions update
- <sup>38</sup> Berry. P. and Brown. I. (2021) UK Climate Change Risk Assessment Evidence Report: Chapter 3, Natural Environment and Assets
- <sup>39</sup> C\CCC (2020). *The Sixth Carbon Budget, The UK's path to Net Zero*.
- <sup>40</sup> Adaptation Sub-Committee progress report (2013) *Managing the land in a changing climate*
- <sup>41</sup> CCC (2018) *Land use: reducing emissions and preparing for climate change*
- <sup>42</sup> Berry. P. and Brown. I. (2021) UK Climate Change Risk Assessment Evidence Report: Chapter 3, Natural Environment and Assets
- <sup>43</sup> Thomas, P.; Büntgen, U. (2018). *First harvest of Périgord black truffle in the UK as a result of climate change*. Climate Research, 74, 67-70. doi:<https://doi.org/10.3354/cr01494>
- <sup>44</sup> Berry. P. and Brown. I. (2021) UK Climate Change Risk Assessment Evidence Report: Chapter 3, Natural Environment and Assets
- <sup>45</sup> Environment Agency (2021), *Working with natural processes to reduce flood risk*
- <sup>46</sup> Parliamentary Office of Science and Technology. (2019). POST note 604: Climate Change and Fisheries. Retrieved from [https://www.researchgate.net/publication/334441815\\_POSTnote\\_604\\_Climate\\_Change\\_and\\_Fisheries](https://www.researchgate.net/publication/334441815_POSTnote_604_Climate_Change_and_Fisheries)
- <sup>47</sup> Defra biodiversity indicators (2020) update
- <sup>48</sup> NAP2 (2021) Actions update
- <sup>49</sup> Rijnsdorp AD, et al. (2018). *Estimating sensitivity of seabed habitats to disturbance by bottom trawling based on the longevity of benthic fauna*. Ecological Applications, 28: 1302–1312.
- <sup>50</sup> UK State of Nature report (2019)

# Chapter 3

## People and the built environment

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## 3.1 Introduction

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The vast majority of people in England live in built-up areas, with about 92% of the population living in cities and towns.\* The built environment therefore has a strong influence on how climate change will impact upon people and communities. For example, the level of flood risk to communities depends on: whether houses are built in areas exposed to flooding; the level of protection provided by flood alleviation schemes; and whether resilience measures are put in place at the individual household level. Housing quality determines whether people live in damp, excessively hot, or cold homes, with the health cost to the NHS of poor housing estimated to be around £1.4 billion per year.<sup>1</sup> The extent of permeable surfaces and urban green space impacts on the quantity and quality of water entering drainage networks and being discharged into watercourses. Green spaces also help to reduce temperatures in built-up areas.

The COVID-19 pandemic has led to people spending more time indoors – particularly their homes – potentially exacerbating exposure to other risks, including weather-related risks.<sup>2</sup> However, the impacts of COVID-19 may have raised awareness of the importance of understanding major threats that can disrupt lives and livelihoods, including low-probability, high-impact events (e.g. flood events).<sup>3</sup>

The third UK Climate Independent Assessment (CCRA3) has updated the evidence on the many, diverse climate change risks that impact upon people and the built environment. Most of these (55 out of 61 risks and opportunities) require more action or further investigation by Government.<sup>4</sup>

This chapter assesses whether climate change is being planned for, whether adaptation actions are taking place, and whether those actions are leading to reductions in vulnerability or exposure. Flooding (Section 3.2); coastal erosion (Section 3.3); water availability (Section 3.4); and health impacts from heat and cold, pathogens, and air pollution (Section 3.5), are all considered here as the key conduits for climate-impacts on people in the built environment. The capacity of responders to cope with climate-related emergencies is also considered (Section 3.6).

\* According to Defra's Official Statistics on Rural population 2018, excluding people living in sparsely populated areas and those in villages and hamlets, 83% of the English population lives in cities and urban towns and nearly 9% in rural towns.

## 3.2 Flood risk management and climate change

This section begins with an analysis of the overall flood risk and response, in the context of climate change. This is then followed by analysis of the CCC's more specific adaptation priorities: river and coastal flood alleviation; development in areas at risk of river or coastal flooding; surface water flood alleviation; development and surface water flood risk; property-level flood resilience; capacity of people and communities to recover from flooding.

The updated flood risk project for the third CCRA<sup>5</sup> found that 1,550,000 people in England currently face a 1 in 75 or greater flood risk (i.e. a 1.33% chance of flooding in any given year), and that direct Expected Annual Damages (EAD) to residential properties from flooding are currently £290 million. This covers all sources of flooding: river; coastal; surface water;\* and groundwater.†

By the 2080s, the projections suggest 2,150,000 people will be at risk under a 2°C scenario and 2,700,000 people under a 4°C scenario.

Assuming no population growth and enhanced adaptation,‡ by the 2050s the projected number of people at a 1:75 year or greater risk rises to around 2,000,000 under a 2°C scenario and 2,450,000 under a 4°C scenario.<sup>6</sup> By the 2080s, the projections suggest 2,150,000 people will be at risk under a 2°C scenario and 2,700,000 people under a 4°C scenario. Direct EAD for residential properties is projected to rise by 25-46% in the 2050s and 36%-84% in the 2080s, depending on the climate scenario used in the analysis.

Is there a good quality plan that presents a response to England's overall flood risk?

**Since 2019 the Government has published a National Policy Statement on flood and coastal erosion risk management, alongside the Environment Agency's national Flood and Coastal Erosion Risk Management (FCERM) Strategy and Action Plan (Box 3.1).**

The Policy Statement and Strategy together aim to ensure that England is more resilient to flooding and coastal erosion in the long-term:

- The Policy Statement forms part of the Government's wider commitment to tackle climate change, with many actions directly relevant. It sets out a long-term approach to commit to making better decisions about the actions and investments taken which account for future risks in a changing climate.
- The FCERM Strategy was laid in Parliament in 2020, as a requirement of the Flood and Water Management Act (2010). It provides a framework to guide the operational activities and decision-making of practitioners, in support of the direction set by the Policy Statement and the 25 Year Environment Plan.

\* Surface water flooding is considered separately from river and coastal flooding in this chapter. Different policies, plans, actors, and responses for these two categories, make their separation in this report, as well as in policy-making, convenient. However, there are also interactions and overlaps that should not be ignored. These include: policy (all flooding sources are covered in the FCERM and Policy Statement); shared flood defence and resilience funding streams; and shared physical drivers for different flooding sources such as high rivers and rising sea levels lead to blocking surface water drainage.

† Groundwater flooding is not examined in this report as there are few data and policies to examine. The issue requires further research.

‡ This 'current objectives+' scenario goes beyond the current implementation of policy (and recently introduced policy) to represent an enhanced whole-system approach to adaptation (i.e. implementation is in-line with the higher level of ambition).

It supports risk management authorities in considering a range of scenarios, including higher climate scenarios, such as a 4°C rise in global temperature.

- The FCERM Strategy Action Plan aims to help deliver the objectives set out in the Strategy with commitments from the Environment Agency, and a range of partners, that will be monitored, reviewed and updated every year.

The Policy Statement and Strategy should help to provide the required policy basis for increasing the level of ambition in tackling flood risk. However, it is too soon to tell what the resulting actions and subsequent risk reductions will be. Alongside this, while the updated flood risk projections for the third CCRA show that future risk can be reduced with continued adaptation action, residual risk remains high.

The FCERM Strategy and Policy Statement are revisited, where relevant, throughout this chapter. Section 2.7 (water management) in the Natural Environment chapter of this report refers to natural flood risk management.

### Box 3.1

#### New commitments in the Government's Flood Policy Statement and Environment Agency's Flood and Coastal Erosion Risk Management (FCERM) Strategy

The Policy Statement sets out the Government's long-term ambition to create a nation more resilient to future flood and coastal erosion risk. The Statement outlines five policy themes, aiming to accelerate progress and increase resilience to flooding and coastal erosion, in the face of more frequent extreme weather due to climate change:

1. Upgrading and expanding national flood defences and infrastructure.
2. Managing the flow of water more effectively.
3. Harnessing the power of nature to reduce flood and coastal erosion and achieve multi-benefits.
4. Better preparing communities.
5. Enabling more resilient places through a catchment-based approach.

These policies are supported by over 40 actions to drive progress and create a more resilient nation. These actions include:

- Reforming local flood and coastal erosion risk planning by 2026, so that every area of England will have a more strategic and comprehensive plan, that drives long-term local action and investment.
- £5.2 billion to create around 2,000 new flood and coastal defences to better protect 336,000 properties in England and reduce national flood risk by up to 11% by 2027.
- £200 million for the Environment Agency's Flood & Coastal Resilience Innovation Programme, for testing and developing innovative approaches to flood and coastal resilience as well as adaptation.
- Doubling the number of Government-funded projects which include nature-based solutions to reduce flood and coastal erosion risk.
- Consulting on changes to the FloodRe scheme, to encourage greater uptake of Property Flood Resilience among households at high risk of flooding across the UK.
- Reviewing national policy for Shoreline Management Plans.
- Developing a national set of indicators to monitor trends and the impact of policies by spring 2022.

The FCERM 2020 Strategy supports the ambition with a range of practical measures to help England strengthen its resilience to flooding and coastal change, for example by enhancing guidance for appraisal of flooding and coastal change projects, so that

investment decisions can better reflect a wider range of resilience actions and climate change scenarios.

The strategy also commits to:

- Enhancing the understanding of all sources of current and future flood risk through improving the National Flood Risk Assessment.
- Developing adaptive approaches and pathways in local places which equip practitioners and policy makers to better plan for future flood and coastal change and adapt to future climate hazards.
- Delivering innovative solutions to flood and coastal resilience in 25 places across the country, through the £150m Flood & Coastal Resilience Innovation Programme.
- Mainstreaming property flood resilience measures and to 'build back better' after flooding.
- Transforming the flood warning and informing service to better reach people living, working or travelling through flood risk areas.

In May 2021 the Environment Agency launched its first FCERM Strategy Action Plan. The plan aims to deliver the strategic objectives set out in the Environment Agency's FCERM Strategy and provides a wide-ranging list of actions. These include the Environment Agency working with:

- The National Flood Forum to expand the network of community flood groups, to support residents and local businesses to develop flood response plans and train flood wardens.
- The Property Flood Resilience Roundtable, to deliver a national suite of training for the property flood resilience industry.
- Partners in the Thames Estuary, Humber Estuary, Severn Valley and Yorkshire, to develop long term plans for adapting to future flooding and coastal change and climate hazards.
- The Local Government Association and ADEPT, to run workshops to help local authorities attract private sector investment and green finance as a means of improving flood and coastal resilience.
- The Town and Country Planning Association, to develop on-line training materials for town planners on flood risk and climate change.

Source: HM Government (2020) Flood and coastal erosion risk management Policy Statement; Environment Agency (2020) National Flood and Coastal Erosion Risk Management Strategy for England; Environment Agency (2021) Flood and Coastal Erosion Risk Management Strategy Action Plan 2021.

## Is progress being made in managing overall flood risk?

### **The Environment Agency's six-year FCERM investment programme has delivered a large number of risk management interventions.**

From April 2019 to March 2020, 176 FCERM schemes were completed, of which 73 improved protection from the risk of flooding from rivers and 36 improved protection from the risk of flooding from the sea. The schemes include interventions such as asset improvements and tidal flood barriers.<sup>7</sup> These schemes have helped to better protect nearly 50,000 homes from flooding and coastal erosion (3,900 of which were in areas of significant flood risk and economic deprivation). Since 2015, the Environment Agency and partners have completed more than 700 projects to better protect more than 300,000 homes, exceeding the programme's target to provide better protection for 300,000 homes between 2015 and 2021.<sup>8</sup>

A review conducted in 2017 focused on those schemes that accounted for a large proportion of the homes better protected.<sup>9</sup> This revealed that based on an improved Standard of Protection (SoP), most of the schemes were taking households from very significant risk, to low or moderate risk. Furthermore, most of

Since 2015, the Environment Agency and partners have completed more than 700 projects to better protect more than 300,000 homes.

the schemes were increasing the existing SoP and allowed for increased risk due to climate change in the design.

**Data regarding which risk bands homes have moved into and out of, for the different types of flooding, is not routinely collected and published.**

Whilst there has been a review of schemes, this type of information needs to be continually collected. Without it, it will not be possible to tell if the continued rate of investment and protection is sufficient to maintain current levels of risk.

**The Government has announced a substantial increase in the amount of capital funding for flood and coastal erosion risk management.**

In March 2020, the Government announced that the capital funding for FCERM would increase from £2.6 billion for the period 2015 to 2021, to £5.2 billion for the period 2021 to 2027. Beyond the £5.2 billion capital investment programme, the Government has also announced other funding measures for flood and coastal erosion risk management over the past two years which include:<sup>10</sup>

- £170 million to accelerate the building of 22 shovel-ready flood defence schemes.
- £150 million (of a £200 million fund) between 2021 and 2027 for a flood and coastal resilience innovation programme, managed by the Environment Agency. The programme will support 25 local areas in urban, rural and coastal areas to trial innovative approaches which increase resilience to flooding and coastal erosion.
- £8 million between 2021 and 2027 for development and implementation of adaptation pathway plans to manage long-term flooding and coastal change and investment, in Thames and Humber estuaries, Severn Valley and Yorkshire.
- £120 million was made available to the Environment Agency to repair assets damaged by Storms Dennis and Ciara during the 2019/20 winter.
- £640 million for a Nature for Climate Fund which will contribute to tree planting and peatland restoration. The Government has stated it will examine ways to secure secondary benefits for flood risk management.

The National Audit Office (NAO) assessed in its 2020 report on flood management that the funding in the first two bullet points meant £5.6 billion of new capital funding had been announced for flooding and coastal erosion up to the end of March 2027.<sup>11</sup>

**The Environment Agency's long-term investment scenarios (LTIS) set out the economic optimum level of investment for FCERM. It is expected that investment for the period 2021 to 2027 will exceed this, though some sources are determined on an annual basis and therefore provide insufficient long-term stability to manage climate risks.**

LTIS estimates the economic optimum level of investment for FCERM to be an annual average of £1.1 billion as a best estimate, possibly as high as £1.3 billion (both in real terms, 2019/20 prices), depending on policy choices, such as very high levels of protection and increased use of Property-level flood resilience (PFR) measures and natural flood management.<sup>12</sup> In real terms, the £5.2 billion of capital funding for FCERM is roughly £775m as an annual average for 2021/22 to 2026/27. LTIS includes flood and coastal capital schemes, asset maintenance and resource and investment associated with other flood and coastal risk management authorities.

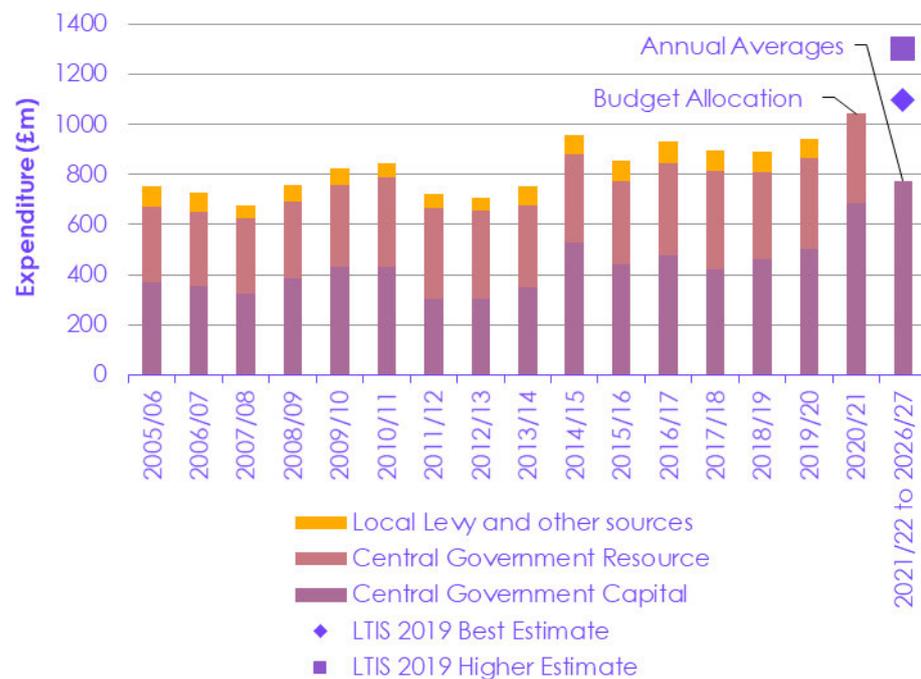
The capital funding for flooding will increase from £2.6bn for the period 2015 to 2021, to £5.2 bn for the period 2021 to 2027.

In real terms, the £5.2 billion of capital funding for FCERM is roughly £775m as an annual average for 2021/22 to 2026/27.

Based on resource and other funding in recent years, similar amounts should fill the gap between announced capital funding and the optimum identified by LTIS as shown in Figure 3.1.\*† However, except for the six-year capital programme, the level of resource funding for all other aspects of FCERM is determined on an annual basis and so remains uncertain.

The NAO stated in its 2020 report on flood management that Defra is confident that resource and other funding will exceed the optimum identified by LTIS. Investment in FCERM for the period 2015 to 2021 was consistent with the optimum identified by LTIS 2014, roughly £940 million (2019/20 prices) as an annual average based on a medium climate change scenario. By 2025 the Environment Agency will produce a new set of long-term investment scenarios to inform future policy and investment choices for achieving flood and coastal resilience.

**Figure 3.1** Spending on flood risk in England and the optimum identified by LTIS 2019 (real terms, 2019/20 prices)



Source: Defra (2021) *Central Government Funding for Flood and Coastal Erosion Risk Management in England*. Environment Agency (2019) *Long-Term Investment Scenarios (LTIS) 2019*. National Audit Office (2020) *Managing flood risk*. HMT (2021) *GDP deflators at market prices, and money GDP March 2021(Budget)*.

**Despite the increase in capital funding, there remain concerns about other aspects of funding flood and coastal erosion risk management. Government should provide greater assurance that all aspects of funding will be set and maintained to**

\* These figures do not include partnership funding raised by other risk management authorities, Internal Drainage Board funding raised from drainage charges and special levies, or local authority funding from their Settlement Funding Assessment (SFA) spent on flood or coastal erosion risk management. See Defra (2021) in Figure 3.1 for further details.

† The announced £170 million and £200 million are not included in the annual average for 2021/22 to 2026/27. This is because there is no annual profile for this funding and LTIS does not make an explicit allowance for funding for innovation.

There may need to be 30% to 80% more investment in asset maintenance to address the greater potential for deterioration from the impacts of climate change.

### **manage the risk, taking the latest evidence on the impacts of climate change into account.**

Recent reports by the NAO in 2020 and the House of Commons Environment, Food and Rural Affairs (EFRA) Committee in 2021, have highlighted concerns related to spending on flood risk.<sup>13</sup> The positive impacts of higher capital spending on flood risk could be undermined if spending on maintaining new and existing flood defence assets is not also increased. A research report published by the Environment Agency in 2017 on the impact of climate change on asset deterioration indicated that there may need to be 30% to 80% more investment in asset maintenance to address the greater potential for deterioration.<sup>14</sup> At present, it is uncertain what maintenance funding will be, since it is only determined on an annual basis.

The House of Commons EFRA Committee's 2021 report on flooding recommended that the Government should put in place a long-term resource budget settlement consistent with the capital investment programme, which would allow the Environment Agency and others to effectively plan and maintain flood and coastal erosion risk management assets. Government responded to this recommendation in April 2021.<sup>15</sup> The response stated that Government had significantly increased funding between 2015 and 2020 for the maintenance of assets and increased maintenance funding in 2020-21 relative to the previous year, with future spending to be determined by the 2021 Spending Review.

The NAO's 2020 report on managing flood risk stated that some beneficial projects are not being implemented because partnership funding is required but cannot be secured. This could lead to projects with partnership funding going ahead while other projects that offer better value for money (in terms of flood risk reduction benefits) do not. Analysis by the NAO in its 2020 report found that the Environment Agency secured £530m of partnership funding in the period 2015 to 2021, above its target of £390m, with £39 million or 7% of this from the private sector. Previous NAO analysis for the period April 2011 to March 2015, found the private sector accounted for £35 million or 25% of all partnership funding for that period.

The Environment Agency stated in its FCERM strategy that in the future there will need to be more partnership funding from non-public sources. There is no target or assessment of what proportion of partnership funding that non-public sources should account for, but Government amended the partnership funding rules in April 2020 and has since consulted on further improvements to increase contributions.

### **Capacity and skills shortages could affect delivery of flood and coastal erosion risk management if funding is inadequate.**

Funding may also be required to help ensure that capacity and skills shortages do not affect the Environment Agency's ability to deliver the FCERM strategy and the ability of lead local flood authorities (LLFAs) to fulfil their role. A wide range of skills are needed for risk management authorities, like the Environment Agency and LLFAs, to deliver the FCERM strategy – engineering, programme management, spatial planning and community engagement skills.

The NAO stated in its 2020 report on managing flood risk that the Environment Agency may also require a 20% increase in the number of engineers it employs, despite independent research finding that Environment Agency engineer salaries are not competitive with salaries on the open market. This is further compounded by a general shortage of engineers in England. LLFAs have also reported concerns about resource funding for maintenance and more general capacity issues.

## 3.2.1 River and coastal flood alleviation

Progress summary – River and coastal flood alleviation		
2019 score:	What has changed since 2019:	2021 score:
5	<p><b>Plan score - high</b></p> <ul style="list-style-type: none"> <li>The plan score has improved. Progress has been made in bringing together a policy statement and long-term strategy to support action on flood and coastal risk management. The Environment Agency's FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperature. Significant announcements have also been made to boost investment in flood defence schemes and supporting projects.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. Good evidence exists of actions being taken through flood defence investment and the number of homes better protected, but there is a lack of evidence to quantify the resulting reduction in vulnerability or exposure of homes and people, which is needed to show good progress in managing future climate change risk. The Environment Agency failed to meet its target for 98% of 'high consequence' flood and coastal risk management assets to be in good condition in 2019/20. Long-term budgets are needed to ensure existing defences are maintained.</li> </ul>	8
<p>Notes: See annex for full datasets            Key Indicators: Flood defence asset condition, Investment in flood defences, Annual damages from river and coastal flooding, Change in property risk bands (not yet available), Nationally consistent future flood risk maps (not yet available).</p>		

### Summary of 2019 report score

**In our last report, river and coastal flood alleviation scored a 5 (medium plan score, medium risk management score).**

Our 2019 report highlighted a series of plans at the time that considered long-term risks from climate change including 2°C and 4°C scenarios, but there was no overarching plan with associated outcomes and targets that brought together the different strands, linked to indicators to measure progress. On progress in managing risk, our previous report highlighted that, despite corporate Environment Agency indicators on flood defence investment and defence maintenance being met, there remained a lack of evidence to assess whether progress in protecting properties was keeping up with the rate of climate change. This is because data is not routinely collected regarding which risk bands better-protected homes have moved into and out of, for different types of flooding, including river and coastal.

Has the plan score changed?

**Yes. The Committee's assessment is that progress has been made in bringing together a long-term plan to support action on flood risk management, and significant announcements have also been made to boost investment in flood defence schemes and supporting projects.**

The Government has produced a new Policy Statement on flood and coastal erosion risk management, which sits alongside the Environment Agency's updated long-term Flood and Coastal Erosion Risk Management (FCERM) Strategy.

The FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperatures. There are also several new commitments and additions that bring together disparate aspects of river and coastal flooding (see Box 3.1).

The Strategy has the objective to develop better evidence to inform future risk assessment and investment. This includes: a new national assessment of flood risk by 2024, that will help local areas better plan and adapt to future risks from all sources of flooding; a new set of long-term investment scenarios to inform future policy and investment choices; and developing adaptive pathways to enable local areas to better plan for future flooding and coastal change, and adapt to future climate hazards. It will also require Risk Management Authorities to make greater use of funding and financing from non-public sector sources, including trialling new and innovative financing to improve flood and coastal resilience.

In May 2021 the Environment Agency launched its first FCERM Strategy Action Plan. The plan will aim to deliver the strategic objectives set out in the Environment Agency's FCERM Strategy and provides a wide-ranging list of actions and monitoring of actions to be taken forward by the Environment Agency and a range of partners.<sup>16</sup>

While evaluation and monitoring of the Policy Statement is not yet in place, actions are underway to produce a new national set of indicators. Strictly speaking, the current lack of an effective monitoring and evaluation system should retain the plan score as medium according to the Committee's criteria (see Chapter 1), but given the significant advances elsewhere, the Committee's view is that the significant progress that has been made should be recognised through an improvement on the plan score. However, the challenge now will be to move from strategic aspirations to delivery on the ground. If, by the time of the Committee's next report in 2023, this system is not well established, the plan score may return to medium.

Has the risk management score changed?

**No, the evidence available on managing risk remains the same as in 2019.**

**Good evidence exists of actions being taken through flood defence investment and the number of homes better protected, but there is a lack of evidence to quantify the resulting reduction in vulnerability or exposure of homes and people, which is needed to show good progress in managing future climate change risk.** As set out above, the current six-year investment programme has met its target to provide better protection for 300,000 homes between 2015 and 2021. Under the Policy Statement, the Government has committed to further upgrading and expanding of national flood defences and infrastructure. The Government announced in 2020, that £5.2 billion (Figure 3.1) would be awarded over the next six-year spending period on flood and coastal erosion risk management, primarily on developing new flood defences. This funding will support schemes to better protect an estimated 336,000 homes.

It remains unclear how the quantified level of risk of homes in England will change, as the risk bands which homes move into and out of, through improvements to flood defences, are not recorded as standard. This information is needed to understand the extent to which risk is being managed or not, and thereby for our assessment to provide a high-risk reduction score.

The Policy Statement includes an action for Government to develop a national set of indicators by 2022 to monitor trends over time to better understand the impacts of policies and it would be beneficial for information on the risk bands of homes to be included within these.

**The Environment Agency has not met its target for defences to be in a 'required condition'. Actions in the Policy Statement should improve how defences are monitored, inspected, and maintained. However, at present, future maintenance funding for defences is uncertain since this is determined on an annual basis.**

Another key indicator of progress is the Environment Agency's 'high consequence' flood and coastal risk management assets that are in the required condition.\* The 2018/19 target of 97.5% was exceeded.<sup>17</sup> The target was increased to 98% in 2019/20. However, the Environment Agency failed to achieve this, with 96.1% of assets in the required condition at the end of 2019/20.<sup>18</sup>

The Environment Agency failed to achieve its target with 96.1% of assets in the required condition at the end of 2019/20.

The position continued to deteriorate in 2021, with 94.5% in the required condition by Q4 of 2020/2021.<sup>19</sup> The Agency reported that this was due to increased asset damage during multiple significant flood events in November 2019 and February 2020. COVID-19 restrictions also impacted the delivery of inspection, repair and maintenance work. The Government has provided £120 million of additional funding for asset repairs that are now in progress or planned in 2020/21.

The Policy Statement includes actions to review statutory powers and responsibilities to map, monitor, inspect, and maintain all defence assets by the end of 2021. By 2024, as part of the FCERM Strategy, the Environment Agency will also develop guidance setting out a common approach for inspecting and managing all flood and coastal defences to improve resilience, information sharing and collaboration.

Whilst the Government has committed to doubling capital investment in flood risk management, it must also ensure that long-term resource spending aligns with this and is available to the Environment Agency and local authorities to be able to effectively plan for and maintain existing flood and coastal defences (see flood introduction section for more detail).

\* The definition of 'high consequence' and the required condition, as well as the inspection process, is set out in Environment Agency (2014) Asset performance tools – asset inspection guidance.

## 3.2.2 Development in areas at risk of river or coastal flooding

Progress summary – Development in areas at risk of river or coastal flooding		
2019 score:	What has changed since 2019:	2021 score:
3	<p><b>Plan score – medium</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same. National Planning Policy in England aims to steer development away from current flood risk areas and advises that future risk should be considered. However, there is a lack of resources in local authorities, and no clear policy for how local authorities should effectively account for future flood risk in plans and development decisions with a 2°C or 4°C rise in global temperature. It is positive to see some actions set out in the recent FCERM Strategy and Policy Statement that aim to ensure future development is safe from flooding. However, unclear proposals in the Government’s White Paper planning consultation may make adaptation more difficult to achieve if implemented.</li> </ul> <p><b>Risk management score – low</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. The number of new homes granted planning permission against Environment Agency flood risk advice has increased; although in the vast majority of cases, the Agency’s advice is followed. Whilst limited building in Flood Zone 3 will not create a large present day increase in flood risk, it still increases exposure in the event of defence breaches and future climate and population changes. If building on the floodplain continues at the current level the funding required to maintain existing defences and build new ones will continue to rise.</li> </ul>	3
<p>Notes: See annex for full datasets            Key Indicators: Planning permissions not in line with Environment Agency advice, Development in Flood Zone 3, Nationally consistent future flood risk maps (not yet available).</p>		

### Summary of 2019 report score

**In our last report, development in areas at risk of river or coastal flooding scored a 3 (medium plan score, low risk management score).**

Our 2019 report highlighted that processes are in place to restrict development in areas of significant river or coastal flood risk, although advice from the Environment Agency on where to restrict development can be overruled. These processes do not consider the increased risk from climate change consistently, as there is no national map showing future flood risk that can be used for planning. On progress in managing risk, our previous report highlighted that exposure to flooding through new development is increasing.

Has the plan score changed?

**No, the score remains the same.**

**There are several new commitments in the new FCERM Policy Statement and updated FCERM Strategy on guiding the design and location of new development.** These include in the Environment Agency’s FCERM Strategy:

- Producing a National Flood Risk Assessment (NaFRA2) system to deliver a single, scalable assessment of flood risk that to be rolled out to in 2024.

When published, this should help places better plan and adapt to future risks from flooding from rivers, the sea and surface water.

- Environment Agency and coastal protection authorities advising planning authorities on how shoreline management plans can better inform planning policies for the coast, including designation of coastal change management areas.

In the Government's Policy Statement:

- Plans to review policy for building in areas of flood risk, to ensure that future development will be safe from flooding and assess whether current protections in the National Planning Policy Framework (NPPF) are adequate. A review and assessment of the NPPF has been undertaken by MHCLG but not yet published at the time of writing.
- Reviewing the effectiveness of existing planning policy on Coastal Change Management Areas (CMAs).
- Identifying what more could be done in cases where Environment Agency's advice on planning applications is not followed and considering ways to boost transparency, data collection, and reporting where Environment Agency or Lead Local Flood Authority advice is given.

**While national planning policy in England should steer development away from current flood risk areas and advises that future risk should be considered, at present there is no standard, national map of future flood risk and no clear policy for how local authorities should effectively account for flood risk with a 2°C or 4°C rise in global temperature in plans and development decisions.**

Planning applications that are subject to river and coastal flood risk have a series of logical tests applied to them. In 2021, MHCLG published a consultation to make some changes to the National Planning Policy Framework (NPPF).<sup>20</sup> The proposals include:

- Clarifying that all sources of flood risk should be accounted for in Local Plans.
- Strengthening the wording around opportunities provided by new developments (e.g. through use of green infrastructure and natural flood management).
- Moving the Flood Risk Vulnerability Classification from Planning Practice Guidance into the NPPF.

The consultation does not take the opportunity to make the significant changes to the approach to planning for flood risk that the Committee thinks are needed and does not take account of the Government's promised review of policy for building in areas at flood risk.

The Environment, Food and Rural Affairs (EFRA) Committee review of flooding in 2021 found that local planning authorities lack the knowledge and/or resources to effectively factor the impacts of climate change into their local plans and development decisions.<sup>21</sup> The EFRA Committee recommended that the Government must ensure that all local planning authorities have the powers, resources and information they need to perform this function, including properly trained, dedicated staff and funding.

As part of the 2021 Spending Review, the Government is considering the priorities for local government finance reform, including how to allocate funding to councils.<sup>22</sup> This should include flood and coastal erosion risk management functions. The 2021 FCERM action plan includes an action for the Environment Agency to work with the Town & Country Planning Association to develop online learning to help planners better account for flood risk and climate change.

**The 2020 Planning White Paper proposals set an aim to provide better quality homes and places that enhance the environment, health, and the character of local areas. However, the paper as published will not achieve this for climate resilience. More information is needed to understand the Government's intentions with the forthcoming Planning Bill.**

Planning reform provides an opportunity to improve the approach to planning for climate change and introduce greater clarity in planning policy and guidance. In August 2020 the Government consulted on a significant reform to planning in England.<sup>23</sup> The White Paper sets out three designated categories for land, with areas at risk of flooding excluded from the 'growth' area category, unless mitigation measures can be put in place. However, it is not clear what level of flood risk will trigger these protections, or what is included within the definition of 'mitigated flood risk'.

The White Paper proposes introducing legally binding housing targets for each local authority, set by Government. There is no detail on how these targets will take account of land constraints in each local authority area, outside of the green belt, including land that is at risk of flooding but also for land that is not suitable for development because it has very high biodiversity or amenity value.

The paper also proposes to roll all planning policy into the Local Plan, while making it shorter and quicker to produce. The Committee is supportive of looking at planning in a more integrated way but is concerned that capacity to consider complex issues such as climate change, will be materially reduced in a system aiming to prepare plans more quickly and making them shorter. Alongside this, removing the 'duty to cooperate' could make adaptation action across local authority areas more difficult to achieve. More information is needed on the plans for the forthcoming Planning Bill and how the proposals in the White Paper are to be achieved in practice. MHCLG, must therefore publish the policy recommendations from the internal review of planning policy for building in areas of flood risk, as soon as possible.

### Recommendation

Ensure that all types of current and future flood risk are included in policies to assess flood risk to new developments. Housing targets for local authorities should take account of flood risk, amongst other environmental issues. Assessments and management of flood risk in new developments must include as a minimum:

- Evidence that the development will be safe over its full lifetime, with a consideration of the downstream interactions and impacts of new developments i.e. not increase flooding in any other areas.
- An assessment of current and future flood risk under both a 2°C and 4°C global climate scenarios.
- Assess and manage the risk of flooding to local infrastructure as well as housing.
- A consideration of better preparedness as set out in the Government's recent FCERM Policy Statement.
- Ensure there are properly funded and trained staff in local authorities.

Department: MHCLG, Timing: 2022.

## Has the risk management score changed?

**No, the evidence available on managing risk remains the same as in 2019.**

**The number of new homes granted planning permission against Environment Agency flood risk advice has increased; although, in the vast majority of cases, the Agency's advice is followed.**

Whilst the Environment Agency is a statutory consultee on development proposed in proximity to a main river, in Flood Zones 2 or 3,<sup>\*</sup> or in areas with critical drainage problems, it is not a statutory consultee in relation to sources of flooding other than rivers and the sea. Nor is it a statutory consultee on development in Flood Zone 1<sup>†</sup> even when such areas are identified as being at future risk of flooding from rivers and the sea due to the predicted impacts of climate change.

Between April 2019 and March 2020, 866 homes (~2.4% of new homes proposed in planning applications) were granted permissions against Environment Agency advice.

Between 1 April 2019 and 31 March 2020, fewer than 5% of planning applications per year were approved against Environment Agency advice, which is comparable to previous years.<sup>24</sup> During this time, 866 homes (~2.4% of new homes proposed in planning applications) were granted permissions against Environment Agency advice. This is up from less than 1% of new homes proposed in 2018-19.<sup>25</sup> Where local authorities wish to grant permission for major development<sup>‡</sup> against Environment Agency advice, they are required to refer cases to the MHCLG Secretary of State. However, it is not clear if this process is always followed. Some of those developments built against Environment Agency advice could therefore be at significant risk now or in the future if advice to reduce flood risk has not been followed.

The Environment Agency publish a list of flood risk objections.<sup>26</sup> Local Planning Authorities also have an obligation under the Single Data List to report to Defra about planning permissions granted against Environment Agency advice.<sup>27</sup> In 2021, the Agency are planning to publish more information where local authorities have granted planning permission against their flood risk advice.<sup>28</sup>

**There is relatively limited building of new homes in Flood Zone 3. However, while it will not create a large present increase in flood risk, fundamentally, it still increases the exposure of people and buildings to current and future flooding in the event of a weakening of planning policy, defence breaches or fails, or future climate and population changes.**

In 2017-18, 9% of new residential addresses were built in Flood Zone 3, up from 7% in 2013-14.

Approximately 10% of land in England is classified as within Flood Zone 3 by the Environment Agency. In 2017-18, 9% (17,580) of new residential addresses were built in Flood Zone 3 (Figure 3.2), up from 7% in 2013-14.<sup>§ 29</sup>

Whilst there is relatively limited building of new homes in Flood Zone 3, the Environment Agency's Long Term Investment Scenarios calculate, based on population growth projections, and the resultant need for new homes, that England is likely to see almost double the number of properties in Flood Zone 3 - an increase from 2.4 million to 4.6 million - over the next 50 years.

<sup>\*</sup> Flood Zone 2 covers areas with between a 1:100-year risk (1% annual probability) and 1:1,000-year risk (0.1% annual probability) of river flooding or between a 1:200-year risk (0.5% annual probability) and 1:1,000-year risk (0.1% annual probability) of sea flooding. Flood Zone 3 covers areas with a greater than 1:100-year risk (1% annual probability) of river flooding or a greater than 1:200-year risk (0.5% annual probability) of flooding from the sea.

<sup>†</sup> Flood Zone 1 covers areas with a less than 1:1,000-year risk (0.1% annual probability) of river or sea flooding.

<sup>‡</sup> Major housing development is where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more.

<sup>§</sup> The effect of flood defences is not considered in this calculation.

This work suggests that as long as local planning authorities implement national planning policy effectively, the increase in future property damages from flooding should be relatively modest at 4%, compared to a scenario where there is no new development on the flood plain. However, if national planning policy or its local implementation is weakened, the outlook could be very different, with property damages potentially increasing by over 30% during this period. In addition, if building on the floodplain continues at this level the funding required to maintain existing, and to build new defences will continue to rise (See Section 3.2.1 for cost estimates).

**There is also concern that a spatial shift in flood zones as a result of climate change will result in more homes built over the last decade ending up in higher flood zones over their lifetime without further action.**

Analysis of new homes in Flood Zone 3 found a greater proportion of new development on the floodplain takes place in the most socially vulnerable communities (~1.5% greater).<sup>30</sup>

One study has found that a disproportionately higher number of homes built in 'struggling or declining' neighbourhoods between 2008 and 2018 are expected to end up in areas at a high risk of flooding over their lifetime as a result of climate change.<sup>31</sup>

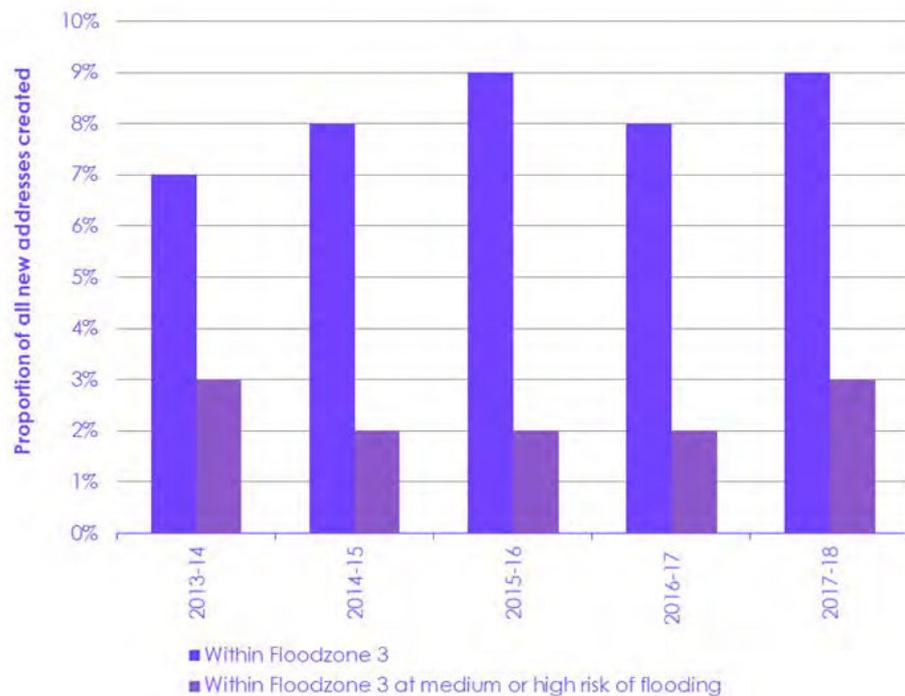
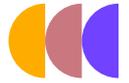
**Figures for new addresses in Flood Zone 3, taking account of flood defences and the condition they are in have been published for the first time for 2017-18 (Figure 3.2).\***

In 2017-18, 3% of all new residential addresses were built in areas at risk of medium or high flooding within Flood Zone 3.

In 2017-18, 3% (5,860) of all new residential addresses were built in areas at risk of medium or high flooding within Flood Zone 3. While the yearly rates of new homes in flood zones have increased only moderately on the national level, differences between regions exist. For a few regions, there is little land within the region that is not on a floodplain so local authorities have few options but to build there in order to meet housing targets. It is not known if these developments are being built with appropriate protection measures in place for current and future flood risk (for example at the property level – see Section 3.2.5).

\* Land assessed as having a chance of flooding from rivers and the sea presented in categories taking account of flood defences and the condition, they are in. High Risk: each year, there is a chance of flooding of greater than 1 in 30 (3.3%). Medium Risk: each year, there is a chance of flooding of between 1 in 30 (3.3%) and 1 in 100 (1%).

Figure 3.2 Proportion of new residential addresses created in National Flood Zone 3, 2013 – 2018



Source: MHCLG (2020) *Land Use Change Statistics (LUCS) residential address-based change table 2017-2018*.

**The high number of static caravans located along the eastern coastline of the UK are particularly vulnerable to current and future coastal flood risk.**

During 2020 there were applications to extend occupancy rights of caravan sites at high risk of coastal flooding, running the risk of creating permanent settlements in locations which would not normally receive planning permission. Any development will increase risk if it allows people to occupy caravans in high risk areas over winter months when coastal flooding is more likely:

- Updated flood projections for the third UK Climate Change Risk Assessment show that the expected annual damages from coastal flooding in eastern regions of England is projected to increase by 50% over the next 30 years, even with the benefit of current flood mitigation plans.\*<sup>32</sup>
- Static caravans are more vulnerable than permanent dwellings during a flood, not least because they provide no upper floor refuge, and are prone to movement, damage or even collapse in flood events.
- Static caravan owners or occupiers may be less familiar with an area if they are not permanent residents, and therefore they could be less aware of potential flood risks, flood mitigations or evacuation routes.

\* Assuming 4C scenario with low population and including direct and indirect damages.

## 3.2.3 Surface water flood alleviation

Progress summary – Surface water flood alleviation		
2019 score:	What has changed since 2019:	2021 score:
2	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The plan score has improved. Progress has been made in bringing together a policy statement and long-term strategy to support action on flood and coastal risk management, including surface water flooding. The FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperatures. The new FCERM Strategy has several commitments for the Environment Agency to work with Ofwat, water companies and other Risk Management Authorities to improve resilience to surface water and drainage flood risks and encourage long-term adaptative planning. Actions mostly draw on building up guidance and re-committing to previous actions. All LLFAs now have surface water flood management strategies published but there has still not been an assessment of the quality and consistency of those plans.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. A third of recently completed FCERM schemes are focussed on surface water flood risk management. Water companies are investing in reducing risk of sewer flooding to homes and money is being invested to improve forecasting and maps of risk. However, the number of properties at risk of surface water flooding is projected to increase, even with adaptation action. Better data on sewer capacity, number and type of SuDS being installed and collection of information of surface water incidents is needed.</li> </ul>	5
<p>Notes: See annex for full datasets            Key Indicators: Area of permeable and impermeable land within all urban areas in England, Number of people and properties at risk of surface water flooding (for return period of 1/30 or 1.33% per year), Number, type and location of SuDS installations in new builds and retrofits (not yet available), Metrics of sewer network capacity and spills as outlined in Water UK's Capacity Assessment Framework (not yet available), Water company investment in retrofitting SuDS (not yet available), Number of people or properties benefitting from SuDS (inc. green infrastructure) (not yet available), Number and cost of surface water flooding events (not yet available).</p>		

### Summary of 2019 report score

**In our last report, surface water flood alleviation scored a 2 (low plan score, medium risk management score).**

Our 2019 report highlighted that the systems for managing surface water flood risk are fragmented but plans and processes are coming together. However, climate change is missing from those plans. On progress in managing risk, our previous report highlighted that water companies are investing in retrofitting sustainable drainage systems (SuDS) for some existing homes. However, limited capacity in the sewer network means that the significant increase in surface water flood risk that is projected is unlikely to be managed adequately based on current action.

Has the plan score changed?

**Yes. The Committee's assessment suggests progress has been made in bringing together a long-term plan to support action on flood risk management, including surface water flood risk.**

The Government has produced a Policy Statement on FCERM supported by the Environment Agency's updated long-term FCERM Strategy (see chapter introduction). The FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperatures.

The new FCERM Strategy has several commitments for the Environment Agency to work with Ofwat, water companies and other Risk Management Authorities to improve resilience to surface water and drainage flood risks and encourage long-term adaptive planning. In terms of surface water flooding, actions mostly draw on building up guidance and re-committing to previous actions, for example:

- The Environment Bill will require water companies to develop Drainage and Wastewater Management Plans<sup>33</sup> by end of 2022 to improve drainage and environmental water quality. Climate change should be a key component considered within water company drainage plans. The 21st Century Drainage Programme Capacity Assessment Framework sets out the need to use a range of climate scenarios.<sup>34</sup> The publication of these may improve the score for the 2023 Progress Report, although it is important that other Risk Management Authorities feed into the plans.
- Water companies will invest more than £1 billion between 2020 and 2025 to protect the environment, homes, business and drinking water from flooding, and have committed to reducing sewer flooding incidents.

The Policy Statement commits to taking forward the actions in the Surface Water Management Plan and publishing an update on progress made to implement the plan for spring 2021.<sup>35</sup> Actions include working with lead local flood authorities (LLFAs) to develop guidance to set out the best practice for local flood defence management and record keeping.

**An independent review of the arrangements for determining responsibility for surface water and drainage assets was published in May 2020.<sup>36</sup>**

The Government agreed to implement 12 of the recommendations in order to make responsibility for surface water and drainage assets more efficient, straightforward and effective which is a positive step, although it will be important to see these recommendations put into action. Recommendations include those which aim to improve clarity over roles and responsibilities, ensure flood investigation reports consider the views of residents and businesses and that lessons learned are shared widely. It also recommends that better advice is made available to homes and businesses at risk of surface water flooding to help them improve their own protection and resilience. The actions should build upon those in the FCERM Strategy and Policy Strategy and the Surface Water Management Action Plan.<sup>37</sup>

As reported in 2019, all LLFAs now have surface water flood management strategies published. However, there has still not been an assessment of the quality and consistency of those plans.

Has the risk management score changed?

**No. The evidence available on managing risk remains the same as in 2019.**

31% of the 176 schemes completed between April 2019 and March 2020 aimed to better protect people and homes from surface water flooding.

**Around 30% of FCERM schemes are focussed on surface water flood risk management and water companies are investing in reducing risk of sewer flooding to homes.**

The data linked with the Environment Agency's six-year FCERM programme show that 54 (31%) of the 176 schemes completed between April 2019 and March 2020 aimed to better protect people and homes from surface water flooding. This is up from April 2017 to March 2018 when 24% of schemes were for surface water flood management.<sup>38</sup> In April 2020, the Government announced changes to how the Government funding is allocated to flood projects including the introduction of a new risk category which will enable schemes that prevent surface water flooding to qualify for more funding.<sup>39</sup>

The Environment Agency publishes an annual report on the environmental performance of the nine water and sewerage companies operating mainly in England. Between 1 April 2019 and 31 March 2020, water companies invested:<sup>40</sup>

- £132 million to reduce the risk of sewer flooding to homes (down from £187 million in 2018-19).
- £300 million to maintain the public sewer system to prevent blockages and flooding (up from £288 million in 2018-19 and £111 million in 2017-18).
- £2 million in property-level measures to reduce the risk of sewer flooding in homes (down from £4.7 million in 2018-19).

**Money is being invested to improve forecasting and produce new maps of risk.**

The Surface Water Management Action Plan has invested £2 million since April 2019 to enable lead local flood authorities (LLFAs) to update their flood risk maps - covering over 1500km<sup>2</sup>, which includes just under 225,000 properties and 2.7 million people at risk of flooding. The FCERM Strategy says that by 2024 the Environment Agency will produce a new national assessment of flood risk that will help places better plan and adapt to future risks from flooding from rivers, the sea and surface water. This should help improve the ability to assess vulnerability changes.

£1.2 billion is also being invested to improve severe weather and climate forecasting which will help to more accurately predict storms that lead to flash flooding.<sup>41</sup> The release of higher resolution data as part of the latest update to the UK Climate Projections should also enable improvements to research on future changes in the frequency, intensity and spatial distribution of the severe storms that often drive surface water flooding.

**The updated flood risk project for the third CCRA highlighted that around 420,000 properties are currently at significant risk from surface water flooding in England.<sup>42</sup>**

Projections show that even under an extended adaptation scenario\* with low population rise, the number of properties at significant (1/30 year, or 3.3%) risk will increase by 59% by 2050, and 83% by 2080 under a scenario of a 2°C global temperature rise. This increases further under a 4°C scenario with an increase of 91% by 2050 and 137% by 2080s.

Research for the CCC found that across all flood risk levels, the south-east has a high percentage of properties at risk of surface water flooding, although all parts of the country are at risk (Figure 3.3).

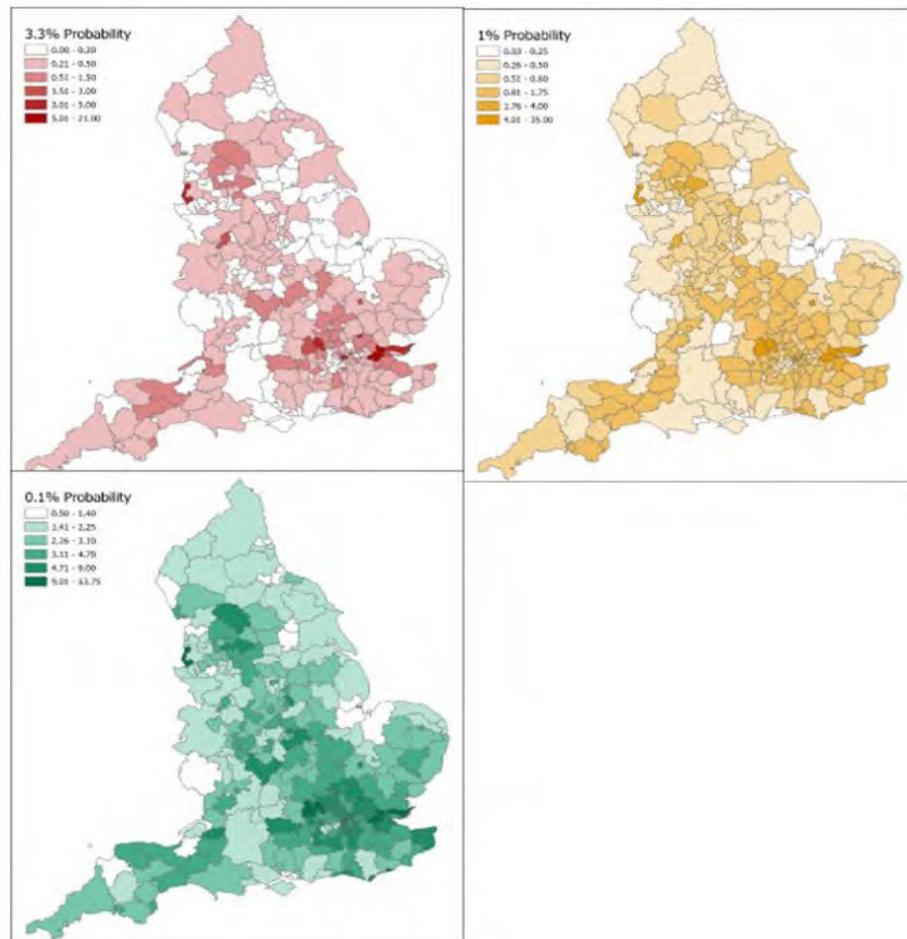
The number of properties at significant (1/30 year, or 3.3%) risk will increase by 59% by 2050, and 83% by 2080 under a scenario of a 2°C global temperature rise.

\* This 'current objectives+' scenario goes beyond the current implementation of policy (and recently introduced policy) to represent an enhanced whole system approach to adaptation (i.e. implementation is in-line with the higher level of ambition).

There remains a need for better data on sewer capacity, asset management and standards, SuDS and collection of information on surface water incidents.<sup>43</sup>

A co-ordinated approach to identifying, incentivising and managing opportunities for installing retrofit SuDS is also required. This should ensure they are not missed and that relevant parties fully understand how SuDS can help them to achieve their own objectives, for example by sharing the cost of the scheme or by qualifying for a reduction in sewerage charges.

**Figure 3.3** Percentage of properties in each Local Authority with a 3.3% (a), 1% (b) and 0.1% (c) probability of flooding from surface water in England.



Source: ADAS for the CCC (2021) *Research to update indicators of climate-related risks and actions in England*.

## 3.2.4 Development and surface water flood risk

Progress summary – Development and surface water flood risk		
2019 score:	What has changed since 2019:	2021 score:
1	<p><b>Plan score - low</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same. There is no plan to address development and surface water flood risk which takes into account a 2°C rise in global temperature, with consideration of 4°C. The planning system has inherent issues for dealing with surface water and ensuring that multi-beneficial SuDS are installed. Planning Practice Guidance and non-statutory SuDS standards have not yet been updated.</li> </ul> <p><b>Risk management score - low</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. Surface water flooding remains a concern in new developments due to the rising level of risk in a changing climate. Homes are being built in areas at risk of surface water that may not have had any expert flood mitigation advice. The data that could show whether the planning system is reducing risk are not collected and there are no other indications that such a reduction is happening. The proportion of urban areas made up of impermeable surfacing, has increased since 2001, but remained stable since 2018.</li> </ul>	1
<p>Notes: See annex for full datasets            Key Indicators: Area of permeable and impermeable land within all urban areas in England, The number of properties built in areas of surface water flood risk (not yet available), Number, type and location of SuDS installations in new builds and retrofits (not yet available)</p>		

### Summary of 2019 report score

**In our last report, development and surface water flood risk management scored a 1 (low plan score, low risk management score).**

Our 2019 report found that there are no plans or processes that ensure new development in areas of surface water flood risk does not increase overall exposure or vulnerability. On progress in managing risk, our previous report highlighted that there is little evidence that 'green' sustainable drainage systems are deployed in new developments and that practitioners had little confidence that this was taking place.

Has the plan score changed?

**No, the score remains the same.**

**The planning system has inherent issues for dealing with surface water and ensuring that SuDS are installed. Although wording has been strengthened in the National Planning Policy Framework and the uptake of sustainable drainage systems has improved in recent years, the installation of high-quality SuDS that deliver multiple environmental benefits may still be insufficiently incentivised.**

In 2019, the Committee recommended that the National Planning Policy Framework (NPPF) and planning practice guidance (PPG) should be updated to ensure that Sustainable Drainage Systems (SuDS) installations maximise their impact in terms of flood risk reduction and their co-benefits, such as biodiversity and amenity value. This could be done by aligning the NPPF and PPG with the aims of

Schedule 3 of the Flood and Water Management Act (2010). \* In 2020 the Committee again made similar recommendations.<sup>44</sup>

In its response, the Government acknowledged the importance of encouraging natural flood management approaches, such as green sustainable drainage systems (SuDS), to ensure flood risk is managed effectively locally and nationally. MHCLG committed to publishing a revised PPG clarifying how green SuDS can reduce impacts of flooding and deliver additional benefits for biodiversity and the environment and set out how new drainage systems must comply with the Environment Agency's climate change allowances for rainfall intensity.<sup>45</sup> As yet, there have been no updates to the PPG, where issues of 'grey' vs 'green' SuDS, their adoption and wider benefits of green infrastructure could be dealt with more explicitly than in the NPPF. Also, Schedule 3 of the Flood and Water Management Act that sets out SuDS standards, an approval process, rules on adoption and changes to the right to connect to public sewers, was never enacted nor its requirements aligned with planning policy.

Several local authorities have produced their own guidance and standards to be followed, but nation-wide standards defining how to implement SuDS are currently non-statutory, only apply to developments of 10 or more properties and do not promote green SuDS. Defra has commissioned research to explore whether updating the Non-statutory Technical Standards for SuDS (NSTS) could help deliver SuDS that provide multiple benefits beyond managing surface water runoff, contributing to improved climate adaptation, health and wellbeing and better places and spaces.<sup>46</sup> The research also considers what the requirements to update the standards for the integration of high-quality multiple benefit SuDS might be.<sup>47</sup> The research report is due to be published in 2021.

The Government's Storm Overflows Taskforce, set up to eliminate harm from storm overflows, will consider a number of drainage issues, such as Sustainable Drainage Systems, including Schedule 3, and section 106 of the Water Industry Act 1991—right to connect to the public sewer. The taskforce will be reporting to Government in summer 2021.<sup>48</sup>

### Recommendation

To address the issue of increased risk of surface waterflooding in new developments, commit to ensuring that new developments do not put more water into the public sewers than what was there before, taking into account climate change. To incentivise this, end the automatic right to connect to the public sewer; planning reforms should enact Schedule 3 of the Flood and Water Management Act (2010); and technical SuDS standards should be made mandatory and be updated to deliver SuDS that provide multiple economic, social and environmental benefits.

Department: MHCLG, Timing: 2022.

**New rules (April 2020) mean that SuDS elements such as swales, basins, soakaways, and ponds, are officially recognised as 'surface water sewers' and can be adopted by water and sewage companies in England.<sup>49</sup>**

Sewers For Adoption will support water companies to take on responsibility for these types of measures. However, it doesn't cover all type of SuDS features and is confined by what is defined as a sewer (e.g. permeable paving is not covered).

\* Schedule 3 of the Flood and Water Management Act (2010), would require all new developments to include SuDS features that comply with national standards.

**There are a range of other plans and policies that provide an opportunity for surface water flood resilience and other wider benefits by improving and increasing green space and green infrastructure.**

It is not clear whether the steer in recent and upcoming policies to undertake more urban greening are being fully realised or taken up by developers yet.

- The Environment Bill: If enacted, will require developers to deliver at least a 10% improvement in biodiversity value (biodiversity net gain). This could be through a green roof or an on-site nature reserve, which could also act as a means of sustainable drainage, adjacent to a new housing development.
- Net Zero: Policies to reduce greenhouse gas emissions and improve air quality may also provide natural flood risk management in urban areas (see Chapter 2). For example, increased tree planting and green spaces for safer pedestrian and cycling access routes.
- Green Recovery: The Natural Capital Committee has highlighted the importance of access to green space. It can be beneficial to health and well-being, in terms of physical and mental health but also by reducing urban heat islands (see Section 3.5.1).<sup>50</sup>
- Sewage Inland Waters Bill: Proposed mitigation for sewage spills (such as nature-based solutions to manage water flow) could also lead to increased flood mitigation.

Has the risk management score changed?

**No. The evidence available on managing risk remains the same as in 2019.**

**The data that could show that the planning system is reducing risk are not collected and there are no other indications that such a reduction is happening.**

It remains unclear how much preference is being given to 'green' sustainable drainage systems (SuDS) in new developments. There is no readily available national dataset on the number of planning applications in areas at risk of surface water flooding, nor the impact of any advice given to developers and no monitoring of the uptake of SuDS. This means it is not possible to assess the effectiveness of current planning policy and whether 'green' SuDS are being installed.

**Recommendation**

To help improve the information on SuDS and surface water flood risk, urgently begin collecting data on sewer capacity and SuDS location, type and capacity. This would bring the level of information in line with that for river and coastal flood risk defences.

Department: MHCLG, Timing: 2021.

**Homes are being built in areas at risk of surface water that may not have had any expert flood mitigation advice. There remain no statutory consultees (such as the Environment Agency) for assessing major new developments in areas at risk of surface water flood risk.**

Between 2013 and 2018, around 23,000 new properties were built in areas at medium or greater risk of surface water flooding (1 in a 100 chance of flooding each year).<sup>51</sup> Environment Agency analysis added a 5m buffer around these at risk areas as an indication of likely increases in flood risk due to climate change, and to take account of errors in mapping.

Between 2013 and 2018, around 23,000 new properties were built in areas at medium or greater risk of surface water flooding (1 in a 100 chance of flooding each year)

Including the buffer, this increases the number of properties to around 67,800, approximately 6.7% of new addresses between 2013-2018.

Given the lack of a statutory planning consultee on development in areas at risk from surface water flooding, there is a high likelihood that a significant proportion of these homes will have been granted planning permission without appropriate expert advice, and may therefore not incorporate the flood mitigation measures needed to make the development safe and resilient over its lifetime.

#### Recommendation

The consultation process for surface water flood risk must be improved. This should be done by adding statutory consultees for all development type and sizes. Consultees must have the appropriate skills to provide advice on surface water flood mitigation. Ensure that local authorities fully justify planning decisions where applications can proceed either without or going against formal flood risk mitigation advice.

Department: MHCLG, Timing: 2022.

#### **The total area of impermeable surfaces in urban locations has increased since 2001.<sup>52</sup>**

The CCC's previous indicator showed an increase in impermeable areas from 477,000 hectares in 2001 to 621,000 hectares in 2018, remaining constant from then to 2020. The impermeable fraction of the total urban area increased from 37% in 2001 to 45% in 2020.

The CCC now has access to an improved indicator (which includes larger areas of greenspace within cities and towns, not captured in the original indicator). Data from this indicator is only available since 2016. The new indicator shows that:

- Impermeable surfaces have increased 1% between 2016 and 2020. This increase is made up of a 4% rise in manmade surfaces (making up 75% of total impermeable area in 2020) and a 7% fall in multiple surfaces that are impermeable, such as partially paved domestic gardens and road verges, for example (making up 25% of total impermeable area in 2020).
- Since 2018, the overall impermeable area fraction has remained stable at 40% of the total urban area.

Research for Yorkshire Water has assessed the impact of reducing impermeable areas in 10 catchment areas.<sup>53</sup> It found that reducing impermeable surfacing can help reduce future flood risk, but that other interventions will also be required.

## 3.2.5 Property-level flood resilience (PFR)

Progress summary – Property-level flood resilience (PFR)		
2019 score:	What has changed since 2019:	2021 score:
3	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same. There has been progress in planning for how to increase the uptake of PFR. New measures in the FCERM strategy and a new Code of Practice, and proposed amendments to the Flood Re Scheme if implemented should all have a positive impact on the uptake and effectiveness of PFR. However, there remains a need for targets for large-scale implementation of PFR measures, with effective monitoring and evaluation built in.</li> </ul> <p><b>Risk management score - low</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. The current rate of PFR implementation remains low and could leave many homes vulnerable to flooding that would benefit from PFR.</li> </ul>	3
<p>Notes: See annex for full datasets Key Indicators: Number of homes that would benefit from PFR, Number of homes installing PFR per year.</p>		

### Summary of 2019 report score

**In our last report, property-level flood resilience (PFR) scored a 3 (medium plan score, low risk management score).**

Our 2019 report identified important aspirations outlined by Defra in their PFR Action Plan and work by Flood Re and others on approaches to encourage homeowners to put PFR in place, such as a Code of Practice and Certification Scheme. However, there were no clear plans for targets for large-scale implementation and PFR plans did not consider interventions in the context of climate changes of any magnitude.

The rate of PFR implementation was low when compared to indicative analysis from the Environment Agency's latest flood risk investment analysis.

### Has the plan score changed?

**No, the plan score for PFR remains medium. There has been positive progress, but to improve this score, targets for large-scale implementation of PFR need to be set out with effective monitoring and evaluation built in.**

**The Environment Agency's FCERM Strategy aims to mainstream PFR measures and encourage homes and businesses to build back better after flooding. An Action Plan published in May 2021 has provided further details on progress and planned action.**

The FCERM Strategy sets a strategic objective that between now and 2040, risk management authorities will work with the finance sector and other partners to mainstream property flood resilience measures and to 'build back better' after flooding.<sup>54</sup> This objective is supported by two measures. The first measure is that from 2021, risk management authorities will work with the finance sector, Flood Re and the property flood resilience industry to increase the uptake of property flood resilience measures in communities at highest risk.

The second measure is that by 2025 the Environment Agency will work with government and other partners to tackle the policy, financial and behavioural barriers to mainstreaming property flood resilience measures and ‘building back better’ after flooding.

Government is also investing £3 million to support three regional property flood resilience pathfinder projects to learn lessons which could be applied more widely. This is supporting new research initiatives, demonstration centres and advice portals that will help local communities in Yorkshire, the Oxfordshire to Cambridge Arc, and Devon and Cornwall, to learn about the benefits of installing property flood resilience measures in their homes.

In May 2021 the Environment Agency published an Action Plan which provided further detail on the progress made against measures in the FCERM Strategy as well as planned further action up to April 2022.

In May 2021 the Environment Agency published an Action Plan which provided further detail on the progress made against measures in the FCERM Strategy as well as planned further action up to April 2022.<sup>55</sup> The planned actions for PFR included:

- In July 2021, the Environment Agency will publish additional research to fill PFR knowledge gaps.
- By summer 2021, the Association of British Insurers (ABI), the British Insurance Brokers Association and Flood Re will publish a new specialist directory of brokers and insurers to support customers that are unable to get flood insurance cover.
- By November 2021, the Environment Agency will launch a new PFR Framework of suppliers.
- By December 2021, the Environment Agency and Chartered Institution of Water and Environmental Management (CIWEM) will support the PFR industry to develop a system of independent PFR training and accreditation.
- By March 2022, the National Flood Forum and the Environment Agency will publish lessons learnt on the measures needed to install property flood resilience.
- By April 2022, the Environment Agency will develop a bespoke tool for better valuing the economic benefits of PFR to local communities.

**The Government’s FCERM Policy Statement committed to several actions to improve the uptake of PFR among homes at high risk of flooding.**

The Government published a Policy Statement on Flood and Coastal Erosion Risk Management in July 2020.<sup>56</sup> This included a commitment to explore ways to provide greater clarity about the use and effectiveness of property flood resilience measures for homes and businesses at high risk of flooding, including how the benefits can be recorded. It stated that Government would build on the three regional pathfinder projects to boost uptake of PFR, including through Government’s new £200m innovative resilience fund. It also announced plans to consult on improvements to the efficiency and effectiveness of the Flood Re scheme to encourage greater uptake of PFR among households at high risk of flooding across the UK, which has since been published.

**The Government has consulted on changes to the Flood Re Scheme to increase the uptake of PFR. The current regulations underpinning the scheme are preventing Flood Re from creating incentives for an acceleration of uptake of PFR, which the consultation is aiming to rectify.**

Based on proposals in Flood Re's Quinquennial Review published in 2019, the Government published a consultation in 2021 on amendments to the Flood Re Scheme.<sup>57</sup> These proposals included:

- The ability for Flood Re to offer discounted premiums to households that have fitted property flood resilience measures, such as airbrick covers or non-return valves.
- Building an evidence base on the uptake and impact of PFR and, if suitable, using the data to stimulate the insurance industry to take account of reductions in damages due to PFR.
- The ability for Flood Re to reimburse insurers, and in turn property owners, up to £10,000 to build back better in order to reduce the future risk of the property flooding and/or the cost of repair.
- Enabling Flood Re to spend any surplus it accrues (beyond what it requires to operate and meet its regulatory requirements) on further activities to support the transition to a risk reflective home insurance market, including accelerating the uptake of PFR.
- Further reducing the cost of its cheapest premiums to ensure it is affordable for low income households.

New proposals from Government would help address some of the barriers that contribute to the low rate of PFR installation if implemented.

These proposals would allow better use of Flood Re's funds to address some of the barriers that contribute to the slow rate of PFR installation, detailed in the section below. A review of Flood Re's Quinquennial Review by the Government Actuary's Department (GAD) found that 'based on the modelling and wide range of scenarios, the financial elements of the QQR recommendations are affordable.'<sup>58</sup>

Defra has also published a call for evidence on local factors in managing flood and coastal erosion risk and Property Flood Resilience.<sup>59</sup> The consultation suggests that a number of enablers need to be made effective to increase the uptake of PFR. Respondents were asked to provide their views on enablers such as: financing and incentives, planning policy, building regulations and standards, training and technical expertise, evidence and data sharing and communication and understanding.

As a result of their 2020 'Bricks and Water' inquiry, Policy Connect and Westminster Sustainable Business Forum recommended that 'given the limited uptake of property flood resilience measures and continued development within the floodplain, Government should either extend the Flood Re scheme to cover residential buildings constructed after 1st January 2009, or put in place an alternative scheme. This should be evaluated as part of the ongoing Blanc review into flood insurance.' The Inquiry also recommended that performance targets should be included in the forthcoming Future Homes Standard.

The Blanc review of flood insurance in Doncaster (following the flooding that took place in November 2019) found some gaps in existing coverage.<sup>60</sup> The review found significant differences between owner-occupiers and tenants; with most tenants being poorly protected. In addition, 6% of buildings insurance and 6.5% of contents insurance for owner-occupiers did not cover flooding. The review made a series of recommendations including for Defra to carry out a larger survey of the

proportion of buildings and contents insurance policies that do not cover the risk of flooding. It is important that measures to address gaps in insurance coverage are consistent with achieving an increase in the uptake of PFR.

**A new Code of Practice and guidance for PFR has been published. A new report has also assessed that Flood Performance Certificates would help address barriers to PFR and help increase the rate of installation.**

A Code of Practice and guidance for property flood resilience was developed by Kelly et al. and published by the Construction Industry Research and Information Association (CIRIA) in 2020.<sup>61</sup> It contains six standards covering requirements for stages from hazard assessment to operation and maintenance, and acts as a PFR benchmark. The guidance notes that risks to the property may increase due to factors such as urbanisation and climate change, and that to ensure a level of protection for a property, PFR measures need to be operated and maintained following the guidance provided in a handover pack.

Policy Connect and Westminster Sustainable Business Forum also recommended in their 2020 'Bricks and Water' inquiry that Part C of the Building Regulations should be updated to require all properties at risk of flooding to include property flood resilience measures and that these measures should be specified and installed in accordance with the industry Code of Practice for property flood resilience.

Flood Performance Certificates for property owners could be made mandatory in the future to help increase PFR uptake.

Flood Re commissioned WPI Economics to produce a report on Flood Performance Certificates which was published in December 2020.<sup>62</sup> This is a document for the homeowner and any potential purchasers or renters of the property which sets out the severity of its flood risk and steps that could be taken to mitigate the risk. The report assesses that this would help address existing barriers and provide greater incentives for improving household resilience. It also suggested that following consultation and supporting legislation, a scheme could be opened in 2022 and made mandatory towards the end of the decade.

Research on applying behavioural insights to property flood resilience was published by the Environment Agency in September 2020 as part of the FCERM R&D Programme.<sup>63</sup> The project identified several factors such as adoption among peers, removing points of 'hassle' in the process and referencing social norms in messaging, which could be taken into account to help increase the uptake of PFR.

**The Government also extended its grant scheme in 2020 to help flood-hit homes and businesses make properties more resilient to future flooding.**

In September 2020 the Government also announced the extension of the £5,000 grant scheme available to those affected by flooding in the winter of 2019/20 to take into account delays to repair work and the additional pressures placed on local authorities by the COVID-19 pandemic.<sup>64</sup> The grants of up to £5,000 are a contribution towards making a property more resilient to future flooding, such as putting in flood doors and raising electrics from ground level. Flood-hit homes, businesses and charities in communities with over 25 properties flooded were eligible to apply. It remains at Government's discretion as to whether this or similar grant schemes are activated after future flooding events.

## Has the risk management score changed?

**No, the risk management score for PFR remains low. While the positive developments detailed in the 'Has the plan score changed?' section should increase the uptake of PFR, the most recent data on installation rates still suggest that many homes that could benefit from PFR would not have it installed for a long time. This rate needs to increase and be measured against an explicit target for the score to improve.**

The current rate of PFR installation is approximately 500 to 2,000 homes per year based on limited data.

The current rate of PFR installation is approximately 500 to 2,000 homes per year based on limited data. The estimate of 500 homes is based on data sourced from the Environment Agency's programme of PFR schemes for 2015/16 to 2020/21.<sup>65</sup> The estimate of 2,000 homes per year is based on a statement by Defra in its 2021 call for evidence that there have been around 23,000 publicly funded installations of PFR since 2008, which includes residential and non-residential properties.

It is difficult to get an accurate number of installations because: a) centrally funded schemes don't necessarily report how many properties are adapted; b) recovery grants issued following flood events may or may not be used for PFR; and c) individuals may install PFR measures independently of any Government funding scheme. Given that, according to the response to 2018 parliamentary question, over 11,000 recovery grants were approved in 2015/16 alone it is likely that the data sourced from the Environment Agency's programme of PFR schemes underestimates the current rate of PFR installation.<sup>66</sup> This highlights the need for better data collection in this area.

**Although the data are limited, the current rate of installation could leave many homes vulnerable to flooding that would benefit from PFR.**

In the FCERM strategy, the Environment Agency states that 'The long-term investment scenarios show the potential for an estimated 200,000 homes in England to be fitted with property flood resilience over the next 50 years.' The figure of 200,000 homes is an approximation and requires more robust information on flood depths to give a more accurate estimate of where PFR needs to be installed. However, it gives an idea of the scale of the challenge given the current rates of installation. There are a range of options which communities can consider to increase resilience, but PFR presents a significant opportunity to reduce the numbers of properties which are vulnerable to the impacts of flooding.

Alongside better data collection this highlights the need for targets for large-scale PFR implementation to assess whether actions are proving effective and to monitor progress. There is an opportunity for the updated long-term investment scenarios in 2025 to make use of the richer information in the new national flood risk assessment to provide better evidence about the potential for PFR installation. This evidence should be used to set smart targets with timescales.

**Recommendation**

Work with the Environment Agency to set out the measures being taken to improve the uptake of property-level flood resilience (PFR) following stakeholder responses to its PFR call for evidence and consultation. This should include improved data collection to monitor progress. Plans for the new national flood risk assessment and 2025 long-term investment scenarios must ensure that the evidence they provide can be used to identify the most effective locations for PFR, and smart targets for their installation with timescales.

Department: Defra, Timing: 2022.

## 3.2.6 Capacity to recover from flooding

Progress summary – Capacity of people and communities to recover from flooding		
2019 score:	What has changed since 2019:	2021 score:
5	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same. Local resilience forums have developed response and recovery plans for flooding, and there is now evidence that most LRFs include climate change in local plans and risk registers. It is not known if local authorities have considered how they will manage the long-term recovery of people and communities who have been flooded. The FCERM Strategy sets a commitment for people to receive the information and support they need to prepare and respond to flooding and coastal change by 2030.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. The Government can provide financial assistance for homes which are flooded, and at-risk homes built before 2009 remain insurable through the Flood Re scheme. However, the time it takes to recover from flooding and return home is based on several complex factors and there can be significant impacts to health and well-being due to flooding. There remains no available national data that allow an assessment of risk or the proportion of homes or businesses that have insurance. Environment Agency figures show that the number of people signed up to the flood warning service in England has increased.</li> </ul>	5
<p>Notes: See annex for full datasets            Key Indicators: Number of flood warnings by type, Flood warning registrations, Mental health impacts from flooding, Number of homes installing PFR per year, Properties that have flood insurance (not yet available), Number of successful insurance claims within x time of flooding (not yet available), Uptake of/spending on flood recovery grants (not yet available), Length of time people are out of their homes following flooding (not yet available).</p>		

### Summary of 2019 report score

**In our last report, capacity of people and communities to recover from flooding scored a 5 (medium plan score, medium risk management score).**

Our 2019 report found that Local Resilience Forums have developed response and recovery plans for flooding based on present-day risk but did not consider how the risk from flooding might be changing now due to climate change. On progress in managing risk, our previous report highlighted that repair and renew grants are available from MHCLG for selected flood events. In severe flood events, insurance claims can take up to a year to settle which has a significant impact on recovery time and well-being of those affected, but more data was needed to understand rates of recovery.

Has the plan score changed?

**No, the score remains the same.**

**The FCERM Strategy (Box 3.1) sets a commitment for people to receive the information and support they need to prepare and respond to flooding and coastal change by 2030.**

This includes the following actions:

- From 2020 the Environment Agency will continue to work with Local Resilience Forums to develop flood plans that better coordinate preparing and responding to incidents.
- By 2022 the Environment Agency will have expanded its flood warning service to all places at high risk of flooding and coastal change from rivers and the sea.
- By 2023 the Environment Agency will work with partners to transport its warning and information services to better reach people living, working or travelling through flood risk areas.
- By 2025 risk management authorities will support people living in places at high risk of flooding and coastal change to set up flood groups, where they are wanted, and to develop and test local flood plans.

The Government's Policy Statement commits to supporting communities, including when flooding happens and during recovery afterwards. This includes undertaking a full review of the Flood Recovery Framework (at the time of writing this is underway) to improve its effectiveness, evaluating the most recent Property Flood Resilience Recovery Support Scheme, and supporting the voluntary sector to improve their capacity and capability to help local communities in the event of a flood.

Once implemented these steps should help towards improving future scores.

**Local Resilience Forums (LRFs) have developed response and recovery plans for flooding based on present-day risk, and there is now evidence that LRFs include climate change in local plans and risk registers. LRF's feel like they are better prepared for river and coastal flooding compared to surface water flooding.**

A survey of Local Resilience Forums found that most responders included climate change in Local Resilience Plans and/or Risk Registers to some extent (see Section 3.6).<sup>\*</sup> The survey also found that several LRFs felt like they were prepared for river and coastal flooding due to increased knowledge and experience of dealing with events previously and the availability of forecasts. Responders however, did not feel as prepared for surface water flooding events. The reasons provided included that surface water flooding is more difficult to forecast, and impacts can occur in areas not previously impacted or covered by flood warnings.

It is not known if local authorities have considered how they will manage the long-term recovery of people and communities who have been flooded. As recently recommended by the EFRA Committee, the Government needs to develop a properly resourced action plan with local partners for the long-term physical, economic, and psychological recovery of communities impacted by flooding.

Has the risk management score changed?

**No. The evidence available on managing risk remains the same as in 2019.**

<sup>\*</sup> Based on results of CCC survey of Local Resilience Forum. There are 38 LRFs in England. 17 LRFs responded to the survey, representing 45% of all LRFs in England.

The costs of flooding to health services have been estimated at £1,878 per adult per flood event with internal depths up to 30cm, rising to £4,136 with depths more than 1m.

### Impacts from flooding on health and well-being remain.

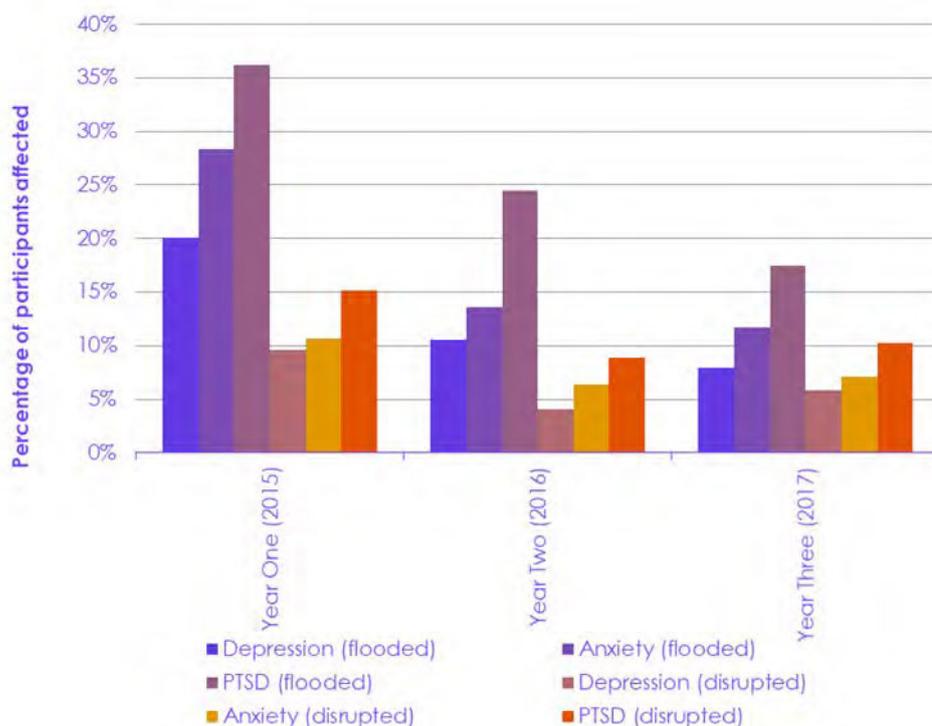
One of the greatest burdens of ill health from flooding is likely to be due to the impacts on mental health. Research has found that after one year following a flood, the prevalence of probable depression amongst homes flooded was 20.1%, anxiety 28.3% and PTSD 36.2% (Figure 3.4).<sup>67</sup> This compares with the general prevalence of depression amongst adults in Great Britain of 10% in 2019/20 (before the COVID-19 pandemic).<sup>68</sup> Three years after being flooded, mental health impacts still existed, although were reduced. Evacuation and displacement, particularly without warning, increases the risk of anxiety and post-traumatic stress disorder.

The COVID-19 pandemic may add to the already significant impacts for those displaced from their homes due to flooding in 2020 and 2021. Displacement from flooding combined with dealing with the impacts of the pandemic (e.g. potential illness, economic challenges and social isolation) are likely to be considerable. The staff needed to help support flooded households may also have reduced capacity whilst dealing with response to the pandemic.

The costs of flooding to health services were calculated in a recent study.<sup>69</sup> Costs were found to increase with depth of flood water inside the home. Costs increase from an average of £1,878 per adult per flood event with internal depths up to 30cm, to £4,136 where the depth is more than 1m deep.

In April 2020, the Government announced changes to its funding formula for flood defences, to include new evidence on the overall impacts of flooding, such as mental health and wellbeing.<sup>70</sup>

Figure 3.4 Mental health outcomes after flooding



Source: BMC Public Health (2020) *The English National Cohort Study of Flooding & Health: psychological morbidity at three years of follow up*; BMC Public Health (2018) *The English National Cohort Study of Flooding & Health: the changes in the prevalence of psychological morbidity at year two*; BMC Public Health (2017) *The English National Cohort Study of Flooding & Health: cross-sectional analysis of mental health outcomes at year one*.  
 Notes: The chart shows the prevalence of mental health outcomes after one, two- and three-years following flooding, for participants who either had their homes flooded, or were disrupted due to flooding.

**The time it takes to recover from flooding and return home is based on several complex factors.**

Recovery from flooding events is a combination of interacting factors, including: the depth of the flood water as well as duration of the flood; how contaminated the flood water is; the length of time it takes to dry out a property; having financial assistance, through insurance and grants, to repair and renew property; the availability of builders and other actors in the recovery process; having access to social support networks; and the medium- and long term strategies to return people to their homes and to manage the physical and mental health impacts.

Alongside these, other factors are discussed elsewhere in this report, such as being well-protected where appropriate (see Sections 3.2.1 on flood alleviation and 3.2.3 surface water flood alleviation); the effectiveness of the immediate emergency response (see Section 3.6); and having flood resilience measures in place to minimise impact (see Section 3.2.5).

**Further research and data collection are still required to understand the scale of this risk in terms of recovery time, how climate change will alter it, and what the most effective mix of social, economic and technical responses are to manage it in the future.**

Returning home from flooding can be a slow process, however monitoring is not routine or formalised (particularly in terms of contextual hazard data, such as depth and duration of flood), so the Committee cannot assess the differences between different flood events over time and whether recovery times are getting better or worse. It is important that monitoring begins to also identify the factors that cause the longest delays, so that future efforts to reduce recovery times can be implemented efficiently.

**The Government can provide financial assistance for homes which are flooded and Flood Re has allowed at-risk homes built before 2009 to be insurable. However, no data is available on how many homes have insurance that covers flood risk.**

Flood recovery grants continue to be made available following major flood events under the Flood Recovery Framework. Flood-hit households following Storm Denis and Ciara in 2020 were able to claim £500 and 100% council tax relief. Under the Bellwin scheme, local authorities dealing with the effects of the event can apply to have 100% of the eligible costs they incur above a threshold reimbursed by the Government.

There remains no available national data that allow an assessment of the proportion of homes or businesses that have insurance to cover flood risk. An independent review of the availability of flood insurance for homes and businesses flooded in Doncaster in 2019 found that 28% of owner-occupiers were not covered. If replicated across the country this could mean tens of thousands of vulnerable households who are unnecessarily unprotected against flooding and missing out on the support that has been set up to help them.

Flood Re has improved the ability of households built before 2009 that have previously been flooded to access affordable insurance. Defra has consulted on several changes to Flood Re which aim to improve its uptake, efficiency and effectiveness (see Section 3.2.5).

**Environment Agency figures show that the number of properties signed up to the flood warning service in England has increased (Figure 3.5).**

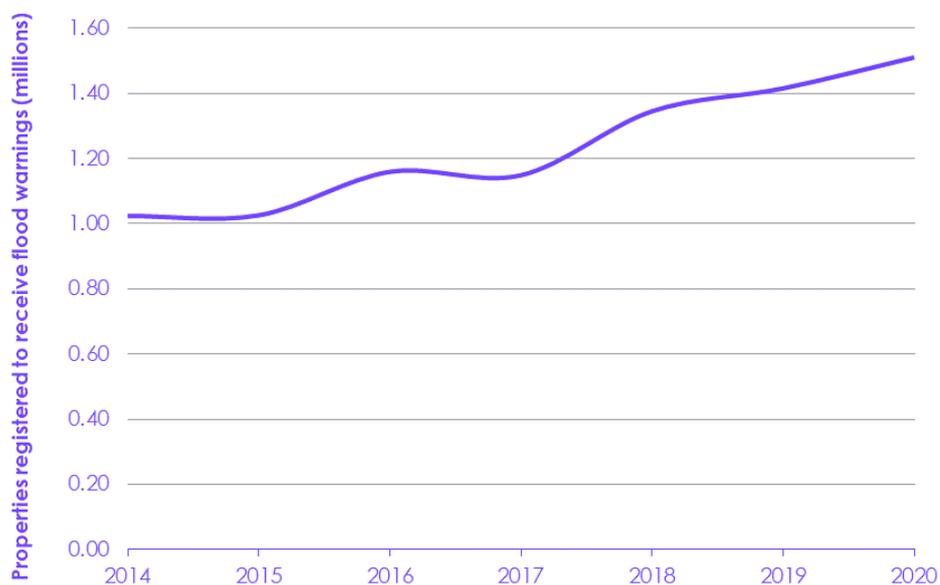
The ability to prepare for flooding in terms of keeping safe and minimising damage to property and possessions relies on high quality forecasts, which are received and acted upon. Between April 2019 and March 2020, the number of properties registered to received flood warnings rose by 7% from the previous year.

Between April 2019 and March 2020, the number of properties registered to receive flood warnings rose by 7% from the previous year.

An increasing number of users are accessing flood warning information through digital channels. In 2020, 6.2m users viewed over 65m pages, a more than threefold increase since 2018.

The FCERM Strategy commits the Environment Agency to expanding its flood warning service to all places at high risk of flooding from rivers and the sea. The Environment Agency's Expanding Flood Warnings project is working to provide all properties at high risk of flooding with warnings by 2022. By the end of 2022, the project aims to add 62,000 properties in England to the flood warning service.

Figure 3.5 Flood warning registrations



Source: Environment Agency

## 3.3 Coastal erosion risk management

Progress summary – Coastal erosion risk management		
2019 score:	What has changed since 2019:	2021 score:
3	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same. Flood and Coastal Erosions Risk Management (FCERM) strategy indicates the Environment Agency is currently in the process of refreshing the evidence (including climate change projections) and technical guidance, which underpin Shoreline Management Plans (SMPs). The SMP Refresh is anticipated to initiate a new planned implementation cycle, however, it is not yet clear how this will change plan outcomes (including for both climate change responses and protecting habitats and species). Furthermore, the non-statutory status of SMPs limits their robustness as long-term plans as it is not clear if the measures outlined in them will be sufficiently funded.</li> </ul> <p><b>Risk management score - low</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. It is not possible at present to conduct a robust assessment of progress in managing vulnerability. Information to track the rate of delivering SMP policies against SMP ambitions is not available. Furthermore, despite the irreversibility of properties lost to coastal erosion (in contrast to flooding), there is still no national dataset of properties lost, meaning it is not possible to assess the change in exposure, or the viability of the coastal local plans that use the SMPs.</li> </ul>	3
<p>Notes: See annex for full datasets Key Indicators: Grants for demolition and removal due to coastal erosion.</p>		

### Summary of 2019 report score

**In our last report, Coastal erosion risk management scored a 3 (low plan score, medium risk score).**

Our 2019 report highlighted that while Shoreline Management Plans (SMPs) had the potential to form a long-term, sustainable plan to address coastal erosion if they were implemented and sufficiently resourced, in practice, this was not the case. Existing plans did not include the full scale of future climate change risks from coastal erosion and thus could not plan long-term adaptation responses that could manage those risks. On progress in managing risk, we highlighted that the absence of a national dataset of properties lost to coastal erosion or data tracking the implementation of SMPs meant it was not possible to assess the change in exposure or the viability of the coastal local plans that use the SMPs as their evidence base.

### Has the plan score changed?

**No – the plan score is unchanged from 2019. Ongoing work to refresh the Shoreline Management Plans in England includes a requirement to assess SMPs against the latest climate evidence, however, it is not clear yet how this will be reflected in plan outcomes. In order for the score to increase the policy the Committee’s view is that SMPs must be made statutory.**

**More clarity is needed on how new evidence on climate change will be included in the process to refresh Shoreline Management Plans (SMPs) in England.**

SMPs remain the key mechanism for coastal defence management planning at both the regional and local level.<sup>71</sup> In England, there are 20 SMPs produced and updated by coastal groups in consultation with local communities and local partners.<sup>72</sup> The Environment Agency is currently working with coastal groups to refresh the SMPs in England. As specified in its FCERM strategy, the scope of the project includes the need to assess SMPs against the latest climate evidence, including impacts under a 2°C rise in global temperature, with consideration of 4°C.

It is understood the technical review phase of the SMP Refresh has been completed and outputs (Supplementary SMP Guidance covering UKCP18 and adaptation, plus individual 'health check' reports for each SMP) distributed to local authorities and Defra agencies. These will be discussed locally and SMP Action Plans updated with new priorities. However, details of how this will be factored into revised plan outcomes (including for both climate change responses and protecting habitats and species) is not currently clear. It is, therefore, not possible at present to determine how the SMP Refresh process will change existing SMP plans or their implementation in practice.

The Shoreline Management Plan Refresh is anticipated to kickstart a new planned implementation cycle.

**The SMP Refresh is anticipated to kickstart a new planned implementation cycle.**

SMPs outline preferred coastal management decisions in the short-term (0–20 years), medium-term (20–50 years) and long-term (50–100 years). These epochs are defined based on the start of the current (i.e. second-round) implementation cycle, which commenced over a decade ago (2009–11), rather than being incrementally updated; the current short-term epoch will end in the next few years. The SMP Refresh process is anticipated to initiate a rebasing of the implementation cycle to present day, which should help foster SMP policies based upon up-to-date data. However, SMPs remain advisory rather than statutory instruments meaning that in practice policy decisions are not necessarily funded or implemented.

Policy decisions within SMPs must be made statutory to ensure they are implemented.

**The Committee's view is that the policy decisions within SMPs must be made statutory to ensure they are implemented.**

The non-statutory status of SMPs severely undermines their effectiveness as the main vehicle that coastal authorities have to outline and implement their long-term strategy for coastal defence management.

**Defra has announced it will conduct a review of national policy for SMPs.**

Alongside the refresh of SMPs, Defra in its FCERM Policy Statement has committed to a review of the national policy for SMPs, which will focus on ensuring local plans are transparent, continuously evaluate outcomes and enable local authorities to make robust decisions for their areas.<sup>73</sup> The review will also assess current mechanisms and legal powers that Coastal Protection Authorities can use to manage the coast. This will include exploring the availability and role of financial products or services that can help people or businesses to achieve a managed transition away from areas at very high risk of coastal erosion.

**The Government has committed to increasing the use of nature-based solutions to address risks from coastal erosion.**

The FCERM Strategy and accompanying Policy Statement include a commitment to 'double the number of Government funded projects which include nature-based solutions to reduce flood and coastal erosion risk' (see also section 2.7). However, as yet no further information as to the scale or location of these projects is available.

**NAP2 includes an action to update the National Coastal Erosion Risk Map (NCERM) and ensure this remains freely available as open data online.**

The scope has been developed for a comprehensive NCERM update, with associated improvements to model architecture. The project will also revise assessments of property and infrastructure at risk in the future and explore combining NCERM within the national SMP Explorer being developed as part of phase 2 of the SMP Refresh.<sup>74</sup>

**The requirement for SMPs to underpin coastal development strategies in England has been removed from the 2018 revision of the National Planning Policy Framework (NPPF).**

Instead, the Planning Practice Guidance (PPG) now includes the requirement that local planners should use SMPs as the evidence base for their local plans, a move which may be considered to give it lesser importance.<sup>75</sup>

Has the risk score changed?

**No. The evidence available on managing risk remains the same as in 2019. It is not possible to assess robustly progress in managing coastal erosion risk in England due to a lack of baseline data on properties lost to coastal erosion and the implementation of SMP policy.**

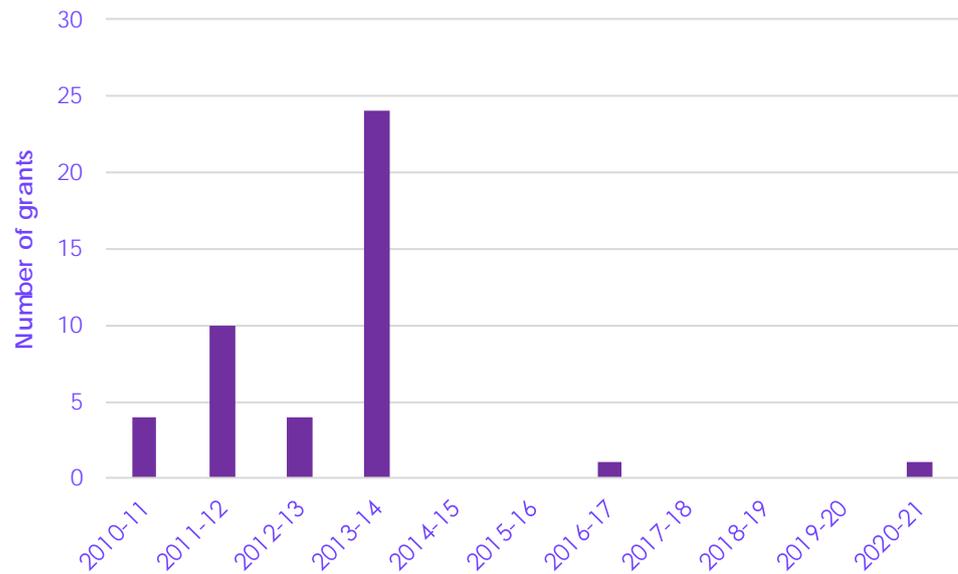
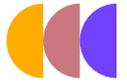
**The Government does not currently offer direct compensation for individual properties at risk from coastal change, and losses are generally uninsurable.**

The irreversibility of properties lost to coastal erosion means the potential risk impact for affected households is extreme, particularly as losses are uninsurable.

Defra's Coastal Erosion Assistance Grant (CAEG) provides £6,000 per property to assist local authorities with the demolition and removal costs associated with homes at imminent risk of loss from coastal erosion. Since 2010-11, 44 grants have been awarded with the majority of incidents concentrated around the east coast of England (e.g. Great Yarmouth and North Norfolk). Only two grants have been awarded since 2014-15. While it is not clear what has driven the drop, this could be a feature of the intermittency of coastal erosion events, such as cliff falls, or other factors linked to the administration or awareness of the grant scheme.<sup>76</sup>

Furthermore, while data suggests incidents are currently low, particularly relative to flooding, the irreversibility of properties lost to coastal erosion means the potential risk impact for affected households is extreme, particularly as losses are uninsurable.

Figure 3.6 Grants for demolition and removal due to coastal erosion



Source: Environment Agency

Notes: Number of successful applications for Coastal Erosion Assistance Grant, each representing one property

**The Environment Agency's new Flood and coastal resilience innovation programme will allocate £150 million across 25 local areas, funded by Government.**

The funding will target projects that demonstrate how practical innovative actions can work to improve resilience to flooding and coastal erosion. The aims of the programme are to:

- encourage local authorities, businesses and communities to test and demonstrate innovative practical resilience actions in their areas
- improve the resilience of 25 local areas, reducing the costs of future damage and disruption from flooding and coastal erosion
- improve evidence on the costs and benefits of the innovative resilience actions and demonstrate how different actions work together across geographical areas
- use the evidence and learning developed to inform future approaches to, and investments in, flood and coastal erosion risk management

**The absence of a national dataset of properties lost to coastal erosion or tracking of SMP policy implementation mean it is not possible to monitor progress in managing coastal erosion risk.**

It is vital that the Government allocates resources to the collection of these baseline data if the change in exposure or the viability of the coastal local plans that use the SMPs as their evidence base is to be assessed.

## 3.4 Water demand in the built environment

Progress summary – Water demand in the built environment		
2019 score:	What has changed since 2019:	2021 score:
8	<p><b>Plan score – high</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same, with a number of positive developments since our last assessment. The Environment Agency National Framework strengthens planning with a move to strategic regional planning on drought resilience, reducing long term water use and reducing leakage. The latest water company plans set new targets for personal water consumption and metering. The Government consulted on measures to reduce personal water use in 2019 and is expected to announce a statutory target on overall demand for public water supply encompassing targets for leakage, personal consumption and non-household consumption in 2021. An updated water resources planning guideline has been published and the next set of company plans are expected to use UKCP18 climate projections.</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. There remains a need for an increase in demand-side measures and stricter targets for reducing household water use. There has been no significant change in average household per capita consumption over the last 5 years. The percentage of homes with water meters continues to increase, however. The latest projections of future water availability show that current demand-side adaptation measures may not be sufficient to ensure risk is kept at least constant. The outcome of the consultation on measures to reduce personal water use and faster progress in actions to reduce demand will be crucial in determining whether risks of water availability are being managed.</li> </ul>	8
<p>Notes: See annex for full datasets            Key Indicators: Per capita consumption (l/h/d) – no significant change, Percentage of households with water meters – improving.</p>		

### Summary of 2019 report score

**In our last report, water demand in the built environment scored an 8 (high plan score, medium risk score).**

Water companies are required within their Water Resource Management Plans (WRMPs) to develop plans that are tied to their investment cycle for adapting to the risks of future water scarcity, including the effects climate change. This includes plans for demand management which is a critical aspect of ensuring resilient water supplies.

While a broad range of actions were being taken to reduce consumption, the Committee concluded that the level of progress in recent years and ambition in company plans may not be adequate to address future risks, particularly in the context of a 4°C global temperature rise scenario.

### Has the plan score changed?

**No, the plan score remains high - there have been a number of positive developments since our last assessment.**

The Environment Agency National Framework for Water Resources is being implemented. The framework looks at climate change pressures on public water supply using UK Climate Projections 2009 (UKCP09) datasets and sets an expectation for water company's regional plans to reduce demand to 110 litres per person per day by 2050.<sup>77</sup> The new National Infrastructure Strategy recognises that future requirements to increase resilience in water supplies and reduce the overall demand for water are key to better managing supply requirements.<sup>78</sup>

### **The latest water company plans set new targets for personal water consumption and metering.**

Water companies produce water resource management plans (WRMPs) every five years which look 25 years ahead. The Ofwat 2019 Price Review for 2020-25 requires water companies to help customers reduce personal consumption to 131 l/p/d by 2025 through their latest plans (WRMP19).<sup>79</sup> They also show that meter penetration will increase to 83% by 2045. WRMP19 plans use climate change projections from UKCP09. The latest plans show that, in the current regulatory environment, companies expect consumption to reduce to an average of 120 litres per person per day by 2045.<sup>80</sup> A further reduction to 110 litres per person per day will need to be achieved by 2050 to meet the expectations set out in the Environment Agency's National Framework for Water Resources.

Water companies expect consumption to reduce to an average of 120 litres per person per day by 2045. A further reduction to 110 litres per person per day is needed by 2050 to meet the expectations set out in the Environment Agency's National Framework for Water Resources.

### **The Government consulted on measures to reduce personal water use in 2019.**

The consultation on measures to reduce personal water use included consideration of demand-side measures including extending metering (including the use of smart meters), water efficiency labelling and amendments to building regulations.<sup>81</sup> An independent review by the Energy Savings Trust in 2019 of the costs and benefits of water labelling options in the UK recommended that the UK Government consider implementing a mandatory water labelling scheme linked to building regulations and minimum standards.<sup>82</sup> The Environment Bill policy targets paper proposed setting a statutory target on overall demand for public water supply encompassing targets for leakage, personal consumption and non-household consumption.<sup>83</sup> Choosing the right mix of acceptable measures will be vital to increasing the resilience of water supplies. The outcome of the consultation has been delayed due to departmental constraints imposed by COVID-19. Government is expected to announce its next steps to reduce per capita consumption in 2021.

### **An updated water resources planning guideline has been published and the next set of company plans are expected to use UKCP18 climate projections.**

Government consulted on the water resources planning guideline in 2020 and published the updated guideline in 2021.<sup>84</sup> In assessing the risk and possible impact of climate change, the guideline asks companies to consider the updated projections of future water availability produced for the third UK Climate Change Risk Assessment.<sup>85</sup> These projections are considered further below. Supplementary guidance on climate change is also being developed. Water companies are now developing cross company plans for 2024 using UKCP18 projections.

Has the risk management score changed?

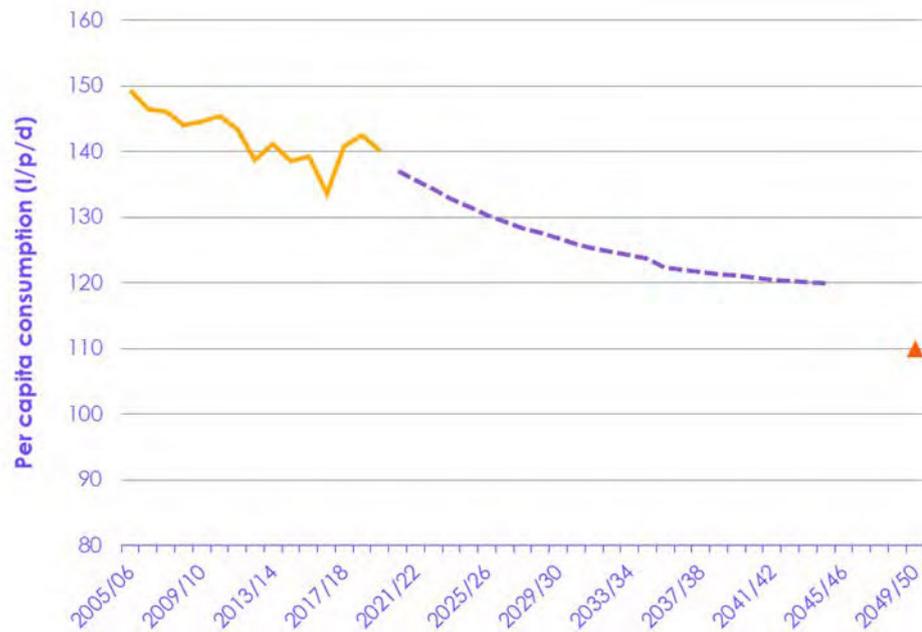
**No, the risk management score remains medium. Further action is needed to manage risks of future water shortages, through an increase in demand-side measures and stricter targets for reducing household water use.**

**There has been no significant change in average household per capita consumption over the last 5 years.**

Per capita consumption is a key measure for how efficiently we are using water. Weighted average\* per capita consumption per household in England was 140 l/h/d in 2019-20 (Figure 3.7). Consumption fell by 2% between 2018-19 and 2019-20. Overall, there has been little change in personal water use in the last 10 years although COVID-19 has reportedly influenced short term consumption patterns, with an increase in household consumption and a decrease in non-household consumption.<sup>86</sup>

There has been little change in personal water use in the last 10 years.

**Figure 3.7** Weighted average water consumption per capita for households in England 2005-2020 and forecast to 2044-45



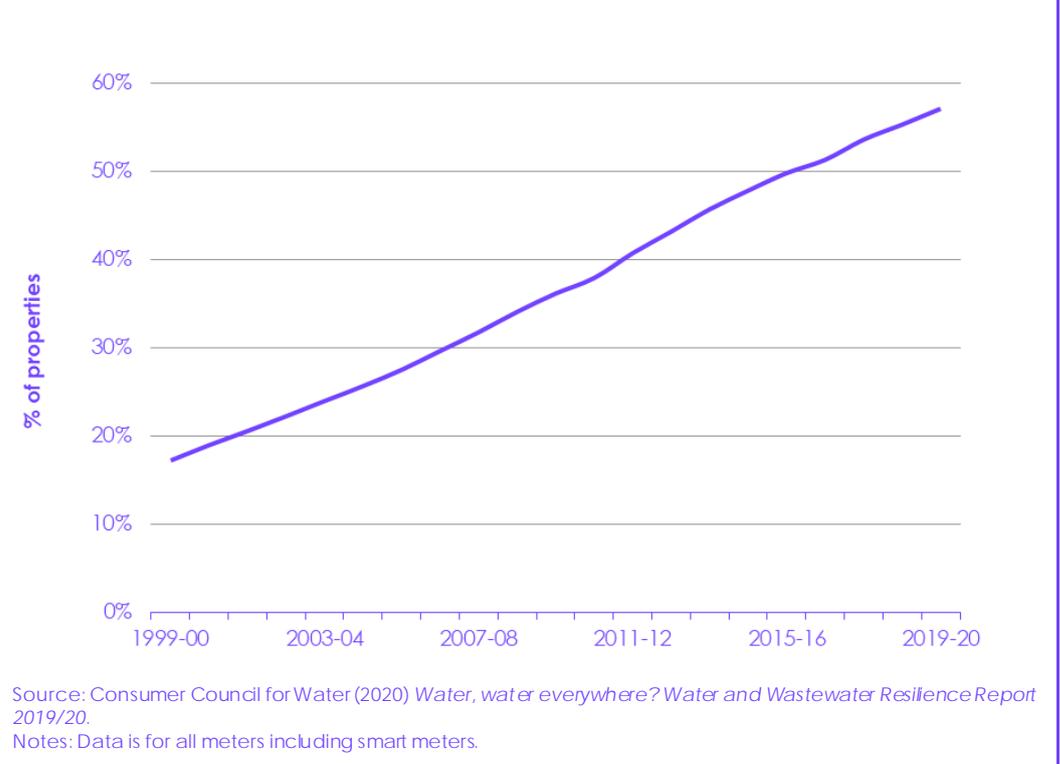
Source: Summary of actual and forecast data from Water Resource Management Plans (WRMP19) for all water companies in England. Data provided by the Environment Agency.  
 Notes: Forecast data to 2045 based on WRMP19. The target of 110 l/p/d represents the required level of per capita consumption by 2050 to meet the expectations set out in the Environment Agency's National Framework for Water Resources.

**The percentage of homes with water meters continues to increase.**

In 2019-20, 57% of households in England (and Wales) had water meters (Figure 3.8). This represents a 7% increase in metering since 2017/18. The latest water company plans show metering will increase to cover 83% of households by 2045. Over 2020-25, companies will invest £650 million in installing at least 2 million new water meters.<sup>87</sup> In the National Infrastructure Assessment, the National Infrastructure Commission recommended compulsory metering by the 2030s beyond water stressed areas, which could increase metering to 95% by 2050.

\* Weighted PCC is PCC weighted by water company population.

**Figure 3.8** Proportion of properties with water meters from 1999-00 to 2019-20



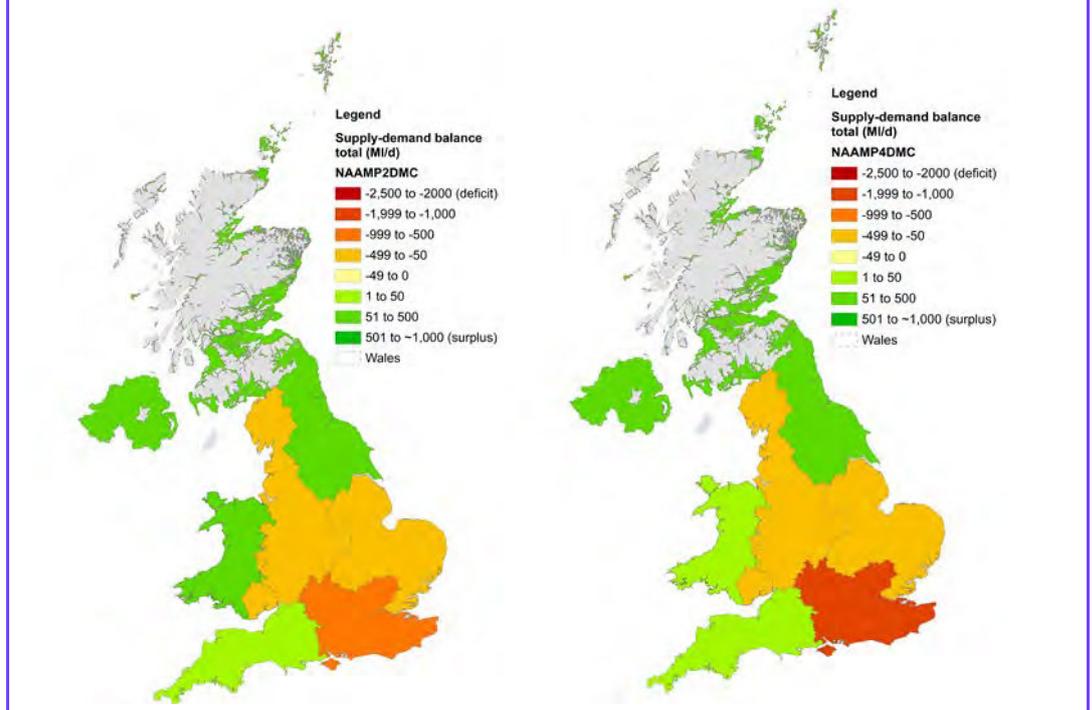
Recent analysis by Waterwise and Arqiva found that fitting one million smart water meters in the UK each year for the next 15 years could result in saving at least one billion litres of water a day (1,000 Ml/d) by the mid-2030s, as well as reducing the UK’s current greenhouse gas emissions by 0.5% (2.1MtCO<sub>2</sub>e).<sup>88</sup> Metering can also help with the management of water usage and supplies during peak demand, and help water companies identify and fix leaks.<sup>89</sup> The Government is expected to announce its approach to metering in 2021 as part of the new package of measures to reduce personal water use.

Although metering is a useful tool to help encourage lower water use by helping customers understand their usage, this may only occur if meters are visible to customers so they can track usage in real time. Meters are often placed out of sight, for instance underneath manhole covers in driveways. Metering also needs to be used in conjunction with other measures such as water labelling and messaging in order to achieve the reduction needed. Choosing the right mix of acceptable measures will be vital to increasing the resilience of water supplies.

**The latest projections of future water availability show that current demand-side adaptation measures may not be sufficient to ensure risk is kept at least constant.** The updated projections of future water availability produced for CCRA3 use the latest UKCP18 climate projections. In the current and announced adaptation scenario, reductions in demand and leakage are modelled in line with announced targets by government and the latest water resource management plans. Demand in England and Wales falls from around 140 to 118 l/h/d and leakage is reduced by around 50% by 2050. Under current and announced levels of adaptation, the latest projections of water availability indicate deficits in the Water Resources South East, Water Resources West and Water Resources East regions by the mid-century, in both 2°C and 4°C warming scenarios (Figure 3.9).\*

\* Under central population projection and assuming no additional adaptation action.

Figure 3.9 Mid-century supply-demand balance for UK Water Resource Regions

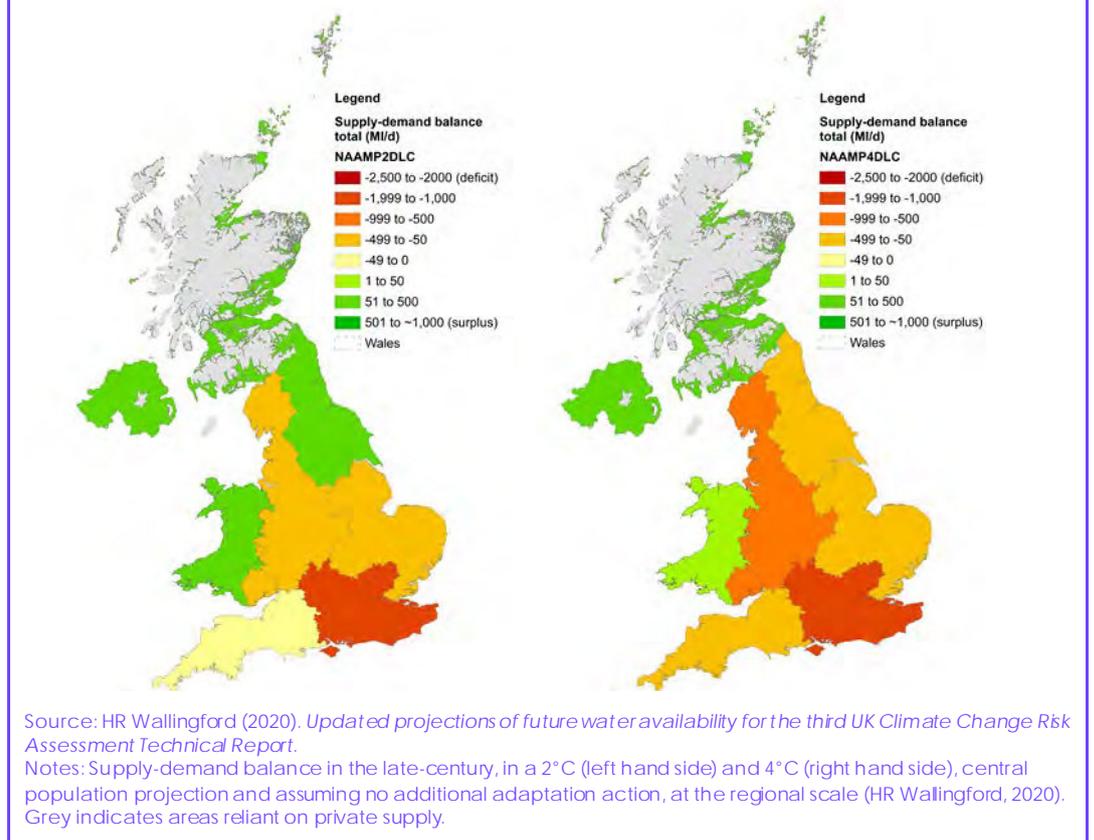


Source: HR Wallingford (2020). *Updated projections of future water availability for the third UK Climate Change Risk Assessment Technical Report.*

Notes: Supply-demand balance in the mid-century, in a 2°C (left hand side) and 4°C (right hand side), central population projection and assuming no additional adaptation action, at the regional scale (HR Wallingford, 2020). Grey indicates areas reliant on private supply.

By the late century, the projections show that in a 4°C world, all water resource regions in England are in deficit (Figure 3.10).

Figure 3.10 Late-century supply-demand balance for UK Water Resource Regions



**There remains a need for an increase in demand-side measures and stricter targets for reducing household water use.**

The outcome of the consultation and faster progress in indicators will be crucial in determining whether risks of water availability are being managed.

## 3.5 Public health and wellbeing

The impact of high temperatures poses a significant threat to people's health and wellbeing now and in the future. High temperatures affect a very wide range of health and social outcomes. The heatwaves in recent summers have caused thousands of excess all-cause deaths and disruptions to daily activities (including hospital services and education).

The impacts of heat from climate change will, to a significant degree, be determined by how well the built environment is adapted to the future climate. Lock-in is a key concern for capacity to adapt to future risks.<sup>\*</sup> Adaptation could be limited by housing and planning policies if they do not sufficiently consider climate change. This also has implications for the future delivery of health and social care as trends indicate a move to more home-based care. To tackle these issues requires cross-government coordination.

There are also more uncertain impacts on air pollution levels from changes in the climate (rather than changes in emissions which will have a very large effect) and threats from climate-sensitive infectious and non-infectious diseases. These changes are likely to alter the weather-related burden on human health and wellbeing in England.

The COVID-19 pandemic has shone light on resilience and capacity for action in Government departments, but particularly for those who deal with people, the built environment and business. The pandemic may have increased risks associated with high temperatures and poor indoor air quality as people have had to spend more time indoors during hot weather.<sup>90</sup> The impacts on health of both high temperatures and COVID-19 are disproportionately higher for vulnerable groups such as older persons, those with underlying conditions, and particularly people in residential care. Further work is required to explore how the concurrent risk of COVID-19 and heatwaves may have intersected to possibly amplify the number of deaths.

COVID-19 has also significantly affected the ability of health agencies to make progress in other areas of work, including climate change. Health bodies have seen a redeployment of staff and the unavailability of key stakeholders. Ongoing business as usual activities have been reoriented towards assessing and managing concurrent risks of COVID-19 and extreme weather events.<sup>91</sup>

<sup>\*</sup> Lock-in: Early actions or decisions that involve long lifetimes or path dependency, which will potentially increase future risk or vulnerability and that are difficult or costly to reverse later (quasi-irreversibility). This can be from an action or decision that is 'business-as-usual', from a lack of an action or decision, or from a mal-adaptative action or decision.

## 3.5.1 Health impacts from heat and cold

Progress summary – Health impacts from heat and cold		
2019 score:	What has changed since 2019:	2021 score:
2	<p><b>Plan score - low</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same, but some progress has been made. MHCLG has proposed to introduce a new regulatory requirement for addressing overheating in new homes, alongside new statutory guidance. However, at the time of writing this is still part of a consultation and not yet policy. There remains no plan to understand overheating risk and adaptation needs in existing homes, nor action to retrofit existing buildings. There is also still no plan to address the lack of understanding of the extent of overheating risks in care facilities or how a move towards home-based care may alter the risks to patients and healthcare delivery from extreme weather. There has been some better planning for 2°C and 4°C scenarios in policies for schools and prisons.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. Cumulative excess all-cause mortality related to heatwaves in summer 2020 was higher than that observed in England during the 2003 pan-European heatwave and 2006 heatwave event. Research since 2019 has found further evidence of overheating occurring in homes. Better indicators would help to understand the extent of overheating in existing homes. While increasing heat is a major climate risk to health, cold related deaths will remain significant and mitigation action to improve the thermal comfort of homes in winter as well as summer remains urgently needed. There is increased evidence of overheating in hospitals and new research into the occurrence and cost of summertime overheating in care homes. The proportion of urban greenspace, which can lessen the urban heat island effect has fallen since 2016.</li> </ul>	2
<p>Notes: See annex for full datasets            Key Indicators: Area of urban greenspace, Number of heat and cold-related deaths per year, Number of hospitals/care homes/surgeries that experience overheating (not yet available for care homes and surgeries), Temperature and air quality monitoring in new and existing homes including the number of overheating exceedances and the number of homes currently adapted to overheating (not yet available), Number of / spending on passive cooling measures and air conditioning uptake in different building types (residential, care homes and healthcare facilities) (not yet available)</p>		

### Summary of 2019 report score

**In our last report, health impacts from heat and cold scored a 2 (low plan score, medium risk management score).**

Our 2019 report found that adaptation plans to mitigate the long-term risks of heat impacts on health were missing, despite CCRA2 highlighting the risks to health from heat as an urgent priority. Plans were in place to review the Building Regulations, but there had not been any significant shifts in policy to ensure that new buildings are being designed with the future climate in mind and no policies exist to help adapt existing buildings. On progress in managing risk, our previous report highlighted that actions are taking place; however, there was little evidence the risk was being managed. The Committee recommended that regulations be strengthened for overheating to prioritise passive cooling measures in existing and new buildings and a need for increased and improved data collection in healthcare facilities, as well as better indicators to monitor overheating in homes.

This priority includes subsections for: housing; schools and prisons; health and social care delivery; and greenspace. Whilst there are also potential heat impacts to people using public transport, these have not been included as it is not known what the national-level picture is for overheating on transport.

Has the plan score changed?

**No, the score remains the same although some progress has been made which could lead to an improved plan score in the next year or two.**

A key issue with tackling heat risk is that ownership of the issue is shared across Government departments. There is a lack of cross-departmental coordination in dealing with the multiple health outcomes from overheating and utilising the multiple adaptation options available for mitigating risk.

The following sections are therefore split roughly by policy/impact area.

### Buildings – Housing

**MHCLG has proposed to introduce a new regulatory requirement for overheating mitigation, alongside new statutory guidance, with the aim of reducing overheating risk in new-build residential buildings.**

The Committee have previously reported that high levels of energy efficiency installed in new and existing homes can increase the retention of heat and airtightness of the building. This can increase the risk of overheating and exposure to indoor air pollutants if appropriate adaptation and ventilation measures are not implemented at the same time. In 2019, the Committee therefore recommended that the Government needed to publish an integrated plan to reduce overheating risk in existing and new homes alongside decarbonising domestic heating and planning for at least 2°C increase in global temperature, with consideration of 4°C. The Government response supported the need for regulation on overheating but had not set out plans for an integrated plan.

In January 2021, MHCLG published the Future Buildings Standard consultation which included proposals for an overheating standard within Building Regulations. The consultation proposed to introduce a new regulatory requirement for overheating mitigation, alongside consideration of usability and new statutory guidance for occupiers, with the aim of reducing overheating risk in new-build residential buildings (including houses, flats, care homes and residential educational buildings). The methodologies proposed take account of climate change and use high emissions scenarios from UKCP09. The Committee have welcomed this consultation as a significant step forward in addressing one of the most urgent climate risks. The overheating requirement and the required guidance address previous CCC recommendations to have an overheating standard in place, to mitigate using passive adaptation measures and to ensure that developers consider energy, ventilation and overheating together.

If introduced, the overheating requirement will come into force at the same time as changes to Part L of the Building Regulations in June 2022.

However, the consultation does not propose to include retrofits of existing buildings or conversions from non-domestic to residential. On the latter, there is evidence that permitted development conversions seem to create a worse quality residential environment than conversions that occur through regular planning permission in relation to several factors widely linked to health, well-being and quality of life for future occupants (see risk section below).<sup>92 93</sup>

These are mainly related to the internal design aspects such as space standards, window arrangements and access to amenity space, and are worse for 'office to residential' conversions – with evidence that adaptation measures such as external shading are being discouraged in some instances.<sup>94</sup> The regulation should therefore be expanded to refurbishments of existing buildings and conversions of non-domestic buildings to residential.

### Recommendation

Implement a strong set of standards - with robust enforcement - that ensure both new and existing buildings are designed for a changing climate and deliver high levels of energy efficiency and low-carbon heat. Including:

- Publish robust definitions of the Future Homes Standard and Future Buildings Standard which are legislated in advance of 2023 and ensure no fossil fuels are burnt in new buildings. This must include coordination with DfE, MoJ, DHSC as well as BEIS and HMT.
- Regulate the overheating requirement as set out in the Future Buildings Standard consultation. Expand the requirement to cover refurbishments of existing buildings and conversions of non-domestic buildings to residential.
- Work with BEIS on the Heat and Buildings Strategy and use standards to set a clear direction for retrofit across the buildings stock.
- Ensure that the remit of the new building safety regulator covers climate change mitigation and adaptation, strengthened through an explicit responsibility for sustainability; and is fully equipped to monitor and enforce compliance with buildings standards.
- Work with HM Treasury to ensure that local authorities are properly funded to enforce buildings standards.
- Close loopholes allowing homes to be built which do not meet the current minimum standards for new dwellings. This includes provisions around the expiry of planning permission and permitted development rights relating to change of use. Make accurate performance testing and reporting widespread, committing developers to the standards they advertise.

Department: MHCLG, Timing: 2021.

### **It is not clear how much overheating risk for new developments is being considered within local planning of most local authorities.**

Local planning policies can reinforce the need for new developments to be planned and designed to manage internal temperatures (for example with regards to orientation, shading, building materials, window design, ventilation and green spaces).

The Greater London Authority (GLA) has made positive steps by requiring overheating mitigation, in accordance with a cooling hierarchy, through the London Plan for major developments.<sup>95</sup> This includes using dynamic overheating modelling to assess internal overheating, taking a design-led approach to mitigation (such as prioritising dual aspect dwellings to enable cross-sector ventilation), and avoiding overheating without reliance on energy intensive mechanical cooling systems.

However, analysis by the CCC has found that most local plans (outside of Greater London) which have been drafted or adopted since 2018 do not include similar requirements for managing overheating risk.

**Despite some progress on addressing risks in new build residential buildings, there remains no plan to increase understanding of overheating risk and adaptation needs in existing homes, nor action to retrofit existing buildings.**

Millions of people have worked from home, rather than offices in 2020.

The majority of homes in England that will be present in 2050 have already been built. The COVID-19 pandemic has increased the amount of time people spend in their homes as millions of people have worked from home, rather than offices.<sup>96</sup> For those people living in modern, urban flats these often have high glazing with little shading, limited natural ventilation, are single aspect, and many have no easy access to outdoor green space.<sup>97</sup>

The Government's plans for reducing emissions in existing homes also do not include climate adaptation as a key priority, which is a missed opportunity to include passive cooling in retrofit programmes, especially given the risk of increased energy efficiency standards potentially exacerbating the risk of overheating.\*

Further research is needed to gain a better understanding of the extent of overheating risk in existing homes (see risk section below), while overheating and ventilation should be considered alongside programmes for energy efficiency retrofit.

Various steps are also needed to enable and encourage the uptake of adaptation measures for overheating in existing homes (Box 3.2), particularly for vulnerable or lower-income groups or those living in homes where it is difficult to make modifications.

### Box 3.2

#### Encouraging the uptake of adaptation measures for overheating in existing homes

- High quality advice and information is critical for enabling measures:
  - Green Building Passports could provide holistic guidance to householders and unlock green finance at scale.
  - Home retrofit plans are a tailored approach which could also bring in wider dimensions of comfort, aesthetics, and affordability as well as adaptation needs.
  - Combining these with the opportunity of smart meter data in a digital Green Building passport could unlock green finance at scale by providing a robust, quality source of information to raise finance against, track progress and help make standards enforceable for both climate adaptation and mitigation.
- Finance and addressing upfront costs of adaptation measures. This could be achieved through a combination of private (including 'green') finance (such as via low cost 'green mortgage products, or grants) and public funding targeted at low-income households and to support the vulnerable, along with other priority areas such as public buildings and social housing.
- Skills remain a further critical enabling measure. The CITB (the industry training board for the construction sector) have identified pace of change as a key challenge, necessitating Government intervention. It is vital that the policy framework also scales up inspections and enforcement activity to ensure householders get what they have paid for.

\* For example, the Energy White Paper (2020) and Green Homes Grant (2020).

## Recommendation

Improve understanding of and support action on overheating in existing residential buildings and encourage retrofit of passive cooling measures. The Heat and Building Strategy must consider overheating risks. The following steps are needed:

- Further research to understand when overheating occurs in existing homes, including: ongoing monitoring of temperatures in the housing stock, monitoring of overheating exceedances in homes, and number of homes currently adapted.
- Guidance and information for homeowners with the steps that can be taken if their homes overheat. This should include an outline of behaviour options and the measures that can be installed to reduce internal temperatures. Green Building Passports and home retrofit plans could provide holistic guidance and help to unlock green finance.
- Overheating risk considered and mitigated against if necessary when doing energy efficiency retrofit programmes.
- Making finance available to install adaptation measures. This could be via grant schemes or green finance for private owners, with public funding targeted at low-income or vulnerable households alongside energy efficiency retrofit.

Department: BEIS and MHCLG, Timing: 2022.

### **The Government is working to reform building safety and regulation.**

Climate change is a building safety issue, both in terms of the health and safety of residents and users and because of the contribution buildings make to emissions and hence to the health and safety of the wider population.

The reforms in the Buildings Safety Bill create a framework to improve the efficacy of building regulations, including those relating to climate change mitigation and adaptation.<sup>98</sup> This should be strengthened through an explicit responsibility for sustainability alongside buildings safety and performance. It will be important to ensure the buildings safety regulator is sufficiently equipped to monitor and enforce compliance across all building regulations and to ensure that local authorities are properly funded for enforcement activities.

### **Buildings – schools and prisons**

#### **There has been better planning for 2°C and 4°C in schools and prisons.**

The general set of adaptation interventions for schools are similar to those for other buildings, although there are additional low regret options for behavioural responses and emergency plans. Adaptation measures are essential to avoid lock-in with building designs and adapt to the future risks of overheating, flooding and other climate hazards.\* The Department for Education (DfE), along with the GLA, provide guidance on climate change and aim to prioritise passive measure over mechanical cooling to mitigate overheating risk.<sup>99 100</sup>

DfE are in the process of revising design standards in 'Specification 21' to adapt to a 2°C global warming scenario and future proof to a 4°C scenario (as far as possible) on all new or refurbished projects. This update is being informed by research carried out by the Chartered Institute of Building Services Engineers (CIBSE) Schools Design Group which has modelled the two scenarios against the 'BB0101' adaptive thermal comfort overheating risk assessment which identified the severity of risk.<sup>101</sup>

\* Lock-in: Early actions or decisions that involve long lifetimes or path dependency, which will potentially increase future risk or vulnerability and that are difficult or costly to reverse later (quasi-irreversibility). This can be from an action or decision that is 'business-as-usual', from a lack of an action or decision, or from a mal-adaptive action or decision.

There has been better planning for 2°C and 4°C in schools and prisons.

In addition to this, the DFE have carried out further research on their resilient schools project and Gen Zero (Construction innovation Hub funded research project) and well as a number of pilots testing the scenarios with industry.

School-specific long-term climate adaptation plans could be useful for the health well-being and safety of students and staff, as well as to promote a more resilient, biodiverse and vibrant school environment. Having a school-specific climate adaptation plan could deliver multiple positive outcomes including reduced bills, increased learning opportunities, improved biodiversity and better air quality.

In relation to prisons, the recent Ministry of Justice's Adaptation Strategy requires that sites assess risks using UKCP18 and use this assessment to inform adaptation plans/actions. A set of measures are recommended, but there is no analysis of costs and benefits.<sup>102</sup> The strategy says that sites should:

- Build in more natural ventilation, solar shading and natural cooling.
- Improve Building Management System (BMS) controls.
- Have emergency plans in place that consider the likely intensity and frequency of heat.
- Deliver against objectives through an action plan to be used to monitor progress of initiatives and actively support the strategic objectives and continuous improvement throughout the estate.

Since 2019 it is a requisite for all newly built prisons to be awarded an Excellent BREEAM 2018\* rating with a costed option to be designed to the 'outstanding' level. Prison builds due to complete within the next year have been assessed against the BREEAM 2014 scheme and are currently on course to meet an Excellent rating. MoJ has included BRE's "designing for future thermal comfort" as a mandatory credit for new build programmes.

## Health and social care

**There is still no plan to assess the extent of current and future overheating risks in care facilities, or how a move towards home-based care may alter the risks to patients and healthcare delivery from extreme weather under current conditions and future projections.**

In 2019 the Committee recommended that DHSC produce a plan to address the risks of overheating in care homes and care facilities, including consideration of home-based care by 2021. The Government disagreed that a plan was needed, stating that current guidance and the Heatwave Plan for England are in place. However, a review of the Heatwave Plan found little evidence that it had helped reduce general summertime impacts of heat on health since it was introduced. Barriers to adaptation also remain, including access to long-term, strategic funding.<sup>†</sup>

CQC's #TempAware campaign raised awareness of the importance of ensuring people in care homes and healthcare facilities are appropriately monitored and their health supported during hot weather, and directs providers to resources such as PHE's 'Beat the Heat' materials and the Care Provider Alliance's guidance on 'Developing Contingency Plans for Adult Social Care Services'.

\* Building Research Establishment Environmental Assessment Methodology.

† As reported during stakeholder discussions.

The Department of Health and Social Care have promised to work with CQC and other relevant agencies to determine whether there is further guidance which can be highlighted.<sup>103</sup>

### Recommendation

Assess health sector vulnerability to existing and future climate risks, particularly, for care homes and home-based care. Following this, develop a cross-sector approach to address risks. This cross-sector approach should include input from CQC, PHE, NHS, MHCLG and local level public health bodies.

Department: DHSC, Timing: 2022.

**Health providers are required to have in place a Green Plan including adaptation, but the percentage of NHS Trusts completing a plan is low.<sup>104</sup> Greener NHS will release green plan guidance, which includes requirements for adaptation planning, and are due to report in the third round of the Adaptation Reporting Power.**

The third Health and Social Care Sector Adaptation Report should:

- Review progress on health and social care sector adaptation since the previous report.
- Identify the level of risk and readiness across the health and social care sector, building on the second UK Climate Change Risk Assessment (CCRA2-2017) and UKCP18 Climate Projections.
- Provide practical recommendations on local, national and systemic actions to mitigate these risks and build resilience.

**The heat and cold health alert systems/weather plans are being revised into a single year-round plan.**

While the current Heatwave Plan for England is central to the acute public health response to heatwaves, the number of heat-related deaths in recent years (see below) indicate more strategic prevention action is required from a range of actors.

Hot weather causes an increase in deaths and emergency hospital admissions. The current Heatwave and Cold Weather Plans for England provide guidance to health, social care and community practitioners and the public in order to protect vulnerable people in hot weather. They do not take a long-term view of risk although the new year-round all-weather plan is aiming to do this (See also Section 3.6 on emergency planning).

The Department of Health and Social Care (DHSC) commissioned an independent evaluation of the implementation and potential effects of the HWP in 2019 which is now published.<sup>105</sup> Our previous report discussed the findings in more detail in our 2019 Progress Report. The evaluation found that there is no evidence that general summertime relationships between temperature and mortality and between temperature and emergency hospital admissions have changed substantially in the years since the introduction of the first HWP in 2004. Evidence did suggest that the Heatwave Plan was good at protecting people during the alert periods (the hottest days), but not so good in hot weather where no alert was issued.

## Greenspace

**There are plans and policies which will provide an opportunity to increase and improve green space and therefore could lead to reduced outdoor temperatures (especially in urban areas).**

However, it is not clear whether the multiple benefits from individual policies are being fully realised and taken up by developers (see Section 3.2.3 above).

Has the risk management score changed?

**No. The evidence available on managing risk remains the same as in 2019.**

**The number of excess all-cause mortality associated with heatwave events in summer 2020 was higher than observed in England during the 2003 pan-European heatwave and 2006 heatwave event.**

PHE has reported that there were an estimated 2,556 all-cause excess deaths (excluding deaths from COVID-19) during episodes of heat across all ages during three heatwave periods in summer 2020 in England (Figure 3.11).<sup>\*</sup> This is the highest heatwave associated all-cause excess mortality observed in England since the introduction of the Heatwave Plan for England in 2004.

There were an estimated 2,556 all-cause excess deaths (excluding deaths from COVID-19) during episodes of heat across all ages during three heatwave periods in summer 2020 in England.

Whilst the third episode of a heatwave in the summer was prolonged, with very high temperatures recorded (day and night-time) (causing 1,734 total excess deaths, 68% of total heatwave excess mortality), the severity and intensity of the meteorological conditions alone does not fully explain the magnitude of the impacts observed. Epidemiological analysis conducted by PHE has found that:

- Notably, significant excess mortality was observed in the 45 to 64 years age group in the August heatwave, compared with previous years where, at a national level, significant excess deaths in younger age groups (<65) during heatwaves were not evident.
- Significant excess mortality was observed in deaths at homes and in care homes for the 65+ age group. Significant excess mortality in this age group was also seen in hospitals during two of the three heatwave periods observed in summer 2020.
- Deaths at home and in hospitals increased significantly in the <65 years group during the third heatwave period compared to non-heatwave days in 2020.
- The COVID-19 pandemic has been associated with a general shift in where deaths have been taking place, with more deaths at home when compared to previous years.
- Excess deaths due to circulatory and respiratory causes, Alzheimer's and Dementia all increased significantly across all three heatwave periods in the 65+ group.

The identification of place and cause of deaths is important for highlighting where to target interventions, particularly for those unable to adapt their indoor environment or their behaviours in response to heat and are reliant on others for their care. However, further work is required to explore how the concurrent risk of

<sup>\*</sup> Excess all-cause mortality was calculated by comparing the average number of all-cause deaths (corrected for delays in registration) on heatwave days with the average from the combination of the 7 non-heatwave days preceding and subsequent to the heatwave period, having subtracting the estimated number of deaths attributed to coronavirus (COVID-19) on those days.

COVID-19 and heatwaves may have intersected to possibly amplify the number of deaths.

Figure 3.11 Excess heat deaths during heatwaves



Source: PHE (2020) *Heatwave mortality monitoring reports 2016-2020*.

Notes: Data split by age range is not available for 2003 and 2006. 2020 data does not include COVID-19 related deaths.

## Buildings – Housing

### Since 2019, there is further evidence of overheating occurring in residential buildings.

Research for the Energy Follow Up Survey 2017 study, due to be published by BEIS in 2021, monitored temperatures in homes between October 2017 and April 2019.<sup>106</sup> The findings from the study were based on data collected from temperature loggers, interviews conducted during 2017 and 2018, and a mobile phone survey undertaken during a hot period in the summer of 2018. The study found that:

- Of the homes included, overheating occurred in 19% of bedrooms and 15% of living rooms during 2018 (the hottest English summer to date), with average temperatures reaching 26.9°C in bedrooms.\*
- The prevalence of monitored overheating was found to be significantly greater in homes occupied by those aged over 75 compared to those under 65. In contrast, those over 75 were significantly less likely to report overheating compared to those under 65.
- Households reported issues with building fabric, the weather, internal heat and ventilation as being the main reasons for overheating.

A recent study found overheating occurred in 19% of bedrooms and 15% of living rooms during 2018 (the hottest English summer to date).

\* The measured overheating assessment used temperatures monitored in the living room and main bedroom during summer 2018. Adaptive temperature thresholds (that recognise that people adapt to warmer temperatures), were used to calculate if overheating had occurred. The adaptive criteria method was expanded to enable the vulnerability of occupants to be taken into consideration by using a lower adaptive temperature threshold for vulnerable groups.

A study has found room temperatures reaching up to 47.5°C in a permitted development flat when no shading was present.

- An adaptive criteria approach to measuring overheating was found to be a credible approach to overheating assessment and could enable targeted approaches to mitigating overheating among the types of dwellings and households most at risk.

Research published in 2019 to evaluate passive mitigation methods for reducing the risk of overheating has found evidence of significant overheating occurring in a permitted development flat.<sup>107</sup> The study was conducted in a south-west facing, single aspect retrofit (office to residential conversion) apartment building in London between August and October 2016. The study found that when no shading was present room temperatures could reach up to 47.5°C.

### **Better indicators would help to understand the wider prevalence of overheating in existing homes.**

As well as target appropriate mitigation measures and allow progress in managing risks to be measured. Useful indicators include ongoing monitoring of temperatures in the housing stock; monitoring of overheating exceedances in homes; and number of homes currently adapted.

### **While increasing heat is a major climate risk to health, cold related deaths will remain significant and mitigation action to improve the thermal comfort of homes in winter as well as summer remains urgently needed.**

An integrated approach to housing and thermal comfort is required. A major programme to retrofit energy efficiency measures in homes needs to be delivered over the next 10-15 years in order to prepare homes for low-carbon heat, and improve comfort and health, particularly for the fuel poor. To ensure year-round comfort and health benefits are realised, retrofit programmes should include work to adapt properties to possible overheating and ventilation risks, as well as providing an opportunity to address flood risks and improve water efficiency.

### **Buildings – schools and prisons**

#### **There is limited evidence regarding the prevalence of high indoor temperatures in schools and educational buildings across the country. However, local studies and evidence from pupils and staff have identified some current serious issues:**

- Schools in London have reported that concentration levels of children had been affected as a result of high temperatures in recent years (GLA, 2020).
- A survey of teachers found that 90% reported taking additional measures to reduce classroom temperature, including purchasing portable air conditioners (Environmental Audit Committee, 2018a). The majority of respondents reported that high temperatures had an impact on student performance; with half reporting that the reduction in productivity was 'significant'.
- Some new student residences have experienced internal temperatures above 30°C, partly because window openings were inadequate.<sup>108</sup>

#### **Current research projects aim to provide refurbishment scenarios to assess the impact on overheating in the existing school stock: \* 109 110**

The GLA has also recently released some guidance to support schools and academies adapt to climate change.<sup>111</sup> The increase in research in COVID-19 aerosol transmission risk has meant that the role of ventilation design in schools is being reviewed by a number of groups from the risk perspective of the transmission of respiratory disease as well as for climate change adaptation risks, including the

\* Through UCL, ARID, NERC, ASPIRE, and EPSRC.

risks of overheating and poor indoor air quality as well as air quality from traffic and other pollution.

The policies set out above are positive steps towards managing overheating risk in the future, particularly for new and refurbished schools. More work is needed to understand the extent of overheating in existing school buildings and take appropriate mitigating action to reduce risk. It would also remain beneficial for schools to have their own adaptation plans.

### **UK prisons are vulnerable to high ambient temperatures.**

The CCRA3 Technical Report found that:<sup>112</sup>

- HM Inspectorate of Prisons' report included concerns from inmates during inspections which included difficulty of breathing, continuous heating, high ambient temperatures in cells and limited oxygen from poor ventilation.
- The Ministry of Justice (MoJ) received nearly 500 reports and complaints of overheating in 2016-17.
- Solutions such as air-cooling technologies have been suggested to be not acceptable for prison conditions.
- Currently, there is no systematic evidence monitoring the indoor temperatures inside prisons in the UK.

The Ministry of Justice received nearly 500 reports and complaints of overheating in 2016-17.

### **Health and social care**

#### **There is increased evidence of overheating in hospitals.**

Data on the number of NHS Trusts that experience overheating is now available for four years from the Estates Return Information Collection (ERIC).<sup>\*</sup> In 2019-20 there were 3,600 recorded instances of overheating down from 4,482 in 2018-19.<sup>113</sup>

As data is only collected on an annual basis it is difficult to identify seasonal trends. Greener NHS plan to collect overheating data informally on a quarterly basis.

In 2019, the Sustainable Development Unit commissioned a survey<sup>†</sup> in health care settings not covered by ERIC which found that in the last three years heatwaves have impacted other healthcare settings:

- 35% of homecare services
- 36% of primary care
- 45% of residential care

COVID-19 may have compounded risk in hospitals and care homes experiencing overheating. This would have a far more significant impact on staff in full PPE.

In 2019-20 there were 3,600 recorded instances of overheating across NHS Trusts.

<sup>\*</sup> Estates Return Information Collection, 2017-2020. ERIC is a mandatory collection for all NHS Trusts. The overheating item of the survey records where wards, for each of the 236 trusts, exceeded a daily maximum temperature of 26°C. The count provided in the survey includes each occupied ward or clinical area having a daily maximum of over 26°C as one incident. At any time of the year where temperatures are found to exceed 26°C, a risk assessment should be carried out and appropriate action taken to ensure the safety of vulnerable patients.

<sup>†</sup> Commissioned report by SDU, 2019. Questions covered years 2016-2019 and engagement was undertaken with stakeholders across the NHS and social care including frontline providers. 249 primary and social care providers engaged in the survey and while the response rate was low, the data provides an insight into providers' experience of and preparedness for extreme weather events. It should be noted that those who experienced the impacts of severe weather may be more likely to respond to a survey that addresses these issues.

### Box 3.3

#### Overheating studies in care studies

##### Care Homes Overheating Audit Pilot Project

The GLA piloted an audit process to produce evidence-based recommendations for reducing the occurrence of summertime indoor overheating and exposure to elevated temperatures in care settings by residents, as well as an easy-to-use Best Practice Overheating Checklist.

The audit results and findings aim to provide consideration by the Care Quality Commission (CQC) to include the risk of overheating due to the impact of climate change in their inspection assessment of care homes.

Care homes could benefit from simple measures incurring minimal or no costs (or possibly cost savings), such as switching off unnecessary heat sources, applying rules for window opening and use of curtains, to highly efficient albeit more complex and expensive solutions that could be implemented in the longer term. These include the application of external shading, high albedo finishing materials and green roofs. Key lessons learnt will be used to inform the establishment of a longer-term process that could be replicated in the future. These include:

- Data monitoring during the heating season can provide valuable insights when studying overheating, as heat exposure and heat related mortality can occur all year round, even when external temperatures are low.
- The all-round effectiveness of summertime overheating adaptation measures should always be considered, as improving one area may cause significant unintended consequences in other areas, including possible impacts on annual heating loads.
- Adaptation measures are best implemented at the design stage, however existing buildings can also benefit significantly from a variety of measures that can be implemented under varying timescales, budgets and other requirements.
- Occupant behaviour plays a significant role in overheating reduction and thus training care home residents and staff on how to best operate the building to keep cool is critical.

##### Mortality benefit of building adaptations:

Initial work has been undertaken to explore a cost-benefit evaluation of building adaptations designed to protect against heat risks to residents of care homes in England. The work found that various physical adaptations have the potential to be cost-effective and reduce heat risk and should therefore be considered as an important complement to operational responses. In one case study, external window shading was estimated to reduce mean indoor temperatures by 0.9 °C in a 'warm' summer and 0.6 °C in an 'average' summer. In this case, for a care home of 50 residents, over a 20-year time horizon and assuming an annual discount rate of 3.5%, the monetized benefit of reduced Years of Life Lost (YLL) would be between £44,000, and £230,000 depending on which life-expectancy assumption is used. Although this range represents appreciable uncertainty, it appears that modest cost adaptations to heat risk may be justified in conventional cost-benefit terms even under conservative assumptions about life expectancy.

Source: UCL, OBU and LSHTM (2021) ClimaCare project; Ibbetson, A. et al. (2021) Mortality benefit of building adaptations to protect care home residents against heat risks in the context of uncertainty over loss of life expectancy from heat.

## Greenspace

### **The proportion of urban greenspace has not changed in recent years.**<sup>114</sup>

The Urban Tree Challenge Fund £10 million fully committed to support the planting of 134,000 trees (above the target of 130,000 trees).<sup>115</sup> However, the proportion of urban greenspace is not increasing. The CCC's previous indicator showed a decrease of permeable urban areas (greenspace) from 821,000 hectares in 2001 to 763,000 hectares in 2020.<sup>116</sup> The permeable fraction of the total urban area has decreased from 63% in 2001 to 55% in 2020.

The CCC now has access to an improved indicator (which includes larger areas of greenspace within cities and towns, not captured in the original indicator). Data from this indicator is only available since 2016.

The new indicator shows that the total proportion of urban greenspace in England declined between 2016 and 2018 from 62% to 60%, with no change between 2018 and 2020. As well as concerns over the amount of urban greenspace, access to greenspace is not equal across the population.<sup>117</sup>

The total proportion of urban greenspace in England declined between 2016 and 2018 from 62% to 60% of urban areas.

### Recommendation

Introduce an urban greenspace target to reverse the decline and ensure towns and cities are adapted to more frequent heatwaves in the future and that the 25-Year goals are met.

Department: MHCLG, Timing: 2022.

## 3.5.2 Risks to people from pathogens

Progress summary – Risks to people from pathogens		
2019 score:	What has changed since 2019:	2021 score:
2	<p><b>Plan score - low</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same. There is no coordinated plan in place which takes account of the impact of climate change on human pathogens. The new Health Security Agency provides an opportunity for climate change to be considered in the context of disease spread. Government are encouraging pro-environmental policies, such as maintaining or expanding urban green and blue space, to include a consideration of increased pathogen prevalence, but it is unclear what the take up of the guidance has been.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. Warmer weather is contributing to increases in tick abundance and the potential exposure of people to tick-borne diseases. Vector abundance of some mosquito species is increasing and spreading through Europe. There is a major risk of lock-in for vectors and pathogens, as once they are established, they are very difficult to eradicate. Resilience must be built proactively before new pathogens become established. While existing surveillance programmes, risk analysis and contingency planning are in place, the current level of surveillance of pathogens such as ticks and mosquitoes should be improved and expanded. This requires additional resources and investment from Government.</li> </ul>	2
<p>Notes: See annex for full datasets            Key Indicators: The distribution of ticks in the UK, The distribution of the Asian Tiger Mosquito in Europe, Geographical spread of other climate-sensitive pests and pathogens (not yet available), Funding for national surveillance mechanisms (not yet available).</p>		

### Summary of 2019 report score

**In our last report, risks to people from pathogens scored a 2 (low plan score, medium risk management score).**

Our 2019 report found that strategies to tackle invasive species – such as new mosquito species - do not consider human health and wellbeing. Other plans do not consider the long-term risks from climate change. On progress in managing risk, our previous report highlighted that existing surveillance programmes, risk analysis and contingency planning is in place, but the current level of surveillance could be improved. The report also found that more research was needed to quantify the impact climate change has on exposure to vector-borne-diseases compared to other influential factors.

Has the plan score changed?

**No, the score remains the same.**

**There is no coordinated plan in place which takes account of climate change scenarios and the impacts of health from pathogens.**

Since our report in 2019 the National contingency plan for invasive mosquitoes has been led by PHE. It highlights that the unprecedented change in status of vector-borne diseases (VBD) in Europe in recent decades is mainly due to increased globalisation and changes in climate and the environment acting on vector abundance.

This is likely to continue and therefore VBD risk in the UK is likely to increase. The plan sets out some actions for surveillance of invasive mosquitoes. However, it does not appear to include an assessment of how these actions relate to different climate change scenarios, although there are various papers published on climate change and pathogens.\*

As reported in 2019, other plans such as NAP2, the 25 YEP, the non-native species strategy, National Risk Register do not take account of the effects of future long-term climate change on human health and well-being due to VBDs.

**The multi-agency cross-government group on surveillance (Human Animal Infections and Risk Surveillance group – HAIRS), acts as a forum to identify and discuss infections with the potential for interspecies transfer.**

A system of horizon scanning is used to identify emerging zoonotic and vector-borne infections which may pose a threat to UK public health. Risk assessments have been done for tick-borne encephalitis, West Nile virus, Chikungunya virus, and Zika virus since 2017.

**Government are encouraging pro-environmental policies, such as maintaining or expanding urban green and blue space, to include a consideration of increased pathogen prevalence.**

Green and blue infrastructure and wetland areas (including in urban areas) that could reduce flood risk and urban heat islands, could potentially increase the risk of tick-borne infections or mosquito breeding grounds. PHE have published a wetland mosquito survey handbook on how to assess Wetlands.<sup>118</sup> To avoid local land-use conflicts, it aims to ensure that decision makers and those with day-to-day responsibilities for wetland management consider the public and veterinary health implications of mosquito populations. It is unclear what the take up of the guidance has been, including by local authorities.

**In 2021 it was announced that a new UK Health Security Agency will be set up to plan, prevent and respond to external threats to health.**

This provides an opportunity for climate change to be considered in the context of disease spread.

Has the risk management score changed?

**No. The score remains the same as in 2019.**

**Warmer weather is contributing to increases in tick abundance and the potential exposure of people to tick-borne diseases.**

The distribution of ticks has changed over time which may have contributed to an increased number of confirmed cases of Lyme disease in the UK and an increased risk of other tick-borne diseases. Climate change could be a cause of this change due to milder winters and warmer temperatures leading to increased tick-human contact patterns.

For example, since 2019 tick-borne encephalitis has been found to be present in Thetford Forest in the East of England and on the Hampshire/Dorset border.<sup>119</sup> Two probable cases of TBE infection have since been diagnosed due to tick-bites in the UK. Climate change models suggest a northern spread of TBE in Europe.<sup>120</sup>

Climate change models suggest a northern spread of TBE in Europe.

\* For example, Metelmann S et al. 2018.

As well as climate change, non-climate drivers such as agriculture, land use, tourism and wild animal populations could be a dominant influence on the incidence and distribution of ticks. Attribution of the different drivers, including climate change is not possible, and more research is needed to understand the links.

**There is a UK wide tick surveillance scheme, however it is constrained by a lack of resource.**

The UK's Tick Surveillance Scheme (TSS) began in 2005, run by PHE. Ticks are not routinely screened for pathogens and surveillance is constrained and would benefit from additional resources. The scheme still processes ~1,000 submissions per year and constitutes the best available data on UK ticks. Dedicated, local monitoring of tick activity would be useful to better understand how local weather conditions impact tick activity. This is currently being done in a small number of locations but could be rolled out and provide useful climate change indicator data.

**The Asian Tiger mosquito (*Aedes albopictus*) is spreading northwards across Europe (Figure 3.12).**

Since 2016, the Asian Tiger mosquito (*Aedes albopictus*) has been found (without confirmed establishment) in a few locations in Kent and west London.<sup>121</sup> This mosquito is an invasive species which can transmit dengue, chikungunya and zika virus, though there is no evidence that the mosquitoes found in the UK were capable of carrying disease (known as vector competence).

Responses to detection have been rapid and well-coordinated by PHE local health protection teams. However, the area where the mosquito is established in Europe has shifted northwards, across much of Italy and into mid and northern areas of France. Italy has experienced an epidemic of chikungunya in 2017 (Box 3.5). A recent study has found:<sup>122</sup>

- The local climate may be sufficient, in small pockets, around the Thames to sustain the Asian Tiger Mosquito currently.
- The area will spread in the future and within 50 years much of England and Wales may have a suitable climate.

Invasive mosquitos are likely to be found in increasingly challenging sites, such as urban areas. Recommendations have been made in a recent study around improving training of pest controllers and environmental health, incorporating PHE's mosquito surveillance schemes into routine local authority activities and developing local mosquito control plans.<sup>123</sup>

The suitable area for the Asian Tiger mosquito will spread in the future and within 50 years much of England and Wales may have a suitable climate.

**Box 3.5**

**Asian Tiger Mosquito (*Aedes albopictus*) in Europe**

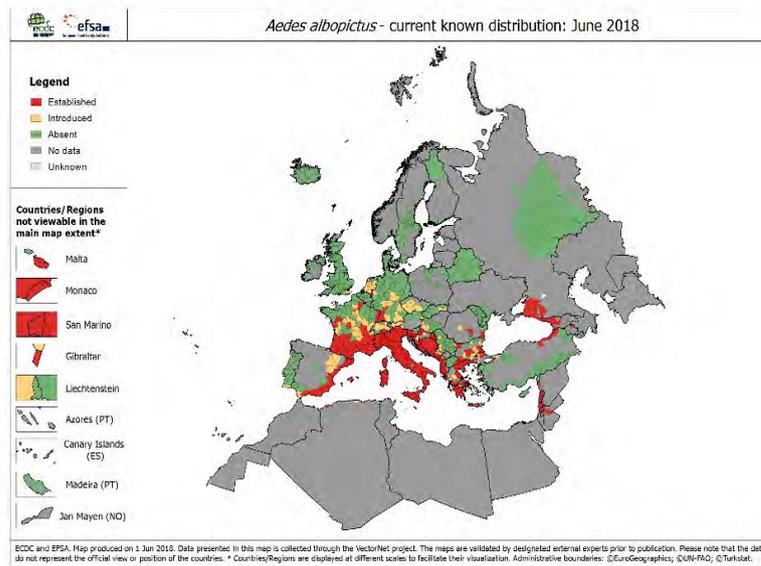
The Asian tiger mosquito (*Aedes albopictus*) has been reported in multiple European countries in recent decades. As a known vector of dengue and chikungunya, this species of mosquito is considered a serious health threat by the European Centre for Disease Prevention and Control. It has become established in most areas of Italy less than 600m above sea level. It is also prevalent in Southern France and Corsica and known to be spreading across Greece, Spain and the Balkan countries (Figure 3.12).

In France, following the establishment of *Aedes albopictus*, a national preparedness and response plan to prevent and control local transmission of chikungunya and dengue was developed in 2006 and is updated annually.

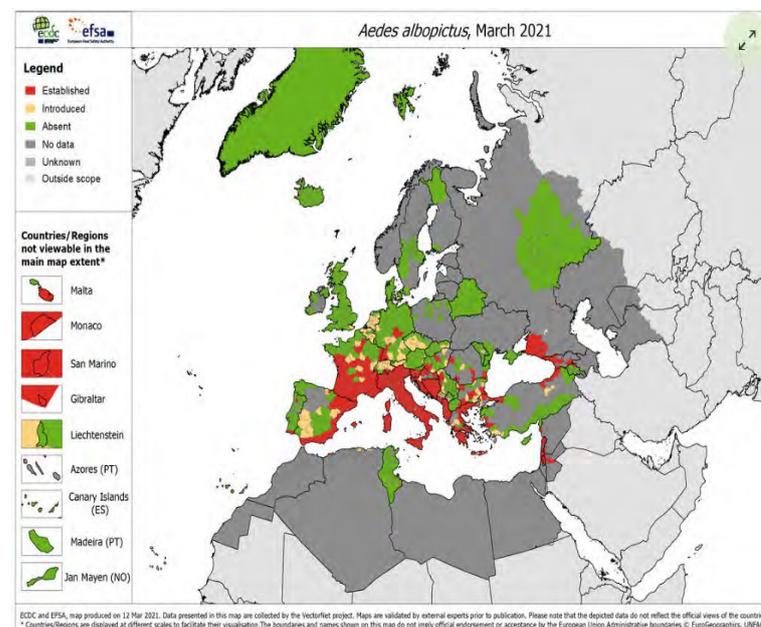
The plan focuses on entomological and epidemiological surveillance, with increased surveillance between May and November as well as increasing awareness among the population and health professionals of the risks. Since implementation, it has led to the detection and containment of several episodes of local transmission of chikungunya and dengue, including a small outbreak of autochthonous cases of Dengue in the city of Nimes in the South of France in 2015 and Chikungunya in Var, South-Eastern France in 2017.

Source: European Centre for Disease Prevention and Control, *Aedes Albopictus* Factsheet for Experts; European Centre for Disease Prevention and Control (2021) Seasonal active surveillance for invasive mosquitos over 2017-2019.; Succo, T. et al. (2016). Autochthonous dengue outbreak in Nimes, South of France, July to September 2015. *Eurosurveillance: bulletin europeen sur les maladies transmissibles = European communicable disease bulletin*. 21. 10.2807/1560-7917.ES.2016.21.21.30240.; European Centre for Disease Prevention and Control. Cluster of autochthonous chikungunya cases in France – 23 August 2017. Stockholm: ECDC; 2017

Figure 3.12 Asian Tiger Mosquito distribution in Europe



June 2018



March 2021

Source: European Centre for Disease Prevention and Control (2020), *Mosquito maps*.  
Notes: June 2018 distribution compared to March 2021 distribution.

**Surveillance of invasive mosquitoes takes place across UK ports and in some motorway stations and truck stops (59 locations largely focussed on south-east England, where the risk of mosquitoes entering and establishing are greater). There is a major risk of lock-in for vectors and pathogens.\* Resilience must be built proactively before new pathogens become established.**

There is uncertainty around if or when pathogens will become established however, if introduced, it is extremely difficult for a zoonotic pathogen to be eradicated, as it will become established within the population in the native fauna. The pathogens can also become adapted to their new hosts. There is not only an impact on people's health but also a potentially large economic cost to local and central governments to monitor and control disease spread.

Climate change and vector-borne disease is an increasing problem, that must be fully addressed and invested in sufficiently. The new health agency provides an opportunity to expand surveillance across the UK, model and monitor species of concern and the mechanism by which invasive species arrive in the UK and provide suitable indicators to measure vector abundance. The Government must ensure such surveillance is appropriately funded.

#### Recommendation

Fund the strengthening and widening of vector and pathogen surveillance and early warning mechanisms, due to the increasing risk of disease spread as a result of climate change and other factors.

Department: DHSC, Timing: Now and ongoing.

\* Lock-in: Early actions or decisions that involve long lifetimes or path dependency, which will potentially increase future risk or vulnerability and that are difficult or costly to reverse later (quasi-irreversibility). This can be from an action or decision that is 'business-as-usual', from a lack of an action or decision, or from a mal-adaptative action or decision.

## 3.5.3 Air quality

Progress summary – Air quality		
2019 score:	What has changed since 2019:	2021 score:
3	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same. The Clean Air Strategy includes long-term targets to reduce the levels of some outdoor air pollutants and these should fall further as a result of the implementation of Net Zero policies. However, there is no consideration of the impact of climate change itself on air quality. Cleaner Air is one of Public Health England's (PHE's) top ten strategic priorities, as set out in PHE's Strategy 2020-2025. The benefits of additional adaptation (to target climate induced changes in outdoor air quality) are likely to be low, but more research is needed on pollution and health monitoring and modelling during different weather events. The Government proposed changes to Part F (ventilation) of Building Regulations in 2019-2021, to simplify and clarify guidance on ventilation in homes to ensure good indoor air quality and comfort to occupants.</li> </ul> <p><b>Risk management score - low</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. Poor air quality causes significant harm to health. Vulnerability to outdoor air pollution, measures by the total number of people living with chronic respiratory conditions (COPD and asthma), has continued to increase. There is little evidence of monitoring of indoor air quality occurring in existing homes.</li> </ul>	3
<p>Notes: See annex for full datasets            Key Indicators: Number of people with chronic respiratory conditions, Instances of poor air quality in homes (not yet available), Number of installations of functional mechanical ventilation systems in buildings (not yet available).</p>		

### Summary of 2019 report score

**In our last report, health impacts from air quality scored a 3 (medium plan score, low risk management score).**

Our 2019 report found that plans and long-term targets are in place to reduce levels of air pollution, but these do not consider the impact of climate change of future air quality levels. On progress in managing risk, our previous report highlighted that research to address the CCRA2 research priority to understand the future impact of climate change on air quality was postponed, and vulnerability to air pollution has continued to increase.

Has the plan score changed?

**No, the score remains the same.**

**The Clean Air Strategy includes long-term targets to reduce the levels of some outdoor air pollutants and these will fall further with Net Zero policies. However, there is no consideration of the impact of climate change.**

As reported in 2019, targets and actions are in place to reduce air pollution within the Clean Air Strategy (CAS) and 25 Year Environment Plan. The Environment Bill delivers key parts of the Strategy and introduces a duty to set a legally binding target for fine particulate matter concentrations, and a duty to set a long-term air quality target. If met, future air pollution levels will be lower than now, and the marginal effect of climate change will act on a much lower baseline.<sup>124</sup>

Future levels of air pollution will fall even further with the implementation of virtually all changes proposed in the CCC's Net Zero pathways.\* There are several areas where the options adopted to meet Net Zero need to be carefully assessed to ensure the pathway is as beneficial as possible. For example, tree planting of certain species of tree and bioenergy crop may lead to increased production of ground level ozone and pollen that can aggravate asthma, hay-fever and other respiratory problems.<sup>125 126</sup>

**The benefits of additional adaptation to target climate induced changes in outdoor air quality are likely to be low.**

The most effective actions would be through the existing air quality policies and identified air quality improvement measures. These must ensure that climate risks are integrated into air quality policy and plans, taking account of both 2°C and 4°C warming scenarios. Further action might also be beneficial around improved early warning and response plans for extreme events, notably where there is an interaction between heat and air quality.

There is also a need for further research on pollution and health monitoring and modelling in different weather events.

**Cleaner Air is one of Public Health England's (PHE's) top ten strategic priorities, as set out in PHE's Strategy 2020-2025. They are considering physical and mental health co-benefits from reduced exposure to air pollution, including climate change.**

PHE is developing a five-year programme of work which aims to reduce the sources of air pollution and people's exposure to it, particularly for the most vulnerable groups. One priority is to understand opportunities and threats associated with air pollution and health, including climate change.<sup>127</sup>

**Fewer options are available to control pollen sources.**

The benefits of further action are mostly in further research and analysis of the linkages, and enhanced health advice and public warning systems. These are low-regret options.

**The Government has proposed changes to Part F (ventilation) of Building Regulations.**

These changes propose to simplify and clarify guidance on ventilation in new build homes to ensure good indoor air quality and comfort to occupants. Indoor air quality is determined by many factors including outdoor pollution, indoor pollutants and ventilation in buildings. Interventions to warm homes by reducing uncontrolled air leakage and prevent heat loss (e.g. through increased draught proofing and insulation) need to include adequate ventilation, otherwise they can worsen indoor air quality by concentrating pollutants generated indoors. This is an unintended consequence of high-performance retrofits, along with overheating, which can have negative impacts on respiratory conditions (including lung cancer), cardiovascular disease and allergic symptoms (e.g. atopic dermatitis, rhinitis, conjunctivitis and hay fever). These effects have major implications for building standards with respect to health.<sup>128</sup>

\* Major benefits to air quality are predicted from, for example, widespread electrification of transport and industry, where electricity supply is from 'clean' sources, and from reduced livestock in agriculture which reduces the emissions of ammonia that contribute to an important fraction of PM2.5. There are some actions where care is needed with respect to potential disbenefit on air quality; for example, the avoidance of high VOC (Volatile organic compounds) emitting species in increased forest and bioenergy cropland cover, which may lead to increased production of ozone. Biogenic VOCs from trees and shrubs contribute to formation of both ozone and particulate matter. Their emission is highly temperature-sensitive and hence climate change is liable to have adverse effects. Such effects would be exacerbated by tree planting programmes unless low-emitting species were selected.

In 2020, guidance from Public Health England on selected volatile organic compounds (VOCs) indoors and World Health Organisation (WHO) recommendations for indoor pollutant levels have allowed further flexibility to be introduced into Approved Document F by allowing designers to assess individual VOCs. In 2019 MHCLG reviewed Part F of Building Regulations (for ventilation) alongside Part L (for energy) in new homes to ensure the right level of ventilation is supplied that provides good indoor air quality. Natural ventilation, continuous extract (MEV systems) or supply and extract (including MVHR systems), are recognised as effective means of ventilating a modern property if designed, installed, used and maintained correctly. The revised Building Regulations guidance in Approved Document F is expected to improve compliance with the standards and therefore improve indoor air quality.

In 2021, MHCLG consulted on changes to the guidance in Approved Document F for existing homes.<sup>129</sup> These proposed changes recommend that extra ventilation is installed when installing common energy efficiency measures in existing properties, as well as when replacing windows, adding rooms, refurbishing kitchens or bathrooms (as is currently). The proposed changes aim to prevent homes becoming under-ventilated and less compliant with Part F as homes become more energy efficient.

A large proportion of homes simply do not comply with the current building regulations' requirements.

Despite positive changes proposed to regulations, the UK Government's 'Ventilation and indoor air quality in new homes' paper, has shown a large proportion of homes simply do not comply with the current building regulations' requirements, and poor indoor air quality has been observed in several sample homes tested.<sup>130</sup> There is a need for more accurate performance testing of new homes, committing developers to the standards they advertise.

The Health Protection Research Unit on Environmental Change (2016-20) has led to the development of a policy brief on the issue of housing energy efficiency and indoor air quality (specifically with regards to radon).

Has the risk management score changed?

**No. The evidence available on managing risk remains the same as in 2019.**

**Poor air quality causes significant harm to health.**

Poor air quality is associated with heart disease and stroke, as well as exacerbating respiratory conditions such as asthma, chronic obstructive pulmonary disease, lower respiratory tract infections and carcinomas of the respiratory tract. Particulates are estimated to contribute to around 29,000 deaths in the UK each year and up to 40,000 deaths when nitrogen dioxide exposure is also included.<sup>131</sup>

Long-term exposure to air pollution is associated with increased morbidity and mortality from chronic diseases, some of which have also been identified as increasing the risk of severe COVID-19 symptoms.

One study has estimated around 10-20 additional ozone related deaths per year in the UK due to climate change, although a reduced number of deaths from particulate matter.

In terms of future deaths from air quality that are attributable to climate change, there have been studies that model climate change impacts on air quality for Europe. One study estimated around 10-20 additional ozone related deaths per year in the UK, although a reduced number of deaths from particulate matter.<sup>132</sup>

**Vulnerability to air pollution, measured by the total number of people living with chronic respiratory conditions (COPD and asthma), has continued to increase.** Vulnerability to risks from air pollution can be monitored through assessing changes in the vulnerable population over time for air pollution related health impacts and deaths.

Although asthma and COPD cases can be viewed as an impact indicator (along with related deaths), in this context the Committee are treating them as vulnerability indicators; people with chronic respiratory conditions are more susceptible to periods of high air pollution:

- There has been a 20% increase in the number of patients receiving treatment for asthma in England, from 3.3 million patients in 2010-11 to 3.9 million patients in 2019-20.<sup>133</sup>
- The number of patients receiving treatment for COPD increased by 30% from 900,000 in 2010-11 to 1.2 million in 2019-20. Over this same period, the percentage of the total population receiving treatment for COPD increased from 1.6% to 1.9%.<sup>134</sup>
- London has the lowest percentage prevalence of both COPD and asthma, with the North of England having the highest percentage for COPD and the south west for asthma.
- Since 2001, deaths from asthma and COPD have increased by 24%.<sup>135</sup>
- Over 85s account for nearly 50% of deaths where asthma was the underlying cause compared to 23% in 2001.<sup>136</sup>

**There is little evidence of monitoring of indoor air quality occurring in existing homes.**

Apart from the MHCLG research mentioned above there is little evidence of monitoring of indoor air quality occurring in existing homes.

## 3.6 Effectiveness of the emergency planning system

Progress summary – Effectiveness of the emergency planning system		
2019 score:	What has changed since 2019:	2021 score:
5	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The plan score remains the same. Climate change has now been recognised in the National Risk Register and is being included by some Local Resilience Forum in local resilience plans and risk registers. However, climate change is already altering the risk profile of some hazards and extreme events are possible in the current climate. It is unclear how this change in risk is being factored into current national risk assessments and legislation. Local Resilience Forum report being less prepared to respond to surface waterflooding, drought and heatwaves, compared to river or coastal flooding.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains the same. Resilience Direct provides a platform for live multi-agency responses, resilience planning, exercising and recovery and has over 83,000 users. There are warnings in place for most climate hazards. However, climate risk is increasing, while the capacity to respond to incidents appears to be decreasing. This may lead to the available response capacity of some local areas becoming overwhelmed by future unprecedented events or series of events in parallel or quick succession. Improvements in resilience should be geographically targeted, with service vulnerability hotspots identified.</li> </ul>	5
<p>Notes: See annex for full datasets            Key Indicators: Environment Agency staff trained to respond to flood incidents, Number of emergency responders, Number of emergency planners and responders using Resilience Direct (not yet available), Time to coordinate responses to events (not yet available).</p>		

### Summary of 2019 report score

**In our last report, effectiveness of the emergency planning system scored a 5 (medium plan score, medium risk management score).**

Our 2019 report found that there are plans in place for the major climate-related emergencies today, but these do not include a consideration of the present-day change in risk from climate change. Weather and climate models have been increasing in the level of skill and granularity and can provide an improved baseline understanding of the current likelihood of extreme weather events. On progress in managing risk, our previous report highlighted that recent events have shown that the response system can be stretch and that capacity to respond in some areas is decreasing. These factors need to be properly assessed to ensure emergency planning is fit for the future climate.

Crisis response in the UK involves a diverse range of national and local organisations. National organisations and guidance clearly have a vital role to play in setting strategic direction. However, the responsibility for crisis planning and response at a local level in England lies with local resilience forums.

Has the plan score changed?

**No, the score remains the same.**

### **Climate change has now been recognised in the National Risk Register.**

In 2019 the Committee reported that the National Risk Register (NRR) (the public facing document of the National Security Risk Assessment, NSRA) did not acknowledge the projected changes in climate extremes that drive environmental hazards. The 2020 NRR now includes up front a section on climate change and recognises it as a significant crisis that the UK will need to face. There is a mismatch in the timescales considered by the NRR and CCRA which means that the NRR does not assess the impact and likelihood of climate trends, though it does now provide a link to the Climate Change Risk Assessment.

It is important that changing climate risk is also factored into the NSRA.

### **Climate change is already altering the risk profile of some hazards and extreme events are possible in the current climate.**

The CCRA3 Technical report reported that significant progress has been made in the attribution of extreme weather events since CCRA2, but this remains challenging because of the UK's highly variable weather and the fact that these events are, by definition, rare.<sup>137</sup> Recent extremes can be largely explained by the prevailing atmospheric circulation anomalies; however, these factors alone are not necessarily sufficient to explain the intensity of events, which may also have an underlying contribution from the warming UK climate.

A new methodology, known as UNSEEN (UNprecedented Simulation of Extremes with Ensembles) is providing a valuable tool for assessing current and near-term climate risks by providing better estimates of the tails of the observed distribution for the current climate and providing bounds on what is meteorologically plausible in terms of extreme events.

There is an 11% likelihood of any current year of summer temperatures exceeding those in 2018.

For example, it suggests that the severity of flooding of the Thames in 2014 should not be unexpected, even under present climate conditions, with even more extreme monthly rainfall totals possible. It has also been used to assess that there is an 11% likelihood of any current year of summer temperatures exceeding those in 2018 (where summer average temperatures were close to +2°C above the 1981–2010 average for a large swathe of southern and central England and Wales).

### **It is unclear how this change in risk is being factored into current national risk assessments and legislation.**

A study by the British Red Cross<sup>138</sup> recommended that there is a need for a future-proofed framework including a clearer role for the voluntary and community sector. Current legislation dates from 2004 and while the Government reviewed the Civil Contingencies Act in 2017, finding the legislation was working as intended, this was prior to some significant flood events of 2017. The Red Cross reports that since the legislation was introduced many in the crisis response sector have learnt important lessons from national crisis and are adapting to new threats such as the increased risk of climate related events. The Government should review regulations and guidance under the Civil Contingencies Act to ensure the legislation is fit for the changing nature of crisis response in the UK, including from the impacts of climate change.

### **Climate change is being included by some LRFs in plans and risk registers.**

An assessment of Local Resilience Plans by the British Red Cross<sup>139</sup> found that the emergency plans consistently prioritised short-term needs over longer-term support. Longer-term issues tended to be considered within the remit of other bodies such as local authorities or were featured in other specific plans such as the Recovery Plan, highlighting a potential lack of joining up between different strategies.

A survey of Local Resilience Forum by the CCC however found that most responders reported that they included climate change in Local Resilience Plans and/or Risk Registers.\* Survey responses said that climate change is usually derived from or embedded within assessments of risks in the National Security Risk Assessment (NSRA). All responders of the survey indicated that local risk assessments were updated once a year or more often and can incorporate changes to hazard likelihoods and impact.

**LRF's capability to respond varies depending on type of event.**

The survey also found that responders felt that their LRF's capability to respond to weather-related emergencies was either good or excellent. Drivers of capability to respond were mixed, although all LRF's surveyed said that one factor was experience of previous weather-related emergencies. Other key factors included the availability of resilience tools (such as Resilience Direct) and resources being made available to fund the LRF.

However, some LRFs felt they were not as prepared to deal with some hazards compared to others, a finding that is reflected in the Committee's earlier analysis of emergency planning from 2014. Whilst, responders of the survey felt that LRFs were prepared for river and coastal flooding, cold, and snow a number said that they were less prepared for heatwaves, drought and surface water flooding.

The Community Resilience Development Framework was published in September 2019 after consultation with representatives from UK Government Departments, statutory responders under the Civil Contingencies Act, the voluntary and community sector and academics.<sup>140</sup> The Framework provides a reference tool for the delivery of strategic approaches to community resilience development. Guidance on planning the coordination of spontaneous volunteers was also released, providing emergency responders with the guidance on how to plan, coordinate and manage spontaneous offers of support from the public during an emergency, including severe weather events.<sup>141</sup>

**England has Heatwave and Cold weather plans that provide guidance to health, social care and community practitioners and the public. However, these do not constitute a comprehensive long-term adaptation plan to reduce the risk of heat- and cold-related mortality and illness.**

The plans are due to be combined into one extreme weather plan, with an aim to move away from focusing on emergency response to longer-term resilience (see Section 3.5.1)

The 2021 Heatwave Plan has no significant changes but does include recognition that concurrent risk of heatwaves and COVID-19 pandemic could amplify risks to health.

Has the risk management score changed?

**No, the evidence available on managing risk remains the same as in 2019.**

\* There are 38 LRFs in England. 17 LRFs responded to the survey, representing 45% of all LRFs in England.

**The Resilience Direct platform is a tool for live multi-agency responses, resilience planning, exercising and recovery.**

The Resilience Direct (RD) service currently has over 83,500 users. Resilience Direct capability is assessed by the resilience community and enhanced accordingly.<sup>\*</sup> New RD mapping capability was launched in June 2020 which included new features to support RD users, such as Nowcasting.<sup>†</sup> Nowcasting allows responders to understand which access routes may be affected by surface water during high rainfall events and allows the emergency services to gain greater insight into the best routes during flooding, saving time in response.

**There are weather warnings in place for most climate hazards.**

There are well developed warning systems in place to alert the public and emergency responders to imminent threats of flooding, heavy rainfall, strong winds and heatwaves. The commissioning of year-round alerting system for heat and cold is complete.<sup>142</sup> The Met Office will issue a new Extreme Heat Warning service in June 2021, designed for extreme heat episodes and to work alongside PHE heat-Health Alert system. The warnings will focus on impacts to the general public.

The Cabinet Office continues to support the Met Office's year-round WeatherReady campaign.<sup>143</sup> The WeatherReady campaign encourages individuals, families and communities to think about preparations they can make to prepare for and cope with severe weather. It also provides resilience practitioners in local authorities, local emergency responders, and voluntary sector partners, with up-to-date expert guidance that can be used to communicate severe weather advice to individuals and communities.

**The capacity to respond to incidents appears to be decreasing, while risk is increasing.**

The effectiveness of the emergency response system is particularly sensitive to the expected impacts of future increases in extreme rainfall and flood risk. The numbers of Civil Category 1 responders, the response times of responders, the number of other responders (such as volunteers and charities) and the funding available for local authorities can impact how much capacity and ability an area has to be able to respond to extreme weather events.<sup>144</sup>

Category 1 responders are decreasing in number from the high point in 2009/10 which could impact the emergency services' ability to respond to any major situation, including floods or heatwaves:

- Fire service personnel have decreased by 23% since 2009.<sup>145</sup>
- Police service personnel have decreased by 8% since a peak in 2010, although numbers have risen since our 2019 report.<sup>146</sup>

Whilst the number of staff working for the Ambulance Service (full-time equivalent) increased by 24% between 2010 and 2019, this is mostly due to an increase in clinical support staff rather than ambulance staff which has remained constant.<sup>147</sup>

This decline may lead to the available response capacity of local areas becoming overwhelmed by future unprecedented events or series of events in parallel or quick succession.

<sup>\*</sup> Discussion with Cabinet Office (2021).

<sup>†</sup> The service is currently experimental and covers London, Birmingham, Manchester, Worcester and Leicester.

Other bodies are also available during emergencies. The armed forces have been used to support the response to natural disasters, for example during the response to Storm Dennis in 2020.<sup>148</sup> The British Red Cross is an auxiliary to Government and helps authorities respond to emergencies. The voluntary and community sector can be used to plan for and respond to emergencies.<sup>149</sup>

The number of Environment Agency staff who are trained and ready to respond to flood and environmental incidents is just above the target of 6,000.

The number of Environment Agency staff who are trained and ready to respond to flood and environmental incidents is just above the target of 6,000 (6,408).<sup>150</sup> Since the floods of winter 2015 to 2016, the Environment Agency has invested in new incident response kit including 40km of temporary flood barriers and 250 high volume pumps.

**Improvements in resilience should be geographically targeted, with service vulnerability hotspots identified before major events occur in areas where emergency services are already under strain.**

Emergency responders are required to reach urgent cases within mandatory timeframes, regardless of weather conditions. However, flooding of transport networks can add critical minutes to travel times between dispatch and arrival. A 2020 study found that vulnerable facilities with concentrations of elderly people, children and people with poor health, fall outside emergency service areas during flood events (even relatively low-magnitude coastal/fluvial (< 1-in-30 years) and surface water (1-in-30 years)). This indicates that for those populations who may need help during a flood (for example, evacuation), it is also much harder for emergency responders to gain access to those affected in good time.<sup>151</sup>

# Endnotes

- <sup>1</sup> Nicol S. et al. (2015) *The cost of poor housing to the NHS*.
- <sup>2</sup> Brown, P. et al. (2020) *Lockdown. Rundown. Breakdown. The COVID-19 lockdown and the impact of poor quality housing on occupants in the North of England*; PHE (2020) *Beat the Heat: Coping with heat and COVID-19*.
- <sup>3</sup> Kovats, S. and Brisley, R. (2021) Health, communities and the built environment. In: *The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London.
- <sup>4</sup> CCC (2021) *The Third UK Climate Change Risk Assessment (CCRA3) – Advice to Government*.
- <sup>5</sup> Sayers and Partners (2020) for the CCC. *Third UK Climate Change Risk Assessment (CCRA3) Future flood risk Main Report*.
- <sup>6</sup> Sayers and Partners (2020) for the CCC. *Third UK Climate Change Risk Assessment (CCRA3) Future flood risk Main Report*.
- <sup>7</sup> Environment Agency (2021) *Flood and coastal erosion risk management report: 1 April 2019 to 31 March 2020*.
- <sup>8</sup> Environment Agency (2021) *FCERM update paper March 2021*.
- <sup>9</sup> Wingfield and Brisley for the CCC (2017) *Assessment of the impact of recently-built flood alleviation schemes in managing long-term residual flood risk in England*.
- <sup>10</sup> HM Government (2020) *Flood and coastal erosion risk management Policy Statement*; Environment Agency (2020) *National Flood and Coastal Erosion Risk Management Strategy for England*; Environment Agency (2021) *Flood and Coastal Erosion Risk Management Strategy Action Plan 2021*.
- <sup>11</sup> National Audit Office (2020) *Managing flood risk*.
- <sup>12</sup> Environment Agency (2019) *Long-term investment scenarios*.
- <sup>13</sup> House of Commons Environment, Food and Rural Affairs Committee (2021) *Flooding: Fourth Report of Session 2019–21*.
- <sup>14</sup> Environment Agency (2020) *Impact of climate change on asset deterioration*.
- <sup>15</sup> HM Government (2021) *Flooding: Government Response to the Committee's Fourth Report of Session: 2019–21*.
- <sup>16</sup> Environment Agency (2021) *Flood and Coastal Erosion Risk Management Strategy Action Plan 2021*.
- <sup>17</sup> Environment Agency corporate scorecard 2018 to 2019 – Quarter four.
- <sup>18</sup> Environment Agency (2021) *Flood and coastal erosion risk management report: 1 April 2019 to 31 March 2020*.
- <sup>19</sup> Figure provided by the Environment Agency from 'Environment Agency corporate scorecard 2020 to 2021 – Quarter four' (to be published 2021).
- <sup>20</sup> MHCLG (2021) *National Planning Policy Framework Draft text for consultation*. See: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/961769/Draft\\_NPPF\\_for\\_consultation.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/961769/Draft_NPPF_for_consultation.pdf)
- <sup>21</sup> Environment, Food and Rural Affairs Committee (2021) *Flooding inquiry*.

- <sup>22</sup> Environment, Food and Rural Affairs Committee (2021) *Flooding: Government Response to the Committee's Fourth Report of Session 2019-21*.
- <sup>23</sup> MHCLG (2020) *Planning for the future White Paper*.
- <sup>24</sup> Environment Agency (2021) *Flood and coastal erosion risk management report: 1 April 2019 to 31 March 2020*.
- <sup>25</sup> Environment Agency (2021) *Flood and coastal erosion risk management report: 1 April 2019 to 31 March 2020*
- <sup>26</sup> See: <https://www.gov.uk/government/publications/environment-agency-objections-to-planning-on-the-basis-of-flood-risk>
- <sup>27</sup> See: <https://www.gov.uk/government/publications/single-data-list>
- <sup>28</sup> Environment, Food and Rural Affairs Committee (2021) *Flooding: Government Response to the Committee's Fourth Report of Session 2019-21*.
- <sup>29</sup> CCC analysis and MHCLG (2020) *Land Use Change Statistics (LUCS) residential address based change table 2017-2018*.
- <sup>30</sup> Sayers and Partners (2020) for the CCC. *Third UK Climate Change Risk Assessment (CCRA3) Future flood risk Main Report*.
- <sup>31</sup> Viktor Rözer and Swenja Surminski (2021) *Current and future flood risk of new build homes across different socio-economic neighbourhoods in England and Wales*. Environ. Res. Lett. 16 054021
- <sup>32</sup> Sayers and Partners (2020) for the CCC. *Third UK Climate Change Risk Assessment (CCRA3) Future flood risk Main Report*.
- <sup>33</sup> Environment Bill 2020.
- <sup>34</sup> See: <https://www.water.org.uk/wp-content/uploads/2018/12/Capacity-Assessment-Framework-Project-Report-Appendix-6-Final-1.pdf>
- <sup>35</sup> NAP Action Update (2021).
- <sup>36</sup> Jenkins, D (2020) *Report of a review of the arrangements for determining responsibility for surface water and drainage assets*.
- <sup>37</sup> Defra (2018) *Surface Water Management, An Action Plan*.
- <sup>38</sup> Environment Agency (2021) *Flood and coastal erosion risk management report: 1 April 2019 to 31 March 2020*.
- <sup>39</sup> NAP Action Update (2021).
- <sup>40</sup> Environment Agency (2021) *Flood and coastal erosion risk management report: 1 April 2019 to 31 March 2020*.
- <sup>41</sup> See: <https://www.gov.uk/government/news/government-takes-action-to-manage-surface-water-flood-risk>
- <sup>42</sup> Sayers and Partners (2020) for the CCC. *Third UK Climate Change Risk Assessment (CCRA3) Future flood risk Main Report*.
- <sup>43</sup> CCC (2019) *Progress in preparing for climate change 2019 Report to Parliament*.
- <sup>44</sup> CCC (2020) *Reducing UK emissions Progress Report to Parliament*.
- <sup>45</sup> HM Government (2019) *Government response to the Committee on Climate Change*.
- <sup>46</sup> See: <https://www.suds-authority.org.uk/2020/10/share-your-views-on-draft-updated-non-statutory-technical-standards-for-suds/>

- <sup>47</sup> See: <https://www.suds-authority.org.uk/2020/10/share-your-views-on-draft-updated-non-statutory-technical-standards-for-suds/>
- <sup>48</sup> Environment, Food and Rural Affairs Committee (2021) *Flooding: Government Response to the Committee's Fourth Report of Session 2019-21*.
- <sup>49</sup> Water UK (2020) *Sewerage Sector Guidance. Sewers for Adoption in England – a changed approach to surface water sewers*.
- <sup>50</sup> Natural Capital Committee (2020) *Interim response to the 25 Year Environment Plan Progress Report & advice on a green economic recovery*.
- <sup>51</sup> Environment Agency analysis 2020 based on MHCLG Live Data Tables.
- <sup>52</sup> ADAS for the CCC (2021) *Research to update the indicators of climate-related risks and actions in England*.
- <sup>53</sup> Stantec (2021) *DWMP Pilot Impermeable Area Removal*.
- <sup>54</sup> Environment Agency (2020) *National Flood and Coastal Erosion Risk Management Strategy for England*.
- <sup>55</sup> Environment Agency (2021) *Flood and Coastal Erosion Risk Management Strategy Action Plan 2021*.
- <sup>56</sup> HM Government (2020) *Flood and coastal erosion risk management: Policy Statement*.
- <sup>57</sup> Defra (2021) *Amendments to the Flood Re Scheme Consultation*.
- <sup>58</sup> Government Actuary's Department (2020) *GAD reviews Flood Re's first self-assessment* [press release – 12 August 2020].
- <sup>59</sup> Defra (2021) *Local factors in managing flood and coastal erosion risk and Property Flood Resilience - call for evidence*.
- <sup>60</sup> Blanc Review (2020) *Independent Review of Flood Insurance in Doncaster*.
- <sup>61</sup> Kelly, D., Barker, M., Lamond, J., McKeown, S., Blundell, E. and Suttie E. (2020) *Guidance on the code of practice for property flood resilience*.
- <sup>62</sup> WPI Economics for Flood Re (2020) *Flood Performance Certificates: Developing a blueprint for how they can support household climate resilience*, C790B, CIRIA, London, (ISBN: 978-0-86017-895-8).
- <sup>63</sup> Park, T., Oakley, M. and Luptakova, V. for the Environment Agency (2020) *Applying behavioural insights to property flood resilience*.
- <sup>64</sup> Defra (2020) *Multi-billion-pound investment as government unveils new long-term plan to tackle flooding* [press release – 14 July 2020].
- <sup>65</sup> ADAS (2019) *Research to update the evidence base for indicators of climate-related risks and actions in England. Report to the Climate Change Committee*; Environment Agency (2021) Unpublished.
- <sup>66</sup> UK Parliament (2018) *Housing: Flood Control. Question for Department for Environment, Food and Rural Affairs UIN 172487, tabled on 10 September 2018*.
- <sup>67</sup> BMC Public Health (2017) *The English National Cohort Study of Flooding & Health: cross-sectional analysis of mental health outcomes at year one*.
- <sup>68</sup> ONS (2020) *Coronavirus and depression in adults, Great Britain: June 2020*.
- <sup>69</sup> Defra, Welsh Government, NRW and Environment Agency (2020) *A method for monetising the mental health costs of flooding*.

- <sup>70</sup> Environment, Food and Rural Affairs Committee (2021) *Flooding: Government Response to the Committee's Fourth Report of Session 2019-21*.
- <sup>71</sup> CCC (2018) *Managing the coast in a changing climate*.
- <sup>72</sup> Environment Agency (2020) *National Flood and Coastal Erosion Risk Management Strategy for England*.
- <sup>73</sup> NAP Action Update (2021)
- <sup>74</sup> NAP Action Update (2021)
- <sup>75</sup> CCC (2018) *Managing the coast in a changing climate*.
- <sup>76</sup> CCC (2019) *Progress in preparing for climate change*.
- <sup>77</sup> Environment Agency (2020). *Meeting our future water needs: a national framework for water resources*.
- <sup>78</sup> HM Treasury (2020) *National Infrastructure Strategy. Fairer, faster, greener*.
- <sup>79</sup> Ofwat (2019) *PR19 final determinations, Overview of companies' final determinations*
- <sup>80</sup> Summary of forecast data from all water company Water Resource Management Plans (WRMP19). Data provided by the Environment Agency.
- <sup>81</sup> Defra (2019). *Consultation on measures to reduce personal water use*.
- <sup>82</sup> Energy Savings Trust (2019). *Independent review of the costs and benefits of water labelling options in the UK, Summary report*.
- <sup>83</sup> Defra (2020) *Policy paper 19 August 2020: Environment Bill - environmental targets*.
- <sup>84</sup> Environment Agency (2021) *Water resources planning guideline*.
- <sup>85</sup> HR Wallingford (2020) *Updated projections of future water availability for the third UK Climate Change Risk Assessment Technical Report*.
- <sup>86</sup> Frontier Economics (2020) *Economic impacts of COVID-19 on the water sector*.
- <sup>87</sup> Consumer Council for Water (2020) *Water, water everywhere? Water and Wastewater Resilience Report 2019/20*.
- <sup>88</sup> Waterwise and Arqiva (2021) *Smart water metering and the climate emergency*.
- <sup>89</sup> Ibid.
- <sup>90</sup> Brown, P. et al. (2020) *Lockdown. Rundown. Breakdown. The COVID-19 lockdown and the impact of poor quality housing on occupants in the North of England*; PHE (2020) *Beat the Heat: Coping with heat and COVID-19*.
- <sup>91</sup> NAP Action Update (2021)
- <sup>92</sup> UCL and University of Liverpool (2020) *Research into the quality standard of homes delivered through change of use permitted development right*.
- <sup>93</sup> Grussa, Z. et al. (2019) *A London residential retrofit case study: Evaluating passive mitigation methods of reducing risk to overheating through the use of solar shading combined with night-time ventilation*.
- <sup>94</sup> Grussa, Z. et al. (2019) *A London residential retrofit case study: Evaluating passive mitigation methods of reducing risk to overheating through the use of solar shading combined with night-time ventilation*.
- <sup>95</sup> Greater London Authority (2021) *The spatial development strategy for Greater London*. March 2021.

- <sup>96</sup> See: <https://www.theguardian.com/business/2020/sep/20/wfh-not-office-working-from-home-2020-radical-change-effects-lockdown>
- <sup>97</sup> See: [https://www.cibsejournal.com/technical/ensuring-thermal-comfort-in-a-warming-climate/?utm\\_content=buffer5e8c9&utm\\_medium=social&utm\\_source=twitter.com&utm\\_campaign=buffer](https://www.cibsejournal.com/technical/ensuring-thermal-comfort-in-a-warming-climate/?utm_content=buffer5e8c9&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer)
- <sup>98</sup> HM Government (2020) The Government Response to the Committee on Climate Change's 2020 Progress Report to Parliament
- <sup>99</sup> Education and Skills Funding Agency (2018) *Building Bulletin 1010 Guidelines on ventilation, thermal comfort and indoor air quality in schools.*
- <sup>100</sup> GLA (2020) *How London Schools and Early Years Settings can Adapt to Climate Change.*
- <sup>101</sup> See: <https://www.cibsejournal.com/general/building-resilience-into-net-zero-schools/>
- <sup>102</sup> Parry, I. & Cole, J. (2020) *Preparing for Climate Change: A Climate Change Adaptation Strategy.*
- <sup>103</sup> NAP Action Update (2021)
- <sup>104</sup> NAP Action Update (2021)
- <sup>105</sup> Williams et al. (2019) *Evaluation of the Heatwave Plan for England Final Report.*
- <sup>106</sup> BEIS (2021) *Thermal Comfort, Damp and Ventilation, Final Report: 2017 Energy Follow Up Survey,* Building Research Establishment and Loughborough University for the Department of Business Energy and Industrial Strategy, 76pp.
- <sup>107</sup> Grussa, Z. et al. (2019) *A London residential retrofit case study: Evaluating passive mitigation methods of reducing risk to overheating through the use of solar shading combined with night-time ventilation.*
- <sup>108</sup> CIBSE (2020) *Maintaining thermal comfort in a changing climate.* London, UK.
- <sup>109</sup> See: [http://gotw.nerc.ac.uk/list\\_full.asp?pcode=NE%2FV01000X%2F1&cookieConsent=A](http://gotw.nerc.ac.uk/list_full.asp?pcode=NE%2FV01000X%2F1&cookieConsent=A)
- <sup>110</sup> See: <https://gow.epsrc.ukri.org/NGBOViewGrant.aspx?GrantRef=EP/T000090/1>
- <sup>111</sup> GLA (2020) *How Schools and Early Years Settings can Adapt to Climate Change.*
- <sup>112</sup> Kovats, S. and Brisley, R. (2021) Health, communities and the built environment. In: *The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London.
- <sup>113</sup> ERIC 2019/20 Data Report. See: <https://digital.nhs.uk/data-and-information/publications/statistical/estates-returns-information-collection/england-2019-20>
- <sup>114</sup> ADAS for the CCC (2021) *Research to update the indicators of climate-related risks and actions in England.*
- <sup>115</sup> NAP Action Update (2021)
- <sup>116</sup> ADAS for the CCC (2021) *Research to update the indicators of climate-related risks and actions in England.*
- <sup>117</sup> Brown, K.A. and Mijic, A. (2019) *Integrating green and blue spaces into our cities: Making it happen.* Grantham Institute Briefing Note, Imperial College London.
- <sup>118</sup> Frances, M. et al (2020) *Wetland Mosquito Survey Handbook: Assessing suitability of British wetlands for mosquitos.* Natural Resources Institute, Chatham, UK.
- <sup>119</sup> Holding M et al. (2019) *Detection of new endemic focus of tick-borne encephalitis virus (TBEV), Hampshire/Dorset border, England, September 2019.* Euro Surveill. 2019;24(47):pii=1900658.

- <sup>120</sup> PHE (2021) *Human Animal Infections and Risk Surveillance (HAIRS) group. Qualitative assessment of the risk that tick-borne encephalitis (TBE) virus presents to the UK human population.*
- <sup>121</sup> Vaux G. et al. (2020) *Invasive Mosquito Detection, Response and Control in the UK.*
- <sup>122</sup> Metelmann S et al. (2018) *The UK's suitability for Aedes albopictus in current and future climates, Journal of The Royal Society Interface* <https://doi.org/10.1098/rsif.2018.0761> ;
- <sup>123</sup> Vaux G. et al. (2020) *Invasive Mosquito Detection, Response and Control in the UK.*
- <sup>124</sup> Kovats, S. and Brisley, R. (2021) Health, communities and the built environment. In: *The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London.
- <sup>125</sup> AQEG (2020) *Impacts of Net Zero pathways on future air quality in the UK.*
- <sup>126</sup> Hume, S. (2016) *Pollen: Friend or foe?* Allergy Today 2016.
- <sup>127</sup> NAP action update.
- <sup>128</sup> Institute of Health Equity (2020) *Sustainable Health Equity: Achieving a Net-Zero UK.*
- <sup>129</sup> MHCLG (2021) *The Future Buildings Standard Consultation.*
- <sup>130</sup> MHCLG (2019) *Ventilation and Indoor Air Quality in New Homes.*
- <sup>131</sup> Institute of Health Equity (2020) *Sustainable Health Equity: Achieving a Net-Zero UK.*
- <sup>132</sup> Kovats, S. and Brisley, R. (2021) Health, communities and the built environment. In: *The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London.
- <sup>133</sup> NHS Digital (2020) *Quality and Outcomes Framework, Achievement, prevalence and exceptions data 2019-20.*
- <sup>134</sup> NHS Digital (2020) *Quality and Outcomes Framework, Achievement, prevalence and exceptions data 2019-20.*
- <sup>135</sup> CCC analysis. For raw data see:  
<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/adhocs/11241deathsfromasthmarespiratorydiseasechronicobstructivepulmonarydiseaseandfluen glandandwales20012018occurrences>
- <sup>136</sup> CCC analysis. For raw data see:  
<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/adhocs/11241deathsfromasthmarespiratorydiseasechronicobstructivepulmonarydiseaseandfluen glandandwales20012018occurrences>
- <sup>137</sup> Slingo, J. (2021) Latest Scientific Evidence for Observed and Projected Climate Change. In: *The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B. and Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London.
- <sup>138</sup> British Red Cross (2019) *People power in emergencies.*
- <sup>139</sup> British Red Cross (2019) *People power in emergencies.*
- <sup>140</sup> HM Government (2019) *Community Resilience Development Framework.*
- <sup>141</sup> Cabinet Office (2019) *Planning the coordination of spontaneous volunteers in emergencies.*
- <sup>142</sup> NAP Action Update (2021).
- <sup>143</sup> See: <https://www.metoffice.gov.uk/weather/warnings-and-advice/weatherready>)
- <sup>144</sup> See: <https://britishredcross.shinyapps.io/resilience-index/>

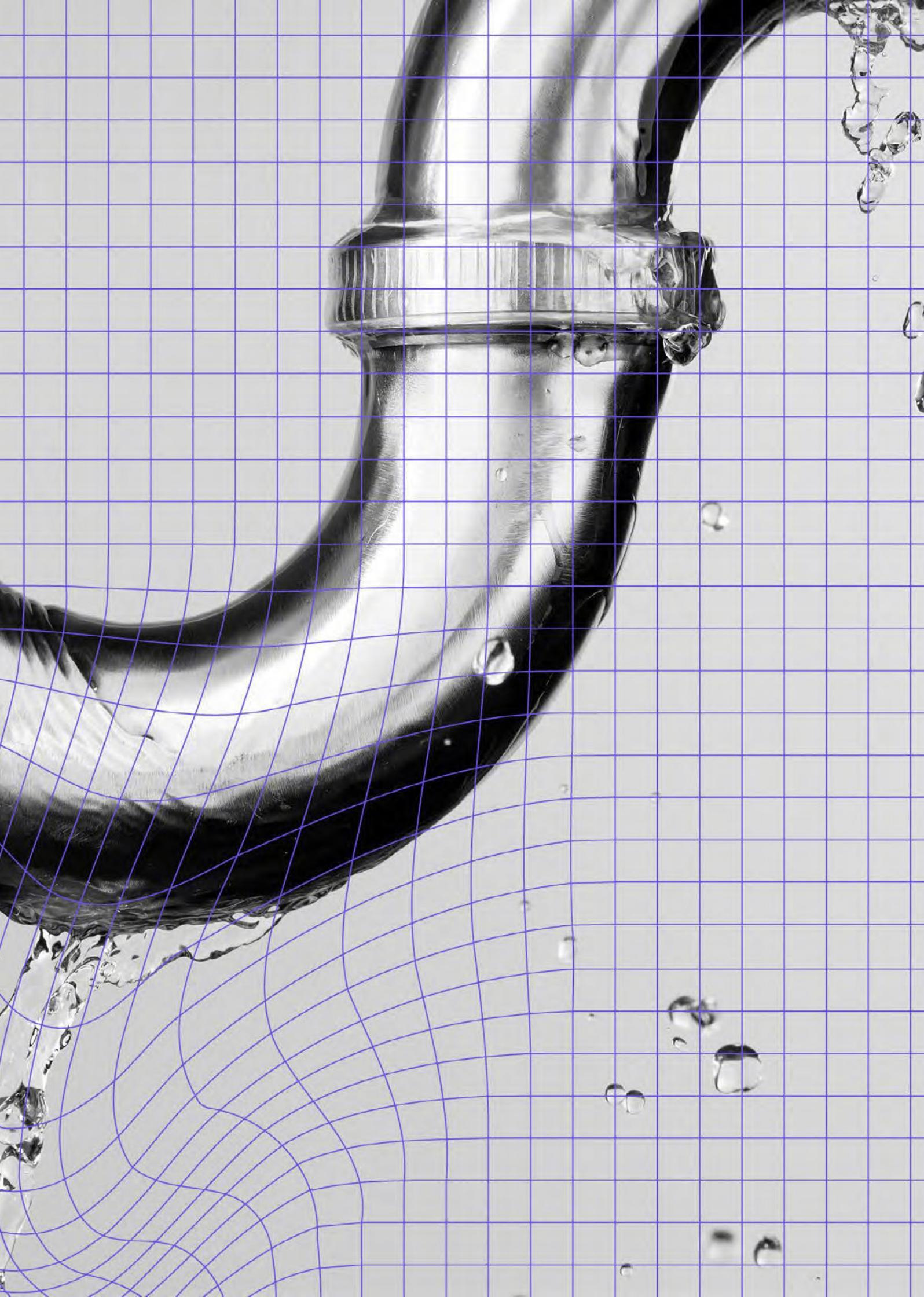
- <sup>145</sup> See: <https://www.gov.uk/government/statistical-data-sets/fire-statistics-data-tables#workforce-and-workforce-diversity>
- <sup>146</sup> Home Office (2021) *Police Workforce, England and Wales, 30 September 2020*.
- <sup>147</sup> NHS Digital (2020) *NHS Workforce Statistics – October 2020*.
- <sup>148</sup> See: <https://www.army.mod.uk/news-and-events/news/2020/02/troops-battle-to-save-flood-victims/> ; <https://medium.com/voices-of-the-armed-forces/british-army-deploy-flood-relief-during-storm-dennis-ffad6d83a8cf>
- <sup>149</sup> British Red Cross (2019) *People power in emergencies*.
- <sup>150</sup> Figure provided by the Environment Agency from 'Environment Agency corporate scorecard 2020 to 2021 – Quarter four' (to be published 2021).
- <sup>151</sup> Yu, D. et al. (2020) *Disruption of emergency response to vulnerable populations during floods*. *Nature Sustainability*/ Vol 3/ 728-736

# Chapter 4

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## Infrastructure

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## 4.1 Introduction

There have been a number of high-profile weather events causing damage to infrastructure in England since our last assessment.

**The functioning of our society and economies is heavily reliant on the services that infrastructure provides. Infrastructure systems in England are vulnerable to disruption and failure from extreme weather and a changing climate.**

Disruption to infrastructure networks from extreme weather can have significant implications not just for economic activity, but societal equity, health and well-being more generally. Networks are also vulnerable to increased degradation and reduced performance over time as a result of long-term changes in climate. There have been a number of high-profile weather events causing damage to infrastructure in England since our last assessment. 2019 was a particularly significant year with intense summer and autumn rainfall producing flash floods, notably impacting several stations on the London Underground. In the summer of 2019, temperatures exceeded 38°C (the hottest day ever recorded in the UK) which led to rail buckling and subsequent widespread damage and disruption on the rail network in England. A lightning strike in August that year caused a loss of power to one million customers including homes, businesses, one hospital and Newcastle Airport, and triggered disruption on the rail network. Winter flooding led to widespread disruption in South Yorkshire, quickly followed by the impacts of Storm Ciara and Dennis in early 2020.

**The UK Climate Risk Independent Assessment (CCRA3)<sup>1</sup> identifies increasing risks to infrastructure in England from high temperatures, flooding, drought, coastal erosion, and potentially wildfire in the coming decades.**

The CCRA3 Technical Report sets out the changes in climate that are expected over the coming decades; increasing average and extreme temperatures, changing rainfall patterns leading to flooding at certain times and water scarcity at others, and rising sea levels (see Chapter 1). An increasing frequency and severity of flooding from a range of sources represents the most significant climate change risk to UK infrastructure, including energy, transport, water, waste and digital communication. Assets and networks across all infrastructure sectors are already exposed to multiple sources of flooding, and the number of assets exposed could double under projected changes in climate by the 2080s. Projected extended periods of rainfall will increase the risk of slope and embankment failure - approximately 8% of the UK's transport and road network is at medium to high risk of landslide disruption.<sup>2</sup> Changes in rainfall, coupled with population growth, are projected to lead to supply-demand deficits in water resource zones across England and in some other parts of the UK by the 2050s, with widespread deficits projected by the 2080s. High temperatures can cause railway tracks to buckle, electricity cables to sag, signalling equipment to overheat and fail and road tarmac to soften and rut. Data centres are vulnerable to flood, high winds, wildfire and droughts as well as a loss of supporting power supply. While future projections remain uncertain, increases in maximum wind speeds experienced during storms would have significant implications for overhead power lines, data network cabling and the rail network, as well as for offshore infrastructure and wind turbines.

**Infrastructure assets can have very long lifetimes, in excess of 100 years, during which the English climate is expected to change considerably.**

Adaptation planning that considers long-term changes in the context of 2°C and 4°C global temperature scenarios is therefore particularly important for infrastructure.

Infrastructure can be built from the outset to be resilient to the anticipated range of future climatic conditions or designed to allow it to be upgraded cost-effectively as the climate changes, i.e. a managed adaptive approach.

**Whilst understanding of sectoral risks has improved over the last few years, the impacts of climate change could be amplified by interdependencies between infrastructure sectors, and these interactions are not well understood.**

No infrastructure network operates in isolation and a failure on one system can interact, and rapidly cascade into other sectors. System resilience to climate change goes beyond just the individual infrastructure network and can have far reaching consequences. All of the major climate hazards considered in CCRA3 could trigger a cascade effect from the power sector to other sectors; flooding, reduced water availability, increased temperatures and wildfire, as well as potential increases in storms. Interaction between climate hazards adds further complexity, for example combinations of drought followed by periods of intense rainfall can exacerbate bank stability issues.

**There have been a number of recent policy developments for national infrastructure and an increased focus on climate change adaptation is emerging.**

The UK Government has produced National Policy Statements which comprise the government's objectives for the development of nationally significant infrastructure and require climate change projections to be considered when developing new major infrastructure assets and projects. The first National Infrastructure Assessment was published in 2018, which included a number of climate change related recommendations such as national flood resilience standards and a plan to enable the water sector to meet changing supply and demand in 2050. A new National Infrastructure Strategy was published in 2020. The 2020 Spending Review committed £640 billion of gross capital investment in infrastructure before 2024-25.<sup>3</sup>

**Broader societal drivers will influence the need for resilient infrastructure.**

There will be significant implications for infrastructure resilience as a result of the transition to a Net Zero economy, for example a marked increase in reliance on electricity and the development of new energy infrastructure. This is explained further in Box 4.1.

#### **Box 4.1** Net Zero implications for infrastructure

The UK Government has adopted a Net Zero target through a revision to the 2008 Climate Act (such that the net UK carbon account for the year 2050 is at least 100% lower than the 1990 baseline). This will impact upon the type of infrastructure the UK will be reliant upon in 2050 as well its role within the wider economy and society. Changes in the energy, water supply and transport sectors will include:

- Increased reliance on electricity and ICT through extensive electrification, which amplifies the consequences of power outages and makes cascade failures to other networks more probable.
- Increased significance of offshore infrastructure to electricity supply.
- New infrastructure (e.g. hydrogen production, distribution and storage, electric vehicle charging points) with implications for scaling up investment in flood risk management.
- Increased requirements for water for CCS and Hydrogen production increases vulnerability to water shortages and, if facilities are sited on the coast, coastal erosion and sea level rise.

All proposed infrastructure investments will need to be critically evaluated through a Net Zero lens.

All of the major climate hazards considered in CCRA3 could trigger a cascade effect from the power sector to other sectors; flooding, reduced water availability, increased temperatures and wildfire, as well as potential increases in storms.

Energy supplies in particular will need to become increasingly resilient to climate change and interdependencies will need to be better understood and managed. Work is needed to understand the implications of water availability projections for the energy sector, in the context of Net Zero. The Government's new National Infrastructure Bank, announced as part of the National Infrastructure Strategy in 2020, will have a major role to play in supporting the transition of the UK's economy to Net Zero emissions by 2050.

*Source: CCC (2021) [The Third UK Climate Change Risk Assessment \(CCRA3\) - Advice to Government](#).*

In a recent White Paper, the Institution of Civil Engineers found that while the UK's long-term infrastructure drivers and challenges have not changed because of Covid-19, in the short to medium term the pandemic highlights the need to prioritise investments around digitalisation of new and existing infrastructure assets.<sup>4</sup>

In the sections below the Committee assess progress being made in accounting for and adapting to climate change for new infrastructure, existing infrastructure (broken down by sector) and with regard to infrastructure interdependencies.

## 4.2 Infrastructure interdependencies

Progress summary – Infrastructure interdependencies		
2019 score:	What has changed since 2019:	2021 score:
1	<p><b>Plan score – low</b></p> <ul style="list-style-type: none"> <li>The plan score has not improved, however there are promising developments through the new National Infrastructure Strategy (NIS) and the National Infrastructure Commission’s Resilience Study, which could lead to an improved plan score over the next two years. The new NIS is welcome and does acknowledge the increasingly important need to identify and limit cascading risks across infrastructure networks. However, there remains no systematic assessment of interdependency risk, or plan to improve resilience or address risks and opportunities from climate change. The Resilience Study develops a framework for the next National Infrastructure Assessment in 2023 and identifies climate change as one of three key challenges for resilient infrastructure.</li> </ul> <p><b>Risk management score – low</b></p> <ul style="list-style-type: none"> <li>The risk management score has not improved. Impacts caused by cascading failures from weather and climate related disruptions are still not recorded and monitored at a national scale. There remains a lack of data to assess whether actions by individual operators are reducing risk, and opportunities for data sharing across networks and Local Resilience Forums could be improved. Defra is promoting use of the UKCP18 climate projections through the Infrastructure Operators Adaptation Forum and the Adaptation Reporting Power. Defra has also been engaging reporting organisations to include better coverage of interdependent risks in ARP3 reports. However, the ARP3 reporting deadline exceeds the timeframe for this report therefore the Committee have been unable to assess the extent to which interdependent risks are being identified and managed. The transition to Net Zero and increased reliance on electricity for heating, transport and industrial processes will increase the potential impact of interacting risks.</li> </ul>	1
<p>Notes: See annex for full datasets Key Indicators: There remains a lack of data on interdependent risks and resilience actions by infrastructure providers.</p>		

### Summary of 2019 report score

**In our last report, infrastructure interdependencies scored a 1 (low plan score, low risk management score).**

In our last assessment the Committee found that there was no systematic national assessment of interdependency risk or plan to improve resilience, including addressing risks and opportunities from climate change. The report also highlighted issues around sharing of resilience data.

Strategic actions to reduce risk did not appear to be happening - there are NAP actions to share data, but these were not on track. Some research was underway and the Committee acknowledged the role of the NIA in beginning to address vulnerabilities. While many assets were being protected to the standard set out in the National Flood Resilience Review, it was not known whether risks were being fully managed.

Has the plan score changed?

**No, but there are promising developments. The new National Infrastructure Strategy acknowledges the increasing importance of managing cascading risks from climate change. However, there remains no systematic national assessment of interdependency risk or plan to improve resilience.**

The new National Infrastructure Strategy acknowledges that the increasingly interdependent nature of the UK's critical infrastructure means the need to identify and limit cascading risks is only becoming more important.<sup>5</sup> The Strategy is the Government's response to the National Infrastructure Commission (NIC) National Infrastructure Assessment (NIA) published in 2018. In its 2019 Resilience Study, the NIC sought feedback on cross-cutting resilience challenges facing the UK, especially those related to its economic infrastructure. In particular, the NIC focussed on the interconnected areas of digital, power, transport and water. The study identifies climate change, population growth and an increasing reliance on, and integration of, digital technologies as the top three challenges for resilient infrastructure in the UK.

In its final report on the Resilience Study, the NIC concludes that there is a need for a new framework for resilience which anticipates future shocks and stresses; improves actions to resist, absorb and recover from them by testing for vulnerabilities; values resilience properly; and drives adaptation. The Commission has made three recommendations to Government, which will help to deliver the framework for resilience:

- Government should publish a full set of resilience standards every five years, following advice from regulators, alongside an assessment of any changes needed to deliver them.
- Infrastructure operators should carry out regular and proportionate stress tests that consider vulnerabilities from interdependencies, overseen by regulators, to ensure their systems and services can meet government's resilience standards, and take actions to address any vulnerabilities.
- Infrastructure operators should develop and maintain long term resilience strategies, and regulators should ensure their determinations in future price reviews are consistent with meeting resilience standards in the short and long term.<sup>6</sup>

This framework will be applied to the next NIA in 2023. It is noted that the recommendations do not specifically include climate change considerations, and the report tends to focus more on resilience to one-off disruptions rather than resilience to a changing climate.

**Some NAP actions on cross-sectoral interdependencies are off-track and information sharing on interdependencies between Local Resilience Forums must be improved.**

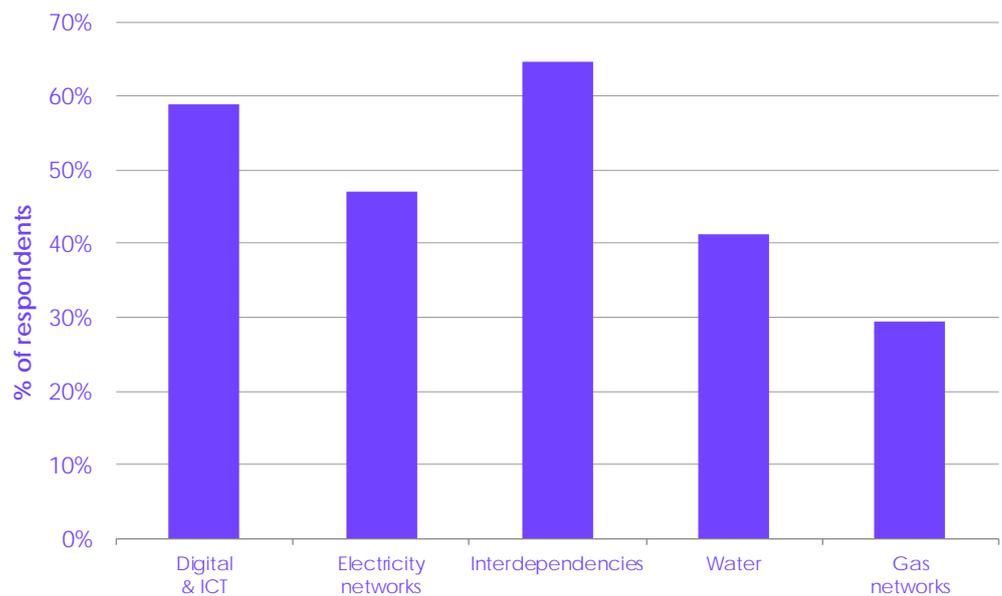
In our last assessment, the Committee highlighted concerns in the extent of actions to manage interdependent risks and data sharing arrangements:

"It remains unclear what action is being taken to reduce the climate risks related to infrastructure interdependencies. Cabinet Office should ensure that data sharing arrangements are in place between infrastructure providers and Local Resilience Forums and provide evidence to the CCC that this is happening".

Two thirds of Local Resilience Forums surveyed by the CCC stated that information on interdependencies between sectors could be improved in their area.

Local Resilience Forums (LRFs) play a key role in responding to and managing the impacts from extreme weather (see also Chapter 3, section 3.2.6 and 3.6). As in our last assessment, a biennial survey by the Cabinet Office of all local responders and LRFs in England has not been completed. In a survey of LRFs completed by the CCC for this report, when asked about the level of knowledge and information about the key risks to infrastructure in their area, two thirds of respondents stated that information on interdependencies between sectors could be improved (Figure 4.1). The majority of respondents also highlighted that better local information was needed on risks to Digital & ICT (59% of respondents) and electricity networks were also an area of concern (47% of respondents). LRFs typically felt that information on transport was sufficient\*; this may be because the location and key attributes of transport infrastructure assets are readily available.

Figure 4.1 LRF survey: Types of infrastructure for which local information could be improved



Source: CCC survey of Local Resilience Forums, conducted in March 2021.

Notes: There are 38 LRFs in England. 17 LRFs responded to the survey, representing 45% of all LRFs in England. Results for transport sectors are not shown in the chart – the % of respondents who said information could be improved for transport sectors is as follows: Railways 24%, Roads 18%, Airports 12% and Ports 12%.

To support the assessment of interdependent risks in the CCRA3 Technical Report, a project was commissioned to assess how climate change affects the interaction of risks across the infrastructure, built environment and natural environment sectors. Interruptions to power supply and disruptions to IT and communication services were identified as having the highest number of knock-on impacts across sectors.<sup>7</sup> It is particularly concerning that these are also the sectors which most LRFs identified in the survey as needing better information at a local level.

\* Transport includes railways, roads, airports and ports.

## Recommendation

Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for electricity, digital and ICT networks.

As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.

Department: Defra, BEIS and DCMS. Timing: Now and ongoing.

The Cabinet Office Civil Contingencies Secretariat is developing a standardised approach to support infrastructure owners and operators to understand the vulnerabilities across different critical sectors, with the goal of enhancing the information sharing of risks to infrastructure between Government departments and operators. The Cabinet Office reports that the scale of the response to the Covid-19 pandemic has led to some delays in delivery of this work. The Critical National Infrastructure Knowledge Base platform has been developed to better understand and manage the UK's critical national infrastructure and its supply chains. While this is a promising development, the extent to which climate risks will be included is not yet clear.

A sector-led forum of water companies and local authorities is being developed to define and develop a standardised methodology for benchmarking. The NAP references a National Infrastructure Resilience Council (NIRC) which was established to take a coordinated approach to flood resilience by utilities companies, however it is unclear whether any actions have yet been delivered under this body. These are positive developments for water and utilities sectors – the Department for Transport (DfT) and the Department for Digital, Culture, Media and Sport (DCMS) should seek to identify similar opportunities for better collaboration and data sharing with transport and digital sectors.

Has the risk management score changed?

**No. There is a continuing lack of data on the vulnerability of infrastructure to extreme weather and the progress that has been made in improving resilience.**

Impacts caused by cascading failures from weather and climate-related disruptions are still not systematically recorded and monitored. Whilst there is a lot of good research underway, there remains a lack of data on resilience actions by infrastructure providers, and especially on the fragility of infrastructure networks, including roads, rail, energy systems and ICT. The Infrastructure Operators Adaptation Forum is a cross-sector group which facilitates information sharing on interdependencies. Defra continues to engage with this group and to promote use of the latest climate projections by operators in their adaptation planning and reporting.

**Adaptation Reporting Power reports can go a long way towards providing this crucial information, however, ARP3 reports have not been available for this assessment.**

Awareness of, and planning for, interdependent climate risks and cascade failures by infrastructure operators seems to be increasing and Defra is encouraging increased focus on interdependencies under the Adaptation Reporting Power. There are two key objectives in Defra's strategy for the third round of reporting under the Adaptation Reporting power (ARP3):

- Support the ongoing integration of climate change risk management into the work of reporting organisations.
- Reports contribute to Government understanding of the level of preparedness of key sectors to climate change, at a sectoral and national level, and feed into the Adaptation Committee's reports to Parliament.<sup>8</sup>

When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies.

**When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies.**

In the CCC's review of ARP2<sup>9</sup> and our response to Defra's consultation on ARP3, the Committee recommended that reporting under the ARP should be mandatory and reports should be completed in time to inform CCRA3 and this Progress Report. Defra consulted on proposals for the third round of adaptation reporting in 2018 and concluded that the majority of respondents supported the continuation of voluntary reporting and there was support for the proposed timing and other circumstances in which the reporting power should be used.<sup>10</sup>

With a deadline of December 2021 however, only four\* ARP3 reports have been available for this assessment and based on the list of organisations who have confirmed they will report, there are expected to be gaps in coverage, particularly related to the resilience of canals and ports (see section 4.6 on ports).<sup>11</sup> These reports are intended to be a key feed-in to the development of the NAP and the CCRA. A recent policy paper by the Chartered Institute of Water and Environmental Management (CIWEM) also recommended the Government consider mandatory reporting and that the sequencing of reporting rounds should be modified so that reports can inform the CCRA.<sup>12</sup>

In 2020, the UK Government set out a roadmap towards mandatory climate risk reporting for large companies and financial institutions in the UK by 2025, aligned to the reporting requirements set out by the Financial Stability Board's Taskforce on Climate-related Financial Disclosures (TCFD). Using the Adaptation Reporting Power to the full extent set out in the Climate Change Act (2008) would send a very strong message on the UK's commitment to tackling climate risks across the economy.

**Recommendation**

Make changes ahead of the next round of reporting under the Adaptation Reporting Power (ARP). When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies. In particular:

- The next round of reporting must be mandatory.
- The deadline for reporting must allow sufficient time for consideration of all the reports in the fourth UK Climate Change Risk Assessment, and the CCC's statutory assessment of progress on adaptation.
- The list of organisations reporting should be expanded to ensure comprehensive coverage of critical infrastructure and services, such as canals and food supply chains, as recommended by the ARP3 consultation.

Department: Defra, Timing: 2023

\* Anglian Water, Energy Networks Association, Energy UK (due to be published 2021) and Port of London Authority

† The Committee notes that the Covid-19 pandemic may have been a contributing factor in fewer organisations submitting their ARP3 reports early.

## 4.3 Design and location of new infrastructure

Progress summary – Design and location of new infrastructure		
2019 score:	What has changed since 2019:	2021 score:
6	<p><b>Plan score – high</b></p> <ul style="list-style-type: none"> <li>The plan score remains high. The new National Infrastructure Strategy (2020) states that national infrastructure will be made resilient to future climate change, by ensuring that its expected effects are fully considered at the design stage and building in cost-effective mitigations over the whole life cycle of the asset. However, there is no explicit consideration of 2°C and 4°C warming scenarios. National Policy Statements require climate change projections to be considered when developing new major infrastructure assets and projects - they include broad consideration of 2°C and 4°C scenarios. New Green Book supplementary guidance on climate change recommends that projects with lifetimes beyond 2035 be assessed under a minimum of 2°C and 4°C scenarios. The Infrastructure and Projects Authority is working to build tests for climate resilience into assurance processes for all infrastructure projects on the Government’s Major Project Portfolio.</li> </ul> <p><b>Risk management score – low</b></p> <ul style="list-style-type: none"> <li>The risk management score remains low. Developments suggest it could improve in the next two years, though better data is required. The progress above, in relation to planning and assurance requirements for new major infrastructure projects, should lead to slower rates of increase in risk. However, there are no actions in the second National Adaptation Programme and no data to assess how the risk is being managed.</li> </ul>	6
<p>Notes: See annex for full datasets            Key Indicators: There remains a lack of data on the extent to which climate risks are being considered in the design and location of new infrastructure.</p>		

This section assesses the extent to which climate change is being considered in new major infrastructure in England.

### Summary of 2019 report score

**In our last report, design and location of new infrastructure scored a 6 (high plan score, low risk management score).**

In our last report, the Committee highlighted the role of The National Infrastructure Assessment (NIA) 2018 in setting out the new flood and water supply infrastructure needs by 2050, considering both 2°C and 4°C scenarios. The National Policy Statements require climate change projections to be taken into account when developing new major infrastructure assets and projects and include broad consideration of 2°C and 4°C scenarios. Nationally Significant Infrastructure Projects were continuing to take account of flooding, however it was more difficult to establish if other climate hazards were also being considered.

On progress in managing risk, there were no new actions in the second National Adaptation Programme (NAP2) for this priority and based on the evidence available, it was not possible to assess how well the risk was being managed.

### Has the plan score changed?

**No, the plan score remains high.**

**All new infrastructure is subject to a complex arrangement of planning and environmental regulations.**

The Planning Act 2008 sets out the development consent regime for nationally significant infrastructure projects in the fields of energy, transport, water, waste water, and waste. These projects are commonly referred to as major infrastructure projects. Climate change considerations are not fully integrated into planning legislation, though authorities are working to set out powers and duties related to adaptation.

**National Policy Statements require climate change projections to be considered when developing new major infrastructure assets and projects.**

They include broad consideration of 2°C and 4°C scenarios. Nationally Significant Infrastructure Projects are continuing to take account of flooding, though it is more difficult to establish if other climate hazards are being considered. The Infrastructure and Projects Authority (IPA) is working to build tests for climate resilience into assurance processes for all projects on the Government's Major Project Portfolio (GMPP), which will ensure that climate risks are assessed from the earliest stage of project development and require new projects to demonstrate how adaptation has been considered in project design.

**New supplementary Green Book guidance covers the consideration of climate change impacts in policy appraisal.**

The IPA work aligns closely with the new HM Treasury Green Book supplementary guidance on climate change, which supports analysts and policymakers to identify if and how their proposals could be affected by climate risks and challenges and to design adaptation measures in response.<sup>13</sup> The guidance recommends that projects with a lifetime to 2035 be appraised against a minimum of one scenario, consistent with a global temperature rise of 2°C, but for projects with longer time horizons, a minimum of at least two climate scenarios should be considered, consistent with 2°C and 4°C warming scenarios.

**The new National Infrastructure Strategy (2020) states that national infrastructure will be made resilient to future climate change.**

The strategy requires that expected effects of climate change are fully considered at the design stage for major projects, including impacts from higher temperatures, more extreme weather, and increased incidence of droughts, floods, and disease, and building in cost-effective climate risk reduction over the whole life cycle of the asset. In doing so, reference is made to the risks identified in the 2017 Climate Change Risk Assessment and the guidance for policy and programme makers set out in the Green Book supplementary guidance on climate change. The Government has committed to embedding environmental net gain\* in infrastructure in its 25 Year Environment Plan and is currently legislating for biodiversity net gain through the Environment Bill. This is discussed further in Chapter 2 (Natural Environment), though recent work of the NIC on natural capital and environmental net gain for infrastructure projects is discussed further in Box 4.2.

**Box 4.2**

**Infrastructure, Natural Capital and Environmental Net Gain**

The National Infrastructure Commission (NIC) provides the Government with impartial, expert advice on major long-term infrastructure challenges. In February 2021, the NIC released a discussion paper setting out its strategic position on Natural Capital and Environmental Net Gain.

\* An approach to development that leaves both biodiversity and the environment in a measurably better state than prior to development.

National Policy Statements require climate change projections to be considered when developing new major infrastructure assets and projects and include broad consideration of 2°C and 4°C scenarios.

The paper states that infrastructure developers should consider the impact of infrastructure development on natural capital assets and take the opportunities to contribute to the environment and biodiversity as part of development. Infrastructure projects should target environmental net gain, ensuring that infrastructure developers leave the environment in a measurably better state than they found it.

The Commission supports an environmental net gain approach across all infrastructure projects, including major infrastructure projects. This means that:

- infrastructure developers on all infrastructure projects should leave the environment in a measurably better state compared to the pre-development baseline;
- natural capital frameworks and analysis should be used in decision making for infrastructure; and
- infrastructure investors, developers, providers and operators should follow the mitigation hierarchy when delivering environmental net gain by:
  - avoiding impacts as far as possible;
  - minimising unavoidable impacts; and
  - as a last resort, compensating for unavoidable losses wherever the greatest benefits can be delivered, either locally or nationally, first considering compensating for losses within the development footprint.

However, the Commission recognises that there is further work that needs to be done and there are challenges that need to be addressed in order to support infrastructure projects to achieve this.

Source: National Infrastructure Commission (2021). [Natural Capital and Environmental Net Gain – A discussion paper](#).

## Has the risk management score changed?

**No, the risk management score remains low, though developments suggest it is improving and the score could increase in the next two years.**

There are no relevant actions in the second National Adaptation Programme. However, the developments above in relation to planning and assurance requirements for new major infrastructure projects should limit the increase in risk from new infrastructure.

**There remains a lack of data on the extent to which climate risks are being considered in the design and location of new infrastructure.**

Potential sources of this information could be data from the IPA on project approvals for GMPPs, or possibly the Nationally Significant Infrastructure Projects dataset, though it is not currently collected.

## 4.4 Energy generation, transmission and distribution

Progress summary – Energy generation, transmission and distribution		
2019 score:	What has changed since 2019:	2021 score:
8	<p><b>Plan score – high</b></p> <ul style="list-style-type: none"> <li>The plan score remains high. National Policy Statements for the energy industry, and new rules under the planning system and the Environmental Permitting Regime, require consideration of climate change impacts in the early stages of development for large installations or major upgrades of existing assets. The electricity transmission and distribution sector has cross-industry technical standards for managing current and future flood risk and a consistent approach to identifying critical assets at high levels of risk. The Energy Emergencies Executive (E3) and its Committee (E3C) monitors key risks to the sector and measures in place to ensure resilience of the system. Wind turbines and offshore energy infrastructure are heavily regulated.</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains medium. The energy generation and network sectors have published their ARP3 reports, collated by Energy UK and the Energy Networks Association. There has been only one significant loss of generating capacity due to weather since 2015, despite several episodes of extreme weather in that time. New analysis for CCRA3 shows an increased exposure to surface water flooding for power stations and electricity substations, even with additional adaptation, though substations serving one million customers were assessed as benefitting from flood protection measures from £172 million planned investment to 2023. The future planned increased reliance on electricity to power, transport, industry and heating increases the potential impact of any risk to the electricity system and work is needed to understand the implications of water availability projections for the energy sector, in the context of Net Zero.</li> </ul>	8
<p>Notes: See annex for full datasets            Key Indicators: Future flood projections from Sayers (2020) and limited data on assets benefitting from flood protection measures (substations only) have been used to assess the risk management score.</p>		

### Summary of 2019 report score

**In our 2019 report, energy generation, transmission and distribution scored an 8 (high plan score, medium risk management score).**

Plans were assessed as high, as the electricity sector has a well-developed understanding of risks faced by flooding which is supported by design guidelines for energy companies which include climate change and require companies to protect primary substations against flooding. Plans to manage risks to nuclear infrastructure include consideration of all relevant hazards.

On progress in managing risk, the Committee concluded that flood protection measures were being implemented by electricity supply, transmission and distribution companies and over 90% of sub-stations (550/589) deemed at risk of flooding should be resilient to a 1/1000 year flood event by 2021, reducing the exposure of customers at risk of interrupted supply. For other hazards and non-primary substations, it was less clear what steps were being taken. NAP2 and the ARP2 reports had highlighted actions and research needed to address CCRA2 gaps such as potential changes to wind speeds and the risk to gas networks crossing bridges.

Has the plan score changed?

**No, the plan score remains high.**

**National Policy Statements for the energy industry and new rules under the planning system and the Environmental Permitting Regime require consideration of climate change impacts in the early stages of development for large installations or major upgrades of existing assets.**

National Policy Statements for energy infrastructure set out how applicants and the Planning Inspectorate should take the effects of climate change into account when developing and consenting infrastructure. The Inspectorate should be satisfied that applicants for new energy infrastructure have taken into account the potential impacts of climate change using the latest UK Climate Projections available at the time the Environmental Statement was prepared. This should cover the estimated lifetime of the new infrastructure. The Environmental Impact Assessment (EIA) Regulations were updated in 2019, requiring energy infrastructure above a certain capacity to provide climate change risk assessments to the Planning Inspectorate as part of their planning application.

**The electricity transmission and distribution sector has cross-industry technical standards for managing current and future flood risk and a consistent approach to identifying critical assets at high levels of risk.**

Engineering Standard ETR138, updated in 2018, remains the industry standard for assessing and addressing asset risk from flooding. Planned actions by electricity supply, transmission and distribution companies are expected to see over 90% of substations deemed at risk of flooding become resilient to 1 in 1000-year flood events by 2021. This is in line with standard ETR138, which applies this requirement to primary substations with over 10,000 connections. This standard includes an assessment of the risks from flooding to all new and existing sites. It is not clear what actions are being taken for non-primary substations.

The Energy Emergencies Executive (E3) and its Committee (E3C) monitors key risks to the sector and measures in place to ensure resilience of the system. Energy distribution companies are including flood protection proposals in their ED2 stakeholder plans with the intention of continuing the retrospective protection of key sites vulnerable to flood risk. Engineering Standard ETR 132 requires Network Operators to fell a proportion of trees within falling distance of overhead lines. The ENA has commissioned a research report to understand impacts of changes in climate projected in UKCP18 on energy assets.

**Wind turbines and offshore energy infrastructure are heavily regulated in design and operation.**

Wind turbines are designed for specific climatic conditions in accordance with IEC 61400, an International Standard published by the International Electrotechnical Commission. The standard prescribes a set of design requirements to ensure that wind turbines are appropriately engineered to provide sufficient structural integrity against damage from all hazards within the planned lifetime of the asset. Design codes are evolving to include requirements to allow for future effects of climate change in the selection of environmental loads and other actions on offshore infrastructure. Any new offshore windfarms and transmission assets connected to the National Grid Transmission system will be subject to Ofgem connection requirements, including resilience to extreme disruptive weather.

Has the risk management score changed?

**No, the risk management score remains medium.**

Planned actions by electricity supply, transmission and distribution companies are expected to see over 90% of substations deemed at risk of flooding become resilient to 1 in 1000-year flood events by 2021.

**The energy generation and network sectors have published their ARP3 reports, collated by Energy UK and the Energy Networks Association (ENA).**

The scope of the Energy UK ARP3 report has been broadened compared to earlier ARP reports, from large (>100 MWe) thermal and hydroelectric power stations to include smaller (50 MWe to 100 MWe), distributed thermal plant and large (>100 MWe) wind turbine assets. The report is based on an assessment of risk under UKCP09 climate projections, however a review by the Joint Environmental Programme for the ARP3 report found that the conclusions of the previous assessment do not change under UKCP18 projections. All adaptation actions identified in the first adaptation report have been progressed and 73 of the 88 agreed actions have now been completed. All of the reporting companies assess climate risks as part of their corporate risk management processes and a number of Energy UK member companies are signed up to the Task Force for Climate-related Financial Disclosures.\* The report states that the sector is continuing to understand and address interdependencies through:

- Engagement with other infrastructure sectors, for example the Infrastructure Operators Adaptation Forum;
- Engagement with research, for example the interacting risks project commissioned for CCRA3;
- Responding to and learning from outages with widespread impacts, such as the 2019 lightning strike outage; and
- Working to support Black Start permit conditions†.

The ENA report<sup>14</sup> consolidates progress by gas and electricity network operators and highlights that interconnections between different industry sectors is a major source of risk for the energy network, with telecommunications and road transport thought to be the most important sources of risk. The report includes an updated risk assessment for energy networks and sets out the actions being taken to address those risks. Risk scores for 2050 have not been allocated in the report, which states there are too many variables that could affect the magnitude of climate change impacts, including Net Zero strategy.

**There has been only one significant loss of generating capacity due to weather since 2015, despite several episodes of extreme weather in that time. However, cascading impacts from a power outage across sectors can be significant.**

In February 2018, the 'Beast from the East' and Storm Emma weather events brought freezing temperatures, blizzards and high winds, prompting a Red alert from the Met Office. The summer of 2018 was exceptionally dry and warm weather – the second warmest June on record for the UK - and in February 2020 Storms Ciara and Dennis brought very strong winds and heavy rain in one of the wettest months ever recorded. Energy UK reports that electricity generation was not significantly affected in any of these instances.<sup>15</sup> A lightning strike in August 2019 caused a loss of power to one million customers including homes, businesses, one hospital and Newcastle Airport, and triggered disruption on the rail network (Box 4.3). In response to that event, the Energy Emergencies Executive Committee (E3C) (in which Energy UK participates) put forward a list of recommendations to enhance the security of the network, and to prevent and manage further power disruption events.

There has been only one significant loss of generating capacity due to weather since 2015, despite several episodes of extreme weather since 2015. However, cascading impacts from a power outage across sectors can be significant.

\* Including Centrica, Drax Power, EDF Energy UK, SSE and Uniper

† A Black Start Event is a significant partial or total failure of the electricity supply system across Great Britain.

The resulting actions, in alignment with those from Ofgem's independent investigation, are being taken forward through the E3C and its various Task Groups.<sup>16</sup>

### Box 4.3

#### Cascading impacts from 2019 power outages in England and Wales

All of the major climate hazards considered in the CCRA could trigger a cascade effect from the power sector to other sectors: flooding, reduced water availability, increased temperatures and wildfire, as well as potential increases in storms.

Power outages in England and Wales on the 9th of August 2019 demonstrate the potential for cascading infrastructure failure (Ofgem, 2020). The event was triggered by a lightning strike on the Eaton Socon-Wymondley circuit between Cambridgeshire and Hertfordshire, causing a routine fault on the national electricity transmission system and the disconnection of a number of small generators connected to the local distribution network. Simultaneously, two larger generators (Hornsea 1 Limited and Little Barford) experienced technical issues and were unable to provide power. The combined power losses exceeded the back-up power generation capacity of the Electricity System Operator (ESO), triggering a power outage.

A total of 892 megawatts (MW) of net demand was disconnected from local distribution networks. The electricity supply of over one million consumers was interrupted. The outage had significant knock-on impacts for the rail sector, with the Train Operating Company (TOC) Govia Thameslink Railway experiencing stranded trains, triggered by on-board automatic safety systems. This in turn caused knock-on delays across the rail network (Ofgem, 2020). Hornsea 1 Limited and RWE Generation UK plc (operators of Little Barford) each agreed to make voluntary payments of £4.5m to the Energy Industry Voluntary Redress Scheme.

Source: *The Third UK Climate Change Risk Assessment Technical Report, Chapter 4: Infrastructure.*

170 power stations and 463 electricity substations are currently exposed to significant risk of surface water flooding (1:30 or greater) in England. 53 power stations and 143 substations are currently exposed to significant risk of river flooding (1:75 or greater).

Under current and announced adaptation measures, energy assets in England will be well protected from river flooding - the number of power stations and electricity substations at risk are projected to decrease by at least 56% in a 4°C world by the 2080s.

#### **New future flood projections show an increased risk of surface water flooding for power stations and electricity substations, even with additional adaptation.**

New analysis for CCRA3 (Sayers et al., 2020) found that 170 power stations and 463 electricity substations are currently exposed to significant risk of surface water flooding (1:30 or greater) in England. 53 power stations and 143 substations are currently exposed to significant risk of river flooding (1:75 or greater). With current levels of adaptation, updated flood projections show that the risk of surface water flooding for power stations and electricity substations still increases compared to present day (Figure 4.2). The adaptation shortfall remains even under an enhanced adaptation scenario that goes over and above current planned adaptation action. By the 2080s in a 4°C world, the increase in risk is as high as 101% for electricity substations.<sup>17</sup>

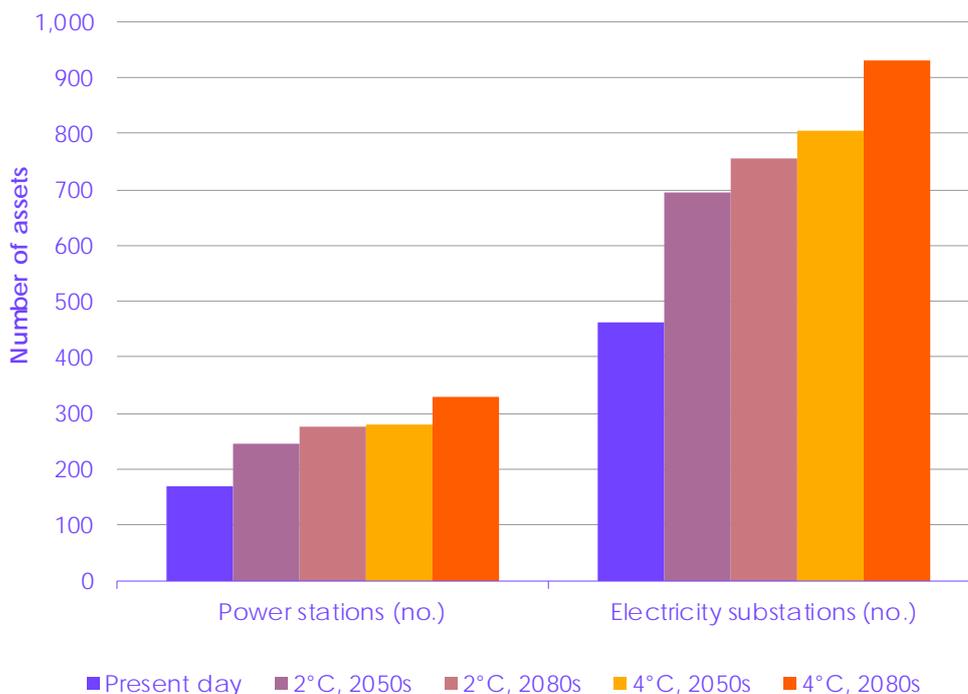
Conversely, Sayers et al (2020) project that under current and announced adaptation measures, energy assets in England will be well protected from river flooding. Under a low population and no additional adaptation scenario, the number of power stations and electricity substations at risk are projected to decrease by at least 56% in a 4°C world by the 2080s.

#### **There is evidence of continued investment from flood protection measures.**

Substations serving one million customers were assessed to benefit from flood protection measures from £172 million planned investment between 2011 and 2023.

There will be significant implications for energy infrastructure resilience and water abstraction as a result of the transition to a Net Zero economy.

**Figure 4.2** Number of electricity assets at significant risk of surface water flooding under a range of climate change scenarios



Source: Sayers et al (2020). *Third UK Climate Change Risk Assessment (CCRA) Future flood risk*.  
 Notes: Data extracted for the CCRA3 technical chapters from the results database available at [www.ukclimate.risk.org](http://www.ukclimate.risk.org). The climate scenarios presented above assume current levels of adaptation and low population growth in the mid and late century.

**Research is underway to better understand the implications of UKCP18 projections on energy networks.**

The Energy Networks Association (ENA) has engaged the Met Office to undertake research and provide a report on the impact of climate change factors on energy industry assets and operation using the revised UKCP18 data, including identifying regional differences. The report from this research has been used to assess the current risks to the energy network in the ARP3 report. Work is needed to understand the implications of CCRA3 water availability projections for the energy sector, in the context of Net Zero.

**There will be significant implications for energy infrastructure resilience and water abstraction as a result of the transition to a Net Zero economy.**

There will be significant implications for energy infrastructure resilience and water abstraction as a result of the transition to a Net Zero economy. The UK will become heavily dependent on electricity as our dominant energy source as we reduce our greenhouse gas emissions to Net Zero. While electricity provides about 15-20% of our energy today, by 2050 it could account for 55-65%, used for light, heat, communications, transport, industry and delivery of other critical services such as water.<sup>18</sup> This is alongside a potential increased reliance on renewables for electricity generation to 80% by 2050.<sup>19</sup> This will necessitate the development of new energy infrastructure, energy supplies will need to become increasingly resilient to climate change and interdependencies will need to be better understood and managed.

<sup>18</sup> Under the CCC's Balanced Pathway to Net Zero from the Sixth Carbon Budget Report.

In their ARP3 report, Energy UK notes that future access to sufficient and reliable freshwater supplies will remain a priority issue for the energy sector for the foreseeable future, given uncertainties around the future energy mix and the water-dependent nature of Carbon Capture Usage and Storage, Bioenergy with Carbon Capture and Storage, and hydrogen production.

## 4.5 Public water supply infrastructure

Progress summary – Public water supply infrastructure		
2019 score:	What has changed since 2019:	2021 score:
8	<p><b>Plan score – high</b></p> <ul style="list-style-type: none"> <li>The plan score remains high. The Draft National Policy Statement for Water Resources Infrastructure sets out how the applicant and the Secretary of State will consider the effects of climate change when developing and considering water resource NSIP applications, using the latest UK Climate Projections. Ofwat set out a £51 billion five-year investment package in its 2019 Price Review for the 2020-25 period, including requirements for water companies to cut leaks by 16% and reduce mains bursts by 12%. The water industry has committed to a 50% reduction in leakage by 2050.</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains medium. Total leakage for 2019/20 was 2950 ml/d - this represents a 7% reduction in leakage on 2017/18 levels. All but one water company in England met their leakage targets in 2019-20. Though there has been some progress in reducing leakage since our last assessment, the long-term trend is unclear and continued progress is required before the risk management score can be improved. The Consumer Council for Water reported in 2020 that though there has been a reduction in interruptions to supply (11% less than the previous year), performance over the last 5 years has remained static and consumers are still experiencing more interruptions than they should. In its initial assessment of water company plans for 2020-25, Ofwat stated that while all companies plan to improve the resilience of their services and systems, resilience in the round needs to be more firmly embedded across the whole of each water company's business.</li> </ul>	8
<p>Notes: See annex for full datasets Key Indicators: Total actual and forecast leakage for all water companies. Interruptions to supply.</p>		

This section considers progress in preparing for climate change in public water supply infrastructure, such as supply-side measures and structural improvements to water company networks, to reduce leakage and make water supply infrastructure resilient to extreme weather. Demand-side measures are typically lower regret and should be pursued first in balancing the supply and demand for water. Chapter 3 considers demand-side measures to reduce household water consumption and the use of water by businesses and industry is discussed in Chapter 5. Water in the natural environment is considered in Chapter 2.

### Summary of 2019 report score

**In our last report, public water supply infrastructure scored an 8 (high plan score, medium risk management score).**

The Water Resource Management Plans (WRMPs) set out how water companies have committed to more ambitious targets to reduce leakage and many had considered possible options for new water supply infrastructure and improving resilience to extreme weather.

On managing risk, progress in reducing leakage had slowed compared with during the 1990s. It was apparent that water companies were investing to improve resilience, but it was not clear if this investment would be adequate to address future risks from climate change.

Has the plan score changed?

**No, the plan score remains high. The National Policy Statement for water infrastructure will incorporate the latest climate projections and evidence from the third UK Climate Change Risk Assessment.**

The Planning Act requires the Secretary of State to have regard to the desirability of mitigating, and adapting to, climate change in designating a National Policy Statement (NPS). The Draft NPS for Water Resources Infrastructure sets out how the applicant and the Secretary of State will consider the effects of climate change when developing and considering water resource Nationally Significant Infrastructure Projects applications, using the latest UK Climate Projections. The draft NPS for water identifies areas where climate change adaptation should be incorporated into detailed design, such as flood risk and coastal change, biodiversity and nature conservation and water quality. Detailed consideration must be given to the range of potential impacts of climate change (for example, the 10th, 50th and 90th percentiles) using the latest UK Climate Projections available at the time, and to identify appropriate adaptation measures. This should cover the estimated lifetime of the new infrastructure.

Under the draft NPS, any adaptation measures should be based on the latest set of UK Climate Projections, the most recent UK Climate Change Risk Assessment, consultation with statutory consultation bodies, and any other appropriate climate projection data. The government consulted on the draft NPS for water resources in 2018/19. The final NPS was due to be laid in 2019 but has been delayed.

**Water companies continue to set targets to increase the resilience of water supplies.**

Ofwat set out a £51 billion five-year investment package in its 2019 Price Review for the 2020-25 period, including requirements for water companies to cut leaks by 16% and reduce mains bursts by 12% (both relative to 2017-18 levels by 2025).<sup>20</sup> In 2019 the water industry announced a new Public Interest Commitment<sup>21</sup> with a goal to triple the rate of leakage reduction by 2030 and the industry has committed to reducing leakage by 50% (on 2017-18 levels) by 2050 at the latest.<sup>22</sup> The 50% reduction was a recommendation from the National Infrastructure Commission.<sup>23</sup>

**The next round of water company plans will incorporate the latest UK climate projections and set stricter leakage targets.**

Current water company plans (WRMP19) use climate change data from UKCP09. WRMP24 is making use of UKCP18 and will include options to further reduce leakage. In 2019 the water industry announced a new Public Interest Commitment, which was created in response to dialogue with customers which revealed that they would like the water industry to do more, not just to improve services, but also to tackle wider social and environmental challenges. As part of the Public Interest Commitment, water companies have agreed to work together towards five challenging goals, one of which is to triple the rate of leakage reduction across the sector by 2030. A programme of work to help achieve each of the above goals will be led by a member of the Water UK board and an independent panel will be established to report annually on how well the sector is performing collectively.

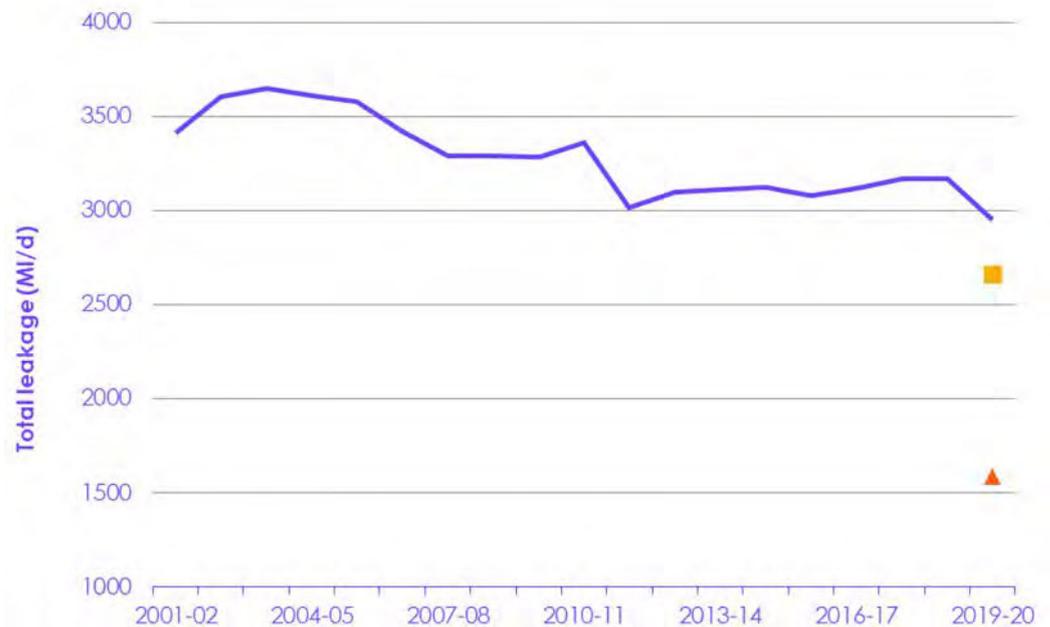
Has the risk management score changed?

**No, the risk management score remains medium. There has been some progress in reducing leakage since our last assessment, though continued progress is required before the risk management score can be improved.**

Total leakage for 2019/20 was 2,950 ml/d - this represents a 7% reduction in leakage on 2017/18 levels.

Total leakage for 2019/20 was 2,950 ml/d - this represents a 7% reduction in leakage on 2017/18 levels (Figure 4.3). Leakage has remained at a similar level since 2011/12 but is beginning to fall. All but one water company in England met their leakage targets in 2019-20.

**Figure 4.3** Total leakage for all water companies from 2000-01 to 2019-20 against future commitments



Source: Total leakage data from consumer Council for Water, Water & Wastewater Resilience Report 2019/20, Data Appendices. Ofwat 2025 commitment from 2019 Price Review for the 2020-25 period. Industry 2025 commitment from a letter from Water UK to the Secretary of State on 17/10/2018.

Notes: Purple line shows actual leakage for all water companies in England for the period 2001-02 to 2019-20. Yellow square shows the Ofwat performance commitment to reduce leakage by 16% (on 2017-18 levels) by 2025. Orange triangle shows industry commitment to reduce leakage by 50% (on 2017-18 levels) by 2050.

Ofwat have set performance commitments to cut leakage by 16% by 2025 (on 2017-18 levels) and the industry has committed to reducing leakage by 50% (on 2017-18 levels) by 2050 at the latest. The 50% reduction was a recommendation from the National Infrastructure Commission.

**Interruptions to water supply are reducing, though these are still considered to be higher than they should be.**

The Consumer Council for Water reported in 2020 that though there has been a reduction in interruptions to supply (11% less than the previous year), performance over the last 5 years has remained static and consumers are still experiencing more interruptions than they should.<sup>24</sup> Interruptions are not exclusively from extreme weather, though extreme weather is the predominant cause and the industry focus is on reducing weather-related interruptions.

In its initial assessment of water company plans for 2020-25, Ofwat stated that while all companies plan to improve the resilience of their services and systems, 'resilience in the round' needs to be more firmly embedded across the whole of each water company's business. Our assessment of progress in demand-side measures to improve the resilience of the public water supply, including analysis of trends in per capita consumption and the uptake of water metering, is set out in Chapter 3.

## 4.6 Ports and airports

In previous assessments, ports and airports have been combined into one adaptation priority. In this report, they have been given separate scores to reflect emerging differences in the publicly available information on the extent of planning for climate change across these two sectors, as well as the different climate hazards to which these sectors are vulnerable.

### Summary of 2019 report score

**In our last report, ports and airports scored a combined score of 5 (medium plan score, medium risk management score).**

Resilience standards and performance are, in general, left to individual port and airport operators to determine. Gatwick and Heathrow are required to produce resilience plans and incorporate resilience into businesses planning. Our last report reiterated that the Adaptation Reporting Power could present sector-wide reporting for ports and airports, however without making the Adaptation Reporting Power mandatory, the Government has no assurance that risk is being effectively managed completely in these sectors as not all operators had submitted a report in ARP2.

On progress in managing risk, the report highlighted that NAP2 actions are focused on developing a better understanding of risk, rather than reporting on changes in vulnerability. There had been progress at some ports in raising quay heights and assessing interdependencies, however actions at airports to improve flood resilience had been more reactive. There was limited data available to assess the frequency of disruptions to port and airport operations from extreme weather events, and how this might change in the future.

Progress summary – Ports		
2019 score:	What has changed since 2019:	2021 score:
5  (Ports and airports combined)	<p><b>Plan score – low</b></p> <ul style="list-style-type: none"> <li>Resilience standards for ports are left to individual operators and due to their commercial nature, there is limited information available on the extent of planning for climate change impacts. The Department for Transport report that they continue to liaise with ports and disseminate relevant climate risk information. Several port operators declined to participate in the second round of the Adaptation Reporting Power (ARP2) and expected participation in ARP3 is unclear. The Port of London Authority (PLA) has, however, submitted a third-round report ahead of the deadline.</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>There is no new data available to assess the frequency of disruptions to port operations from extreme weather events, and how this might change in the future. The PLA ARP3 report acknowledges the benefits of adaptation reporting and identifies new risks from climate change. ARP3 reports may provide detail on adaptation actions to manage risk across the sector, however only the PLA report was available the time of assessment. There are limited actions in the NAP related to ports.</li> </ul>	2  (Ports)
<p>Notes: See annex for full datasets Key Indicators: There are no data available to assess the extent to which ports in England are resilient to climate change.</p>		

What is the plan score?<sup>\*</sup>

**The plan score is low.**

**There is limited information available on the extent of planning for climate change impacts by port operators.**

Ports are not subject to economic regulation and as a result there is a general lack of data regarding the overall resilience of ports compared to most other regulated sectors. Resilience standards for ports are left to individual operators and due to their commercial nature, there is limited information available on the extent of planning for climate change impacts. Since our last assessment, the implications of Brexit have been a key focus for the sector.

Internationally, there is non-mandatory guidance from the World Association for Waterborne Transport Infrastructure (PIANC, Working Group 178) regarding climate change adaptation for ports and inland waterways. It is not clear how many ports in England have implemented this guidance. The growing importance of and increased investment in freeports<sup>†</sup> presents an opportunity for early adaptation.

What is the risk management score?

**The risk management score is medium.**

**There is no new data available to assess the frequency of disruptions to port operations from extreme weather events, and how this might change in the future.**

ARP3 reports may provide detail on adaptation actions to manage risk, however only one ARP3 report from the ports sector, the Port of London Authority, was available at the time of assessment. Half of the UK's port capacity is located on the east coast, where the risk of damage from a tidal surge is greatest. Sea-level rise of around or beyond 50cm by 2080 is a particular concern, especially for some ageing port infrastructure, but flooding and physical damage to harbour infrastructure will also become an increasing threat.<sup>25</sup> It is also important to manage interdependencies with other infrastructure, particularly energy and the preparedness of the road and rail networks for climate change.

**The Port of London Authority ARP3 report acknowledges the benefits of adaptation reporting and identifies new risks from climate change.**

Following submission of the first ARP report in 2011, the Port of London Authority (PLA) has been reviewing climate risks regularly, undertaking adaptation measures, and collecting monitoring data the changes. PLA states that these actions have helped the PLA better understand the extent of the impacts and enable the evaluation of the action's effectiveness.

The report sets out new adaptation measures to address the following previously unidentified risks:

- Risks on the delivery of the Net Zero commitments of the organisation;
- An increased risk on port trade by climate change-induced disruption in the international supply chain; and

<sup>\*</sup> As the ports and airports adaptation priorities have been split out for the first time in this report, the assessment questions are slightly different. For all other adaptation priorities in this report the assessment questions are 'Has the plan score changed?' and 'Has the risk management score changed?'.

<sup>†</sup> An area that is exempt from customs duties and tariffs to enable added-value processes to take place.

- The increased chance of pandemics which affect port trade, inland freight and passenger transport;

PLA has been collaborating with the Environment Agency, including data sharing with regard to river flow level, monitoring the changes and managing the foreshores, liaising on the operation and maintenance of flood defences, engaging with the 10-year full review of the TE2100 plan, and the River Basin Management Plan for the Thames catchment.

**ARP reports could provide key information about the actions port operators are taking to identify and manage climate risks, but a sector-wide picture is not available.**

Six port operators submitted a report in round 2, while a number of operators invited to report declined to do so.<sup>26</sup> Only seven operators have indicated they will submit a report for round 3 in 2021.<sup>27</sup> Without making the Adaptation Reporting Power mandatory, the Government has no assurance that risk is being effectively managed in this sector. A more tailored approach for the ports sector may be appropriate, to ensure key information on climate risks and adaptation actions is being captured. Information that would enable an evidence-based assessment of the vulnerability could include time-series data on the number of disruptions caused by extreme weather events and the level of investment being made in improving standards of resilience.

Without making the Adaptation Reporting Power mandatory, the Government has no assurance that risk is being effectively managed in this sector.

**Recommendation**

Work with Port Operators and the British Ports Association to ensure the format of reporting under the Adaptation Reporting Power is appropriate for port operators and that the right operators are being asked to report. Defra should work with these organisations to identify what further support could be offered to enable more comprehensive reporting on adaptation by the ports sector.

Department: Defra, Timing: 2023

**There are limited actions in the NAP related to ports.**

The Department for Transport (DfT) continue to liaise with ports and disseminate relevant climate risk information. It is understood that there are individual projects to look at interruptions from extreme weather, but these are not industry wide. Shoreline Management Plans are in place for the full length of the English coastline and while they provide long-term considerations for all parts of the English coast, they cannot be relied upon as committed adaptation plans as they are non-statutory and unfunded.

## Progress summary – Airports

2019 score:	What has changed since 2019:	2021 score:
5  (Ports and airports combined)	<p><b>Plan score – medium.</b></p> <ul style="list-style-type: none"> <li>Resilience standards for most airports are left to individual operators, though Gatwick and Heathrow are required to produce resilience plans and incorporate resilience into business planning. Flood risk is assessed by airports with over five million passengers per year through their annual resilience plans. A new Aviation 2050 Strategy is expected - the draft strategy proposes that Government works with the aviation industry to improve resilience to weather but does not mention adapting to specific levels of future climate change such as 2°C or 4°C warming scenarios.</li> </ul> <p><b>Risk management score – medium.</b></p> <ul style="list-style-type: none"> <li>There are limited data available to assess the frequency of disruptions to airport operations from extreme weather events, and how this might change in the future, though actions being taken by individual airport operators should be lowering risk, in particular in relation to flooding. Defra expects all airports to submit an ARP3 report, however these were not available at the time of this assessment. Though the impacts of climate change on airports are expected to be lower than other transport modes (CCRA2), it is important to manage interdependencies with other infrastructure, particularly energy and the preparedness of the road and rail networks for climate change.</li> </ul>	5  (Airports)
<p>Notes: See annex for full datasets Key Indicators: There are no data available to assess the extent to which airports in England are resilient to climate change.</p>		

What is the plan score?\*

**The plan score is medium.**

**The two major airport operators in England must produce resilience plans under economic licence conditions and larger airports assess flood risk annually.**

The mandatory preparation of resilience plans for Gatwick and Heathrow airports continues to be governed by economic licence conditions. These require resilience plans to be incorporated into business plans. Other airport operators continue to be responsible for their own resilience planning and flood risk is assessed by airports with over five million passengers per year through their annual resilience plans. Heathrow airport has begun the planning process for the next regulatory period (2019-2023) which includes a climate change adaptation risk register and incorporating climate change adaptation into business planning processes.

**A new Aviation 2050 Strategy is expected.**

The draft strategy proposes Government works with the aviation industry to improve resilience to weather but does not mention 2°C or 4°C warming scenarios. The strategy was consulted on in 2019 but has not yet been published.

\* As the ports and airports adaptation priorities have been split out for the first time in this report, the assessment questions are slightly different. For all other adaptation priorities in this report the assessment questions are 'Has the plan score changed?' and 'Has the risk management score changed?'.

**As an industry, airport operators appear to be actively collaborating to improve resilience across the sector.**

The Industry Resilience Group - a collaboration between airports, airlines, air traffic control and regulators – was created in 2018 to ensure the activities and changes identified by the Voluntary Industry Resilience Group in its report to industry are delivered. The output will support a systemised approach to the way in which the UK's aviation network is planned and operated to enhance its day to day operating resilience. The Airport Operators Association convenes an adaptation working group with UK airports quarterly.

What is the risk management score?

**The risk management score is medium.**

**There are limited data available to assess the frequency of disruptions to airport operations from extreme weather events.**

While the impacts of climate change on UK aviation are expected to be the least significant of all transport modes, interdependencies with other infrastructure networks can be problematic, in particular power and ICT. The safety critical nature of airport operations means that even a small flood or power outage due to extreme weather can cause major disruption. Flooding of road and rail infrastructure can also affect passenger travel to and from airports. A widespread power cut due to extreme weather in 2019 affected two airports in England, and extreme weather caused widespread disruption at Gatwick airport on Christmas Eve 2013: unprecedented levels of river flooding led to the loss of three airfield electrical sub stations that serve the runway's lighting system; heavy rainfall caused the North Terminal basement to be flooded leading to the loss of electrical power and of some key systems; and local transport networks – both road and rail – were also severely impacted by the weather.

**There is only one action in the NAP for adaptation actions by airports.**

This is focused on improving the understanding of risk rather than reporting on reducing vulnerability or exposure. Birmingham, Gatwick, Glasgow, Heathrow, Manchester Group (including East Midlands), and Stansted Airports all reported for ARP2 and Defra states that all airports are expected to report in ARP3, however, participation is voluntary. The ARP3 reports will include climate risk assessments and steps to increasing resilience, however these were not available on time for this assessment.

While there is a lack of data to assess the risk for this report, the actions being taken by the industry set out above are promising. In particular, the Committee will be interested to see the new Aviation 2050 strategy and the outputs of the Industry Resilience Group.

While the impacts of climate change on UK aviation are expected to be the least significant of all transport modes, interdependencies with other infrastructure networks can be problematic, in particular power and ICT.

## 4.7 Rail network

Progress summary – Rail network		
2019 score:	What has changed since 2019:	2021 score:
8	<p><b>Plan score - high</b></p> <ul style="list-style-type: none"> <li>The plan score remains high. The rail sector continues to prepare for climate risks across a range of warming levels - Network Rail has now published Weather and Route Climate Change Adaptation plans for all routes, which includes consideration of warming scenarios exceeding 4°C. Network Rail has published its Environmental Sustainability Strategy to 2050 and Adaptation Roadmap, with defined outcomes to incorporate long-term adaptation planning and investment into business as usual by 2034.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains medium. There are limited data on trends in vulnerability to climate risks, though weather-related delay data is relevant. Monitoring data from Network Rail's climate risk assessment is expected to provide better trend data in future. The rail sector remains at increasing risk of river and surface water flooding under a continuation of planned adaptation action, and increased heat risk causing rails to buckle, overhead cables to sag and signals to fail.</li> </ul>	8
<p>Notes: See annex for full datasets            Key Indicators: The total number of minutes delay per type of weather-related incident in England recorded by Network Rail between 2006-07 and 2020-21. Updated number of bridge sites at intolerable risk of bridge scour.</p>		

### Summary of 2019 report score

**In our last report, the rail network scored an 8 (high plan score, medium risk management score).**

Weather resilience and climate change adaptation plans were in place for each Network Rail route. The plans set out actions, timeframes, accountability and responsibilities in relation to implementing resilience measures under a medium emissions scenario. A climate change and weather resilience strategy was also in place, which is a good starting point for a framework to embed adaptation and resilience into policies, standards, decisions and investment.

The risk management score was assessed as medium. Though actions relating to rail infrastructure were associated with risk reduction and likely reducing vulnerability in some areas, the Committee did not have the evidence required to show this. The main indicators available for rail reliability were delay data and although of interest, they did not give a sense of how vulnerability to climate risk was changing.

Has the plan score changed?

**No, the plan score remains high. The rail sector continues to prepare for climate risks in a range of future warming scenarios, exceeding 4°C.**

The rail sector continues to prepare for climate risks in a range of future warming scenarios, exceeding 4°C.

Network Rail has now published updated Route Weather Resilience and Climate Change Adaptation (WRCCA) plans for all routes, which contain actions which prepare for warming scenarios exceeding 4°C.<sup>28</sup> According to the Control Period 6 WRCCA Plan Progress Report for 2019 – March 2021, the target of 80% of milestones completed has been met or exceeded for six of the eight plans.<sup>\*29</sup>

Network Rail also has a new Adaptation Roadmap with defined outcomes to incorporate long term adaptation planning and investment into business as usual by 2034 (Box 4.4).

#### Box 4.4

##### Network Rail Climate Change Adaptation Roadmap

Network Rail has set out an Adaptation Roadmap with defined outcomes to incorporate long term adaptation planning and investment into 'business as usual' operations by 2034.

Key milestones:

- Asset policies and standards updated to reflect long-term climate change projections by 2024.
- Review criticality and vulnerability mapping of all assets for climate change across the network by 2024.
- Agree level of service in extreme weather conditions with Government and regulators by 2027.
- Regions develop long-term adaptation pathway strategies and identify level of investment required for different scenarios by 2029.

Source: Network Rail Environmental Strategy (2020)

Regions are developing adaptation pathways strategies by the end of Control Period 7 (2029), which will include detailed adaptation pathway strategies for the entire network, and detail for areas with the highest level of risk or a need for transformational change.

Has the risk management score changed?

**No, however a large programme of work has been undertaken at Network Rail to enable better monitoring of how specific actions are managing climate risks.**

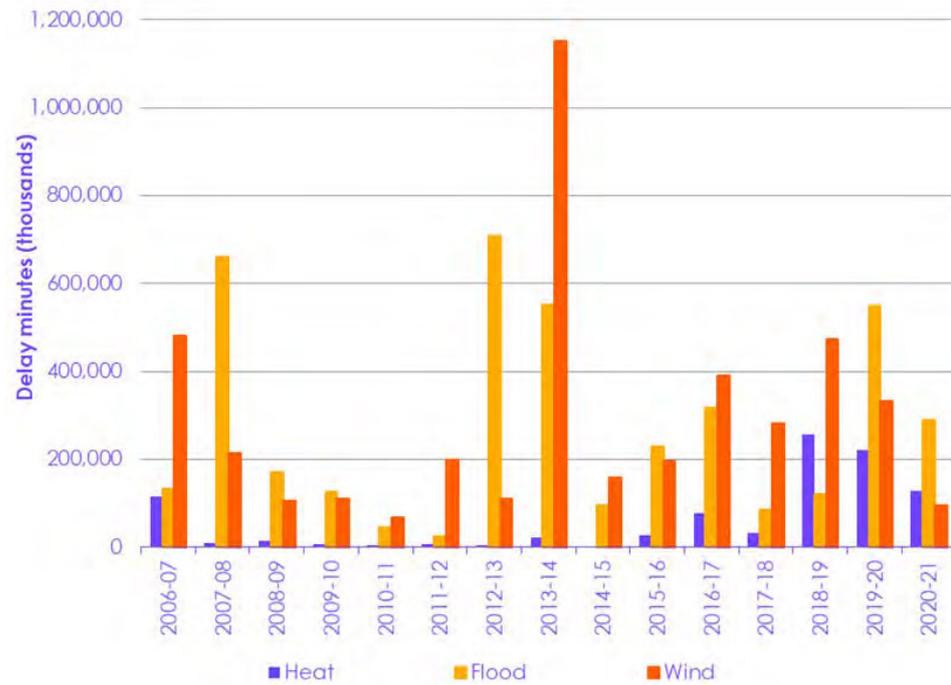
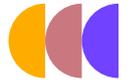
Network Rail has developed an Asset Function Risk Assessment which includes a full risk assessment including severity distribution of risks now and projections for the 2050s and 2080s. The risk assessment is supported by an Asset Function Action Plan which maps actions to risks.

**Network Rail continues to monitor weather-related delays to the network.**

Data on weather-related delays show how the network is being affected by weather, and the Committee is particularly interested in trends in heat, flood and wind impacts which are shown in Figure 4.4. Heat-related delays have been relatively consistent over the past 15 years, though these were significantly higher in 2018-19 and 2019-20 due to the summer heatwaves which are discussed further below. There is no clear trend in flood impacts and wind related delays.

\* Network Rail notes that due to some data reporting issues in using the milestones tracker for the first time, actual performance may be higher.

Figure 4.4 The total number of minutes delay per type of weather-related incident in England (2006/07 - 2020/21)



Source: Network Rail (unpublished).

Notes: Data doesn't include long-term closures as a result of extreme weather. While this is recorded, Network Rail report that the data collection is not consistent enough to give reliable data on longer term closures.

**There has been increased attention on the impacts of extreme weather on rail infrastructure since our last report.**

Recent hot summer weather in 2018 and 2019 has highlighted the effects that high temperatures can have on rail infrastructure and the potential for widespread impacts across sectors.

Recent hot summer weather in 2018 and 2019 has highlighted the effects that high temperatures can have on rail infrastructure and the potential for widespread impacts across sectors. On July 25th 2019, temperatures exceeded 38°C (the hottest day ever recorded in the UK) which led to rail buckling and subsequent widespread damage and disruption on the rail network in England.<sup>30</sup> VA Rail completed an independent review of Network Rail's response to the effects of the hot weather and found that there were good examples of widespread best practice, including lessons learnt from previous hot weather, a long-term asset resilience plan underway and hot weather plans being project-managed and delivered. However, future assets need to be designed and installed for greater resilience at higher temperatures and some standards were being misapplied or not living up to scrutiny. VA Rail made 18 recommendations in the following six categories:

- To ensure that an appropriate level of future resilience is designed into the infrastructure;
- To make the relevant standards & guidance notes fit-for-purpose;
- To reduce the number of unknown risk sites;
- To reduce the number of known risk sites;
- To make more predictable the industry response to hot weather;

- To identify, share and adopt industry best-practice.\*

Network Rail has begun work to address some of the recommendations, including updating operational weather management standards and implementing resilience measures on the network. A Seasonal Management Strategy is also under development, with the aim of supporting the transition between seasons and reducing repeat impacts from seasonal weather.

**Network Rail continues to manage bridge sites at intolerable risk of scour and there has been no notable change in the total number of sites at risk.**

Higher risk scour sites requiring remedial works are identified by Network Rail at the start of each year. While a programme of work is completed throughout the year to rectify those sites, new high-risk sites also emerge during the year. Over the past four years the number of sites rectified has been balanced out by the number of new sites identified, therefore the overall number of high risk sites remains unchanged. In 2019/20, 181 sites were identified as being at high risk at the start of the year, 45 sites were rectified and 43 new sites were identified.†

**Following a fatal train derailment in Scotland in August 2020, the Secretary of State requested a wider assessment of the impact of extreme weather on the resilience and safe performance of the rail network.**

Though the incident was in Scotland, the subsequent response will consider the resilience of the whole of the network, including England. Network Rail published the findings of two independent task forces - a Weather Advisory Task Force (WATF) and an Earthworks Management Task Force – in March 2021.‡ The key findings from the WATF are summarised in Box 4.5. Neither taskforce was tasked with assessing how Network Rail is responding to the challenge of future climate change, however implementation of the recommendations will address some of the challenges facing the railway.

**Box 4.5**

**Stonehaven derailment – Key findings of the independent Weather Advisory Task Force**

The major recommendations for Network Rail from the Weather Advisory Task Force include:

- Formal trial of the latest forecasting capabilities with the Met Office;
- Improvements in assessing the probability of earthwork failures, using forensic analysis of selected events to provide a complete picture of the context surrounding earthwork failures;
- Urgently transform the delivery of weather services, by considering the development of a new hazard and impact-based digital platform;
- A partnership-driven, integrated transport hub to provide 24/7 access to all operational services and expert advice, including flooding, and thus deliver an authoritative set of services across Network Rail routes and regions;
- Build its professional competencies in meteorology, hydrology and climate change so that staff can act as intelligent users of science and services across all its functions.

Source: Network Rail (2021). Weather Advisory Task Force, Final report, February 2021.

\* The report was provided by Network Rail for this assessment. It has been published internally at Network Rail and shared with the National Performance Board.

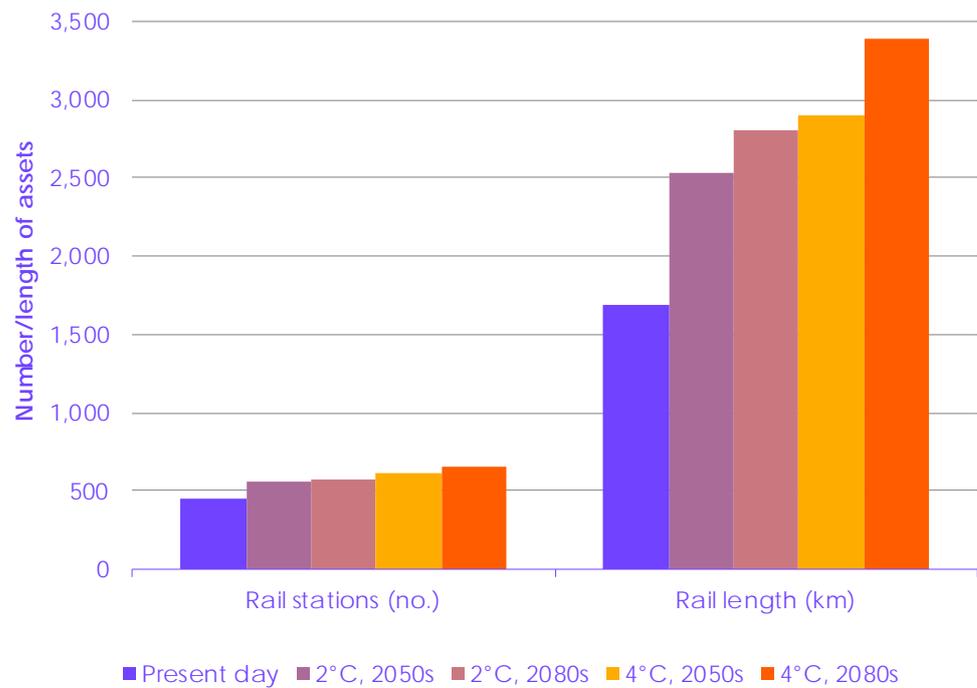
† Data provided by Network Rail (unpublished).

‡ The two taskforces were overseen by Dame Julia Slingo Lord Robert Mair, both of whom have authored and advised on the CCRA3 Technical Report.

**The rail sector remains at increasing risk of surface water and river flooding.**

New analysis for CCRA3 shows that, under current levels of adaptation, the rail sector remains at increasing risk of river and surface water flooding.<sup>31</sup> Sayers et al (2020) project that in England, under a low population and current levels of adaptation scenario, the risk of surface water flooding increases significantly in both the 2050s and 2080s. In a 4°C world by the 2080s, there is a projected 101% increase in length of railway track at risk and a 46% increase in railway stations at risk (Figure 4.5).

**Figure 4.5** Length of railway track and number of railway stations at significant risk of surface water flooding under a range of climate change scenarios



Source: Sayers et al (2020). *Third UK Climate Change Risk Assessment (CCRA) Future flood risk*.  
Notes: Data extracted for the CCRA3 technical chapters from the results database available at [www.ukclimaterisk.org](http://www.ukclimaterisk.org). The climate scenarios presented above assume current levels of adaptation and low population growth in the mid and late century.

For river flooding, risk also increases for all rail assets in both the 2050s and 2080s. By the 2080s in a 4°C world, there is an increase of up to 21% for length of railway track at risk and a 17% increase in stations at risk (under current levels of adaptation and a low population scenario).

## 4.8 Strategic road network

Progress summary – Strategic road network		
2019 score:	What has changed since 2019:	2021 score:
8	<p><b>Plan score - high</b></p> <ul style="list-style-type: none"> <li>The Road Investment Strategy 2 (2020 – 2025) includes a vision that the strategic road network is resilient to climate change and incidents, such as flooding, poor weather conditions and blockages on connecting transport networks. It includes performance indicators on structural, drainage and geotechnical condition. Highways England continues to embed climate change resilience and adaptation into standards. In May 2020, the Government announced a £1.7 billion Transport Infrastructure Investment Fund for local road and motorways (and railways). It is not yet clear what proportion of this additional funding will go towards improving strategic road condition or increasing climate resilience more generally.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>Roads in better condition should be better able to withstand extreme weather impacts. In 2019-20, Highways England met its performance target for road condition. However, there has been an increase in the percentage of roads classified as being in poor condition, which is a concern. Targets to address flooding have changed since our last assessment and new metrics on drainage resilience are being developed.</li> </ul>	8
<p>Notes: See annex for full datasets            Key Indicators: Percentage of Highways England managed roads requiring maintenance in England by type (2007/08-2017/18). Numbers of flooding hotspots mitigated.</p>		

### Summary of 2019 report score

**In our last report, strategic road networks scored an 8 (high plan score, medium risk management score).**

Highways England was embedding resilience and climate change into plans and investments, and taking action to safeguard against flooding on the road network as set out in their climate change risk assessment, which covers all climate hazards. Highways England published a Sustainable Development and Environment Strategy in 2017 which set out the high-level ambitions for the business.

On progress in managing risk, NAP2 actions were found to be relevant, focussed particularly around flood risk, slope stability and bridges. Highways England was meeting performance targets, for example, it met its 2018 target of at least 95% of the network in good condition. However, disruptive events remained a regular occurrence even in the current climate.

Has the plan score changed?

**No, it remains high.**

**Highways England continues to plan for a range of future climate scenarios.**

The Highways England Climate Adaptation Risk Assessment considers high emissions scenarios in identifying climate impacts and prioritising actions.

The Road Investment Strategy 2 (2020 – 2025) includes a vision that the strategic road network is resilient to climate change and incidents, such as flooding, poor weather conditions and blockages on connecting transport networks.<sup>32</sup> It includes performance indicators on structural, drainage and geotechnical condition. In May 2020, the Government announced a £1.7 billion Transport Infrastructure Investment Fund for local road and motorways (and railway).<sup>33</sup> It is not yet clear what proportion of this additional funding will go towards improving strategic road condition or increasing climate resilience more generally.

The Highways England Strategic Business Plan includes a performance outcome 'delivering better environmental outcomes' which states:

"We will monitor, assess and respond to the impacts of climate change on our network. We will work in partnership with organisations such as the Environment Agency, the Met Office and local authorities to improve the resilience of our network to more severe weather. We will focus on reducing flooding on our roads and minimising risks for local communities, retrofitting our assets to meet new environmental and drainage standards. We will also improve the resilience of our concrete pavements to prolonged high temperatures as part of our concrete maintenance and renewals programme, taking remedial action where necessary".

Highways England is developing a Geotechnical Climate Change Adaptation Plan as well as guidance for geotechnical design, construction and management. This will help to ensure that activities are identified to support the objective of making the network resilient to climate change and extreme weather events in the future.

#### **Highways England continues to embed climate change resilience and adaptation into standards.**

The Design Manual for Roads and Bridges sets standards for road design. Standard GG103 includes 12 sustainable development goals that design shall aspire to, including: 'be resilient to climate change'.<sup>34</sup> An accompanying National Application Annex for England includes a requirement that "resilience to future climatic conditions specific to the local and surrounding area shall be identified, assessed and incorporated into the design." Standard LA114 sets out the requirements for assessing and reporting the effects of climate on highways, as well as the effect on climate of greenhouse gas emissions from construction, operation and maintenance projects. It includes requirements for environmental assessments in relation to vulnerability to climate change including: scoping, study area, baseline scenario, data collection, significance criteria, evaluation of significance, and design and mitigation requirements.<sup>35</sup> Standards for drainage require flood risk assessments which apply the latest climate change allowances in accordance with relevant national legislation requirements.<sup>36</sup>

Has the risk management score changed?

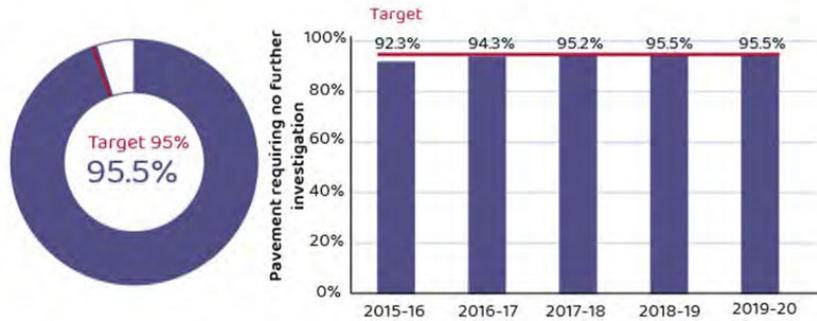
**No, it remains medium.**

#### **Highways England has met performance targets related to road condition.**

The Office of Road and Rail completes an annual assessment of Highways England's performance, which includes a key performance indicator that Highways England must maintain the pavement asset such that at least 95% of it does not require further investigation for possible maintenance. At the end of 2019-20, Highways England reported that 95.5% of its pavement (road surface) asset did not require further investigation for possible maintenance (Figure 4.6). This is above the target of 95% and is the same as the score recorded in 2018-19. Highways England has therefore returned the asset in a better condition than it started the road period with, as defined by the metric.

**Figure 4.6** Highways England performance against road condition KPI 2015-16 to 2019-20

Percentage of pavement not requiring further investigation for possible maintenance in 2019-20, and for individual years in RP1

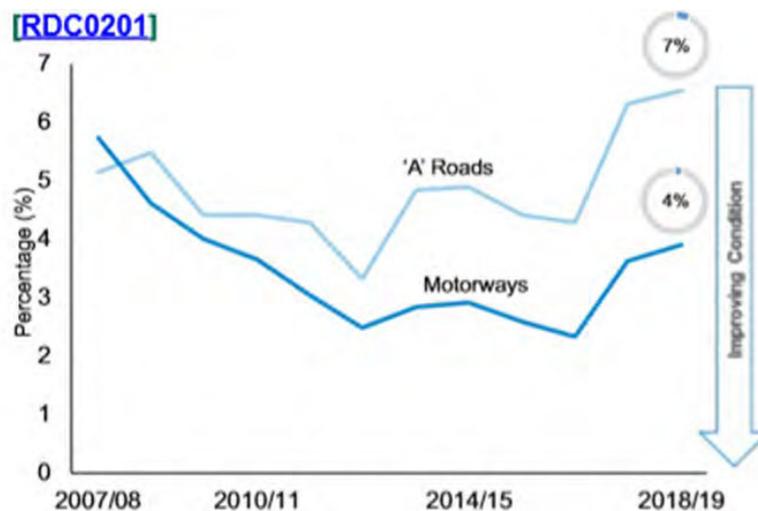


Source: ORR Annual Assessment of Highways England End of Road Period 1 2015-2020

The condition of strategic roads has worsened since our last assessment.

**However, the condition of strategic roads has worsened since our last assessment.** Roads in better condition should be better able to withstand extreme weather impacts. For Highways England managed motorways and 'A' roads, 4% and 7% respectively were categorised as red and should have been considered for maintenance in 2018/19 (Figure 4.7).<sup>\*</sup> The proportion broadly fell between 2007/08 and 2012/13 but has fluctuated thereafter with a peak in 2018/19. The relatively small size of the strategic road network could mean these figures are subject to fluctuation, as a change in the proportion denotes a relatively small change in the amount of road. Although the strategic road network is relatively small compared with the local road network, the impact of disruption on individual journeys and nationwide connectivity can be far greater.

**Figure 4.7** Proportion of the Highways England managed road network categorised as red\*, by road type, 2007/08 to 2018/19



Source: Department for Transport (2019). Road conditions in England to March 2019.

Notes: \*roads categorised as red should have been considered for maintenance (i.e. further investigation required).

<sup>\*</sup> Current measures of road condition are based on surface condition only and do not reflect the ability of the pavement structure to drain excess water or react to extreme temperatures.

**Targets to address flooding have changed since our last assessment.**

Highways England report that there were 118 flooding incidents in 2020.<sup>\*</sup> In Road Period 1 (2015–20) Highways England mitigated 248 flooding hotspots and 12 culverts considered to be at risk of flooding.<sup>37</sup> In Road Period 2 (2020-25), the flood resilience metric is ‘percentage of carriageway at low risk of flooding’, with an aspirational target for mitigation of 30 flooding hot spots per annum.

Flooding of transport networks can affect the provision of critical services, including emergency response. Recent research has found that even low magnitude floods can lead to a reduction in national level compliance with mandatory response times for ambulance and fire and rescue services in England.<sup>38</sup> As highlighted in the indicator wish-list published with this report, better indicators are needed that enable the assessment of impacts from disruption due to extreme weather on key infrastructure, including the impact of flooding events on roads.

<sup>\*</sup> Data provide by Highways England, from National Incident Liaison Officer (NILO) reports. The measure relates to flooding events closing sliproads and affecting 50% or more of carriageway, under the NILO criteria. A change in reporting criteria in 2020 may have affected the number of flooding incidents captured.

## 4.9 Local road network

Progress summary – Local road network		
2019 score:	What has changed since 2019:	2021 score:
5	<p><b>Plan score – medium</b></p> <ul style="list-style-type: none"> <li>The plan score remains medium. There have been no new, or updates to existing, strategies, plans or codes of practice for local roads since our last assessment. In May 2020, the Government announced a £1.7 billion Transport Infrastructure Investment Fund for local roads and motorways (and railways). It is not yet clear what proportion of this additional funding will go towards improving local road condition or increasing climate resilience more generally</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains medium. Road condition has remained the same over the most recent 3 years, following a period of gradual improvement from 2011/12. While it is positive that road condition has not become any worse, there remains a lack of data to assess the vulnerability of local roads to specific climate risks and to assess progress in managing the impact of climate risks on local roads.</li> </ul>	5
<p>Notes: See annex for full datasets            Key Indicators: Percentage of roads requiring maintenance in England by type (2007/08-2017/18).</p>		

### Summary of 2019 report score

**In our last report, local road networks scored 5 (medium plan score, medium risk management score).**

Our assessment in 2019 noted that local highway authorities have a duty under the Highways Act 1980 to ensure highways, and the assets associated with them such as lighting and bridges, are well maintained. A Highways Code of Practice asks local authorities to take account of climate change when maintaining the local road network. This includes applying the latest UK Climate Projections, ensuring infrastructure is resilient to climate change and determining actions to address risks. However, there was no statutory requirement for them to use this guidance and there had been no systemic assessment of the disruptions caused by flooding or extreme weather on local roads and the actions taken to reduce risk.

On progress in managing risk, the NAP sets out actions related to DfT sharing information with local highway authorities, however, it is the authorities' own responsibility to manage risks to the local road network. The Government allocates funding to local highway authorities to help improve local roads, including to increase resilience to weather, flooding and extreme heat.

### Has the plan score changed?

**No - there have been no new, or updates to existing, strategies, plans or codes of practice for local roads since our last assessment.**

In May 2020, the Government announced a £1.7 billion Transport Infrastructure Investment Fund for local roads and motorways (and railways). It is not yet clear what proportion of this additional funding will go towards reactive repair and what resources will be allocated to adaptation and increasing climate resilience. A

recent survey by the Asphalt Industry Alliance (AIA), found that, despite an increase in highway maintenance budgets, maintaining roads to target conditions is still out of reach for local authorities in England, with a reported shortfall in road carriageway budgets of £522.9m for 2021/21.<sup>39</sup>

A recent survey by the Asphalt Industry Alliance (AIA), found that, despite an increase in highway maintenance budgets, maintaining roads to target conditions is still out of reach for local authorities in England, with a reported shortfall in road carriageway budgets of £522.9m for 2021/21.

Has the risk management score changed?

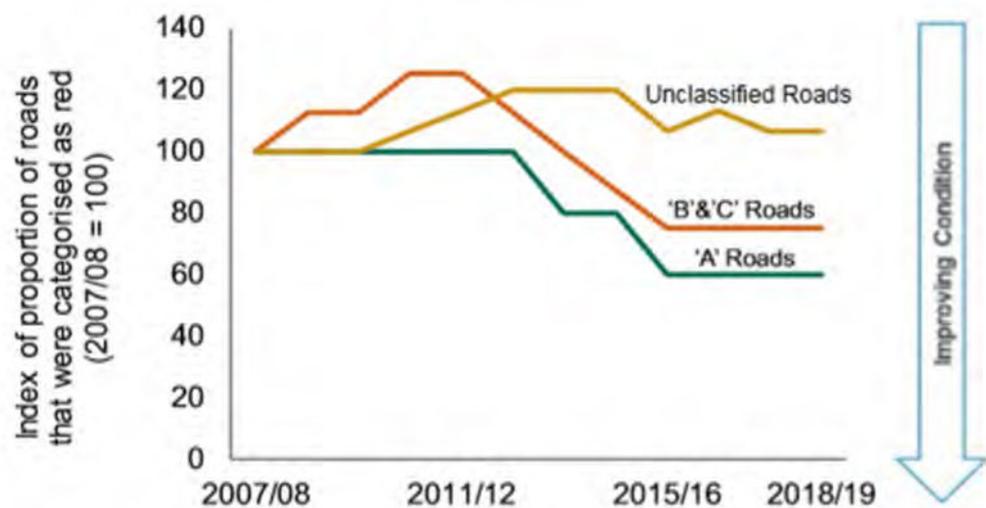
**No. There remains a lack of data to assess progress in managing the impact of climate risks on local roads.**

Data on road condition are a useful indicator of the potential vulnerability of roads to extreme weather, though information is not available on specific actions being taken to manage the impact of climate risks on local roads.

**Road condition has remained the same since our last assessment.**

The latest figures for local authority surface condition are broadly in line with the previous 3 years (Figure 4.8). Prior to this, 'A' roads, and 'B' and 'C' roads combined, had seen a period of gradual improvement since 2011/12 (i.e. fewer roads categorised as red). Unclassified roads had not seen the same improvement over this period.

**Figure 4.8** Trend in the proportion of local authority managed roads categorised as red, by road type, 2007/08 to 2018/19



Source: Department for Transport (2019) *Road conditions in England to March 2019*.

## 4.10 Telecoms, digital and ICT infrastructure

Progress summary – Telecoms, digital and ICT infrastructure		
2019 score:	What has changed since 2019:	2021 score:
2	<p><b>Plan score – low</b></p> <ul style="list-style-type: none"> <li>The plan score remains low, however there are signs of progress beginning to appear. Resilience planning in the data centre sector is conducted at corporate level by individual private operators, who compete on their ability to ensure business continuity for their customers. Resilience standards for the digital sector do not include requirements pertaining specifically to climate change risks. In its final report on the Resilience Study, the NIC recommended Government should introduce a statutory requirement by 2022 for clear, proportionate and realistic standards every five years for the resilience of digital (and other) services, with obligations on infrastructure operators to meet these resilience standards by 2023. These standards must include requirements pertaining to climate change risks.</li> </ul> <p><b>Risk management score – medium</b></p> <ul style="list-style-type: none"> <li>The risk management score remains medium. There is still a lack of data to assess how risks to telecoms, digital and ICT are changing. However, all major providers have flood defences compliant with the National Flood Resilience Review requirements and DCMS continues to engage with the EC-RRG on resilience and emergency response. ARP3 reports from the EC-RRG and TechUK should provide valuable information on steps the industry is taking to manage risks, however the reporting deadline exceeds the timeframe for this report. While data centres do not appear to have been affected by recent extreme weather events, CCRA3 has assessed the current climate risks to digital infrastructure as medium magnitude, increasing to ‘high’ under more extreme climate scenarios.</li> </ul>	2
<p>Notes: See annex for full datasets Key Indicators: There remains a lack of data on risks to and resilience actions by digital infrastructure operators.</p>		

### Summary of 2019 report score

**In our last report, telecoms, digital and ICT infrastructure scored a 2 (low plan score, medium risk management score).**

There was no visible clear plan or process by the industry or Government with actions to manage long-term climate risks to the sector. The Committee highlighted the opportunity to show a plan to manage risks through the Adaptation Reporting Power (ARP), however in the absence of reporting being mandatory there is no guarantee that organisations will continue to report. Recent Ofcom and industry guidance asks providers to maintain services during flooding incidents but does not include a consideration of climate change.

Data were not available to assess how the risk was changing. There had however been activity since the first NAP period, especially in relation to flooding, which should reduce the vulnerability of some assets.

Has the plan score changed?

**No, the plan score remains low, however there are signs of progress beginning to appear.**

Resilience planning in the data centre sector is conducted at corporate level by individual private operators, who compete on their ability to ensure business continuity for their customers. There remains no visible plan or process by the industry or Government with actions to manage long-term climate risks to the sector. The level of resilience offered by commercial providers and the standards they adhere to are set out in contractual SLAs (Service Level Agreements). A number of data centre facilities are designated Critical National Infrastructure. The EC-RRG\* Resilience Guidelines for Providers of Critical National Telecommunications Infrastructure do provide design considerations and operational processes for communications providers to build resilience to physical threats, including extreme weather, floods and lightning. However, there is no consideration of climate scenarios and how these may affect the prevalence or impact of such impacts. Ofcom's general conditions require communications providers to maintain uninterrupted access to emergency organisations "to the greatest extent possible", with significant fines for failures.

A standard for availability of service can to some extent be considered a proxy for the resilience of the infrastructure, however there remains a need for future climate risks to the sector to be reflected in industry standards.

**Resilience standards for the digital sector do not include requirements pertaining specifically to climate change risks.**

EN50600 is an availability standard which covers all aspects of data centre infrastructure including power, cooling and telecommunications. It also provides recommendations for operations and management, security and energy and sustainability. EN50600 is being harmonised with ISO and with the practices of the EU Code of Conduct for Data Centres. Provisional data from Tech UK† suggests that almost 80% of data centre sites are working towards practices compliant with EN50600 (representing 75% of sector activity) and over half of the sites in the UK conform to ISO50001 (representing around 70% of sector activity). ‡ Tech UK will report formally on the uptake of standards in their ARP3 report by the end of 2021.

**The NIC has recommended a statutory requirement for resilience standards for the sector by 2022 – these must include requirements pertaining to climate change risks.**

In May 2020, in its final report on the Resilience Study, the NIC recommended Government should introduce a statutory requirement by 2022 for clear, proportionate and realistic standards every five years for the resilience of digital (and other) services, with obligations on infrastructure operators to meet these resilience standards by 2023. This presents a real opportunity to incorporate consideration of climate change risks and adaptation actions into the standards.

**Recommendation**

Resilience standards for the digital sector must include requirements pertaining to climate change risks. In addressing the National Infrastructure Commission recommendations from the Resilience Study, Government should incorporate consideration of climate change risks and adaptation actions into any new standards being developed.

Standards for digital infrastructure operators should include requirements to:

- assess climate risks under both 2°C and 4°C global climate scenarios
- consider interdependencies with other critical infrastructure, and
- set out actions to reduce risk and monitor progress

Department: DCMS, Timing: 2022

\* EC-RRG is a cross government and telecoms industry forum whose aim is to ensure the telecoms sector remains resilient to threats and risks to services.

† Tech UK is the UK's technology trade association, whose remit is digital infrastructure, comprising communications networks and data centres.

‡ Provisional data collated by Tech UK in preparation of the ARP3 report.

Has the risk management score changed?

**No, the risk management score remains medium.**

**There remains a lack of data to assess how risks to telecoms, digital and ICT are changing.**

However, all major providers have flood defences compliant with the National Flood Resilience Review requirements and DCMS continues to engage with the EC-RRG on resilience and emergency response. ARP3 reports from the EC-RRG and TechUK should provide valuable information on steps the industry is taking to manage risks, however the reporting deadline exceeds the timeframe for this report.

**Data centres do not appear to have been affected by recent extreme weather events.**

The Data Centre Incident Reporting Network (DCIRN) does not currently collect quantitative data on climate change related outages to data centres, however there has been no publicly reported disruption from data centre outages as a result of recent extreme weather events (see introduction to this chapter). There are observations within the sector that older sites are more likely to be vulnerable to heatwaves than newer sites, especially if they are working to capacity, because their cooling systems will be challenged by sustained high temperatures.<sup>40</sup>

**CCRA3 has assessed the current climate risks to digital infrastructure as medium magnitude, increasing to 'high' under more extreme climate scenarios.**

While there is a general understanding of the interactions between ICT infrastructure and weather, quantitative projections assessing how climate change will affect the frequency and magnitude of these interruptions are lacking.

While there is a general understanding of the interactions between ICT infrastructure and weather, quantitative projections assessing how climate change will affect the frequency and magnitude of these interruptions are lacking.

However, there remains a lack of evidence. While there is a general understanding of the interactions between ICT infrastructure and weather, quantitative projections assessing how climate change will affect the frequency and magnitude of these interruptions are lacking. This is compounded by a lack of information in the public domain on the location or specification of assets for interests of security and commercial sensitivity. ICT is critical to the operation of wider infrastructure networks as well as underpinning business activities, access to key services and wider communication. Outages can therefore have significant effects on the locality and more broadly via interdependent infrastructure. Overall, CCRA3 concludes that further attention to the climate resilience of this sector and quantitative information on current and future risks under climate change is needed, to better assess its vulnerability and exposure to climate change.<sup>41</sup>

# Endnotes

- <sup>1</sup> Jaroszweski, D., Wood, R., and Chapman, L. (2021) *Infrastructure. In: The Third UK Climate Change Risk Assessment Technical Report*. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London.
- <sup>2</sup> Jaroszweski, D., Wood, R., and Chapman, L. (2021) *Infrastructure. In: The Third UK Climate Change Risk Assessment Technical Report*. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London.
- <sup>3</sup> HM Treasury (2020). *Budget 2020 Policy paper*.
- <sup>4</sup> Institution of Civil Engineers (2020). *Covid-19 and the new normal for infrastructure systems – next steps*.
- <sup>5</sup> HM Treasury (2020). *National Infrastructure Strategy: Fairer, Faster, Greener*.
- <sup>6</sup> National Infrastructure Commission (2020). *Anticipate, React, Recover: Resilient infrastructure systems*.
- <sup>7</sup> WSP et al. (2020). *Interacting risks in infrastructure and the built and natural environments: research in support of the UK's Third Climate Change Risk Assessment Independent Assessment*.
- <sup>8</sup> Defra (2018). *The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting: Making the country resilient to a changing climate*.
- <sup>9</sup> CCC (2017). *Adaptation Reporting Power: second round review*.
- <sup>10</sup> Defra (2018). *Summary of responses, A consultation on the government's proposed strategy for the third round of the Adaptation Reporting Power*.
- <sup>11</sup> Defra (2018). *List of organisations reporting under adaptation reporting power: third round*.
- <sup>12</sup> CIWEM (2021). *Climate Change Adaptation Reporting in the UK: Mainstreaming best practice and harnessing the benefits*.
- <sup>13</sup> Defra (2020). *Accounting for the Effects of Climate Change, Supplementary Green Book Guidance*.
- <sup>14</sup> ENA (2021) *Gas & Electricity Transmission and Distribution Network Companies, 3rd Round Climate Change Adaptation Report*.
- <sup>15</sup> Energy UK (Due to be published - 2021) *Climate Change Risks and Adaptation Responses for UK Electricity Generation – A Sector Overview 2021*.
- <sup>16</sup> Department for Business, Energy & Industrial Strategy (2020) *GB power system disruption 9 August. Energy Emergencies Executive Committee: Final Report*.
- <sup>17</sup> Sayers et al (2020). *Third UK Climate Change Risk Assessment (CCRA3) Future flood risk Main Report*, and results database available at [www.ukclimaterisk.org](http://www.ukclimaterisk.org).
- <sup>18</sup> CCC (2021) *The Third UK Climate Change Risk Assessment (CCRA3) - Advice to Government*.
- <sup>19</sup> CCC (2020). *The Sixth Carbon Budget, The UK's path to Net Zero*.
- <sup>20</sup> Ofwat (2019). *2019 price review final determinations*.
- <sup>21</sup> Water UK (2019). *Public Interest Commitment*.
- <sup>22</sup> Water UK letter to Secretary of State Rt Hon Michael Gove MP, 17 October 2018.
- <sup>23</sup> National Infrastructure Commission (2018). *Preparing for a drier future: England's water infrastructure needs*.

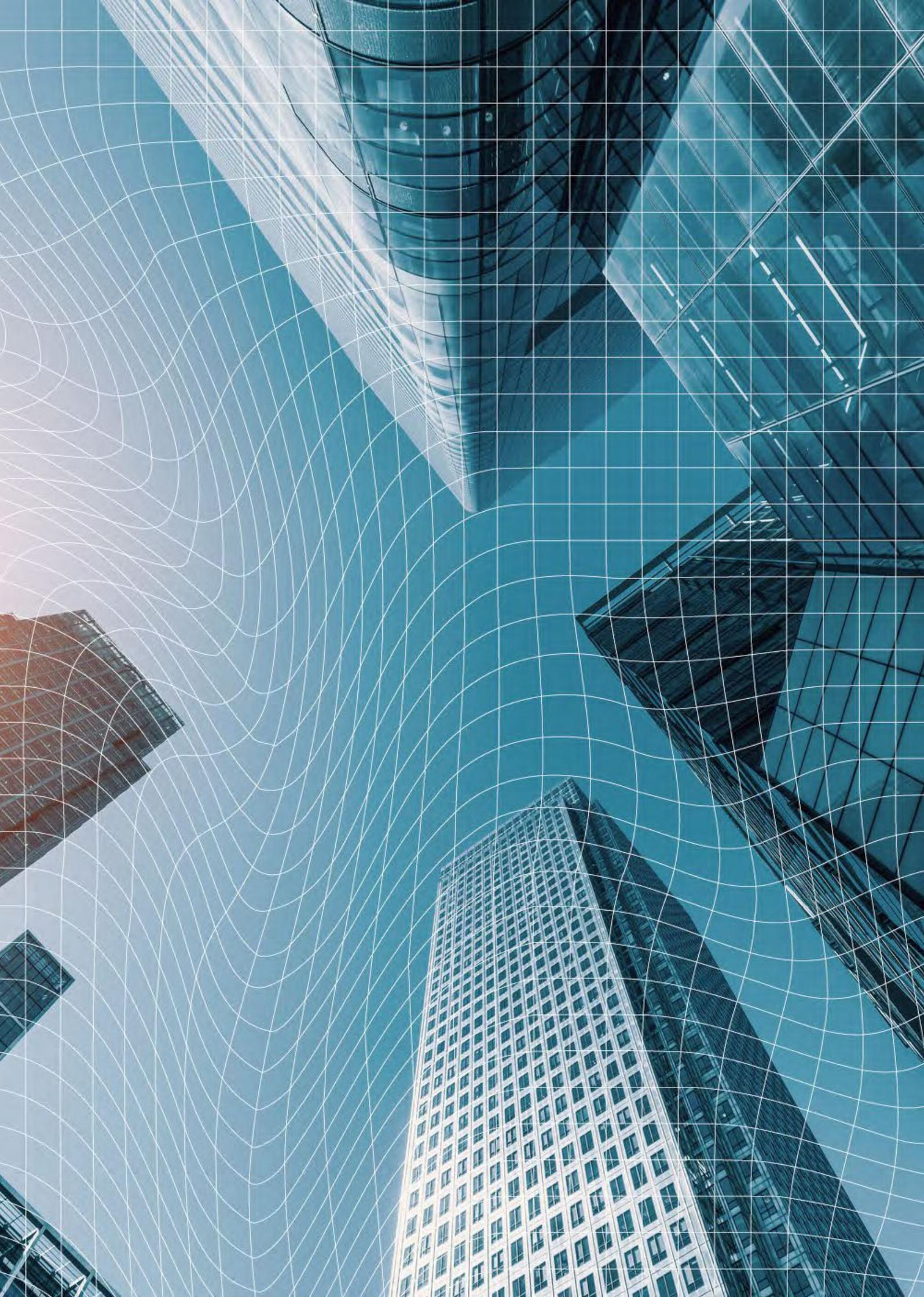
- <sup>24</sup> Consumer Council for Water (2020). *Water, Water Everywhere? Resilience report 2019-20*.
- <sup>25</sup> Dawson et al (2016). *UK Climate Change Risk Assessment Evidence Report: Chapter 4, Infrastructure*. Report prepared for the Adaptation Sub-Committee of the Committee on Climate Change, London.
- <sup>26</sup> CCC (2017). *Adaptation Reporting Power: second round review*.
- <sup>27</sup> Defra (2018). List of organisations reporting under adaptation reporting power: third round. List published 21 December 2018.
- <sup>28</sup> Network Rail Route Weather Resilience Plans.
- <sup>29</sup> Network Rail (2021). *Route CP6 Weather Resilience and Climate Change Adaptation Plans 2019-2024 National Implementation Progress Report*.
- <sup>30</sup> Met Office (2019). Record breaking heat-wave July 2019.
- <sup>31</sup> Sayers et al (2020). *Third UK Climate Change Risk Assessment (CCRA3) Future Flood Risk*.
- <sup>32</sup> DfT (2020). *Road Investment Strategy 2: 2020–2025*.
- <sup>33</sup> DfT (2020). Multi-billion pound road and railway investment to put nation on path to recovery.
- <sup>34</sup> DMRB Standard GG103 – Introduction and general requirements for sustainable development and design, July 2019.
- <sup>35</sup> DMRB Standard LA114 Climate, October 2019.
- <sup>36</sup> DMRB: LA113 Road Drainage and the Water Environment; DMRB: CG501 Design of Highway Drainage Systems.
- <sup>37</sup> Office of Road and Rail (2020) *Annual Assessment of Highways England, End of road period one 2015 – 2020*.
- <sup>38</sup> Yu, D., Yin, J., Wilby, R.L. et al. (2020). *Disruption of emergency response to vulnerable populations during floods*. *Nat Sustain* 3, 728–736.
- <sup>39</sup> AIA (2021). Annual Local Authority Road Maintenance survey (ALARM), Key findings chart.
- <sup>40</sup> techUK (2018). Adapting to Climate Change, Environmental Audit Committee Inquiry on Heatwaves: techUK Response: Core Digital Infrastructure (data centres).
- <sup>41</sup> Jaroszweski, D., Wood, R., and Chapman, L. (2021) *Infrastructure*. In: *The Third UK Climate Change Risk Assessment Technical Report*. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London.

# Chapter 5

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## Business

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## 5.1 Introduction

**Businesses that are better prepared for the impacts of climate change will be able to capitalise on opportunities and avoid future damages.**

Opportunities to businesses include those through an increase in demand for existing and new goods and services, which might specifically relate to adaptation. Businesses and industry in England face a number of opportunities and risks from climate change. Through international supply chains, distribution networks and global markets, businesses are exposed to risks from extreme weather, including flooding and water shortages around the world.

**Since our last report in 2019, the context for businesses in England and outlook for the immediate future has changed dramatically.**

The economic impacts of Covid-19 have been severe though varied among sectors and business types. It has highlighted the importance of business resilience and the reliability of key supply chains for people and the economy. The ways in which people work may change. Before the pandemic, around 5% of people in employment worked from home regularly.<sup>1</sup> As a result of the COVID-19 pandemic, levels of homeworking have risen substantially, with an average of around 30% of the workforce working exclusively from home each week during 2020.<sup>2</sup> Some businesses and workers may choose to adopt this style of working on a permanent basis.

Since 2019, the context for businesses in England has changed dramatically due to factors like the Covid-19 pandemic, the end of the EU exit transition period and the setting of the Net Zero target.

There is also change for many businesses who trade internationally following the end of the transition period after leaving the EU, who may reorganise their supply chains due to this and the impacts of Covid-19.

Many businesses have also responded positively to the UK's legislation of the Net Zero target and are undertaking long-term planning to ensure their operations align with the target. As demonstrated by the Government's plans for a green recovery, there are opportunities for industrial strategies and policies, and for businesses to do things differently to achieve key policy goals, including Net Zero. Helping businesses and industry prepare for the impacts of climate change should be among these goals.

**As in our 2019 report, the continuing growth of support for the Task Force on Climate-Related Financial Disclosures (TCFD) remains a key development for assessing businesses' preparedness for climate change.**

TCFD, and similar initiatives, such as the Taskforce on Nature-Related Financial Disclosures (TNFD), are relevant to all of the adaptation priorities within this chapter, though they are discussed primarily in the first 'Impact on business of extreme weather events.'

**It is critical to distinguish between different types of business in assessing preparedness and considering where further support may be required.**

It is important to note that the TCFD and other initiatives including compulsory reporting are primarily focussed on large, publicly listed organisations, with a focus on the financial sector. Small and Medium Enterprises (SMEs), as defined by the number of employees, account for 5.9 million or 99.9% of all UK private sector businesses, 61% of employment and 52% of turnover.<sup>3</sup> These businesses are a significant part of the UK economy and have fewer resources to adapt to the risks and opportunities arising from climate change than those targeted by TCFD and other initiatives.

It is important to distinguish between different types of business, particularly between larger businesses and SMEs, and between those who engage with climate change surveys and the general corporate sector.

The increasing growth of 'green' business practices and strategies may also mean that survey responses and other evidence better reflect this 'green' sector, rather than the general corporate sector.

## 5.2 Impact on business from extreme weather events

Progress summary – Impact on business from extreme weather events		
2019 score:	What has changed since 2019:	2021 score:
2	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The plan score has increased from low to medium. Government has set out a roadmap for mandatory climate-related disclosures following legislation of the Net Zero target. This has been complemented by important work from other organisations to strengthen reporting of climate risks and adaptation through new standards and guidance. There remains a gap, where SMEs, the majority of businesses in England, are unlikely to benefit from most of these measures. A new SME Climate Hub is a welcome development, though the vast majority of its resources and promotion are focussed on Net Zero rather than adaptation.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>There is no change in the risk management score from 2019. The number of large businesses, particularly in the financial sector, aligning with TCFD and assessing climate risks continues to increase and mandatory reporting should lead to further improvements. However, there remain significant gaps, such as scenario analysis and reporting of adaptation measures, which will hinder the effectiveness of new reporting initiatives unless addressed.</li> </ul>	5
<p>Notes: See annex for full datasets            Key Indicators: TCFD disclosure (various surveys), Contingency planning for extreme weather, Economic impact of extreme weather events / Insurance losses due to extreme weather.</p>		

### Summary of 2019 report score

**In our last report, impact on business from extreme weather events scored a 2 (low plan score, medium risk management score).**

Our 2019 report found that while there were incentives for businesses to plan for how they might be impacted by climate change through initiatives such as the Task Force on Climate-related Financial Disclosures (TCFD), there was little evidence that planning was taking place for more than a 2°C increase in global temperature or that plans were in place to help smaller businesses prepare for climate change.

There was evidence of increasing action in response to climate change by businesses and the investment community. However, support for initiatives like TCFD had not yet led to better assessment and planning for climate change risks, particularly higher climate change scenarios relevant for adaptation.

### Has the plan score changed?

**Yes, the plan score has increased from low to medium. There have been significant steps to help businesses better prepare for the impacts of climate change, such as setting out a clear roadmap for making TCFD-aligned disclosures mandatory. To improve the score further, there need to be clear plans and support for smaller businesses and measures to ensure that approaches to considering physical risk continue to progress.**

100% of listed commercial companies could be covered by regulation or legislation regarding climate disclosures by the end of 2022.

### **Government has taken welcome steps over the past two years to improve consideration and reporting of the impacts of climate change by businesses and the finance sector.**

The UK announced its intention to make TCFD-aligned disclosures mandatory in 2020. A cross-Whitehall/cross-regulator UK Taskforce developed a roadmap that sets out an indicative path over the next five years for different categories of organisation.<sup>4</sup> For example, 100% of listed commercial companies could be covered by regulation or legislation regarding disclosures by the end of 2022, while for occupational pension schemes it could be 72% by the end of 2022, rising to 85% by the end of 2025, though this roadmap could be affected by consultations or other reviews.

Most action is planned to occur over the first three years, with the overall aim of providing comprehensive and high-quality information on how climate-related risks and opportunities are being managed across the UK economy. This will be achieved by incrementally increasing the coverage of supervisory expectations, disclosure rules or legislative requirements for seven categories of organisation: listed commercial companies; UK-registered companies; banks and building societies; insurance companies; asset managers; life insurers and Financial Conduct Authority (FCA)-regulated pension schemes; and occupational pension schemes.

Government has published several supporting consultations and will provide an update on progress in the 2022 refresh of the Green Finance Strategy.

The Government has already published related consultations. New pension regulations propose that trustees must establish and maintain oversight of the climate-related risks and opportunities which are relevant to their scheme, including publishing a report on a publicly available website free of charge.<sup>5</sup> It recently consulted on mandatory climate-related disclosures by certain UK publicly quoted companies, large private companies and Limited Liability Partnerships (LLPs) as well.<sup>6</sup>

Other consultations, such as on government procurement criteria which is discussed further in the following supply chains section, will also lead to greater consideration of climate change by affected businesses, if the proposed changes are implemented effectively. The Government will provide an update on progress in the 2022 refresh of the Green Finance Strategy. The Bank of England also confirmed the next step of its Climate Biennial Exploratory Scenario, after postponement due to the pandemic, would be published in June 2021.

### **The Government's steps have been complemented by the work of other climate-related reporting organisations which aim to improve the consistency and quality of information globally through new standards and guidance.**

The International Financial Reporting Standards (IFRS) published a consultation paper on sustainability reporting in 2020.<sup>7</sup> Feedback to this consultation identified an urgent need for better information about sustainability matters, including climate-related information. As a result, the IFRS confirmed its intention to produce a proposal by the end of September 2021, and possibly make an announcement on the establishment of a global sustainability standards board at COP26.

Five of the major organisations in sustainability disclosure; CDP, the Climate Disclosure Standards Board (CDSB), the Global Reporting Initiative (GRI), the International Integrated Reporting Council (IIRC) and the Sustainability Accounting Standards Board (SASB), proposed a vision for a global and comprehensive corporate reporting system.<sup>8</sup> This system would seek to reduce complexity in reporting and incorporate both financial accounting and sustainability disclosure, connected via integrated reporting.

In December 2020, these five organisations published a prototype climate-related financial disclosure standard for illustrative purposes to contribute to the IFRS' development of a sustainability standards board.<sup>9</sup> The work of the IFRS and these five organisations has received public support from the UK Taskforce and the Financial Reporting Council (FRC). The FRC has stated it plans to 'raise the bar' on climate change reporting and encouraged UK public interest entities to report in line with the TCFD recommended disclosures and make use of the SASB's metrics.<sup>10</sup>

The new Taskforce on Nature-related Financial Disclosures (TNFD) aims to complement TCFD and will provide a framework for corporates and financial institutions to assess, manage and report on their dependencies and impacts on nature, aiming to improve the appraisal of nature-related risk and redirect global financial flows away from 'nature-negative outcomes' and towards 'nature-positive outcomes.'

**The new Audit, Reporting and Governance Authority could oversee annual Resilience Statements which would include climate change, if proposals are implemented.**

BEIS published a consultation on 'Restoring trust in audit and corporate governance' which aims to respond to separate independent reviews of the audit system by Sir John Kingman, Sir Donald Brydon and the Competition and Markets Authority.<sup>11</sup> The proposals included establishing a strengthened regulator to replace the FRC, the Audit, Reporting and Governance Authority (ARGA) which would protect and promote the interests of investors, other users of corporate reporting, and the wider public interest. It is proposed that directors of public interest entities would need to publish an annual Resilience Statement setting out how directors are assessing the company's prospects and addressing challenges to its business model over the short, medium and long-term, including risks posed by climate change.

**These improvements in reporting could be undermined unless businesses are better supported when trying to assess physical risk and adaptation.**

As described in the section below, the evidence from reviews such as the latest TCFD status report suggest that there are aspects of reporting that organisations are struggling with.<sup>12</sup> This includes aspects that are critical for assessing physical risk and adaptation such as scenario analysis, the financial impacts of climate change and metrics and targets beyond those related to reducing emissions.

However, there are more examples of organisations considering higher climate change scenarios, such as a 4°C increase in global temperature, than at the time of our report two years ago. Unless this is addressed and regulators and auditors have the necessary expertise to monitor the quality of reporting, initiatives as described above will not be effective in ensuring businesses are prepared for the impacts of climate change.

**There are some good examples of work by organisations to address this, which could be further promoted and developed.**

There are some good examples of work by organisations in the past two years to address this. In 2020 Acclimatise et al. published a detailed set of questions to assist non-executive director oversight of physical climate change risk management.<sup>13</sup> The TCFD published further guidance on scenario analysis and consulted on forward looking financial metrics including metrics specifically for physical risk such as Climate Value at Risk (Climate VAR).<sup>14</sup> The Goal 13 Impact platform aims to help businesses collaborate on similar climate change initiatives and share best practice on aspects such as target setting, drivers of change and lessons learned.

More organisations are considering higher climate change scenarios, such as 4°C than two years ago, though reporting of physical risks and adaptation remains a concern.

There are also more examples of risk management and advisory firms offering services to help organisations assess their physical risk. These are all promising developments; however, progress needs to accelerate. Alongside effective enforcement of reporting requirements, organisations must be able to afford and access such information or services, otherwise preparation for physical risks will likely be ineffective. Without government support, there is likely to be a capacity barrier for SMEs in particular.

The BSI also has continued to work on adaptation-related standards which set out principles that organisations can follow, rather than set out an overly prescriptive approach. In addition to ISO 14090 *Adaptation to climate change – Principles, requirements and guidelines*, new adaptation-related standards have been published since 2019:

- *ISO 14091 Adaptation to climate change — Guidelines on vulnerability, impacts and risk assessment*
- *BS 8631:2021 Adaptation to climate change. Using adaptation pathways for decision making. Guide*
- *PD ISO/TS 14092:2020 Adaptation to climate change. Requirements and guidance on adaptation planning for local governments and communities*

There is ongoing work on standards focussing on financing local adaptation to climate change and reporting investments and financing activities related to climate change. Other standards on sustainable finance and natural capital accounting can also help organisations better plan for the impacts of climate change, such as PAS 7340 *Framework for embedding the principles of sustainable finance in financial services organizations*, published in January 2020, and BS 8632 *Natural Capital Accounting for Organizations*, published in June 2021.

**New reporting initiatives are less likely to influence smaller businesses, who make up the majority of businesses in England, and have fewer resources to adapt. The impacts of Covid-19 have hit these businesses particularly hard and has highlighted the importance of contingency planning for their resilience.**

The full impact of Covid-19 is still being understood but it and the resulting economic volatility has clearly had a significant effect on small businesses. Smaller firms were more likely than bigger ones to have had to temporarily close or pause trading during the pandemic, although this was not necessarily the same across all industries.<sup>15</sup> Analysis by the Bank of England in 2020 found that the pandemic reduced cash flows for many companies, with smaller companies 'more likely than larger companies to operate in sectors that have been most affected by the shock, such as accommodation and food, arts and recreation, and construction.'<sup>16</sup>

Previous research by the FSB in 2015 suggests the impacts of flooding and extreme weather can be severe for small businesses, but many do not have contingency plans for extreme weather, despite the benefits of doing so exceeding the costs.<sup>17</sup>

In the recovery from Covid-19 there will be many new small businesses established and some operating in different ways than before due to enforced changes from Covid-19. There is an opportunity to increase the level and effectiveness of contingency planning, including for extreme weather, by providing updated guidance and accessible information. Small businesses, including very small businesses working largely from home, will also benefit from investment in resilient digital infrastructure.

The impacts of flooding and extreme weather can be severe for small businesses, but many do not have contingency plans for extreme weather.

**A new SME Climate Hub offers several resources for physical risk and understanding climate impacts, though most of its promotion and resources focus on reducing emissions to Net Zero.**

A new SME Climate Hub was launched in December 2020 and is an initiative of the International Chamber of Commerce, the Exponential Roadmap Initiative, the We Mean Business coalition and the United Nations Race to Zero campaign. This is a welcome development as it aims to provide a 'one-stop-shop' for SMEs to make a climate commitment and access 'best-in-class' tools and resources, which was highlighted as something needed in the CCC's 2019 Adaptation Progress Report. It already offers several resources for physical risk and understanding climate impacts, though the vast majority of its promotion and resources focus on reducing emissions to Net Zero.

It will be important to monitor feedback for the SME Climate Hub and whether action from Government is required to develop resources accordingly to ensure the needs of different types of business and organisations are met. A NAP Action update reports that 'the Small Business Engagement campaign, led by Andrew Griffith MP, the UK's Net Zero Business Champion, will embed the need for adaptation and resilience to climate change in stakeholder-related activity.'

**Recommendation (Joint CCC 2021 Progress Report)**

Support businesses to play their full role in the Net Zero transition and in adapting to climate risks and opportunities, for example by extending and expanding the role of the Net Zero Business Champion beyond COP26, building on the Race to Zero and Race to Resilience campaigns and providing sufficient resources to fully support businesses of all sizes to engage in the transition, to input to policy development and to set their own robust Net Zero and adaptation action plans.

Department: BEIS, Timing: 2021-22.

**Even with the challenges of Covid-19, many businesses and investors have continued to demonstrate a desire for improved climate-related information and aligning their operations and portfolios to be consistent with the goals of achieving Net Zero and being prepared for the impacts of climate change.**

The Principles for Responsible Investment (PRI) report that climate change has remained a top priority for its signatories, particularly in advance of COP26. ShareAction proposed a Responsible Investment bill, stipulating in law that the 'best interests' of beneficiaries includes environmental and social considerations. Major asset management firms such as BlackRock have taken further steps to make consideration of climate change a central part of their investment decisions.

The UK Government set out plans for a green recovery in line with the majority preference of the UK Citizens' Assembly on climate change. Government can help further meet this demand by addressing the above weaknesses in planning for and supporting climate-positive behaviours by businesses and investors by providing clear signals about future policy and timescales.

**Has the risk management score changed?**

**No, the risk management score remains medium. New evidence published since 2019 suggests continued progress in some aspects of reporting, but others, which are particularly important for physical risk and adaptation, show very limited progress. The availability of indicators focussed on physical risk and adaptation for this priority remains limited and there is little new information on the economic impacts of extreme weather.**

The TCFD Status Report states that there have been improvements both in terms of the number of companies reporting and the quality of such reporting. The percentage of reviewed reports disclosing information aligning with a particular TCFD disclosure (for example, climate-related targets) increased on average by six percentage points between 2017 and 2019.

Only one in 15 companies reviewed by the TCFD disclosed information on the resilience of its strategy.

However, companies' disclosure of the potential financial impact of climate change on their businesses and strategies remains low. Only one in 15 companies reviewed disclosed information on the resilience of its strategy. The percentage of companies disclosing the resilience of their strategies, taking into consideration different climate-related scenarios, was significantly lower than that of any other recommended disclosure.

Some of the highlighted case studies demonstrated good approaches for assessing physical risk, such as use of a 4°C or higher scenario and the reporting by hazard in scenario analysis.<sup>18</sup> However, even those reports highlighted as best practice had some weaknesses related to assessing physical risk. Most of the reported physical risk metrics were related to water use. Physical and transition risks were often considered separately and only vague measures like the percentage of sites affected were reported with little information on the adaptation response.

#### Recommendation (Joint CCC 2021 Progress Report)

Develop further ways to embed Net Zero and climate risk in financial decisions by UK firms, building on the UK's Green Finance Strategy. This should include implementing mandatory climate disclosure, adoption of a robust green taxonomy with clear guidance on how it should be used, and considering the recommendations of the Committee's Finance Advisory Group, such as making Net Zero and adaptation plans mandatory for financial institutions and monitoring financial flows into climate action.

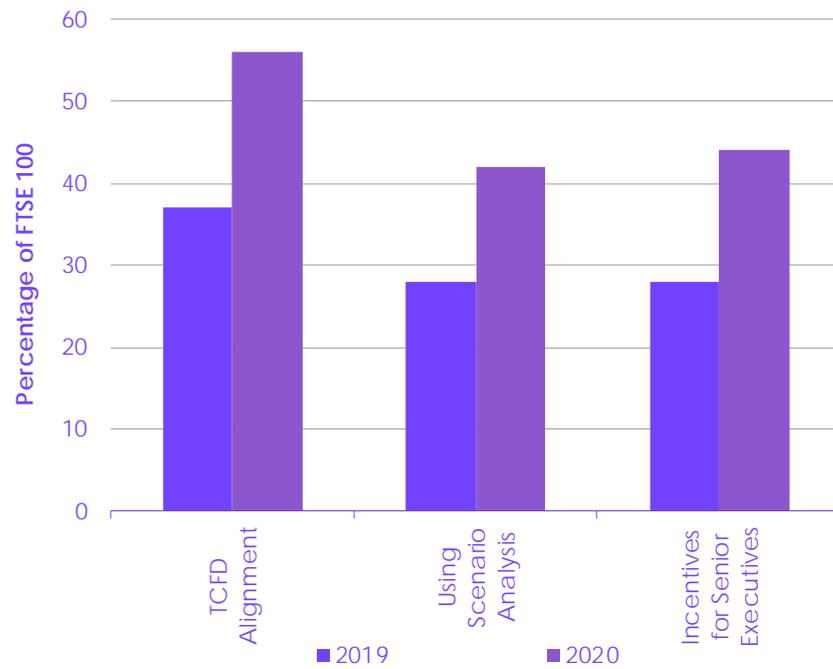
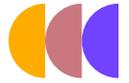
Department: BEIS and HM Treasury, Timing: 2021-25.

The proportion of companies reporting that they are planning for climate change is increasing but further progress is needed.

Figure 5.1 sets out responses from FTSE 100 companies to specific questions from Eco Act's most recent sustainability research. While there is improvement since the previous survey, the results still suggest a significant proportion of FTSE100 companies are not reporting in alignment with the TCFD recommendations, using scenario analysis, or taking steps like offering incentives for Senior Executives.

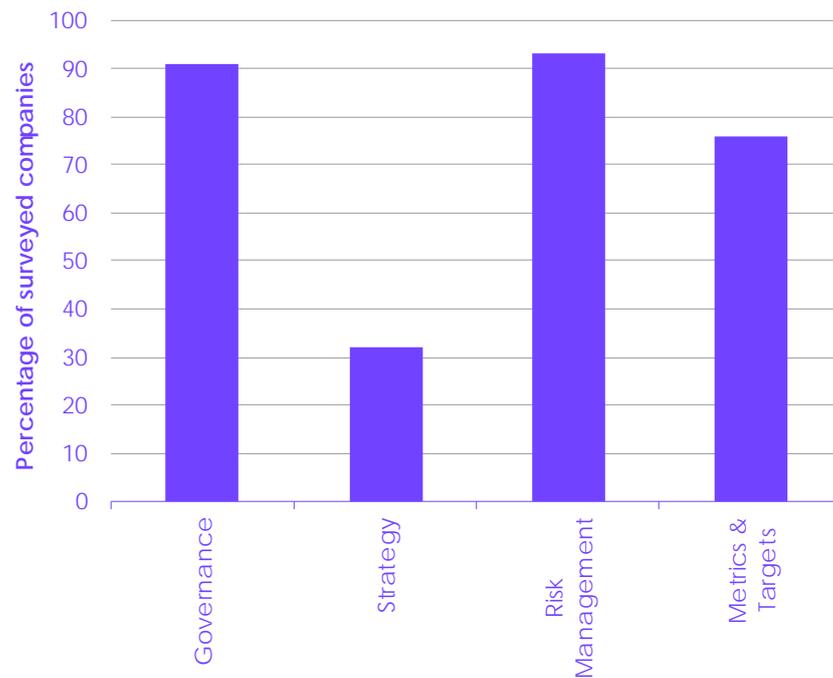
Figure 5.2 shows a survey by CDP which found a high proportion of respondents were providing information on three of the four thematic TCFD areas. However, two-thirds were not reporting under the strategy theme. This is largely because scenario analysis, which businesses have struggled with, is assessed under this theme. This suggests that many organisations are still unable to effectively assess the potential impacts of climate-related risks and opportunities on their businesses, strategy, and financial planning.

Figure 5.1 Survey responses from FTSE100 companies on climate risk



Source: The Sustainability Reporting Performance of the FTSE 100 (EcoAct, 2020)

Figure 5.2 Percentage of CDP respondents reporting under TCFD thematic areas



Source: Disclosure and the TCFD Recommendations: United Kingdom (CDP, 2020)

There are some initial estimates for the impact on businesses of the Autumn-Winter Floods 2019-20 based on insurance claim information from the ABI.<sup>19</sup>

- Of the estimated £110 million payouts, £45 million covered damaged homes and possessions; £58 million for business property and stock, with £7.5 million relating to damaged vehicles.
- The average household flood claim is likely to be around £31,000, and £70,000 for a flooded business. This compares to the average claim across all insured risks of £2,200 under a home insurance policy and an average claim of £11,500 on a commercial policy.

Sayers et al. for the CCC used the new UKCP18 climate projections to provide an updated assessment of future flood risk in 2020.<sup>20</sup> The results did not suggest a significant increase in risk for non-residential properties from flooding compared to their previous assessment in 2015 using UKCP09.

## 5.3 Supply chain interruptions

Progress summary – Supply chain interruptions		
2019 score:	What has changed since 2019:	2021 score:
2	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>The plan score has increased from low to medium. The first part of the National Food Strategy has been published and Government has made further commitments to report and better understand issues related to food supply chains, including climate change. There are also examples of private sector initiatives to inform supply chain planning for climate change and efforts by Government to revise its procurement rules. There still needs to be greater assurance for key supply chains and assessment of the impacts of climate change in new industrial and economic policies.</li> </ul> <p><b>Risk management score - low</b></p> <ul style="list-style-type: none"> <li>The risk management score has decreased from medium to low. The risks of supply chain interruptions are greater than in our last report. Action to respond to the risk is at roughly the same level as in 2019, with some surveys suggesting that businesses are increasingly prioritising resilience in their supply chain planning rather than speed and cost-efficiency, but others suggesting engagement with suppliers on climate change is still limited.</li> </ul>	3
<p>Notes: See annex for full datasets            Key Indicators: Supplier engagement on climate change (various surveys), Economic impact of supply chain interruptions.</p>		

### Summary of 2019 report score

**In our last report, supply chain interruptions scored a 2 (low plan score, medium risk management score).**

Our last report found that there were no stated goals or specific planning for adapting supply chains, and the UK Industrial Strategy did not make any references to helping supply chains become more resilient to the impacts of climate change. NAP2 did not address the risks that the UK faces from the international impacts of climate change.

The limited survey evidence available suggested some businesses were taking action but also suggests some did not engage with their suppliers on climate change.

### Has the plan score changed?

**Yes, the plan score has increased from low to medium. There are some promising new initiatives from Government and the private sector and surveys suggest that businesses are increasingly balancing the need for resilience in their supply chain planning alongside speed and cost-efficiency. To increase the score further there needs to be greater assurance for key supply chains, and plans for industry and the economy should incorporate the impacts of climate change on supply chain resilience.**

**Key supply chains such as food and medical supplies require stronger assurance about their resilience to future shocks, including the impacts of extreme weather.**

Covid-19 has highlighted the importance of having reliable and resilient supply chains, particularly for food and medicine. A report by the House of Commons International Trade Committee in July 2020 identified various adverse effects from the disruption caused by the pandemic, though also noted that UK supply chains for medicines and food had withstood many of the challenges at the time of writing.<sup>21</sup> In the Government's response to this report, it stated that the 'DEFEND programme, led by DIT, interrogates vulnerabilities in UK global supply chains for critical goods (excluding food) and develops strategies to strengthen supply chain resilience.'<sup>22</sup>

It is not clear to what extent extreme weather is currently considered alongside other current and future supply chain vulnerabilities. The CCRA3 Advice Report and CCRA3 Technical Report assessed that extreme weather is already causing supply chain disruption and that exposure to climate hazards is set to increase.<sup>23</sup> It also noted that there are 'opportunities to learn from the lessons on supply chain resilience during the COVID-19 pandemic' and that 'enhancing supply chain resilience should be a priority for post-COVID recovery planning and should also be a factor in the development of new trade agreements as trade patterns change following EU-Exit.'

**The Government is making progress with its work on food security and supply chains.**

The first part of the independent Dimpleby review of the new National Food Strategy was published in July 2020.<sup>24</sup> Part one focussed on the impacts of Covid-19 and the end of the EU exit transition. It assessed that the food supply chain proved resilient during Covid-19 but reminded us there is no room for complacency and that 'the fact that the food system didn't, in the end, break down is largely due to the nature of this particular crisis.'

On climate the Dimpleby review assessed that 'Climate change is currently the biggest threat to food security, perhaps the most serious the world has ever seen. The problems it creates are likely to be disruptions of supply rather than demand. One worst-case scenario would be the failure of multiple harvests worldwide. If that happened, there might not be enough food to go around. This is a food security issue on a grand scale.'

Part two of the review will assess the entire national food system, including the issues of climate change in more depth.

The UK Government committed in the Agriculture Act 2020 to publish a regular food security report, with the first report published before the end of 2021, and subsequent reports every 3 years.<sup>25</sup> The Food Standards Agency (FSA) has published its Areas of Research Interest (ARI), including considering climate change's influence on patterns of foodborne disease prevalence, the availability or need for new or novel foods, and its impact on international trade.<sup>26</sup>

**Recommendation**

Set out measures to ensure the resilience of the food supply chain, including to the risks of extreme weather in England and internationally, as part of its white paper responding to the independent review of the National Food Strategy for England.

Department: Defra, Timing: 2022.

The Dimpleby review assessed that climate change is currently the biggest threat to food security.

Government has committed to publishing a white paper six months after part two is published and has asked Henry Dimpleby to review progress six months after this.

## Recommendation

Ensure that adaptation is integrated into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the third UK Climate Change Risk Assessment (CCRA3) for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary:

- Risks to the supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (with Defra and DIT)
- Risks to people and the economy from climate-related failure of the power system

In addition, for the coming five-year period 2023-2028, BEIS should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Annex).

Department: BEIS, Timing: By 2023.

### **Government has consulted on changing its procurement processes to better take account of climate change. These are good proposals but require strengthening to really drive progress in planning.**

Public procurement accounts for around a third of all public expenditure at £290 billion according to a 2020 consultation by the Cabinet Office.<sup>27</sup> Government has consulted on ways to improve its public procurement process, including supporting national priorities such as the environment and tackling climate change.

Proposed changes would permit contracting authorities to assess how suppliers are operating across the whole of their business, not just criteria related to the delivery of the contract, for example a supplier's plans for achieving environmental targets across its operations. However, the proposals also state that this would only be allowed in a limited number of circumstances so as not to disadvantage small businesses.

Creating a level playing field for smaller businesses is important, however it is imperative that public procurement sends the right messages to suppliers by asking them to demonstrate their planning for and response to the impacts of climate change. In a previous consultation on social value in procurement, mitigating and adapting to climate change were listed as criteria that departments could use to assess a supplier's contribution to environmental policy objectives.<sup>28</sup>

Guidance should accompany any changes in procurement to ensure that suppliers are asked to provide useful qualitative and quantitative information on their contribution to environmental and climate change goals, and that these criteria are considered as widely as possible across contracts.

### **Government confirmed it is progressing the development of a new Greening Government Commitments (GGC) framework for 2021-25. There is an opportunity to increase the coverage of adaptation in GGC reports.**

In its NAP action update the Government confirmed it is progressing the development of a new Greening Government Commitments (GGC) framework for 2021-25. It is looking to include climate adaptation commitments as part of this framework and aims to publish new commitments in spring 2021. There is an opportunity to increase the coverage of adaptation in GGC reports, such as requesting more detailed information and highlighting best practice through case studies to help departments learn from one another. Reporting requirements for the most recent GGC report were reduced to the impact of Covid-19 on government departments.

Suppliers should provide evidence of their contribution to environmental and climate change goals, and these criteria should be considered as widely as possible across contracts.

**There are also examples from the private sector of greater consideration of the sustainability and resilience of their supply chains.**

HSBC and the Sustainability Consortium published a report in 2020 on improving supply chain resilience to manage climate change risks.<sup>29</sup> It discusses physical risk and why this may be different to other supply chain risks that organisations may face, as well as strategies to improve supply chain resilience.

There are other examples which do not currently focus on the risks from climate change specifically but have developed approaches which could be applied and learned from. WRAP's Sustainable Clothing Action Plan aims to reduce the environmental footprint of clothing by bringing together industry, government and the third sector. Industry includes both retailers and suppliers, as well as trade bodies. One of the working groups focuses specifically on metrics. The Courtauld Commitment 2025 has similar aims and processes to address sustainability issues in food and drink supply chains.

These and other approaches could help inform new industrial and economic strategies and policies, which must take into account the long-term impacts of climate change on supply chain resilience.

### Has the risk management score changed?

**Yes, the risk management score has decreased from medium to low. This is because of new evidence published since 2019 that points to a higher degree of underlying risk, while action has remained at roughly the same level, with mixed progress.**

**In addition to the impact of Covid-19, recent survey evidence from the Economist Intelligence Unit suggests high costs associated with supply chain disruption. It also suggests businesses are rethinking their approaches to supply chain management following Covid-19.**

In 2021 The Economist Intelligence Unit assessed the business costs of supply chain disruption across eight countries, including the UK.<sup>30</sup> In November and December 2020 it surveyed 400 senior supply-chain and procurement executives in five sectors (agriculture and food, industry, consumer goods and retail, healthcare and pharmaceuticals, and energy and utilities).

Its research found that disruptions have incurred substantial financial costs over the past three years, averaging 6 to 10% of annual revenues, as well as reputational costs, in terms of customer complaints and damage to brand reputation, as companies have struggled to maintain supplies of their goods. 54% of the executives surveyed said that organisations must make significant changes in order to effectively manage supply-chain disruptions in the next five years.

The report assesses that 'until now, companies have emphasised efficiency. But this is changing, with firms recognising a need to prioritise supply-chain resilience. Six in ten respondents agreed that redundancy and resilience in their company's supply chain are more important than speed and efficiency, with a third of respondents strongly agreeing. Climate-related risks and natural disasters are among the factors considered most likely to impact supply chains in the next five years, though geopolitical and pandemic-related risks were cited by a higher proportion of respondents.

A recent Economist Intelligence Unit survey suggests supply chain disruptions have incurred substantial financial costs over the past three years, averaging 6 to 10% of annual revenues, as well as reputational costs.

UK respondents to CDP reported \$2.2 billion of revenue at risk over the next five years due to physical and transition climate change risks, deforestation and water insecurity risks in their supply chains.

### **Other recent survey evidence suggests mixed progress for the responses of business to supply chain risks.**

In response to CDP's Supply Chain Survey in 2020, respondents from all countries expected total increased costs of \$120 billion in the next five years, caused by physical environmental impacts as well as addressing regulation and market changes, which could be passed on to buyers.<sup>31</sup> UK respondents reported \$2.2 billion of increased costs over the next five years due to climate change (including mitigation), deforestation and water insecurity risks in their supply chain.

Research by Eco Act in 2020 found that 64% of FTSE100 companies assessed value chain risks. It found businesses in the fast-moving consumer goods sector, a key sector for supply chain risks, generally performed better on its survey responses, though only half of respondents, across the FTSE100, DOW30, IBEX35 and CAC40 indexes, made use of scenario analysis. 89% of all FTSE 100 companies reported some engagement with their suppliers on climate change issues, though this includes mitigation as well as adaptation. The number of businesses disclosing to CDP in 2020 through its supply chain survey published in 2021 was nearly 8,100, more than double the amount in 2015.

## 5.4 Water demand by industry

Progress summary – Water demand by industry		
2019 score:	What has changed since 2019:	2021 score:
5	<p><b>Plan score - medium</b></p> <ul style="list-style-type: none"> <li>There is no change in the plan score from 2019. The Environment Agency's National Framework identifies key sectors for regional water groups to engage with and agree strategies for managing their water use. The retail market continues to only deliver limited benefits in terms of improved water efficiency. However, the Retailer Wholesaler Group (RWG) water efficiency sub-group, supported by the Environment Agency and Ofwat, has set out an action plan to improve this. There remains a lack of clear targets for the contribution of industry to managing water availability.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>There is no change in the risk management score from 2019. Non-household consumption of the public water supply is roughly the same as a decade ago. There is no more recent data on abstraction by industry than there was in 2019. Survey evidence published since 2019 suggests some sectors and businesses are reducing their water use. Additional data which take into account production levels are still required to assess genuine improvements in water efficiency in the future.</li> </ul>	5
<p>Notes: See annex for full datasets            Key Indicators: Abstraction by industry (Ml/d), Non-household consumption of the public water supply (Ml/d), Businesses reporting water use per unit of production.</p>		

### Summary of 2019 report score

**In our last report, water demand by industry scored a 5 (medium plan score, medium risk management score).**

Our last report found that there were some plans in place to reduce water use by businesses through abstraction reform, the water retail market and company initiatives and targets. However, there was no overarching plan or target and the effect of the water retail market on improving water efficiency was limited.

Direct abstraction from freshwater sources had fallen between 2012 and 2017 but consumption from the public water supply was the same as in 2012. There was good evidence that some businesses were reducing water use, for example reporting members of the Food and Drink Federation.

### Has the plan score changed?

**No, the plan score remains medium. There has been significant progress through the Environment Agency's National Framework and joint letter with Ofwat to improve uptake of water efficiency measures by business. There remains a lack of clear targets for the contribution of business to managing future water availability.**

**The Environment Agency's National Framework sets out how regional groups should work with local business sectors to help manage water availability in their regions.**

Based on the analysis for the National Framework for water resources in 2020, the Environment Agency identified key abstractors and water using sectors for regional groups to engage with:<sup>32</sup>

- Water Resources East should continue to engage with the agricultural sector (particularly spray irrigation), the food and drink industry, power sector and wider industry.
- Water Resources South East should engage with industry, particularly paper and pulp, and agriculture. This includes previously exempt abstractors using trickle irrigation for a range of purposes such as soft fruit growers.
- West Country Water Resources should engage with the minerals sector and agriculture (particularly the livestock subsector).
- Water Resources West should engage with navigation operators and industry, particularly the chemicals sector, as well as agriculture.
- Water Resources North should engage the power generation sector, industry and agriculture.

Reducing the demand for water from the non-household sector would have co-benefits such as improving the efficiency of business processes and reducing energy consumption.

The assessment identifies that reducing the demand for water from non-household sectors will play an important part in reducing demand overall and would have co-benefits such as improving the efficiency of business processes and reducing energy consumption. Regional groups' engagement is expected to include the approach to planning for water resources, managing droughts, reducing demand, and forecasting and monitoring non-household use of mains water. It will also consider a range of solutions such as re-using process water for other neighbouring businesses or large and business scale grey and rainwater harvesting.

**Ofwat's review of the retail market suggests it is still only having a limited impact on water efficiency. However, the Retailer Wholesaler Group (RWG) water efficiency sub-group, supported by the Environment Agency and Ofwat, has set out an action plan to improve this.**

Only around 6% of businesses who switched suppliers in 2019 received new water efficiency or leak detection devices as a result of switching.

Ofwat's third review of the impact of the water retail market for businesses in 2020 found that take-up of water efficiency services has increased but remains low.<sup>33</sup> Only around 6% of businesses who switched suppliers in the year preceding the report received new water efficiency or leak detection devices as a result of switching. Ofwat acknowledged this lack of progress in a joint open letter with the Environment Agency.<sup>34</sup>

The Retailer Wholesaler Group (RWG) water efficiency sub-group has since consulted and signed off a Headline Action Plan with a series of actions and milestones, mostly over the coming year, which Ofwat and the Environment Agency have publicly supported.<sup>35</sup> The plan has now been presented to the Senior Water Demand Steering Group (SWDSG), a new group established by Defra, as part of a new monitoring and reporting framework to report on progress on demand management.

As part of the environmental targets under the Environment Bill, it is being considered whether to set a target for the overall demand for water. By including non-household use, this would help to drive progress in conjunction with the retail market.<sup>36</sup>

## Recommendation

Work with the Environment Agency, Ofwat and other stakeholders to set out targets and supporting measures for reducing water use by business. This could be through ensuring that any water reduction targets linked to the Environment Bill include business as well as household water use, as well as responding to advice and recommendations from Defra's new Senior Water Demand Reduction Group.

Department: Defra, Timing: 2022.

### **There are examples of private sector initiatives which plan to reduce water at sector or company level.**

The Food and Drink Federation (FDF) and several member companies are supporters of the Courtauld 2025 Water Ambition. This commits signatory businesses to monitor water use in their own operations, improve efficiency and work collectively to improve the quality and availability of water in key sourcing areas by 2025. It includes a catchment project in the UK and going forward, the FDF and WRAP will look to develop a Water Roadmap for businesses.

### Has the risk management score changed?

**No. There is some evidence of positive action by industry to reduce water use. Additional data which take into account production levels are still required to assess genuine improvements in water efficiency in the future.**

### **Non-household consumption of the public water supply is at roughly the same level as a decade ago.**

Data from the Environment Agency suggest that non-household consumption of the public water supply was 2,700 MI/d in 2019/20.<sup>37</sup> This is the same as for our last report two years ago, but also the same as consumption in 2009/10. Due to the impacts of Covid-19 on resources for data collection, there are no updated data for abstraction. Additional data which take into account production levels are still required to assess genuine improvements in water efficiency.

### **Reports and survey data suggest positive action by businesses to address water efficiency, though this is not necessarily widespread across sectors.**

In CDP's most recent Global Water Report published in 2021, disclosures indicate that not addressing water risks is more costly than addressing them, though this includes flooding in addition to water availability.<sup>38</sup> The information submitted suggested the potential financial impact of global water risks to businesses is five times higher than the cost of addressing them. The sectors facing highest financial impacts are manufacturing, power generation, and food, beverage, and agriculture.

Since 2018, almost two-thirds of responding companies state they are reducing or at least maintaining their water withdrawals compared to the previous year. 27% of respondents reported adopting water efficiency, conservation, re-use and recycling measures and the proportion that factor water availability at a basin or catchment level into water risk assessments had increased from the previous year's survey from 48% to 65% of respondents.

CDP's Global Water Report also highlighted case studies of action by businesses. L'Oréal uses a 'waterloop' standard, where all process water is reused or recycled on site. It reports that the cost of equipping facilities with the water recycling technology required is lower than the potential financial impact of water-related risks. It aims to use this approach in all of its factories by 2030. Nissan uses rainwater

Non-household consumption of the public water supply was 2,700 MI/d in 2019/20. This is the same as for our last report two years ago, but also the same as consumption in 2009/10.

There are good examples of businesses developing processes to re-use or recycle water for which they report that the benefits exceed the costs.

harvesting and wastewater recycling at one its sites, allowing it to be independent of external water sources and save on water bills through reducing use.

Food and Drink Federation (FDF) members reporting in 2019 had reduced their absolute water consumption by 41.5% between 2007 and 2019 and the amount of water consumed per tonne of product was reduced by 44.5% over the same period.<sup>39</sup>

## 5.5 Business opportunities from climate change adaptation

Progress summary – Business opportunities from climate change adaptation		
2019 score:	What has changed since 2019:	2021 score:
2	<p><b>Plan score - low</b></p> <ul style="list-style-type: none"> <li>There is no change in the plan score from 2019. There has been progress in planning for a green recovery in response to the economic impacts from Covid-19, launching a race for resilience and some promising pilot schemes for adaptation. However, the business opportunities from climate change adaptation specifically are generally not considered in relevant national plans or strategies.</li> </ul> <p><b>Risk management score - medium</b></p> <ul style="list-style-type: none"> <li>There is no change in the risk management score from 2019. From the available data it is not possible to tell the extent to which UK businesses are planning for any direct opportunities from climate change (such as potentially longer growing seasons). There is some evidence published since 2019 suggesting businesses are considering opportunities from climate change adaptation.</li> </ul>	2
<p>Notes: See annex for full datasets            Key Indicators: Number of businesses reporting that they assess opportunities from climate change adaptation, Issues of resilience or other sustainability bonds to finance adaptation opportunities, Sales of adaptation goods and services.</p>		

### Summary of 2019 report score

**In our last report, business opportunities from climate change adaptation scored a 2 (low plan score, medium risk management score).**

Our last report found that there was no overarching plan and the Industrial Strategy did not mention climate change as a potential driver of business growth or city regeneration through adaptation-related technologies. There were no specific schemes from Innovate UK or use of the Industrial Strategy Challenge Fund to encourage climate-related adaptation opportunities.

Opportunities were identified for banking and green finance which had the potential to direct more finance towards adaptation and develop new adaptation products and services. The available data did not demonstrate the extent to which businesses were realising the opportunities from climate change.

### Has the plan score changed?

**No, the plan score remains low. There has been progress in planning for a green recovery in response to the economic impacts from Covid-19 and achieving Net Zero, and some promising pilot schemes for adaptation. However, to improve the score, there needs to be better plans at national level.**

**The Government has set out plans for transforming the financial system to better support environmental objectives. These plans reference the opportunities from climate change adaptation, though there is little detail at this stage.**

Shortly after our last report in 2019, the Government published its Green Finance Strategy.<sup>40</sup> The strategy specifically mentioned 'championing the resilience agenda' and exploring measures to unlock new revenue streams in areas such as natural capital and resilience.

It is due to conduct a formal review of progress against the ambitions and plans across all parts of the Green Finance Strategy in 2022.

A report by the London Stock Exchange Group in December 2020 highlighted examples of the use of new green finance products around the world, including for adaptation and resilience, such as green and sustainability bonds.<sup>41</sup> The review of the Green Finance Strategy should consider these and other new products and services. The review should also consider how the use of these or similar products and services could be increased and therefore create more opportunities for UK businesses from climate change adaptation.

The new sovereign green bond could help provide green and resilient infrastructure and create jobs.

In addition to announcing plans for making TCFD reporting mandatory, the UK Government announced a sovereign green bond in 2020. The Green Finance Institute assessed that this 'delivers on plans to move towards a resilient, Net Zero carbon economy,' it will 'bring a range of positive social benefits such as creating green collar jobs, skills and regional revitalisation,' and 'provide finance for green infrastructure, it will create green jobs and catalyse the sterling green bond market.'<sup>42</sup>

**The 2021 Dasgupta Review of the economics of biodiversity highlights the need for new standards, data and tools to help businesses and financial institutions integrate nature-related considerations into their decision-making.**

The 2021 Dasgupta Review of the economics of biodiversity identified the need for a financial system that channels financial investments – public and private – towards economic activities that enhance the stock of natural assets and encourages sustainable consumption and production activities.<sup>43</sup>

Much like for TCFD reporting and climate change, it sets out that 'what is ultimately required is a set of global standards underpinned by credible, decision-grade data, which businesses and financial institutions can use to fully integrate Nature-related considerations into their decision-making, and assess and disclose their use of, and impact on, Nature.'

Transforming the financial system to achieve this should incorporate the long-term impacts of climate change and consider the opportunities this transformation could create for business in the financial sector and more widely. Tools such as ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) could be promoted to help businesses become aware of new opportunities related to natural capital.

**A 'Race to Resilience' has been launched for COP26. This and other international initiatives can help to raise awareness of adaptation opportunities at the same time as improving resilience in the UK and other countries.**

The 'Race to Resilience' was announced in January 2021 and aims by 2030, to catalyse action by non-state actors\* that builds the resilience of 4 billion people from vulnerable groups and communities to climate risks.<sup>44</sup> The campaign will report back on progress annually starting at COP26. Mark Carney also announced a strategy for building a private finance system for Net Zero, with one of the four pillars being 'returns.' Similar principles could be used to consider the opportunities for adaptation.

**There could also be more opportunities for UK businesses if measures for a green recovery are able to better integrate adaptation and resilience.**

\* Non-state actors for the Race to Resilience could be individual companies, cities, regions, NGOs or organizations.

If more people work at home, there will be opportunities for new products and services which help people to be productive, including during periods of hot weather now and in the future.

In 2020, the Government has also announced a series of measures to help support a green recovery from the economic impacts of Covid-19, such as a ten-point plan for a green industrial revolution and a green jobs taskforce on skills, both currently focussed on Net Zero.<sup>45</sup> The Institute for Apprenticeships and Technical Education has also launched a green apprenticeships advisory panel.<sup>46</sup> Many of the areas under the ten-point plan will require consideration of mitigation and adaptation in parallel.

There could also be more opportunities for adaptation-related jobs and apprenticeships schemes particularly given possible changes in work and supply chains as a result of Covid-19 and the end of the transition period after leaving the EU. For example, if more people work at home, there will be opportunities for new products and services which help people to be productive, including during periods of hot weather now and in the future.

A report published by the Green Alliance in May 2021 considers the potential for creating new green jobs across Britain and found opportunities in seagrass planting, tree planting and wetlands restoration, peatland restoration initiatives and creating new green spaces.<sup>47</sup>

**There are examples of regional or project use of green finance which support adaptation and could be scaled up to provide greater opportunities for business.** The IGNITION project aims to increase investment in Greater Manchester's natural environment and build the city region's ability to adapt to the increasing impacts of climate change.

An example is the Greater Manchester IGNITION project which aims to develop innovative financing solutions for investment in Greater Manchester's natural environment and build the city region's ability to adapt to the increasing impacts of climate change.<sup>48</sup> It focuses on solutions such as rain gardens, street trees, green roofs and walls and development of green spaces. The aim is to develop a model that enables major investment in large-scale environmental projects which can increase climate resilience.<sup>49</sup>

From 12 February 2021, organisations can apply for a natural environment investment readiness fund (NEIRF) grant.<sup>50</sup> The NEIRF is a competitive grants scheme providing grants of between £10,000 and £100,000 to support environmental projects in England. Projects should have the ability to produce revenue from ecosystem services to attract and repay investment. Ecosystem services could include selling biodiversity units from a habitat bank or selling 'catchment services' such as improved water quality and natural flood management benefits resulting from natural environment improvements.

Has the opportunity score changed?

**No, the opportunity score remains medium. From the available data it is not possible to tell the extent to which UK businesses are realising the opportunities from climate change. There is some evidence published since 2019 suggesting businesses are considering opportunities from climate change adaptation.**

**There is some work being undertaken by government departments and agencies to create adaptation-related export opportunities for UK businesses.**

There are several NAP Action updates related to opportunities. UK Export Finance is undertaking work with the Environment Agency and OGDs on export opportunities related to 'flood control risk management,' with the aim of producing a 'prospectus' in 2021.

The Department for International Trade (DIT) carried out work to help businesses and the City of London demonstrate leadership in finance and insurance, including through the 2021 Global Resilience Summit. DIT is also undertaking work to link UK firms with international partners to help deliver resilient infrastructure in other countries.

**There is evidence of a growing demand for adaptation-related advisory services and data.**

In January 2020 a special issue of the journal 'Climate Services' summarised the findings of two EU-funded projects, called MARCO and EU MACS.<sup>51</sup> These projects aimed to characterise the current and untapped market for climate services in Europe and derive opportunities for market growth. For the UK they identified a range of case studies and examples for different types of services:

- adaptation and engineering solutions;
- risk assessments and reporting;
- climate models and scenario analyses
- climate finance;
- climate data;
- climate communications; and
- climate intelligence.

This demand for better business capability when it comes to assessing physical risk and adaptation can also be seen in recent corporate acquisitions; insurance broker Willis Towers Watson recently acquired adaptation consultancy Acclimatise, and McKinsey acquired consultancy Vivid Economics and climate analytics platform Planetrics.

**Survey evidence published since 2019 suggests there may be significant opportunities for businesses and that some are planning specifically for adaptation. However, much of this evidence is either for both mitigation and adaptation (making adaptation difficult to separate out) or for companies based outside the UK.**

Research by Eco Act in 2020 found that 70% of FTSE 100 companies assess the opportunities from climate change, though this is for both mitigation and adaptation. Data published by FTSE Russell in 2020 suggest that the green economy, and potentially related opportunities for climate change adaptation, is increasing in size. FTSE Russell's analysis found that the global green economy has grown from US\$2 trillion in 2009 to US\$4 trillion in 2018, an annualized growth rate of 8%.<sup>52</sup> However, it still remains a small proportion of all finance and the UK in particular has relatively low exposure to the green economy compared to other countries. In the 2020 TCFD Status Report, a case study from Pfizer stated that it was seizing the opportunities presented by climate change adaptation, particularly in terms of sustainable product development. It claims it is the first company in the pharmaceutical sector to issue a green bond.

Based on the responses of the 500 biggest companies by market capitalization that disclosed to CDP in 2018, \$236 billion of potential increased revenue through new solutions to adaptation needs was identified in a 2019 CDP report. The responses covered a range of sectors, though manufacturing businesses identified the most potential revenue of any sector.<sup>53</sup>

70% of FTSE 100 companies reported they assess the opportunities from climate change mitigation and adaptation.

# Endnotes

- <sup>1</sup> ONS (2020) *Coronavirus and homeworking in the UK labour market: 2019*.
- <sup>2</sup> ONS (2021) *Social behaviours during the different lockdown periods of the coronavirus (COVID-19) pandemic*.
- <sup>3</sup> BEIS (2020) *Business population estimates 2020*.
- <sup>4</sup> HM Treasury (2020) *A Roadmap towards mandatory climate-related disclosures*.
- <sup>5</sup> DWP (2021) *The Occupational Pension Schemes (Climate Change Governance and Reporting) Regulations 2021*.
- <sup>6</sup> BEIS (2021) *Consultation on requiring mandatory climate-related financial disclosures by publicly quoted companies, large private companies and Limited Liability Partnerships (LLPs)*.
- <sup>7</sup> IFRS (2021) *Foundation Trustees announce strategic direction and further steps based on feedback to sustainability reporting consultation* [Blog – 08 March 2021].
- <sup>8</sup> CDP et al. (2020) *Statement of Intent to Work Together Towards Comprehensive Corporate Reporting*.
- <sup>9</sup> CDP et al. (2020) *Reporting on enterprise value: Illustrated with a prototype climate-related financial disclosure standard*.
- <sup>10</sup> Financial Reporting Council (2020) *Time to raise the bar on climate change reporting* [Blog – 10 November 2020].
- <sup>11</sup> BEIS (2021) *Restoring trust in audit and corporate governance: Consultation on the government's proposals*.
- <sup>12</sup> TCFD (2020) *2020 Status Report*.
- <sup>13</sup> Acclimatise et al. for Chapter Zero (2020) *Questions to Assist Non-Executive Director Oversight of Physical Climate Risk management*.
- <sup>14</sup> TCFD (2020) *Guidance on Risk Management Integration and Disclosure*; TCFD (2020) *Guidance on Scenario Analysis for Non-Financial Companies*.
- <sup>15</sup> ONS (2020) *The impact of the coronavirus so far: the industries that struggled or recovered*.
- <sup>16</sup> Bank of England (2020) *How has Covid-19 affected small UK companies?*
- <sup>17</sup> FSB (2015) *Severe Weather: A More Resilient Small Business Community*; Chartered Management Institute (2013) *Weathering the Storm: 2013 Business Continuity*.
- <sup>18</sup> Moody's (2020) *TCFD report*.
- <sup>19</sup> ABI (2019) *Yorkshire and Midlands flood damage payouts set to top £100 million says the ABI* [Blog 27 November 2019].
- <sup>20</sup> Sayers et al. for the CCC (2020) *Third UK Climate Change Risk Assessment (CCRA3) Future flood risk Main Report*.
- <sup>21</sup> House of Commons International Trade Committee (2020) *The COVID-19 pandemic and international trade: First Report of Session 2019–21*.
- <sup>22</sup> HM Government (2020) *The COVID-19 pandemic and international trade: Government Response to the Committee's First Report of Session 2019–21*.
- <sup>23</sup> CCC (2021) *The Third UK Climate Change Risk Assessment (CCRA3) - Advice to Government*; Surminski, S. (2021) *Business and industry*. In: *The Third UK Climate Change Risk Assessment*

- Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London; Challinor, A. and Benton, T. (2021) *International Dimensions*. In: *The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London.
- <sup>24</sup> Dimbleby et al. (2020) *National Food Strategy: Part One*.
- <sup>25</sup> NAP Action Update (2021).
- <sup>26</sup> NAP Action Update (2021).
- <sup>27</sup> Cabinet Office (2020) *Transforming public procurement*.
- <sup>28</sup> Cabinet Office (2019) *Social Value in Government procurement*.
- <sup>29</sup> HSBC and the Sustainability Consortium (2020) *Improving Supply Chain Resilience to Manage Climate Change Risks*.
- <sup>30</sup> Economist Intelligence Unit for GEP (2021) *The Business Costs of Supply Chain Disruption*.
- <sup>31</sup> CDP (2021) *CDP Global Supply Chain Report 2020*.
- <sup>32</sup> Environment Agency (2020) *Meeting our future water needs: a national framework for water resources*.
- <sup>33</sup> Ofwat (2020) *State of the market 2019-20: review of the third year of the business retail water market*.
- <sup>34</sup> Ofwat and the Environment Agency (2020) *Delivering greater water efficiency in the business sector: A joint Ofwat – Environment Agency open letter*.
- <sup>35</sup> RWG Water Efficiency Sub-Group (2021) *Delivering Greater Water Efficiency in the Business Sector Action Plan*.
- <sup>36</sup> Defra (2020) *Policy paper: 19 August 2020: Environment Bill - environmental targets*.
- <sup>37</sup> Environment Agency (2021) Unpublished.
- <sup>38</sup> CDP (2020) *Global Water Report*.
- <sup>39</sup> Food and Drink Federation (2021) *Shaping Sustainable Value Chains Progress Report 2020*.
- <sup>40</sup> HM Government (2019) *Green Finance Strategy*.
- <sup>41</sup> London Stock Exchange Group (2020) *Navigating the green finance landscape*.
- <sup>42</sup> Green Finance Institute (2020) *UK Government announces a sovereign green bond* [Blog 9 November 2020].
- <sup>43</sup> Dasgupta et al. for HM Treasury (2021) *The Economics of Biodiversity: The Dasgupta Review*.
- <sup>44</sup> UNFCCC (2021) *Race to Resilience: Catalysing a step-change in global ambition to build the resilience of 4 billion people by 2030*.
- <sup>45</sup> BEIS and the Prime Minister's Office, 10 Downing Street (2020) *The Ten Point Plan for a Green Industrial Revolution*.
- <sup>46</sup> Institute for Apprenticeships (2020) *Invitation to join new green apprenticeships advisory panel* [2 December 2020].
- <sup>47</sup> WPI Economics for Green Alliance (2021) *Jobs for a green recovery: levelling up through nature*.
- <sup>48</sup> Greater Manchester Combined Authority (2020) *The IGNITION Project*.
- <sup>49</sup> Greater Manchester Green City Region (2020) *IGNITION: overcoming the challenges* [30 November 2020].

- <sup>50</sup> Environment Agency (2021) *Apply for a grant from the natural environment investment readiness fund*.
- <sup>51</sup> Climate Services (2020) *Special issue on European Climate Services Markets – Conditions, Challenges, Prospects, and Examples*. Edited by T.-T Le, A.H. Perrels, J. Cortekar. Volume 17, January 2020.
- <sup>52</sup> FTSE Russell (2020) *Investing in the green economy – sizing the opportunity*.
- <sup>53</sup> CDP (2019) *Major Risk or Rosy Opportunity: Are companies ready for climate change?*

# Departmental risk owners

This report assesses progress for 33 adaptation priorities representing different policy teams in the UK Government. In CCRA3, there are 61 risks and opportunities that should be included in the next iteration of the National Adaptation Programme. Table 1 below shows the departmental owners for the risks and opportunities in CCRA3, which are linked to the Committee's recommendations (see Executive Summary). It also shows a rough mapping to the priorities assessed in this report.

<b>Table A2</b> CCRA3 risks, departmental owners and adaptation priorities			
CCRA3 Risk or opportunity	Lead department	Secondary departments	Progress Report Adaptation Priority
N1 - Risks to terrestrial species and habitats from changing climatic conditions and extreme events	Defra		Terrestrial habitats and species Farmland habitats and species
N2 - Risks to terrestrial species and habitats from pests, pathogens and invasive species	Defra		Terrestrial habitats and species Farmland habitats and species
N3 - Opportunities from new species colonisations in terrestrial habitats	Defra		Terrestrial habitats and species Farmland habitats and species
N4 - Risk to soils from changing climatic conditions, including seasonal aridity and wetness.	Defra		Terrestrial habitats and species Agricultural productivity Commercial forestry
N5 - Risks to natural carbon stores and sequestration from changing climatic conditions, including temperature change and water scarcity.	Defra		Terrestrial habitats and species Agricultural productivity Commercial forestry
N6 - Risks to and opportunities for agricultural and forestry productivity from extreme events and changing climatic conditions	Defra		Agricultural productivity Commercial forestry Water management
N7 - Risks to agriculture from pests, pathogens and invasive species	Defra		Agricultural productivity
N8 - Risks to forestry from pests, pathogens and invasive species	Defra		Commercial forestry
N9 - Opportunities for agricultural and forestry productivity from new/alternative species becoming suitable.	Defra		Agricultural productivity Commercial forestry
N10 - Risks to aquifers and agricultural land from sea level rise, saltwater intrusion	Defra		Agricultural productivity
N11 - Risks to freshwater species and habitats from changing climatic conditions and extreme events	Defra		Freshwater habitats and species Water management

N12 - Risks to freshwater species and habitats from pests, pathogens and invasive species	Defra		Freshwater habitats and species
N13 - Opportunities to freshwater species and habitats from new species colonisations	Defra		Freshwater habitats and species
N14 - Risks to marine species, habitats and fisheries from changing climatic conditions, including ocean acidification and higher water temperatures.	Defra		Marine and coastal habitats and species Commercial fisheries and aquaculture
N15 - Opportunities to marine species, habitats and fisheries from changing climatic conditions	Defra		Marine and coastal habitats and species Commercial fisheries and aquaculture
N16 - Risks to marine species and habitats from pests, pathogens and invasive species	Defra		Marine and coastal habitats and species Commercial fisheries and aquaculture
N17 - Risks and opportunities to coastal species and habitats due to coastal flooding, erosion and climate factors	Defra		Marine and coastal habitats and species
N18 - Risks and opportunities from climate change to landscape character	Defra		N/A
I1 - Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures	Cabinet Office	BEIS, DfT, MHCLG, DCMS	Infrastructure interdependencies Design/location of new infrastructure
I2 - Risks to infrastructure services from river, surface water and groundwater flooding	Defra	BEIS, DfT, MHCLG	River and coastal flood alleviation Surface water flood alleviation Development – surface water flooding Development – river or coastal flooding Energy sector Rail network Strategic road network Local road network Ports Airports Design/location of new infrastructure Telecoms, digital and ICT
I3 - Risks to infrastructure services from coastal flooding and erosion	Defra	BEIS, DfT, MHCLG	River and coastal flood alleviation Surface water flood alleviation Development – surface water flooding

			Development – river or coastal flooding Energy sector Rail network Strategic road network Local road network Ports Airports Telecoms, digital and ICT Design/location of new infrastructure
I4 - Risks to bridges and pipelines from flooding and erosion	Defra	DfT, BEIS, MHCLG	River and coastal flood alleviation Rail network Strategic road network Local road network Energy
I5 - Risks to transport networks from slope and embankment failure	DfT	MHCLG	Rail network Strategic Road Network Local road network
I6 - Risks to hydroelectric generation from low or high river flows	BEIS		Energy
I7 - Risks to subterranean and surface infrastructure from subsidence	Defra	BEIS, DfT, DCMS, MHCLG	Energy Telecoms, digital and ICT
I8 - Risks to public water supplies from reduced water availability	Defra		Public water supply infrastructure Water demand – built environment
I9 - Risks to energy generation from reduced water availability	BEIS		Energy
I10 - Risks to energy from high and low temperatures, high winds, lightning	BEIS		Energy
I11 - Risks to offshore infrastructure from storms and high waves	BEIS		Energy
I12 - Risks to transport from high and low temperatures, high winds, lightning	DfT	MHCLG	Rail network Strategic road network Local road network
I13 - Risks to digital from high and low temperatures, high winds, lightning	DCMS	MHCLG	Telecoms, digital and ICT
H1 - Risks to health and wellbeing from high temperatures	MHCLG	DHSC, BEIS	Health impacts from heat and cold
H2 - Opportunities for health and wellbeing from higher temperatures	DHSC		Health impacts from heat and cold

H3 - Risks to people, communities and buildings from flooding	Defra	MHCLG, Cabinet Office,	River and coastal flood alleviation Surface water flood alleviation Development – surface water flooding Recovery from flooding Property-level flood resilience
H4 - Risks to people, communities and buildings from sea level rise	Defra	MHCLG	River and coastal flood alleviation Recovery from flooding Coastal erosion risk management
H5 - Risks to building fabric	MHCLG	BEIS	N/A
H6 - Risks and opportunities from summer and winter household energy demand	BEIS		Energy
H7 - Risks to health and wellbeing from changes in air quality	Defra	DHSC	Air quality
H8 - Risks to health from vector-borne diseases	DHSC		Human pathogens
H9 - Risks to food safety and food security	Defra		Human pathogens
H10 - Risks to health from water quality and household water supply	Defra		N/A
H11 - Risks to cultural heritage	DCMS		N/A
H12 - Risks to health and social care delivery	DHSC	MHCLG	Emergency planning system Health impacts from heat and cold
H13 - Risks to education and prison services	MoJ and DfE		Health impacts from heat and cold
B1 - Risks to business sites from flooding	Defra	BEIS, MHCLG, DfT	Extreme weather impacts on business
B2 - Risks to business locations and infrastructure from coastal change from erosion, flooding and extreme weather events	Defra	BEIS, MHCLG, DfT	Extreme weather impacts on business
B3 - Risks to businesses from water scarcity	Defra	BEIS	Water demand by industry
B4 - Risks to finance, investment and insurance including access to capital for businesses	BEIS	DIT, DWP, HMT	N/A
B5 - Risks to business from reduced employee productivity due to infrastructure disruption and higher temperatures in working environments	BEIS	DHSC, DWP	Health impacts from heat and cold Extreme weather impacts on business

B6 - Risks to business from disruption to supply chains and distribution networks	BEIS	DfT, MHCLG, DIT	Supply chain interruptions
B7 - Opportunities for business from changes in demand for goods and services	BEIS	DIT	Business opportunities from adaptation
ID1 - Risks to UK food availability, safety, and quality from climate change overseas	Defra	FCDO, DIT	Supply chain interruptions
ID2 - Opportunities for UK food availability and exports from climate impacts overseas	Defra	FCDO, DIT	N/A
ID3 - Risks to the UK from climate-related international human mobility	FCDO	Home Office	N/A
ID 4 - Risks to the UK from international violent conflict resulting from climate change on the UK	FCDO	Home Office, MoD, Cabinet Office	N/A
ID5 - Risks to international law and governance from climate change overseas that will impact the UK	FCDO	MoD, Cabinet Office	N/A
ID6 - Opportunities from climate change (including arctic ice melt) on international trade routes	DIT	FCDO	N/A
ID7 - Risks from climate change on international trade routes	DIT		Supply chain interruptions
ID8 - Risk to the UK finance sector from climate change overseas	HM Treasury	DIT, FCDO	N/A
ID9 - Risk to UK public health from climate change overseas	DHSC	FCDO	Human pathogens
ID10 - Risk multiplication from the interactions and cascades of named risks across systems and geographies	Cabinet Office		N/A
Source: CCC, Defra			

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# June 2021

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Progress in adapting to climate change – 2021 Report to Parliament  
Climate Change Committee

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June 2021

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# Joint Recommendations

## 2021 Report to Parliament



# Climate Change Committee Recommendations

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## Central Government departments:

- **Table A1:** Cabinet Office and Number 10
- **Table A2:** COP Unit, the Foreign, Commonwealth and Development Office (FCDO) and the Department for International Trade (DIT)
- **Table A3:** HM Treasury (HMT)
- **Table A4:** Department for Business, Energy and Industrial Strategy (BEIS)
- **Table A5:** Department for Environment, Food and Rural Affairs (Defra)
- **Table A6:** Department for Transport (DfT)
- **Table A7:** Ministry of Housing, Communities and Local Government (MHCLG)
- **Table A8:** Department for Digital, Culture, Media and Sport (DCMS)
- **Table A9:** Department for Education (DfE)
- **Table A10:** Department for Work and Pensions (DWP)
- **Table A11:** Department of Health and Social Care (DHSC)
- **Table A12:** Home Office and the Ministry of Justice (MoJ)
- **Table A13:** Ministry of Defence (MoD)

## Regulators and the Office for National Statistics:

- **Table A14:** Office of Gas and Electricity Markets (Ofgem)
- **Table A15:** Water Services Regulation Authority (Ofwat)
- **Table A16:** Office for National Statistics (ONS)

## Devolved administrations:

- **Table A17:** The Scottish Government
- **Table A18:** The Welsh Government
- **Table A19:** The Northern Ireland Executive

**Table A1**  
Recommendations for Number 10 and Cabinet Office

Timing

Cross-cutting	Use the <b>Cabinet Committees</b> on Climate Strategy and Climate Action to drive home the need for more pace in policy development across Departments. Consider whether additional governance mechanisms such as independent delivery bodies are required in particular areas, such as heat decarbonisation.	2021-22 Priority recommendation
	Commit to a ' <b>Net Zero Test</b> ' to ensure that all Government decisions are compatible with the legislated emissions targets.	2021 Priority recommendation
	Develop (with BEIS) a <b>public engagement strategy</b> for Net Zero which builds on the findings of the UK Climate Assembly by involving people in decision-making, providing trusted information on decarbonisation choices and the need to reduce emissions and adapt to climate change. The strategy should also identify preferred policy options to empower people to contribute fully towards the path to Net Zero.	2021-22 Priority recommendation
	Support <b>local government</b> (with MHCLG) to play a full role in the Net Zero transition, including through increased resourcing, guidance, involvement in local area energy plans, statutory reporting on the emissions from their estate and reforming the planning framework to enable delivery of low-carbon and climate-resilient measures.  This is likely to require additional funding for staffing and resources for local delivery plans, alongside a 'duty to collaborate' to encourage authorities to work with local, regional and national partners to deliver their climate ambitions.	2021-23  (funding for local authorities at next Budget) Priority recommendation
	Cabinet Office should ensure that <b>adaptation</b> is integrated into major upcoming policies in the next two years related to the priority CCRA3 risk for which it has lead responsibility, coordinating work with other relevant departments as necessary:  <ul style="list-style-type: none"> <li>Multiple risks to the UK from climate change impacts overseas</li> </ul> In addition, for the coming five-year period (2023-2028), Cabinet Office should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the other risks and opportunities in the CCRA3 for which it is the lead department (see Adaptation Report Annex).	By 2023  Priority recommendation
	Review <b>guidance documents</b> used in policy and business case development (e.g. the Green Book) and ensure these are consistent with the requirements of Net Zero and account for the impacts of climate change.	2022
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Cabinet Office should build a strong <b>climate resilience capability</b> for the UK, including making use of storyline or 'what-if' scenarios to assess risks, in addition to or instead of using 'reasonable worst-case' approaches. It should develop an early warning system for global climate shocks. It should consider how more allowance and flexibility can be built into policy making and policy implementation. This could include enhancing the ability of the Government to make fast decisions by bringing in technical advice and expertise quickly when needed, and both protecting, and enhancing, monitoring and surveillance systems to enable faster reactions as events unfold.	By 2023
	Develop and implement fully-funded plans towards making all <b>public buildings and vehicle fleets</b> zero-carbon in the long term. This must include a move to multi-year programmatic funding to deliver the stated ambitions of switching to ultra-low emission vehicles by 2030 and to halve emissions from public buildings by 2032, supported by cross-government strategy (including an ambitious new set of Greening the Government commitments) and capital funding levels in the order of £1 billion/year for buildings.	2021-22
	As the public sector, lead the shift to other positive behaviours that <b>reduce travel demand</b> , for example encouraging home-working.	2021
International (With BEIS and the COP Unit)	Work towards securing more <b>climate finance commitments</b> from developed countries to get back on track for mobilising \$100 billion a year in climate finance as soon as possible.	2021
	Work to bring forward additional <b>emissions reduction ambition</b> from countries that haven't yet strengthened commitments ahead of COP26.	H2 2021
	Place aligning <b>global COVID-19 recovery plans</b> with the goals of the Paris Agreement as a core goal of the UK's G7 and COP26 presidencies.	2021-22
	Ensure that any outcome on <b>international carbon markets</b> at COP26 has high integrity and genuinely supports global ambition to tackle climate change.	H2 2021
	Develop the option of applying either <b>border carbon tariffs or minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.	2021 Priority recommendation

<b>Table A2</b> Recommendations for the COP Unit, the Foreign, Commonwealth and Development Office (FCDO) and the Department for International Trade (DIT)		Timing
Cross-cutting	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
Action in the run-up to COP26	Work towards securing more <b>climate finance commitments</b> from developed countries to get back on track for mobilising \$100 billion a year in climate finance as soon as possible.	2021 (COP26)
	Work to bring forward additional <b>emissions reduction ambition</b> from countries that haven't yet strengthened commitments ahead of COP26.	H2 2021
	Provide a clear commitment prior to COP26 regarding the timescale by which the <b>UK's official development assistance (ODA) contribution</b> will return to 0.7% of GNI given the UK's commitment to align its ODA spend with Paris Agreement requirements and the need for increased finance to achieve the Paris Agreement.	H2 2021
	Place aligning <b>global COVID-19 recovery</b> plans with the goals of the Paris Agreement as a core goal of the UK's G7 and COP26 presidencies.	2021-22
	Ensure that any outcome on <b>international carbon markets</b> at COP26 has high integrity and genuinely supports global ambition to tackle climate change.	H2 2021
	Develop the option of applying either <b>border carbon tariffs or minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.	2021 Priority recommendation
Ongoing climate action	For the coming five-year period (2023-2028), FCDO should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Publish a new strategy for the UK's <b>international climate policy</b> for after COP26 - ensuring that the initiatives for the COP26 presidency have long-term benefits for global emissions over the coming decade and supports the implementation of policies to deliver on strengthened national targets.	H1 2022
	For the coming five-year period (2023-2028), DIT should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks and opportunities in the CCRA3 for which it is the lead department (see Adaptation Report Annex).	2023
	DIT should use trade policy to <b>encourage increased ambition</b> on both climate change mitigation and adaptation in other countries, including considering the role for border carbon adjustments and standards to <b>prevent carbon leakage</b> .	Spring 2022

Table A3 Recommendations for the HM Treasury (HMT)		Timing
	Complete the overdue <b>Net Zero Review</b> , which should: <ul style="list-style-type: none"> <li>Develop a plan for funding decarbonisation fairly, reviewing the distribution of costs for businesses, households and the Exchequer.</li> <li>Set approach to near-term and long-term decarbonisation funding needs.</li> <li>Consider policy implications for a just transition.</li> </ul>	2021 Priority recommendation
	The <b>spending review(s)</b> should ensure departments are fully equipped to deliver the necessary actions across climate change mitigation and adaptation, during the rest of this Parliament and beyond.	2021 Priority recommendation
	For the coming five-year period (2023-2028), outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
Funding	Increase resources for <b>local government</b> to play a full role in the Net Zero transition.	2021-23 (funding for LAs at next budget) Priority recommendation
	Fund plans towards making all <b>public buildings and vehicle fleets</b> zero-carbon in the long term. This must include a move to multi-year programmatic funding to deliver the stated ambitions of switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032, supported by cross-government strategy (including an updated set of Greening the Government commitments) and capital funding levels in the order of £1 billion/year for buildings.	2021-22
	Provide a clear commitment prior to COP26 regarding the timescale by which the <b>UK's official development assistance (ODA) contribution</b> will return to 0.7% of GNI given the UK's commitment to align its ODA spend with Paris Agreement requirements and the need for increased finance to achieve the Paris Agreement.	H2 2021
	Establish mechanisms (with BEIS) to close the substantial funding gap for <b>heat networks</b> , with a multi-year funding programme needed of sufficient scale to deliver the growth in network deployment, and transition to low-carbon heat sources.	2022
Taxation, carbon and energy pricing	Work with BEIS on the <b>Heat and Buildings Strategy</b> : to ensure that relative prices favour a shift to low-carbon technologies, consulting widely including with the Committee on Fuel Poverty; to ensure that sufficient funding is available; and to consider the role of tax incentives (e.g. Stamp Duty differentials). Work with MHCLG and the new buildings safety regulator to ensure that local authorities are properly funded to enforce buildings standards.	2021 Priority recommendation
	Consult on <b>reforms to electricity pricing</b> to remove disincentives to electrification, based on consideration of the strategic and fair allocation of legacy policy costs associated with the past deployment of less-mature low-carbon electricity generation. Also consider the balance of existing taxes, such as the Climate Change Levy, on different energy sources. These reforms in combination with wider sectoral incentives, standards and carbon pricing should remove price barriers to electrification.	H1 2022
	Consult (with BEIS) on the introduction of a <b>carbon tax</b> (either as part of the UK ETS or a separate instrument) aimed at curbing rising emissions from Energy from Waste.	2022
	Reform <b>Vehicle Excise Duty</b> , with larger differentials across all vehicle types, to provide stronger incentives to purchase zero-emission vehicles and reverse the shift towards cars that have higher lifecycle emissions. The reforms should consider the impact and design of second and subsequent year rates, to ensure they encourage the purchase of zero-emission vehicles in the second-hand market.	H1 2022
	<b>Aviation tax reform</b> should seek to address price imbalances between aviation and surface transport, encouraging the low-carbon alternative (e.g. rail) for journeys where one exists. Taxation should also be used, alongside improvements in broadband, to embed positive behaviours that have arisen during the pandemic (e.g. replacing business travel with videoconferencing and online collaboration).	2021-22
	Create a clear incentive for manufacturing facilities not currently covered by the UK ETS to switch to low-carbon energy sources by reforming the suite of energy and carbon policies, which could include rebalancing the <b>Climate Change Levy</b> rates for electricity and gas.	2023
	Set out a clear plan for ensuring that carbon prices and taxes on manufacturers, energy producers and aviation encourage emissions reductions in line with the CCC Pathway, planning for revised (and likely higher) carbon prices from 2023. This should include setting out a <b>cap for the UK ETS</b> consistent with a credible path to the Sixth Carbon Budget for consultation by Q3 2021.	2021
	Develop (with DIT) the option of applying either <b>border carbon tariffs or minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.	2021 Priority recommendation

Table A3 Recommendations for the HM Treasury (HMT)		Timing
Green finance	Develop further ways to embed Net Zero and climate risk in <b>financial decisions</b> by UK firms, building on the UK's Green Finance Strategy. This should include implementing mandatory climate disclosure, adoption of a robust green taxonomy with clear guidance on how it should be used. It should also consider the recommendations of the Committee's Finance Advisory Group, such as making Net Zero and adaptation plans mandatory for financial institutions and monitoring financial flows into climate action.	2021-25
	In the <b>green gilt framework</b> , setting out the rules on what spending green sovereign bonds can be used for, ensure that revenue is used to fund expenditure that will genuinely contribute to Net Zero and improved climate resilience.	2021

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Cross-cutting	<p>Publish the overall <b>Net Zero Strategy</b>. It should:</p> <ul style="list-style-type: none"> <li>• Provide a comprehensive plan for achieving Net Zero, the 2030 NDC and the carbon budgets, setting out ambition for sectors and key technologies and behaviours that together will meet the challenge.</li> <li>• Set out the approach to the key cross-cutting challenges of fair funding, just transition, skills, public engagement, local delivery, governance.</li> <li>• Set timelines for how policies will start to deliver decarbonisation with the required urgency, and ensure that wider policy development is consistent with the UK's climate goals.</li> <li>• Ensure adaptation is properly integrated in the plan, maximising synergies and minimising trade-offs, while recognising the risks and impacts from climate change (see Adaptation Progress Report for more details).</li> <li>• Introduce processes for monitoring progress and mechanisms to course-correct over time.</li> </ul>	2021 Priority recommendation
	<p>Ensure that <b>adaptation is integrated</b> into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the third UK Climate Change Risk Assessment (CCRA3) for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>• Risks to the supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (with Defra and DIT).</li> <li>• Risks to people and the economy from climate-related failure of the power system.</li> </ul> <p>In addition, for the coming five-year period (2023-2028), BEIS should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).</p>	By 2023 Priority recommendation
	<p>Develop a <b>public engagement</b> strategy for Net Zero which builds on the findings of the UK Climate Assembly by involving people in decision-making, providing trusted information on decarbonisation choices and the need to reduce emissions. The strategy should link to engagement on adaptation and identify preferred policy options to empower people to contribute fully towards the path to Net Zero.</p>	2021-22 Priority recommendation
	<p>Ensure <b>all departmental policy decisions</b>, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.</p>	Now and ongoing
International	<p>Update the UK's long-term <b>low greenhouse gas emission development strategy with the UNFCCC</b> to reflect a formulated economy-wide plan to achieve Net Zero by 2050 (expected to be the Net Zero Strategy).</p>	H2 2021
	<p>Place aligning <b>global COVID-19 recovery plans</b> with the goals of the Paris Agreement as a core goal of the UK's G7 and COP26 presidencies.</p>	H2 2022
	<p>Publish a new strategy for the UK's <b>international climate policy for after COP26</b> - ensuring that the initiatives for the COP26 presidency have long-term benefits for global emissions over the coming decade and support the implementation of policies to deliver on strengthened national targets.</p>	H1 2022
Jobs and skills	<p>Working with DWP, DfE, the Home Office and MHCLG, develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.</p>	2021 Priority recommendation
	<p>Design industrial decarbonisation policies to <b>support and create jobs</b>, especially in regions with reliance on industrial jobs.</p>	Now and ongoing

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Supporting business action	<b>Support businesses</b> to play their full role in the Net Zero transition and in adapting to climate risks and opportunities, for example by extending and expanding the role of the Net Zero Business Champion beyond COP26, building on the Race to Zero and Race to Resilience campaigns and providing sufficient resources to fully support businesses of all sizes to engage in the transition, to input to policy development and to set their own robust Net Zero and adaptation action plans.	2021-22
	Develop further ways to embed Net Zero and climate risk in <b>financial decisions</b> by UK firms, building on the UK's Green Finance Strategy. This should include implementing mandatory climate disclosure, adoption of a robust green taxonomy with clear guidance on how it should be used. It should also consider the recommendations of the Committee's Finance Advisory Group, such as making Net Zero and adaptation plans mandatory for financial institutions and monitoring financial flows into climate action.	2021-25
	Determine appropriate regulatory arrangements, rules and guidance for the use of <b>carbon offsetting by UK corporates</b> within their Net Zero strategies, recognising the growing demand for offsetting markets, the interactions with the UK ETS and currently accredited schemes (i.e. the Woodland Carbon Code and the Peatland Code), and the need to avoid double-counting or negative outcomes for non-carbon objectives.	2021-22
Research and data	Drawing on the Energy Innovation Needs Assessments ensure <b>innovation funding</b> (e.g. through UKRI, Catapults, the Industrial Strategy Challenge Funding, BEIS Innovation Programme and the Net Zero Innovation Portfolio) drives forward an extensive research and innovation package for delivering a Net Zero, climate-resilient future.	Now and ongoing
	<b>Make monitoring and data analysis</b> of climate risks more accessible, alongside better digitisation of past records. Further efforts should be taken to make the evidence on climate risks more usable for decision makers through co-design of research programmes with end users, where the user drives the research question from the beginning of the process. A major gap is the lack of projections of impacts in 2°C and 4°C scenarios; this needs addressing as an urgent priority ahead of CCRA4.	2022
	Review plan for improving <b>data collection</b> and statistical reporting for the purposes of monitoring and informing the low-carbon transition, as part of the broader work the ONS are already undertaking to improve the collection of climate-related data.	2022
	Work with ONS to put in place plans to <b>collect and report data</b> annually on low-carbon heat networks, specifically the amount of heat delivered (split by DUKES consumption sector, i.e. Residential/Public/Commercial/Industry, and where possible, by source of heat supply). This should be part of a plan for improving data collection and statistical reporting for the purposes of monitoring and informing the low-carbon transition.	2022
	Improve the collection and reporting of <b>industrial decarbonisation data</b> to allow for progress to be monitored more effectively, particularly on energy and resource efficiency.	2022
	Set out a clear plan (with HMT) for ensuring that carbon prices and taxes on manufacturers, energy producers and aviation encourage emissions reductions in line with the CCC Pathway, planning for revised (and likely higher) carbon prices from 2023. This should include setting out a <b>cap for the UK ETS</b> consistent with a credible path to the Sixth Carbon Budget for consultation by Q3 2021.	2021
Energy / carbon pricing and emissions trading	Consult (with HMT) on <b>reforms to electricity pricing</b> to remove disincentives to electrification, based on consideration of the strategic and fair allocation of legacy policy costs associated with the past deployment of less-mature low-carbon electricity generation. It should also consider the balance of existing taxes, such as the Climate Change Levy, on different energy sources. These reforms in combination with wider sectoral incentives, standards and carbon pricing should remove price barriers to electrification.	H1 2022
	Consult (with HMT) on the introduction of a <b>carbon tax</b> (either as part of the UK ETS or a separate instrument) aimed at curbing rising emissions from Energy from Waste.	2022
	Commit (with DfT) not to use credits from the <b>Carbon Offsetting and Reduction Scheme for International Aviation</b> (CORSIA) for flights covered by the UK ETS unless and until they can satisfy strict eligibility criteria (equivalence, additionality, permanence, sustainability).	2021-22
	Develop (with DfT) the option of applying either <b>border carbon tariffs</b> or <b>minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.	2021 Priority recommendation

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Buildings	Produce a robust, equitable and ambitious <b>heat strategy</b> to eliminate emissions from buildings through a clear direction for the next 30 years. This must include: <ul style="list-style-type: none"> <li>Standards covering all segments of the building stock, with support for consumers through the transition.</li> <li>Plans to rebalance policy costs - in consultation with the Committee on Fuel Poverty and wider stakeholders - while making low-carbon solutions more financially attractive.</li> <li>Plans to introduce Green Building Passports.</li> <li>Formalisation of a governance framework to drive decisions on heat infrastructure including a role for area-based energy plans and zoning of heat networks.</li> </ul>	2021 Priority recommendation
	Provide a stable long-term policy framework to support sustained <b>energy efficiency and heat pump</b> growth at sufficient scale (i.e. 600,000 heat pumps per year in existing homes by 2028). This must include a replacement for the Green Homes Grant voucher scheme which works, backed by standards and support for non-residential heat pump installations. Create a level-playing field for hybrid heat pumps off the gas grid and ensure hybrid heat pumps are an integral part of PAS2035 retrofit coordinator advice.	2021 Priority recommendation
	Establish mechanisms to close the substantial funding gap for <b>heat networks</b> , with a multi-year funding programme of sufficient scale to deliver the growth in network deployment, and transition to low-carbon heat sources, needed. Finalise policy on the future market framework for heat networks, including requiring new district heat schemes to utilise low-carbon sources from 2025 at the latest and setting regulations for the conversion of legacy fossil fuel schemes to low-carbon sources.	2022
	Publish proposals for standards to phase out the installation of <b>new liquid and solid fossil fuel heating</b> by 2028 at the latest. Send clear signals on the phase-out of gas heating, including the roles for area-based planning and standards in phasing out gas installations (as in Scotland).	2021
	Move to <b>multi-year programmatic funding</b> to deliver the stated ambition of halving emissions from public buildings by 2032. This must be supported with cross-government strategy (either independent or integrated with the Net Zero or Buildings Strategies) and funding levels in the order of £1 billion/year. Support mechanisms must be designed so that smaller public bodies can access them.	2022
	Set requirements for all <b>new gas boilers to be hydrogen-ready</b> by 2025 at the latest, while ensuring that all new boilers outperform current and expected future air quality standards.	2021
	Implement improvements to the <b>Energy Performance Certificate (EPC) and Standard Assessment Procedure (SAP)</b> framework, including: <ul style="list-style-type: none"> <li>Ensuring EPCs drive deployment of the necessary energy efficiency measures and do so on a holistic basis to address overheating, ventilation, and moisture-risk.</li> <li>Supporting delivery objectives across both energy efficiency and low-carbon heat, and valuing properly the benefits of low-carbon and flexible technologies.</li> <li>Formally integrating a forward trajectory for declining grid carbon-intensity, in line with Government projections.</li> <li>Addressing wider issues of quality/robustness, with a commitment to integrate in-use performance metrics from 2023.</li> <li>Plans for the future role of Green Building Passports.</li> </ul>	2022
	Improve understanding of and support action on <b>overheating in existing residential buildings</b> and encourage retrofit of passive cooling measures. The Heat and Building Strategy must consider overheating risks. The following steps are needed: <ul style="list-style-type: none"> <li>Further research to understand when overheating occurs in existing homes, including ongoing monitoring of temperatures in the housing stock, monitoring of overheating exceedances in homes, and the number of homes currently adapted.</li> <li>Guidance and information for homeowners with the steps that can be taken if their homes overheat. This should include an outline of behavioural options and the measures that can be installed to reduce internal temperatures. Green Building Passports and home retrofit plans could provide holistic guidance and help to unlock green finance.</li> <li>Overheating risk considered and mitigated against if necessary when doing energy efficiency retrofit programmes.</li> <li>Making finance available to install adaptation measures. This could be via grant schemes or green finance for private owners, with public funding targeted at low-income or vulnerable households alongside energy efficiency retrofit.</li> </ul>	2022
	Bring forward the date to reach EPC C in <b>social homes</b> to 2028, in line with the Private Rented Sector (PRS) proposals and finalise the delivery mechanism. Implement ambitious <b>PRS standards</b> for homes which drive fabric efficiency, while valuing deployment of cost-effective low-carbon heat alongside this. Implement the EPC B target for <b>PRS non-domestic buildings</b> in line with new proposals. Consult on options to cover the regulatory policy gap for <b>owner-occupied homes</b> .	2021

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Power	Publish a plan for reaching an emissions intensity of 50 gCO <sub>2</sub> /kWh by 2030, with a total of around 350 TWh of low-carbon generation. Set out a schedule for regular auctions to procure <b>low-carbon generation</b> , with a clear pathway of volumes to be procured and robust contingency for uncertainties in demand and delivery. Address potential barriers to deploying and using low-carbon generation at scale (e.g. the planning and consenting regime for renewables and networks, exposure to climate risks) and, with Ofgem, develop a framework under which sufficient supply resilience can be ensured.	2022 Priority recommendation
	Commit to phasing out <b>unabated gas generation</b> by 2035, subject to ensuring security of supply.	2021 Priority recommendation
	Publish a comprehensive long-term strategy for <b>unabated gas phase-out</b> , including ensuring new gas plant are properly CCS- and/or hydrogen-ready as soon as possible and by 2025 at the latest.	By Spring 2022 Priority recommendation
	Develop a strategy as soon as possible on <b>market design</b> for the medium to long term for a fully decarbonised, resilient electricity system in the 2030s and onwards.	2023
	Develop mechanisms for strategic investment in coordination with Ofgem to ensure that <b>electricity networks</b> can accommodate increased future demand levels, including large localised demand increases associated with electrification in manufacturing, transport and buildings, and that lack of network capacity does not cause delays in emissions reduction.	2023
	Develop a strategy to coordinate the development of <b>interconnectors</b> , connections for offshore wind farms and the enhancement of inter-area transfer capacity for the onshore network, ensuring cost-effective, timely delivery, bringing forward any legislation necessary to enable it.	H1 2022
	Work in partnership with Ofgem to publish and implement a new <b>Smart System Plan and Energy Data and Digitalisation Strategy</b> , including working with DCMS on cyber-security, in order to continue to unlock the full benefits of electricity system flexibility. Ensure that, alongside smart standards for heating, all electricity users have access to half-hourly metering and the option of tariffs that encourage flexibility in use of electric heat and electric vehicle charging.	2021
	Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for <b>electricity, digital and ICT networks</b> . As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.	Now and ongoing
Waste	Set out capacity and usage requirements for <b>Energy from Waste</b> consistent with plans to improve recycling and waste prevention. Issue guidance to align local authority waste contracts and planning policy to these targets.	2021 Priority recommendation
	Introduce the necessary planning guidance and policy to ensure any <b>new Energy from Waste</b> plants (including incineration, gasification & pyrolysis facilities) are built with carbon capture usage and storage (CCUS) or are 'CCUS-ready'.	Spring 2022 Priority recommendation
	Set out how <b>existing Energy from Waste</b> plants will be supported to be retrofitted with CCUS from late 2020s onwards, with 2050 a backstop date for full CCUS coverage.	2022

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Manufacturing and construction	Establish funding mechanism(s) to support operational and capital costs of both <b>electrification and hydrogen-use in manufacturing</b> , as soon as possible, with the aim of awarding funding in 2022. There must be mechanisms for both options, not only hydrogen, and the mechanism(s) should be designed to ensure that, in the medium term, hydrogen-use and electrification compete on a level playing field, to ensure the best value for consumers and taxpayers. Support for electrification may be combined with reforms to electricity pricing.	2022 Priority recommendation
	Continue to support <b>innovation</b> and demonstration of fuel switching and CCS technologies for decarbonising manufacturing and construction. Ensure that a full range of options is developed, filling previous gaps in support, such as encouraging electrification projects to come forward.	Spring 2022
	Set out which policies will deliver the pathway to 4 MtCO <sub>2</sub> e of <b>industrial energy efficiency</b> abatement set out in the Industrial Decarbonisation Strategy and quantify how much abatement will come from each policy: <ul style="list-style-type: none"> <li>Set out the future role of Climate Change Agreements (CCAs) and any required CCA reforms.</li> <li>Consult on mandating the use of Energy Management Systems and on Government support and incentives for implementing energy management standards.</li> <li>Set out the role of energy efficiency standards and audit programmes.</li> <li>Develop resources such as direct advice and training to address capacity and expertise gaps, and highlight available energy efficiency solutions, particularly for SMEs.</li> </ul>	Spring 2022
	Ensure the policy package for decarbonising manufacturing addresses manufacturers' low appetite for investments with long <b>payback times</b> , either using grants or favourable loans, particularly for energy efficiency.	2022
	Work with the minerals industries to develop a detailed joint plan for <b>CO<sub>2</sub> transport from dispersed sites</b> .	Spring 2022
	Commit to <b>targets</b> for ore-based steelmaking and cement production in the UK to reach near-zero emissions by 2035 and 2040, respectively.	2021
	Deliver industrial <b>carbon capture contracts (ICC)</b> to enable final investment decisions on the first ICC projects by mid-2022.	H1 2022
	Deliver the proposed <b>CCS transport and storage</b> regulatory investment model to enable final investment decisions by mid-2022 that are consistent with establishing at least two CCS transport and storage clusters in the mid-2020s.	H1 2022
	Create a clear incentive for <b>manufacturing facilities not currently covered by the UK ETS</b> to switch to low-carbon energy sources by reforming the suite of energy and carbon policies, which could include rebalancing the Climate Change Levy rates for electricity and gas.	2023
	Set out a strategy for decarbonisation of <b>off-road mobile machinery</b> and work with industry to identify potential policies to increase uptake of low-carbon off-road mobile machinery. This will require work across BEIS, MHCLG, DfT and Defra.	2021

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Resource efficiency in manufacturing and construction	<p>Step up efforts (with Defra) to deliver the <b>waste prevention and resource efficiency</b> improvements required as part of the pathway to Net Zero, including by:</p> <ul style="list-style-type: none"> <li>Accelerating delivery of the Waste Prevention Programme so that key policies, such as Extended Producer Responsibility and new product standards, are on track to be in place well before 2025.</li> <li>Setting out how levels of resource efficiency improvements identified within the Industrial Decarbonisation Strategy will be delivered.</li> <li>Beginning to develop and implement any additional policies needed to deliver these resource efficiency improvements, by the end of 2022.</li> <li>Ensure cross-departmental working, potentially through new cross-Whitehall governance focused on resource efficiency.</li> </ul>	<p>Spring 2022 <b>Priority recommendation</b></p> <p>(end 2022 for additional policies)</p>
	<p>Develop policies (with MHCLG, Defra and DfT) to drive more <b>resource-efficient construction</b> and use of existing low-carbon materials, including a substantial increase in the use of <b>wood in construction</b>. Policies should include:</p> <ul style="list-style-type: none"> <li>Reviewing and clarifying the position of structural timber in the ban on combustible materials, underpinned by further research and testing where necessary, and ensuring there are no barriers to the safe use of timber in buildings. The buildings safety regulator to play a role in overseeing this on an ongoing basis.</li> <li>The development of a fully-funded policy roadmap on the use of timber, including policies to support the development of UK wood supply chains.</li> <li>Finalising the reporting methodology for whole-life carbon standards.</li> <li>Setting out a plan for phasing in mandatory whole-life reporting followed by minimum whole-life standards for all buildings, roads and infrastructure by 2025, with differentiated targets by function, scale, and public/private construction.</li> </ul>	Spring 2022
	<p>Consult on detailed proposals (with Defra) for <b>product standards and extended producer responsibility</b> to improve the resource efficiency of consumer goods' lifecycles. The proposals should include all consumer goods with high environmental impact and cover how products are made, through indicators such as the level of recycled content and critical material content, and the reparability, durability and upgradability of a product.</p>	Spring 2022
	<p>Work with business to encourage and <b>enable consumers to share</b>, lease and use products for longer while discouraging 'disposable' business models.</p>	Spring 2022
Transport	<p>Continue to support (with DfT and Ofgem) widespread deployment of <b>EV charging infrastructure</b>:</p> <ul style="list-style-type: none"> <li>This should ensure it can support high EV uptake levels. Project Rapid has the right ambition for the strategic road network and should be developed into a full strategy for the 2020s and beyond.</li> <li>Further investment is needed to support on-street and other urban charging solutions for those without off-street parking and destination charging.</li> <li>Government should aim for there to be around 150,000 public charge points operating by 2025. These should be widely available across all regions of the UK.</li> <li>Implement the recommendations of the EV Energy Taskforce, in particular improving the consumer charging experience and making smart-charging accessible, appealing and cost-effective for as many EV users as possible.</li> </ul>	Now and ongoing <b>Priority recommendation</b>
	<p>Produce a clear assessment (with DfT) of how best to re-use and <b>recycle EV batteries</b> and fund development of competitive, large-scale battery recycling facilities in the UK.</p>	2021-22
	<p>Continue innovation and demonstration support (with DfT) for <b>zero-carbon fuel technologies</b> and their use in shipping, and ship efficiency measures. Develop incentives for zero-carbon ammonia and hydrogen supply chains.</p>	Early 2020s

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Greenhouse gas removals (GGRs)	The overall Net Zero Strategy should place <b>GGRs in context</b> of a wider strategic approach to reaching Net Zero, setting out a plan for development and deployment of removals, but also for actions elsewhere to limit the need for them.	2021 Priority recommendation
	Building on the Greenhouse Gas Removals (GGR) call for evidence, launch consultation on Government's preferred <b>GGR strategy</b> and long-term expected requirement for GHG removals, including a proposed market design, a set of governance principles and proposals that recognise the need for a long-term price signal.	H1 2022 Priority recommendation
	Support the <b>demonstration of engineered GGR</b> at scale in the 2020s, either through amending existing policies or introducing new support mechanisms.	2022 Priority recommendation
	Build on the recently commenced <b>innovation programmes</b> , the Direct Air Capture and other Greenhouse Gas Removals Competition and UK Greenhouse Gas Removal Demonstration Programme, to support both the demonstration and commercialisation of more advanced greenhouse gas removal technologies (taking these from technology readiness level 5 to 8), and alongside undertake research and development into less advanced removal approaches including through pilots and field experiments.	Now and ongoing
	Ensure that a <b>public engagement strategy</b> for Net Zero includes national, regional, and local communities to improve the public's understanding of GGR approaches and both the local and system-wide implications of different options - awareness is currently very low, and support is mixed or uncertain.	2021-22
	Align with adaptation policies to ensure long-term <b>resilience and effectiveness of GGRs</b> in the face of climate impacts and exploit potential for co-benefits (e.g. choice of tree species, protecting new infrastructure from flood risks).	Before 2025
Fuel supply	Develop a <b>Hydrogen Strategy</b> out to 2035 that determines plans and sets out pathways to appropriate hydrogen use across power, industry, transport, and buildings; low-carbon hydrogen production options; and the associated infrastructure. Ensure that large-scale hydrogen trials begin in the early 2020s.	2021 Priority recommendation
	Deliver a <b>Biomass Strategy</b> that is aligned to the UK's path to Net Zero, and which reflects recommendations on governance, monitoring and best-use from the Committee's 2018 Biomass report and 2020 Land Use report. The UK should also continue to take a global lead on further developing and improving UK and international biomass governance and sustainability criteria.	2022 Priority recommendation
	Set new requirements for CCS-readiness at <b>biofuel conversion facilities</b> of all scales. This should include dates beyond which new facilities should be built with CCS, and dates for when CCS will need to be retrofitted to biofuel facilities already in operation.	2022
	Set out policies to reduce <b>upstream emissions from oil and gas</b> production by 68% by 2030, relative to 2018 levels: <ul style="list-style-type: none"> <li>Develop policies to reduce emissions from existing oil and gas platforms, including developing carbon-intensity measurement standards for gas and oil.</li> <li>Set a requirement for new plans for offshore oil and gas platforms and associated installations to use low-carbon energy for their operations, aligning to zero direct emissions from operational energy use by 2027.</li> <li>Make plans to ensure flaring and venting is only permitted for safety reasons from 2025.</li> </ul>	2021
	Work with Ofgem to make explicit how current and future policies will reduce emissions associated with <b>methane leakage</b> from the gas networks in a way that is consistent with the Sixth Carbon Budget.	2021
	Formalise the process, governance framework and timeline for decisions on the <b>conversion to hydrogen</b> of appropriate parts of the gas pipeline networks. This should include starting a programme of research with Ofgem to identify areas which are unlikely to be suitable (such that electrification and alternatives can be prioritised), alongside priority candidate areas for hydrogen.	2021

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Cross-cutting	<p>The next <b>National Adaptation Programme</b>, due in 2023, should ramp up adaptation ambition, implementation and evaluation. It should:</p> <ul style="list-style-type: none"> <li>• Set out the Government's vision for a well-adapted UK, alongside the measurable outcomes that the Government is aiming to achieve by the end of the next NAP period (2023 – 2028).</li> <li>• Include a detailed monitoring and evaluation framework, including which indicators will be used to monitor progress in reducing risk and showing the effectiveness of different adaptation responses for each risk in CCRA3.</li> <li>• Report how departments have addressed the top eight priority risks set out in the CCRA3 Advice Report for urgent action between 2021 and 2023.</li> <li>• Set out how adaptation is being integrated into policy, and the measurable actions by department for adaptation across each of the 61 risks and opportunities set out in the CCRA3 Technical for the period 2023-2028.</li> <li>• Ensure the adaptation actions and the programme as a whole are framed around the principles for good adaptation outlined in the CCRA3 Advice Report: <ul style="list-style-type: none"> <li>– Adapt to 2°C warming, assess the risks for 4°C</li> <li>– Prepare for unpredictable extremes</li> <li>– Assess interdependencies</li> <li>– Understand threshold effects</li> <li>– Integrate adaptation into relevant policies</li> <li>– Ensure adaptation is sufficiently financed</li> <li>– Avoid lock-in</li> <li>– Address inequalities</li> <li>– Consider opportunities from climate change</li> </ul> </li> <li>• Specific actions to manage international climate risks should be included, setting out the direct response to the risks identified in CCRA3.</li> </ul>	2023 onwards Priority recommendation
	<p>Ensure that <b>adaptation is integrated</b> into major upcoming policies in the next two years related to the priority CCRA3 risks for which Defra has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>• Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards.</li> <li>• Risks to soil health from increased flooding and drought.</li> <li>• Risks to natural carbon stores and sequestration (trees, soils and wetlands) from multiple hazards.</li> <li>• Risks to crops, livestock, and commercial trees from multiple hazards.</li> </ul> <p>In addition, for the coming five-year period (2023-2028), Defra should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).</p>	By 2023 Priority recommendation
	<p>Implement a <b>public engagement programme about national adaptation objectives</b>, acceptable levels of risk, desired resilience standards, how to address inequalities, and responsibilities across society. The findings from the programme should feed into the vision and desired outcomes of the next National Adaptation Programme.</p>	2021 Priority recommendation
	<p>Implement measures to address <b>non-financial barriers to tackling emissions from land use and agriculture</b>, including awareness and improving skills in sustainable forestry and peatland management; scaling up supply chains; streamlining application processes and addressing contractual and tax issues where they are acting as barriers. Delivery plans should also set out measures to:</p> <ul style="list-style-type: none"> <li>• Improve knowledge exchange of low-carbon farming practices to provide confidence to farmers to take up measures to reduce on-farm GHGs.</li> <li>• Improve the science and evidence base for woodlands and peatlands, to deliver GHG reductions and multiple other benefits, ensure the right tree is planted in the right place and that they are resilient to future climate impacts.</li> </ul>	2021-25 Priority recommendation

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Cross-cutting	Legislate the <b>Environment Bill</b> this year, using it to strengthen commitments on waste, resource efficiency, agriculture and land-use.	2021
	Develop (with DIT) the option of applying either <b>border carbon tariffs or minimum standards to imports</b> of selected embedded-emission-intense industrial and agricultural products and fuels. This should include initiating development of carbon intensity measurement standards and fostering international consensus around trade policies through the G7 and COP presidencies.	2021 Priority recommendation
	Ensure <b>all departmental policy decisions</b> , and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.	Now and ongoing
Research and data	Fund a programme of work to design and populate the appropriate new <b>priority adaptation indicators</b> for England. These should complement other environmental and social indicators collated by Government. The CCC could be tasked to coordinate this activity in partnership with other relevant organisations such as the Office for Environmental Protection and Environment Agency.	2021
	Continue to monitor <b>consumption emissions</b> . These are important to ensure that action to decarbonise UK-based activities does not result in emissions moving offshore, and to track progress in decarbonisation of imports to the UK, which in turn can inform future policy (e.g. border carbon adjustments).	Now and ongoing
	Improve the collection and reporting of <b>industrial decarbonisation data</b> to allow for progress to be monitored more effectively, particularly on energy and resource efficiency.	2022
Nature and land use	Extend current ambition set out by the UK government and the devolved administrations to implement a comprehensive delivery mechanism to address <b>degraded peatland</b> : <ul style="list-style-type: none"> <li>17% of upland peat is restored, equivalent to 200,000 hectares (and where this is not possible, stabilise the peat) by 2025; 58% by 2035 (700,000 hectares) and the remaining area by 2045.</li> <li>Rewet and sustainably manage 12% of lowland peat used for crops by 2025 (24,000 hectares), rising to 38% by 2035 (72,000 hectares).</li> <li>Rewet 8% of lowland grassland area by 2025 (18,000 hectares), rising to 25% by 2035 (54,000 hectares).</li> <li>Remove all low-productive trees (i.e. less than YC8) from peatland (equivalent to 16,000 hectares by 2025), and restore all peat extraction sites by 2035 (equivalent to 50,000 hectares by 2025).</li> </ul>	2021-25 Priority recommendation
	Extend current ambition set out by the UK government and the devolved administrations to implement a comprehensive <b>delivery mechanism for new woodland</b> to create at least 30,000 hectares per year across the UK by 2025 (in line with the Government's commitment) and an average of 40,000 hectares per year in the 2030s.	2021-25 Priority recommendation
	Introduce legislation to: <ul style="list-style-type: none"> <li>Extend the <b>ban on rotational burning of peat</b> from certain protected upland bog sites to all peatland before the start of the burn season in 2021</li> <li>End peat extraction, and ban its sale for all horticultural uses including in the professional sectors and apply this to imports by 2023.</li> <li>Mandate water companies to restore peatland under their ownership.</li> <li>Ensure lowland peat soils are not left bare.</li> </ul>	2021-23 Priority recommendation
	Publish an overarching strategy that clearly outlines the relationships and <b>interactions between the multiple action plans</b> in development for the natural environment, including those for peat, trees, nature and plant biosecurity. This must clearly outline how the different strategies will combine to support the Government's climate change goals on both Net Zero and adaptation, along with the wider environment and other goals.	2021
	Make <b>long-term targets for biodiversity</b> , set out under the Environment Bill, and associated timeframes outcome-based and linked directly to the goals set out in the Government's 25-Year Environment Plan.	H1 2022
	Make <b>interim targets for biodiversity</b> statutory and link them clearly to the long-term targets set out in the Environment Bill.	H1 2022
	The commitment in the 25 Year Environment Plan to achieve 75% <b>restoration for terrestrial and freshwater</b> protected sites should be extended to include all priority habitat sites.	2021
	Set out a clear mechanism to account for the consequences of <b>higher water temperatures and low flows</b> (including drying up) in water bodies for freshwater habitats and species, and for meeting the Water Framework Directive (WFD) targets. This is lacking in current plans to revise the River Basin Management Plans (RBMPs).	H1 2022
	Extend the statutory requirements of <b>marine plan policies</b> to the decisions of public and private organisations. At present only public authorities are duty bound under law to apply the plan policies to their decisions meaning there is a significant gap in the protections they are designed to provide.	Now

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Agriculture and food	<p>Provide <b>incentives and address non-financial barriers</b> across all of the UK to:</p> <ul style="list-style-type: none"> <li>Plant <b>trees</b> on 2% of farmland by 2025 while maintaining their primary use, rising to 5% by 2035.</li> <li>Extend <b>hedgerows</b> by 20% by 2035 and better manage existing hedgerows.</li> <li>Increase the area growing <b>energy crops</b> across the UK to 6,000 hectares per year by 2025, and 30,000 hectares per year by 2035.</li> </ul>	2021-25 Priority recommendation
	<p>Implement measures to encourage consumers to <b>shift diets and reduce food waste</b> across the supply chain, including:</p> <ul style="list-style-type: none"> <li>Low-cost, low-regret actions to encourage a 20% shift away from all meat by 2030, rising to 35% by 2050, and a 20% shift from dairy products by 2030. Develop an evidence-based strategy to establish options for successful behaviour shifts and demonstrate public sector leadership.</li> <li>Policy to reduce food waste by 50% by 2030 and 60% by 2050, with the public sector taking a lead through measures such as target setting and effective product labelling.</li> </ul>	Start now and review mid-2020s for diet change Priority recommendation
	<p>Introduce a strong <b>post-CAP regulatory baseline</b>, and adopt and retain existing EU rules that benefit GHG mitigation into UK legislation. These include low-cost, low-regret on-farm measures to reduce emissions; extending coverage of Nitrate Vulnerable Zones across all of the UK; including measures that reduce enteric methane emissions in the Clean Air Strategy, specifically under the proposal to extend environmental permitting to the dairy and intensive beef sectors; and mandating UK feed producers to incorporate methane inhibiting additives in compound feed and mineral supplements.</p>	2021-23
	<p>Set out measures to ensure the resilience of the <b>food supply chain</b>, including to the risks of extreme weather in England and internationally, as part of its white paper responding to the independent review of the National Food Strategy for England.</p>	2022
	<p>Introduce a comprehensive plan and incentives to deliver <b>emissions reduction across all UK farms</b> through:</p> <ul style="list-style-type: none"> <li>High take-up of low-carbon agricultural measures (60-75% by 2050) covering livestock (diets, breeding, and health), soils (cover crops and grass-legume mix) &amp; waste management (anaerobic digestion and slurry covers).</li> <li>Measures to incentivise the take-up of near-zero-emissions options for agricultural machinery and vehicles from the mid-2020s, and develop options where they are not currently available.</li> </ul>	2021-25
	<p>The landscape-level and on-farm measures set out above should:</p> <ul style="list-style-type: none"> <li><b>Leverage private and public finance</b> (e.g. a trading scheme or auctioned contracts). New and existing funding streams should continue during the transition period to this system to avoid a hiatus in deployment.</li> <li>Be accompanied by a strong <b>monitoring, reporting and verification</b> system that uses the latest monitoring tools and technologies to create a strong institutional framework to verify actions across the UK.</li> </ul>	2021-25
	<p>Set out a strategy for decarbonisation of <b>off-road mobile machinery</b> and work with industry to identify potential policies to increase uptake of low-carbon off-road mobile machinery. This will require work across BEIS, MHCLG, DfT and Defra.</p>	2021

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Waste	Introduce the necessary planning guidance and policy to ensure any new <b>Energy from Waste</b> plants (including incineration, gasification & pyrolysis facilities) are built with carbon capture usage and storage (CCUS) or are 'CCUS ready'.	Spring 2022 Priority recommendation
	Set out how existing <b>Energy from Waste</b> plants will be supported to be retrofitted with CCUS from late 2020s onwards, with 2050 a backstop date for full CCUS coverage.	2022 Priority recommendation
	Set out capacity and usage requirements for <b>Energy from Waste</b> consistent with plans to improve recycling and waste prevention. Issue guidance to align local authority waste contracts and planning policy to these targets.	2021 Priority recommendation
	Set out <b>funding arrangements for local authorities</b> to provide the recycling, composting and waste management services and infrastructure required to deliver at least the commitments in the Environment Bill, Waste Prevention Programme and Resources and Waste Strategy, by 2022.	2022-25
	Consult on the introduction of a <b>carbon tax</b> (either as part of the UK ETS or a separate instrument) aimed at curbing rising emissions from Energy from Waste.	2022
	Set a target for a 68% <b>recycling rate</b> by 2030 covering all wastes in England via the Environment Bill and announce new policies to meet this target. Northern Ireland to set a 70% target for 2030. Scotland and Wales to set new targets for 2030 that go beyond their 70% targets for 2025.	2021
	<b>Composting facilities</b> should be incentivised to install forced aeration as a method of reducing on-site emissions.	From 2022
	Mandatory <b>business food waste</b> reporting to be introduced by 2022, building on WRAP's existing voluntary scheme.	2022
	Legislate for (in England via the Environment Bill, and in Wales, Scotland, and Northern Ireland via new legislation) and implement a <b>ban on landfilling of the main biodegradable waste</b> streams from 2025 (both municipal and non-municipal). There must be sufficient recycling/composting/AD treatment capacity made available before the ban comes into force, so that significant increases in energy-from-waste are avoided.	2021
	Long-term plans should be announced for eventual <b>diversion of all wastes from landfill</b> (except for where no alternative treatment or disposal method exists) but with a date conditional on sufficient action on reduction, re-use and recycling, and installation of CCS at energy-from-waste plants, to avoid a surge in fossil emissions when the ban comes into force.	Mid-2020s
	Introduce policies and funding for increased <b>methane capture and oxidation at landfill sites</b> , to decrease fugitive landfill methane emissions significantly.	2022
Phase out <b>exports of waste</b> by 2030 at the latest, through improvements in waste prevention and domestic recycling and recovery, while strengthening tracking and enforcement to ensure that any exports intended for recycling are being treated appropriately.	2020s	
Greenhouse gas removals and offsets	Build on the recently commenced innovation programmes (with BEIS), the Direct Air Capture and other Greenhouse Gas Removals Competition and UK Greenhouse Gas Removal Demonstration Programme, to support both the <b>demonstration and commercialisation of more advanced greenhouse gas removal</b> technologies (taking these from technology readiness level 5 to 8), and alongside undertake research and development into less advanced removal approaches including through pilots and field experiments.	Now and ongoing
	Align with adaptation policies to ensure long-term <b>resilience and effectiveness of GGRs</b> in the face of climate impacts and exploit potential for co-benefits (e.g. choice of tree species, protecting new infrastructure from flood risks).	Before 2025
	Consider (with BEIS) the appropriate regulatory arrangements, rules and guidance for the use of <b>carbon offsetting by UK corporates</b> within their Net Zero strategies, recognising the growing demand for offsetting markets, the interactions with the UK ETS and currently accredited schemes (i.e. the Woodland Carbon Code and the Peatland Code), and the need to avoid double-counting or negative outcomes for non-carbon objectives.	2021-22

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Resource efficiency	<p>Step up efforts to deliver the <b>waste prevention and resource efficiency</b> improvements required as part of the pathway to Net Zero, including by:*</p> <ul style="list-style-type: none"> <li>Accelerating delivery of the Waste Prevention Programme so that key policies, such as Extended Producer Responsibility and new product standards, are on track to be in place well before 2025.</li> <li>Setting out how levels of resource efficiency improvements identified within the Industrial Decarbonisation Strategy will be delivered.</li> <li>Beginning to develop and implement any additional policies needed to deliver these resource efficiency improvements, by the end of 2022.</li> <li>Ensure cross-departmental working, potentially through new cross-Whitehall governance focused on resource efficiency.</li> </ul>	<p>Spring 2022 Priority recommendation</p> <p>(end 2022 for additional policies)</p>
	<p>Consult on detailed proposals for <b>product standards and extended producer responsibility</b> to improve the resource efficiency of consumer goods' lifecycles. The proposals should include all consumer goods with high environmental impact and cover how products are made, through indicators such as the level of recycled content and critical material content, and the reparability, durability and upgradability of a product.</p>	Spring 2022
	<p>Develop policies (with BEIS, MHCLG and DfT) to drive more <b>resource-efficient construction</b> and use of existing low-carbon materials, including a substantial increase in the use of <b>wood in construction</b>. Policies should include:</p> <ul style="list-style-type: none"> <li>Reviewing and clarifying the position of structural timber in the ban on combustible materials, underpinned by further research and testing where necessary, and ensuring there are no barriers to the safe use of timber in buildings. Buildings safety regulator to play a role in overseeing this on an ongoing basis.</li> <li>The development of a fully funded policy roadmap on the use of timber, including policies to support the development of UK wood supply chains.</li> <li>Finalising the reporting methodology for whole-life carbon standards.</li> <li>Setting out a plan for phasing in mandatory whole-life reporting followed by minimum whole-life standards for all buildings, roads and infrastructure by 2025, with differentiated targets by function, scale, and public/private construction.</li> </ul>	Spring 2022
	<p>Work with business to encourage and enable consumers to share, lease and use products for longer whilst <b>discouraging 'disposable' business models</b>.</p>	Spring 2022
Buildings and infrastructure	<p>Make changes ahead of the next round of reporting under the <b>Adaptation Reporting Power (ARP)</b>. When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies. In particular:</p> <ul style="list-style-type: none"> <li>The next round of reporting must be mandatory.</li> <li>The deadline for reporting must allow sufficient time for consideration of all the reports in the fourth UK Climate Change Risk Assessment, and the CCC's statutory assessment of progress on adaptation.</li> <li>The list of organisations reporting should be expanded to ensure comprehensive coverage of critical infrastructure and services, such as canals and food supply chains, as recommended by the ARP3 consultation.</li> </ul>	2023
	<p>Work with the Environment Agency to set out the measures being taken to improve the uptake of <b>property-level flood resilience (PFR)</b> following stakeholder responses to its PFR call for evidence and consultation. This should include improved data collection to monitor progress. Plans for the new national flood risk assessment and 2025 long-term investment scenarios must ensure that the evidence they provide can be used to identify the most effective locations for PFR, and smart targets for their installation with timescales.</p>	2022
	<p>Work with <b>Port Operators and the British Ports Association</b> to ensure the format of reporting under the Adaptation Reporting Power is appropriate for port operators and that the right operators are being asked to report, as well as to identify what further support could be offered to enable more comprehensive reporting on adaptation by the ports sector.</p>	2023
	<p>Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for <b>electricity, digital and ICT networks</b>. As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital &amp; ICT.</p>	Now and ongoing

**Table A5**

Recommendations for the Department for Environment, Food and Rural Affairs (Defra)

Timing

Waste and  
wastewater

Work with the Environment Agency, Ofwat and other stakeholders to set out targets and supporting measures for **reducing water use by business**. This could be through ensuring that any water reduction targets linked to the Environment Bill include business as well as household water use, and responding to advice and recommendations from Defra's new Senior Water Demand Reduction Group.

2022

Commit innovation funding to development and demonstration of novel **wastewater treatment** process that achieve a step change improvement in direct process emissions.

2022

Outside of the municipal wastewater sector, incentivise **industrial wastewater plants** to reduce their process emissions.

From 2022

Table A6 Recommendations for the Department for Transport (DfT)		Timing
Cross-cutting	For the coming five-year period (2023–2028), DfT should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Decisions on <b>investment in roads</b> should be contingent on analysis justifying how they contribute to the UK's pathway to Net Zero. This analysis should demonstrate that the proposals would not lead to increases in overall emissions. Wherever possible, investment in roads should be accompanied by proportionate investment in EV charging infrastructure and in active travel and public transport.	2021-22
	Develop policies (with BEIS, Defra and MHCLG) to drive more <b>resource-efficient construction</b> and use of existing low-carbon materials. DfT's focus should be on: <ul style="list-style-type: none"> <li>Finalising the reporting methodology for whole-life carbon standards</li> <li>Contributing to a plan for phasing in mandatory whole-life reporting followed by minimum whole-life standards for all roads and infrastructure by 2025, with differentiated targets by function, scale, and public/private construction.</li> </ul>	Spring 2022
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
Electric vehicles	Develop a comprehensive policy package to <b>support the supply and uptake of EVs</b> to enable delivery of the 2030 phase-out of new petrol and diesel cars and vans. This will require: <ul style="list-style-type: none"> <li>Strong consumer incentives to purchase zero-emission vehicles, whether in the form of purchase subsidies or preferential tax rates and duties. These should be fair across consumer groups and scaled back as costs of EVs fall.</li> <li>Introducing a zero-emission vehicle mandate requiring car manufacturers to sell a rising proportion of zero-emission vehicles (specifically, fully battery-electric vehicles), reaching nearly 50% by 2025 and 100% by 2030, with only a very small proportion of hybrids allowed alongside until 2035. This will benefit air quality and consumers, as well as greenhouse gas emissions.</li> <li>Setting out ambitious UK regulations on new car and van CO<sub>2</sub> intensities to 2030, with more regular intervals than the EU's five years, requiring around a 55% reduction by 2025 and 97% by 2030.</li> </ul>	Policy package: 2021 Support: Now and ongoing  Priority recommendation
	Continue to support widespread deployment of <b>EV charging infrastructure</b> : <ul style="list-style-type: none"> <li>This should ensure it can support high EV uptake levels. Project Rapid has the right ambition for the strategic road network and should be developed into a full strategy for the 2020s and beyond.</li> <li>Further investment is needed to support on-street and other urban charging solutions for those without off-street parking and destination charging.</li> <li>Government should aim for there to be around 150,000 public charge points operating by 2025. These should be widely available across all regions of the UK.</li> <li>Implement the recommendations of the EV Energy Taskforce, in particular improving the consumer charging experience and making smart-charging accessible, appealing and cost-effective for as many EV users as possible.</li> </ul>	Now and ongoing Priority recommendation
	Produce a clear assessment of how best to re-use and <b>recycle EV batteries</b> and fund development of competitive, large-scale battery recycling facilities in the UK.	2021-22

Table A6 Recommendations for the Department for Transport (DfT)		Timing
Public transport and active travel	Strengthen support for, and provision of, schemes to support <b>walking, cycling and public transport</b> to reduce demand for higher-carbon travel: <ul style="list-style-type: none"> <li>Provision of infrastructure for active travel and other support schemes, as well as measures to make it less attractive to drive, are needed.</li> <li>This should include maintaining positive behaviour shifts and addressing risks resulting from the COVID-19 pandemic.</li> <li>Working across delivery bodies (e.g. local authorities) is critical.</li> </ul>	2021-22 Priority recommendation
	Government should support the <b>public transport and shared mobility</b> sectors to recover from the COVID-19 pandemic: <ul style="list-style-type: none"> <li>Positive communications and messaging will be required to rebuild public confidence in the safety of public transport.</li> <li>Financial support for the sector should be maintained while confidence and demand are rebuilt, to avoid the risk of operators cutting service provision.</li> <li>Government should seek to reverse the increasing relative price advantage of car travel over public transport.</li> </ul>	2021-22
	Set out a clear vision to deliver Net Zero in <b>rail</b> , and support Network Rail and other bodies in delivering the target to remove all passenger diesel trains by 2040. This should cover a mix of zero-emission technologies (e.g. track electrification, battery-electric, hydrogen and hybrid trains). The strategy should be published by 2021 as recommended by the National Infrastructure Commission.	2021
	Mandate a <b>phase-out</b> of new sales of all <b>diesel buses and coaches</b> by 2040 at the latest. <ul style="list-style-type: none"> <li>This should include a requirement for new sales of diesel vehicles operating on shorter, urban routes to end considerably sooner.</li> <li>Local authorities should be empowered to continue driving zero-emission bus take-up and to deliver improvements to bus services.</li> </ul>	2021-22
	Implement large-scale <b>trials of zero-emission HGVs</b> in the early-2020s to demonstrate the commercial feasibility of these technologies and establish the most suitable and cost-effective technology mix.	Early 2020s
Freight and off-road mobile machinery	Set out and implement a <b>strategy to transition to zero-carbon freight</b> , including: <ul style="list-style-type: none"> <li>Ending sales of new diesel HGVs by 2040 at the latest.</li> <li>Stronger purchase and other incentives for zero-emission HGVs.</li> <li>Infrastructure plans and support (e.g. ultra-rapid chargers for battery-electric HGVs and hydrogen refuelling stations for hydrogen HGVs).</li> <li>Clean air zones.</li> </ul>	2021
	Implement schemes to <b>reduce HGV and van use</b> in urban areas (e.g. e-cargo bikes and use of urban consolidation centres), to reduce traffic and improve the safety of active travel.	2021
	Set out a strategy for decarbonisation of <b>off-road mobile machinery</b> and work with industry to identify potential policies to increase uptake of low-carbon off-road mobile machinery. This will require work across BEIS, MHCLG, DfT and Defra.	2021
	Build on the <b>Clean Maritime Plan</b> and formal inclusion of international shipping in CB6 and Net Zero to set a Net Zero 2050 goal for UK shipping (including international shipping) and a pathway to get there.	2021
Shipping	Take a leadership role in working with the <b>International Maritime Organisation (IMO)</b> and other willing partners on global shipping policies, research funding, tighter efficiency targets and other initiatives to reduce shipping emissions. Work to strengthen the IMO 2050 global target.	2021-22
	Commit to the UK's first <b>clean maritime cluster(s)</b> operating at commercial scale (supplying at least 2 TWh/year of zero-carbon fuels) by 2030 at the latest, with zero-carbon fuels expanding to 33% of UK shipping fuel use by 2035.	2021-22
	Continue <b>innovation and demonstration support for zero-carbon fuel</b> technologies and their use in shipping, and ship efficiency measures. Develop incentives for zero-carbon ammonia and hydrogen supply chains.	Early 2020s
	Provide support for ports' investment in <b>shore power</b> and electric recharging infrastructure.	Early 2020s
	Start monitoring <b>non-CO<sub>2</sub> effects</b> of shipping and decide on how best to tackle them alongside UK climate targets.	2021

Table A6 Recommendations for the Department for Transport (DfT)		Timing
Aviation	Commit to a Net Zero goal and pathway for UK aviation as part of the forthcoming <b>Aviation Decarbonisation Strategy</b> , with UK international aviation reaching Net Zero emissions by 2050 at the latest, and domestic aviation potentially earlier. Plan for residual emissions (after efficiency, low-carbon fuels, and demand-side measures) to be offset by verifiable greenhouse gas removals, on a sector net emissions trajectory to Net Zero.	2021 Priority recommendation
	Assess the Government's <b>airport capacity strategy</b> in the context of Net Zero and any lasting impacts on demand from COVID-19, as part of the aviation strategy. There should be no net expansion of UK airport capacity unless the sector is on track to sufficiently outperform its net emissions trajectory and can accommodate the additional demand. A demand management framework will need to be developed (by 2022) and be in place by the mid-2020s to annually assess and, if required, control sector GHG emissions and non-CO <sub>2</sub> effects.	2021-22 Priority recommendation
	Take a leadership role within the <b>International Civil Aviation Organisation (ICAO)</b> , and work with other high-ambition nations, to set a long-term goal for aviation consistent with the Paris Agreement, strengthen the CORSIA scheme and align CORSIA to this long-term goal.	2021-22
	Continue innovation and demonstration support for <b>sustainable aviation fuel (SAF)</b> technologies, aircraft efficiency measures, hybrid, full electric and hydrogen aircraft development and airspace modernisation. Set out a policy package for supporting the near-term deployment of commercial SAF facilities in the UK (with carbon capture and storage where applicable).  Longer-term, support for SAF should transition to a more bespoke, enduring policy to drive uptake.	Now and ongoing Policy package in 2021
	Use <b>aviation tax reform</b> to address price imbalances between aviation and surface transport, encouraging the low-carbon alternative (e.g. rail) for journeys where one exists. Taxation should also be used, alongside improvements in broadband, to embed positive behaviours that have arisen during the pandemic (e.g. replacing business travel with online networking).	2021-22
	Commit to not use credits from the <b>Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)</b> for flights covered by the UK ETS unless and until they can satisfy strict eligibility criteria (equivalence, additionality, permanence, sustainability).	2021-22
	Start monitoring <b>non-CO<sub>2</sub> effects</b> of aviation (including through CORSIA for eligible aeroplane operators), set a minimum goal of no further warming after 2050, research mitigation options, and consider how best to tackle non-CO <sub>2</sub> effects alongside UK climate targets without increasing CO <sub>2</sub> emissions.	2021-22

Table A7 Recommendations for the Ministry of Housing, Communities and Local Government (MHCLG)		Timing
Cross-cutting	<p>Support <b>local government</b> to play a full role in the Net Zero transition, including through increased resourcing, guidance, involvement in local area energy plans, statutory reporting on the emissions from their estate and reforming the planning framework to enable delivery of low-carbon and climate resilient measures.</p> <p>This is likely to require additional funding for staffing and resources for local delivery plans, alongside a 'duty to collaborate' to encourage authorities to work with local, regional and national partners to deliver their climate ambitions.</p>	<p>2021-23 <b>Priority recommendation</b></p> <p>(funding for local areas at next budget)</p>
	<p>Ensure that <b>adaptation is integrated</b> into major upcoming policies in the next two years related to the priority CCRA3 risks for which MHCLG has lead responsibility, coordinating work with other relevant departments as necessary:</p> <ul style="list-style-type: none"> <li>Risks to human health, wellbeing and productivity from increased exposure to heat in homes and buildings (with DHSC).</li> <li>In addition, for the coming five-year period (2023-2028), MHCLG should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).</li> </ul>	<p>By 2023 <b>Priority recommendation</b></p>
	<p>Working with BEIS, DWP, DfE and the Home Office, develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.</p>	<p>2021 <b>Priority recommendation</b></p>
	<p>Ensure that developments and infrastructure are compliant with <b>Net Zero</b> and appropriately <b>resilient to climate change</b> through proposed amendments to the Planning Bill.</p>	<p>2021-22</p>
	<p>Introduce an <b>urban greenspace</b> target to reverse the decline and ensure towns and cities are adapted to more frequent heatwaves in the future and that the 25-Year Plan goals are met.</p>	<p>2022</p>
	<p>Ensure all departmental policy decisions, planning decisions and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b>.</p>	<p>Now and ongoing</p>
Flooding	<p>Ensure that all types of current and future <b>flood risk</b> are included in policies to assess flood risk to new developments. Housing targets for local authorities should take account of flood risk, amongst other environmental issues. Assessments and management of flood risk in new developments must as a minimum:</p> <ul style="list-style-type: none"> <li>Include evidence that the development will be safe over its full lifetime, with a consideration of the downstream interactions and impacts of new developments (i.e. it should not increase flooding in other areas).</li> <li>Include an assessment of current and future flood risk under both 2°C and 4°C global climate scenarios.</li> <li>Assess and manage the risk of flooding to local infrastructure as well as housing.</li> <li>Include a consideration of better preparedness as set out in the Government's recent FCERM Policy Statement.</li> <li>Ensure there are properly funded and trained staff in local authorities.</li> </ul>	<p>2022</p>
	<p>To help improve the <b>information on SuDS and surface water flood risk</b>, urgently begin collecting data on sewer capacity and SuDS location, type and capacity. This would bring the level of information in line with that for river and coastal flood risk defences.</p>	<p>2021</p>
	<p>To address the issue of increased risk of <b>surface water flooding</b> in new developments, commit to ensuring that new developments do not put more water into the public sewers than what was there before, taking into account climate change. To incentivise this, end the automatic right to connect to the public sewer; planning reforms should enact Schedule 3 of the Flood and Water Management Act (2010); and technical SuDS standards should be made mandatory and be updated to deliver SuDS that provide multiple economic, social and environmental benefits.</p>	<p>2022</p>
	<p>The <b>consultation process for surface water flood risk</b> must be improved. This should be done by adding statutory consultees for all development type and sizes. Consultees must have the appropriate skills to provide advice on surface water flood mitigation. Ensure that Local Authorities fully justify planning decisions where applications can proceed either without or going against formal flood risk mitigation advice.</p>	<p>2022</p>

Table A7 Recommendations for the Ministry of Housing, Communities and Local Government (MHCLG)		Timing
Buildings	<p>Implement a <b>strong set of standards – with robust enforcement</b> – that ensure both new and existing buildings are designed for a changing climate and deliver high levels of energy efficiency and low-carbon heat. Including:</p> <ul style="list-style-type: none"> <li>Publish robust definitions of the Future Homes Standard and Future Buildings Standard which are legislated in advance of 2023 and ensure no fossil fuels are burnt in new buildings. This must include coordination with DfE, MoJ, DHSC as well as BEIS and HMT.</li> <li>Regulate the overheating requirement as set out in the Future Buildings Standard consultation. Expand the requirement to cover refurbishments of existing buildings and conversions of non-residential buildings to residential.</li> <li>Work with BEIS on the Heat and Buildings Strategy and use standards to set a clear direction for retrofit across the buildings stock.</li> <li>Ensure that the remit of the new buildings safety regulator covers climate change mitigation and adaptation, strengthened through an explicit responsibility for sustainability; and is fully equipped to monitor and enforce compliance with buildings standards.</li> <li>Work with HM Treasury to ensure that local authorities are properly funded to enforce buildings standards.</li> <li>Close loopholes allowing homes to be built which do not meet the current minimum standards for new dwellings. This includes provisions around the expiry of planning permission and permitted development rights relating to change of use. Make accurate performance testing and reporting widespread, committing developers to the standards they advertise.</li> </ul>	2021-22 <b>Priority recommendation</b>
	<p>Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.</p>	2021-22
	<p>Implement improvements to the <b>Energy Performance Certificate (EPC) and Standard Assessment Procedure (SAP)</b> framework, including:</p> <ul style="list-style-type: none"> <li>Ensuring EPCs drive deployment of the necessary energy efficiency measures and do so on a holistic basis to address overheating, ventilation, and moisture-risk.</li> <li>Supporting delivery objectives across both energy efficiency and low-carbon heat, and valuing properly the benefits of low-carbon and flexible technologies.</li> <li>Formally integrating a forward trajectory for declining grid carbon-intensity, in line with Government projections.</li> <li>Addressing wider issues of quality/robustness, with a commitment to integrate in-use performance metrics from 2023.</li> <li>Plans for the future role of Green Building Passports.</li> </ul>	2022
Construction	<p>Step up efforts to deliver the <b>waste prevention and resource efficiency</b> improvements required as part of the pathway to Net Zero, including by:</p> <ul style="list-style-type: none"> <li>Setting out how levels of resource efficiency improvements in construction identified within the Industrial Decarbonisation Strategy will be delivered.</li> <li>Beginning to develop and implement any additional policies needed to deliver these resource efficiency improvements, by the end of 2022.</li> <li>Ensure cross-departmental working, potentially through new cross-Whitehall governance focused on resource efficiency.</li> </ul>	Spring 2022 <b>Priority recommendation</b>  (end 2022 for additional policies)
	<p>Develop policies (with BEIS, Defra and DfT) to drive more <b>resource-efficient construction</b> and use of existing low-carbon materials, including a substantial increase in the use of <b>wood in construction</b>. Policies should include:</p> <ul style="list-style-type: none"> <li>Reviewing and clarifying the position of structural timber in the ban on combustible materials, underpinned by further research and testing where necessary, and ensuring there are no barriers to the safe use of timber in buildings. Buildings safety regulator to play a role in overseeing this on an ongoing basis.</li> <li>The development of a fully funded policy roadmap on the use of timber, including policies to support the development of UK wood supply chains.</li> <li>Finalising the reporting methodology for whole-life carbon standards.</li> <li>Setting out a plan for phasing in mandatory whole-life reporting followed by minimum whole-life standards for all buildings, roads and infrastructure by 2025, with differentiated targets by function, scale, and public/private construction.</li> </ul>	Spring 2022
	<p>Set out a strategy for decarbonisation of <b>off-road mobile machinery</b> and work with industry to identify potential policies to increase uptake of low-carbon off-road mobile machinery. This will require work across BEIS, MHCLG, DfT and Defra.</p>	2021

Table A8 Recommendations for the Department for Digital, Culture, Media and Sport (DCMS)		Timing
Cross-cutting	Support BEIS in developing a <b>public engagement strategy</b> for Net Zero which builds on the findings of the UK Climate Assembly by involving people in decision-making, providing trusted information on decarbonisation choices and the need to reduce emissions and adapt to climate change. The strategy should also identify preferred policy options to empower people to contribute fully towards the path to Net Zero.	2021-22 Priority recommendation
	For the coming five-year period (2023-2028), outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Work in partnership with Ofgem to publish and implement a new <b>Smart System Plan and Energy Data and Digitalisation Strategy</b> , including on cyber-security, in order to continue to unlock the full benefits of electricity system flexibility. Ensure that, alongside smart standards for heating, all electricity users have access to half-hourly metering and the option of tariffs that encourage flexibility in use of electric heat and electric vehicle charging.	2021
	Ensure <b>sport and culture strategies</b> align to other departments' plans for lower-carbon buildings, more active travel and improved public health.	2021
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
Digital infrastructure	Ensure plans for a <b>digital transition and fibre roll-out</b> can complement changing work patterns and travel behaviours, leading to lower-carbon working. Co-ordinate with DfT to invest in digital infrastructure to lock in positive behaviours that reduce travel demand (e.g. home-working).	2021
	<b>Resilience standards for the digital sector</b> must include requirements pertaining to climate change risks. In addressing the National Infrastructure Commission recommendations from the Resilience Study, Government should incorporate consideration of climate change risks and adaptation actions into any new standards being developed. Standards for digital infrastructure operators should include requirements to: <ul style="list-style-type: none"> <li>Assess climate risks under both 2°C and 4°C global climate scenarios.</li> <li>Consider interdependencies with other critical infrastructure, and</li> <li>Set out actions to reduce risk and monitor progress.</li> </ul>	2022
	Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for <b>electricity, digital and ICT networks</b> . As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.	Now and ongoing

Table A9 Recommendations for the Department for Education (DfE)		Timing
	Working with BEIS, DWP, MHCLG and the Home Office, develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.	2021 Priority recommendation
	Support BEIS in developing a <b>public engagement strategy</b> for Net Zero which builds on the findings of the UK Climate Assembly by involving people in decision-making, providing trusted information on decarbonisation choices and the need to reduce emissions and adapt to climate change. The strategy should also identify preferred policy options to empower people to contribute fully towards the path to Net Zero.	2021-22 Priority recommendation
	For the coming five-year period (2023-2028), DfE should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the one risk in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	2021-22
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing

Table A10 Recommendations for the Department for Work and Pensions (DWP)		Timing
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Working with BEIS, DfE, MHCLG and the Home Office, develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.	2021 Priority recommendation
	Design industrial decarbonisation policies to <b>support and create jobs</b> , especially in regions with reliance on industrial jobs.	Now and ongoing
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	2021-22

Table A11 Recommendations for the Department of Health and Social Care (DHSC)		Timing
	For the coming five-year period (2023–2028), DHSC should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Assess <b>health sector vulnerability</b> to existing and future climate risks, particularly for care homes and home-based care. Following this, develop a cross-sector approach to address risks. This cross-sector approach should include input from DHSC, CQC, PHE, NHS, MHCLG and local level public health bodies.	2022
	Fund the strengthening and widening of vector and pathogen surveillance and early-warning mechanisms, due to the increasing risk of <b>disease spread</b> as a result of climate change and other factors.	Now and ongoing
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	Now and ongoing
	Support the NHS in delivering on its Net Zero plan.	Now and ongoing
	Take an active role in climate policy development that also has <b>health benefits</b> , such as active travel, access to green space, air quality, better buildings and healthier diets.	Now and ongoing
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing

Table A12 Recommendations for the Home Office and the Ministry of Justice (MoJ)		Timing
	For the coming five-year period (2023–2028), MoJ should outline appropriate actions in the next <b>National Adaptation Programme</b> to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Adaptation Report Annex).	2023 Priority recommendation
	Home Office, BEIS, DWP, DfE and MHCLG, should develop a strategy for a <b>Net Zero workforce</b> that ensures a just transition for workers transitioning from high-carbon to low-carbon and climate-resilient jobs, integrates relevant skills into the UK's education framework and actively monitors the risks and opportunities arising from the transition. This strategy should include the development and roll-out of plans for training and skills, with buildings and manufacturing being priority areas.	2021 Priority recommendation
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	2021-22
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing

Table A13 Recommendations for the Ministry of Defence (MoD)		Timing
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Develop and implement plans to make all <b>public-sector buildings and vehicle fleets</b> within the department's remit zero-carbon in the long term, switching to ultra-low emission vehicles by 2030 and halving emissions from public buildings by 2032. This must be part of a coherent cross-government strategy including an updated set of Greening the Government commitments, multi-year spending commitments and annual reporting.	2021-22
	Assess the potential for <b>alternative fuels</b> (such as low-carbon electricity, hydrogen or bioenergy) to be used for land vehicles, ships and aircraft, and consider opportunities to support wider use of low-carbon technologies in civil applications (e.g. through research or demonstration).	Now and ongoing

Table A14 Recommendations for the Office of Gas and Electricity Markets (Ofgem)		Timing
	Continue to support widespread deployment of <b>EV charging infrastructure</b> : <ul style="list-style-type: none"> <li>This should ensure it can support high EV uptake levels. Project Rapid has the right ambition for the strategic road network and should be developed into a full strategy for the 2020s and beyond.</li> <li>Further investment is needed to support on-street and other urban charging solutions for those without off-street parking and destination charging.</li> <li>Around 150,000 public charge points will need to be operating by 2025. These should be widely available across all regions of the UK.</li> <li>Implement the recommendations of the EV Energy Taskforce, in particular improving the consumer charging experience and making smart-charging accessible, appealing and cost-effective for as many EV users as possible.</li> </ul>	Now and ongoing <b>Priority recommendation</b>
	Ensure all regulatory decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Develop mechanisms for strategic investment in coordination with BEIS to ensure that <b>electricity networks</b> can accommodate increased future demand levels, including large localised demand increases associated with electrification in manufacturing, transport and buildings, and that lack of network capacity does not cause delays in emissions reduction.	2023
	Start a programme of research with BEIS to identify <b>areas which are unlikely to be suitable for hydrogen</b> (such that electrification and alternatives can be prioritised), <b>alongside priority candidate areas for hydrogen</b> . Distribution Network Operators should gather and share detailed information on network capacity (at least to substation level) to feed into this.	2021
	Set out reforms to encourage the <b>utilisation of existing network capacity</b> and ensure that costs of local network upgrades are shared fairly and do not disincentivise the roll-out of low-carbon technologies.	2021
	Work in partnership with BEIS to publish and implement a new <b>Smart System Plan and Energy Data and Digitalisation Strategy</b> , including working with DCMS on cyber-security, in order to continue to unlock the full benefits of electricity system flexibility. Ensure that, alongside smart standards for heating, all electricity users have access to half-hourly metering and the option of tariffs that encourage flexibility in use of electric heat and electric vehicle charging.	2021
	Develop (with BEIS) a strategy to coordinate the development of <b>interconnectors</b> , connections for offshore wind farms and the enhancement of inter-area transfer capacity for the onshore network, ensuring cost-effective, timely delivery, bringing forward any legislation necessary to enable it.	H1 2022
	Work with BEIS to make explicit how current and future policies will reduce emissions associated with <b>methane leakage</b> from the gas networks in a way that is consistent with the Sixth Carbon Budget.	2021

Table A15 Recommendations for the Water Services Regulation Authority (Ofwat)		Timing
	Ensure all regulatory decisions, and procurement decisions, are consistent with the <b>Net Zero goal</b> and reflect the latest understanding of <b>climate risks</b> .	Now and ongoing
	Include <b>decarbonisation</b> as one of Ofwat's core principles, to assist the water industry's goal of decarbonising by 2030, and the need to roll out advanced anaerobic digestion systems.	2021
	Work with Defra, the Environment Agency and other stakeholders to set out targets and supporting measures for <b>reducing water use by business</b> . This could be through ensuring that any water reduction targets linked to the Environment Bill include business as well as household water use as well as responding to advice and recommendations from Defra's new Senior Water Demand Reduction Group.	2022

Table A16 Recommendations for the Office for National Statistics (ONS)		Timing
	Review plan for improving <b>data collection</b> and statistical reporting for the purposes of monitoring and informing the low-carbon transition, as part of the broader work the ONS are already undertaking to improve the collection of climate-related data.	2022
	Work with BEIS to put in place plans to collect and report data annually on <b>low-carbon heat networks</b> , specifically, the amount of heat delivered (split by DUKES consumption sector, i.e. Residential/Public/Commercial/Industry, and where possible, by source of heat supply).	2022
	Improve the collection and reporting of <b>industrial decarbonisation data</b> to allow for progress to be monitored more effectively, particularly on energy and resource efficiency.	2022

**Table A17**  
Recommendations for the Scottish Government

Timing

Scale up delivery across all sectors in line with the ambition set out in the recent <b>Climate Change Plan Update</b> .	Now and ongoing
<p>Publish the finalised <b>Heat in Buildings strategy</b>.</p> <ul style="list-style-type: none"> <li>• This must include finalising the regulatory framework and role of different trigger points (including area-based plans), and setting in train the legislation needed to underpin these.</li> <li>• Consult on the trajectory of reform for metrics such as EPCs, to ensure they are robust and enforceable, fit for purpose to deliver the measures needed on a holistic basis, do not disincentivise low-carbon heat, integrate in-use performance metrics from 2023, and include plans for the future role of Green Building Passports.</li> <li>• Provide further detail on the ambition for heat networks and heat pumps over the coming decade, and determine how funding for energy efficiency and low-carbon heat will be allocated to meet strategic priorities.</li> </ul>	2021
Proposals in Scotland's Updated Climate Change Plan 2018-32 to set out a <b>route map for agricultural transformation</b> should be scaled up, with the development of environmental conditionality that incentivises emission reduction and carbon sequestration measures in the land sector that build towards Scotland's climate goals. It is essential that appropriate incentives are in place to drive early action, given the time (often decadal) needed for some measures to reduce and sequester carbon (e.g. afforestation and peat restoration).	2021
<p>Renew efforts to improve <b>recycling and resource efficiency</b>, including by:</p> <p>Bringing forward the planned circular economy package for legislating within the forthcoming Programme for Government.</p> <p>Putting in place the policy and support to ensure the 2025 targets (including the 70% recycling target) within the package are delivered, and setting new ambitious targets for 2030.</p> <p>Legislating to ban key biodegradable waste streams going to landfill from 2025, and ensuring this is delivered through increased resource efficiency and recycling.</p>	2021
<p>Publish a strategy setting out how the Scottish Government will achieve a 20% reduction in <b>car-kilometres</b> by 2030 and deliver 20-minute neighbourhoods. This should be supported by:</p> <p>Continuing to strengthen schemes to support walking, cycling, and public transport.</p> <p>Investment in infrastructure connectivity to lock in positive behavioural changes that reduce travel demand (e.g. home-working).</p> <p>Supporting the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.</p>	2021
Continue to support the expansion of Scotland's <b>public EV charge point network</b> , to ensure the EV transition works for all road users in Scotland.	Now and ongoing
Maintain the provision of <b>interest-free loans</b> for EVs (now including second-hand EVs) on top of existing UK government grants. Plan for a transition to fiscally-neutral incentives as EV costs fall.	2021-22
Taxation should be used, alongside improvements in broadband, to <b>embed positive behaviours</b> that have arisen during the pandemic, replacing business travel with videoconferencing and online collaboration.	2021-22
Seek to address price imbalances between aviation and surface transport, once <b>aviation taxation</b> is devolved to Scotland, encouraging the low-carbon alternative (e.g. rail) for journeys where one exists.	2021-22
Play a leading role in decarbonising the <b>shipping</b> sector by exploring opportunities to transition ferries operated by Transport Scotland to low-carbon energy and establishing appropriate business models to encourage their adoption.	Now and ongoing

Table A18 Recommendations for the Welsh Government	Timing
Publish a new <b>Net Zero Delivery Plan</b> that sets out a long-term vision for meeting the Net Zero goal in 2050, with a particular focus on the Third Carbon Budget and beyond.	2021
Publish a coherent, <b>long-term strategy for heat and energy</b> efficiency in Welsh homes and other buildings, setting a framework for progress in areas of devolved responsibility.  As part of this, energy efficiency policy should be designed so as to ensure that funds go as far as possible in reducing the fuel poverty gap and improving the energy efficiency of homes, by focusing on the most cost-effective interventions (including upgrading homes to EPC B and EPC C where applicable).	2021
Deliver on the priorities set out in Llbwyr Newydd to <b>reduce demand for higher-carbon travel</b> . This includes: <ul style="list-style-type: none"> <li>• Delivering a better, more integrated, decarbonised bus system.</li> <li>• Developing a network of connected local routes for walking and cycling.</li> <li>• Investing in infrastructure connectivity to enable delivery of the ambition for 30% of the workforce to work remotely on a regular basis.</li> <li>• Supporting the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.</li> </ul>	2021-22
Support delivery of a <b>charging network</b> that meets the ambition set out in the Electric Vehicle Charging Strategy, to ensure the EV transition works for all road users in Wales.	Now and ongoing
The Welsh Government's second statutory decarbonisation plan (LCDP2), due out later this year, should set out policies to <b>accelerate afforestation rates</b> to deliver its share of the UK target to plant 30,000 hectares in 2025.	2021
Build on strong progress made on <b>recycling and resource efficiency</b> , including by: <ul style="list-style-type: none"> <li>• Implementing the policies set out in the recent 'Beyond Recycling' strategy.</li> <li>• Legislating and progressing towards the existing 70% recycling target, and set new ambitious targets for 2030.</li> <li>• Legislating to ban key biodegradable waste streams going to landfill from 2025, and ensuring this is delivered through increased resource efficiency and recycling.</li> </ul>	2021

**Table A19**  
Recommendations for the Northern Ireland Executive

Timing

<p>Legislate a credible <b>long-term emissions reduction target</b> that is backed up by evidence on its deliverability and a clear plan for how it can be achieved in a way that is fair for Northern Ireland's citizens – the Committee previously advised that an 82% reduction on 1990 levels by 2050 is Northern Ireland's appropriate contribution to the Paris Agreement and the UK Net Zero goal.</p>	<p>2021-22</p>
<p>Publish a final energy strategy that sets out how Northern Ireland will achieve a <b>net-zero-carbon energy system</b> by 2050, in line with the pathways recommended in our December 2020 advice.</p>	<p>2021</p>
<p>Publish a coherent, <b>long-term strategy for heat and energy efficiency</b> in Northern Ireland's homes and other buildings; encompassing regulatory, policy and funding commitments to facilitate delivery.</p> <ul style="list-style-type: none"> <li>• The strategy should include a trajectory of regulatory standards for energy efficiency, supported by reforms to relevant metrics (such as EPCs) to ensure they drive the measures needed on a holistic basis and do not disincentivise low-carbon heat. Reforms should ensure metrics are robust and enforceable such that standards targeted are achieved in practice.</li> <li>• Publish proposals on the phase-out of fossil fuel heating, including standards to phase out the installation of new liquid and solid fossil fuel heating. Proposals should recognise the critical role of heat pumps and hybrid heat pumps in these homes, minimising the use of biofuels to reflect economy-wide needs.</li> </ul>	<p>2022</p>
<p>Consult on an ambitious trajectory of <b>new-build standards</b> uplifts, including ensuring all new homes are designed for a changing climate, are ultra-efficient and use low-carbon heating from 2025.</p>	<p>2021</p>
<p>Set out provisions to integrate a <b>post-CAP framework</b> that helps the land sector contribute to Northern Ireland's climate goals as soon as the climate legislation is introduced. This should include providing incentives for landowners and tenants to deliver low-carbon farming practices and change the use of land to reduce emissions and increase carbon sequestration.</p>	<p>2022</p>
<p>The Northern Ireland Executive should bring forward a <b>resource efficiency package</b> which matches the ambition of Wales and Scotland, including by:</p> <ul style="list-style-type: none"> <li>• Setting a target for 70% recycling across all wastes by 2030.</li> <li>• Policies to deliver such a target, as well as improving waste prevention and re-use.</li> <li>• Legislating to ban key biodegradable waste streams going to landfill from 2025, and ensuring this is delivered through increased resource efficiency and recycling.</li> </ul>	<p>2022</p>
<p>Strengthen support for and provision of schemes to support <b>walking, cycling and public transport</b> to reduce Northern Ireland's high levels of car-dependence:</p> <ul style="list-style-type: none"> <li>• Strengthen schemes to ensure access to local amenities without dependency on cars.</li> <li>• Invest in infrastructure connectivity to lock in positive behavioural changes that reduce travel demand, e.g. home-working.</li> <li>• Support the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.</li> </ul>	<p>2021-22</p>
<p>Support the deployment of <b>public charge points</b> across Northern Ireland, to address the issue that Northern Ireland currently has the fewest EV charge points per capita of any of the UK nations.</p>	<p>Now and ongoing</p>
<p>Resume collecting and publishing <b>data on vehicle-kilometres</b> travelled by mode in Northern Ireland. This will help identify which actions are effective in encouraging modal shift away from car travel.</p>	<p>2021-22</p>
<p><b>Long-haul air passenger duty</b>, which is devolved to Northern Ireland, should be increased at least in line with UK-wide long-distance APD, to better reflect the climate change impact of flying.</p>	<p>2021-22</p>

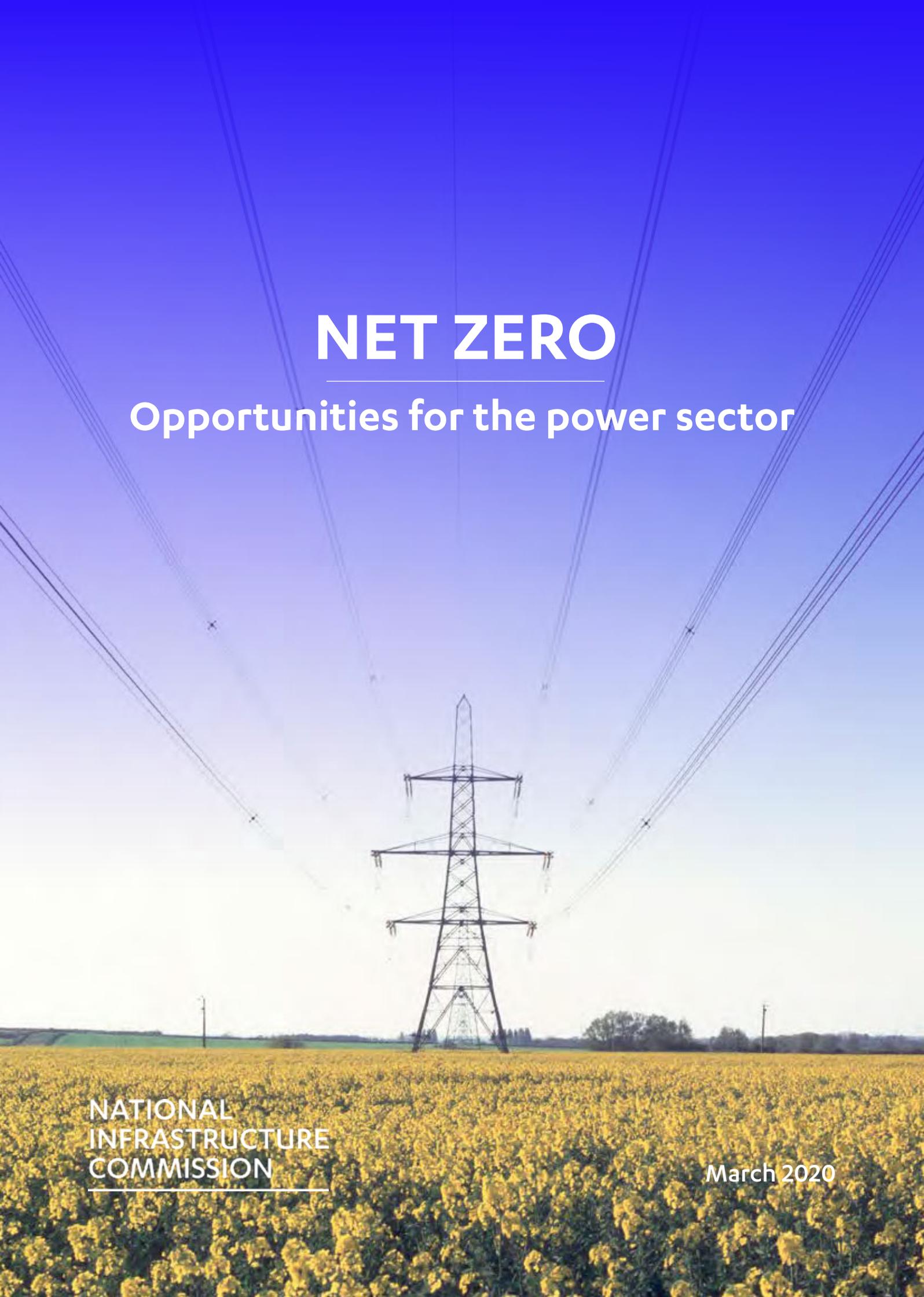
# June 2021

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Joint Recommendations – 2021 Report to Parliament  
Climate Change Committee

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# NET ZERO

## Opportunities for the power sector

NATIONAL  
INFRASTRUCTURE  
COMMISSION

March 2020

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# The Commission

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## The Commission's remit

The Commission provides the government with impartial, expert advice on major long term infrastructure challenges. Its remit covers all sectors of economic infrastructure: energy, transport, water and wastewater (drainage and sewerage), waste, flood risk management and digital communications. While the Commission considers the potential interactions between its infrastructure recommendations and housing supply, housing itself is not in its remit. Also out of the scope of the Commission are social infrastructure, such as schools, hospitals or prisons, agriculture, and land use

The Commission's objectives are to support sustainable economic growth across all regions of the UK, improve competitiveness, and improve quality of life.

The Commission delivers the following core pieces of work:

- a National Infrastructure Assessment once in every Parliament, setting out the Commission's assessment of long term infrastructure needs with recommendations to the government
- specific studies on pressing infrastructure challenges as set by the government, taking into account the views of the Commission and stakeholders, including recommendations to government
- an Annual Monitoring Report, taking stock of the government's progress in areas where it has committed to taking forward recommendations of the Commission.

The Commission's binding fiscal remit requires it to demonstrate that all its recommendations for economic infrastructure are consistent with, and set out how they can be accommodated within, gross public investment in economic infrastructure of between 1.0% and 1.2% of GDP each year between 2020 and 2050. The Commission's reports must also include a transparent assessment of the impact on costs to businesses, consumers, government, public bodies and other end users of infrastructure that would arise from implementing the recommendations.

When making its recommendations, the Commission is required to take into account both the role of the economic regulators in regulating infrastructure providers, and the government's legal obligations, such as carbon reduction targets or making assessments of environmental impacts. The Commission's remit letter also states that the Commission must ensure its recommendations do not reopen decision making processes where programmes and work have been decided by the government or will be decided in the immediate future.

The Commission's remit extends to economic infrastructure within the UK government's competence and will evolve in line with devolution settlements. This means the Commission has a role in relation to non-devolved UK government infrastructure responsibilities in Scotland, Wales and Northern Ireland (and all sectors in England).

The Infrastructure and Projects Authority (IPA), a separate body, is responsible for ensuring the long term planning carried out by the Commission is translated into successful project delivery, once the plans have been endorsed by government.

## The Commission's members

**Sir John Armitt CBE (Chair)** published an independent review on long term infrastructure planning in the UK in September 2013, which resulted in the National Infrastructure Commission. Sir John is the Chair of National Express Group and the City & Guilds Group. He also sits on the boards of the Berkeley Group and Expo 2020.

**Dame Kate Barker** sits on the boards of Taylor Wimpey plc and Man Group plc. She also chairs the Jersey Fiscal Policy Panel, is the Chairman of Trustees at the British Coal Staff Superannuation Scheme, and a member of the Geospatial Commission. She was an external member of the Bank of England's Monetary Policy Committee from 2001 to 2010. In April 2020, she will become Chair-elect of the Universities Superannuation Scheme.

**Professor Sir Tim Besley CBE** is School Professor of Economics and Political Science and W. Arthur Lewis Professor of Development Economics at the LSE. He served as an external member of the Bank of England Monetary Policy Committee from 2006 to 2009.

**Professor David Fisk CB** is the Director of the Laing O'Rourke Centre for Systems Engineering and Innovation Research at Imperial College London. He has served as Chief Scientist across several government departments including those for environment and transport, and as a member of the Gas and Electricity Markets Authority.

**Andy Green CBE** holds several Chair, Non-Executive Director and advisory roles, linked by his passion for how technology transforms business and our daily lives. He chairs Lowell, a major European credit management company and has served as Chair of the Digital Catapult, an initiative to help grow the UK's digital economy.

**Bridget Rosewell CBE** is a director, policy maker and economist. She served as Chief Economic Adviser to the Greater London Authority from 2002 to 2012 and worked extensively on infrastructure business cases. She is a Non-executive Director at Network Rail, Chair of the Atom Bank and Non-executive Chair of the Driver and Vehicle Standards Agency.

**Professor Sadie Morgan OBE** is a founding director of the Stirling Prize winning architectural practice dRMM. She is also Chair of the Independent Design Panel for High Speed Two and one of the Mayor of London's Design Advocates. She sits on the boards of the Major Projects Association and Homes England.

**Julia Prescott** is a co-founder and Chief Strategy Officer of Meridiam and sits on the Executive Committee of Meridiam SAS. She has been involved in long term infrastructure development and investment in the UK, Europe, North America and Africa. Since 2019 she has sat on the board of the Port of Tyne.

# Executive summary

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## **Putting the UK on the pathway to a highly renewable electricity system is the best way to deliver low cost low carbon electricity for the UK.**

**The net zero target makes this more urgent than ever.**

In June 2019 the government raised the UK's ambition on tackling climate change by legislating for a net zero greenhouse gas emissions target for the whole economy by 2050.<sup>1</sup> Decarbonising the power sector is integral to achieving this goal. Good progress has been made. Power sector emissions have fallen by around 53 per cent in the past decade,<sup>2</sup> and government has played a central role in supporting this reduction. The government's ambition to deploy 40 GW of offshore wind by 2030 is another welcome step. This positive progress must continue.

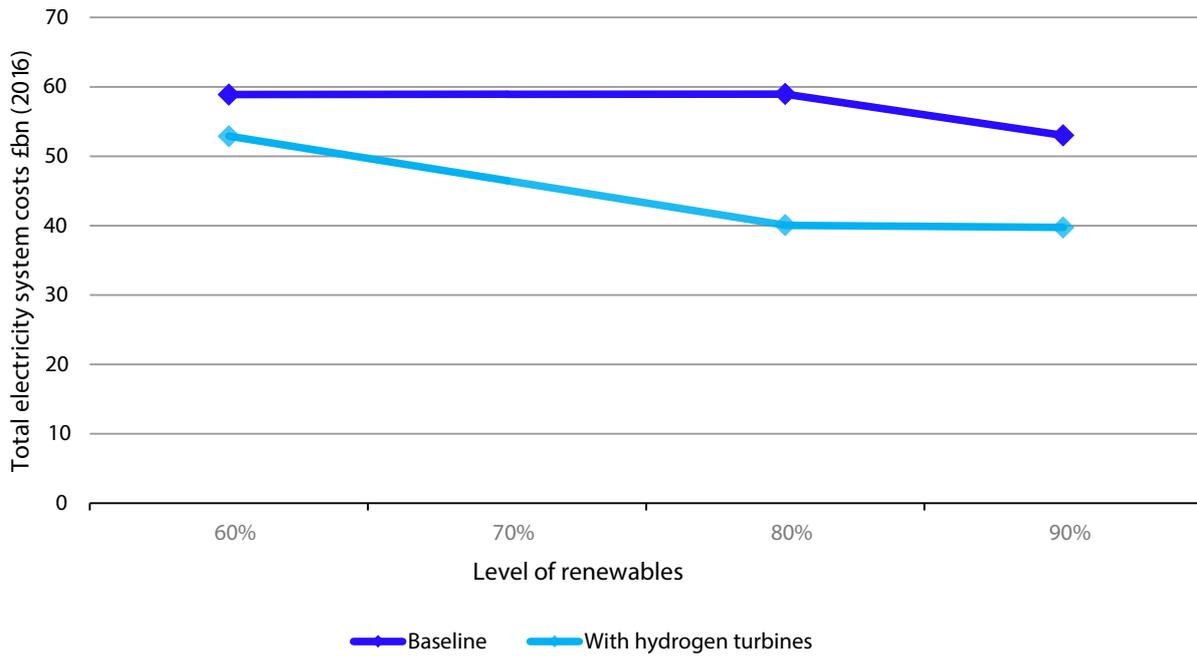
Delivering low carbon electricity while keeping costs affordable to consumers is key. Currently the average energy bill is around £1,200 per year<sup>3</sup>, with electricity making up around £600 of this,<sup>4</sup> and energy bills make up on average 4 per cent of household expenditure.<sup>5</sup> For households in the bottom 10 per cent of the income distribution this increases to 8 per cent.<sup>6</sup>

Clearly, there is a lot of uncertainty when considering the UK in 2050. Accurately knowing how people are going to heat their homes or move around cities and towns 30 years from now is an unachievable task. But uncertainty is not an excuse for inaction. It simply underlines the need to maintain optionality and flexibility in how the UK power system evolves.

That is why, in the *National Infrastructure Assessment*, the Commission set out clear, robust and achievable actions for government to take in the near term to support the decarbonisation of the power sector. These actions focused on setting the UK on the pathway to a highly renewable system. This is the best way to reduce emissions, keep costs low, and maintain optionality in a rapidly changing sector.

Modelling of the total cost of the power system in a net zero economy, carried out for the Commission by Aurora Energy Research,<sup>7</sup> demonstrates that increasing the proportion of renewables on the system does not materially impact the cost of the system. Future system costs may even be lower if action is taken to test the feasibility of deploying hydrogen turbines, an emerging technology for the power sector.

Figure 1: Costs of net zero power systems (average annual costs from 2030 to 2050)



Note: the costs at 70% renewables have been estimated and not modelled.

Table 1: Scenarios, cost and level of nuclear deployment

Level of renewable penetration in 2050	Total system costs (£2016)	Nuclear capacity deployed in addition to already contracted capacity
60 per cent	£59bn	24 GW, approximately 7 Hinkley Point C sized plants.
80 per cent	£59bn	7 GW, approximately 2 Hinkley Point C sized plants.
90 per cent	£53bn	3 GW, approximately, 1 Hinkley Point C sized plant.

## Recommendations from the National Infrastructure Assessment

The analysis and insights summarised in this paper reaffirm the case for the Commission’s recommendation to deliver at least 50 per cent renewable generation by 2030, as part of the transition to a highly renewable generation mix. Since the *National Infrastructure Assessment*, reductions in the cost of renewables have outstripped forecasts.

The latest modelling results also show that a highly renewable power system, combined with flexible technologies including hydrogen powered generation, could be substantially cheaper than alternatives that rely heavily on a fleet of nuclear power plants. There is considerable uncertainty around modelling over such a long time period and in a sector with so much technological change. It does not make sense to fully commit now to a system dominated by one technology, whether that is nuclear, offshore wind or another. Making such decisions now, for example by committing to a fleet of nuclear power plants, rules out a more diverse future generation mix and the potential this has to reduce costs to consumers.

That is why the Commission recommends that the government take action to ensure the UK is running on at least 50 per cent renewable generation by 2030, as part of the transition to a highly renewable system. A renewables based system looks like a safer bet at present than constructing multiple new nuclear plants. But a large amount of uncertainty does remain. Cancelling the nuclear programme entirely risks a 'stop start' approach which is likely to be highly inefficient. Agreeing support for no more than one more nuclear plant before 2025 allows the UK to pursue a highly renewable mix without closing off the nuclear alternative.

## Modelling approach

The work carried out for the Commission analyses the total electricity system costs of delivering a net zero compatible electricity system out to 2050. This involves modelling an electricity system that balances supply and demand for every half hour of the year. The costs presented include the costs of building, connecting and operating generation technology.

There are two different electricity demand scenarios assumed. One scenario assumes electrification of heating and the other assumes hydrogen for heating ('Greener Gas'). The modelling compares electricity systems with upwards of 50 per cent renewable generation beyond 2030 given current government commitments and the previous recommendation of the Commission.

Additionally, this work considers the impact that either hydrogen or bioenergy with carbon capture and storage could have if deployed in the power sector. Natural gas, which is used for producing hydrogen in some scenarios, is assumed to be available at current forecast prices.

## Net zero power systems with electrification of heat

Highly renewable systems are still a low cost option in a net zero world. The analysis once again finds that electricity system costs are broadly flat across a range of different levels of renewable penetrations. If hydrogen is deployed, providing low carbon and flexible generation, it could further reduce the costs of highly renewable systems, by up to 30 per cent in some scenarios modelled here.

If bioenergy with carbon capture and storage is deployed in the power sector, it is likely to be used to generate baseload. This leads to lower levels of nuclear, further highlighting the risks of committing to an extensive new nuclear fleet now.

## Net zero power systems with Greener Gas

The conclusions also hold in a lower demand scenario where heating has been decarbonised using hydrogen. This demonstrates that the Commission's analysis, and recommendations, are robust to uncertainty.

# Recommendations from the National Infrastructure Assessment

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The Commission considers that the UK electricity system should be running on at least 50 per cent renewable generation by 2030, as part of the transition to a highly renewable electricity supply. To achieve this, the government should set out a pipeline of Contracts for Difference auctions to deliver the needed generation. Recent analysis for the Commission also highlights the potential for hydrogen technology in the power sector, which further supports the case for pursuing a highly renewable system.

The government's ambition to deploy 40 GW of offshore wind will go a long way to delivering at least 50 per cent renewable generation by 2030. This positive progress needs to continue. Delivering the Commission's recommendations would allow government to take the needed concrete action in the near term, whilst not closing down options for the future.

## The Commission's recommendations deliver a 21st century power system

In the National Infrastructure Assessment the Commission recommended that government:

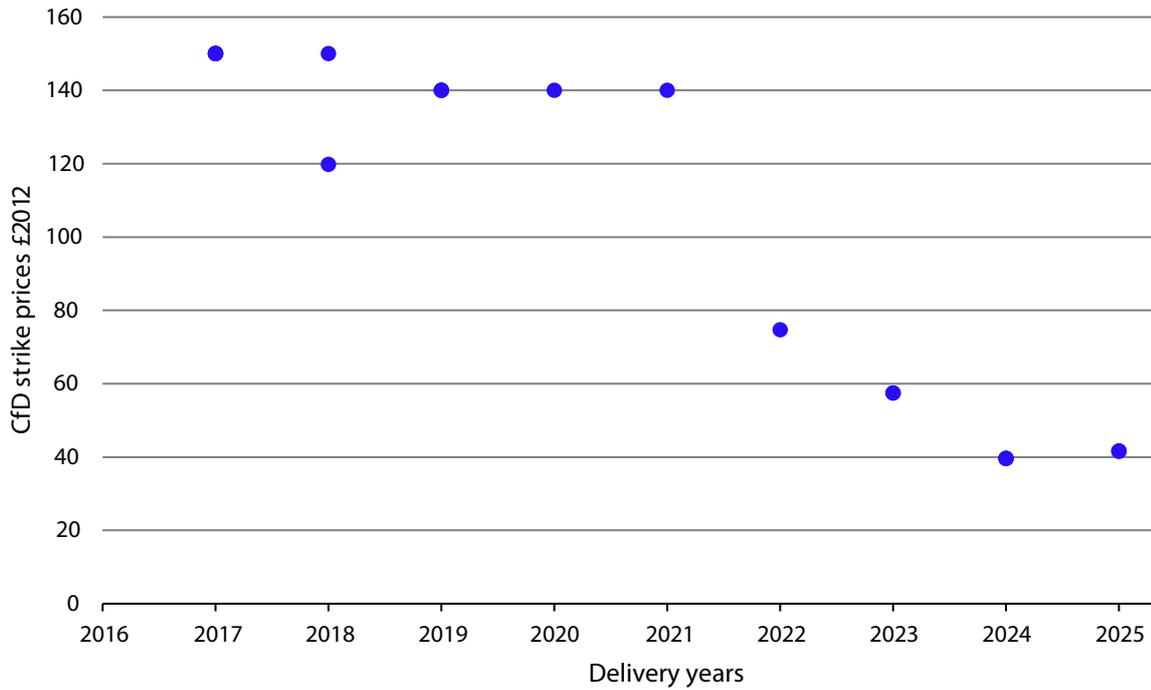
- set out a pipeline of pot 1 Contracts for Difference auctions, to deliver at least 50 per cent renewable generation by 2030, as part of the transition to a highly renewable generation mix
- move technologies that have recently become cost competitive, such as offshore wind, to pot 1 following the next Contracts for Difference auction in Spring 2019. Pot 1 should be used for the overwhelming majority of the increase in renewable capacity required
- publish indicative auction dates and budgets for the next decade by 2020
- over time take whole systems costs into account in Contracts for Difference auctions, as far as possible
- consider whether there is a case for a small-scale, pot 2 auction in the 2020s, if there are technologies which are serious contenders for future pot 1 auctions
- not agree support for more than one nuclear power station beyond Hinkley Point C, before 2025.

The considerations underpinning these recommendations are:

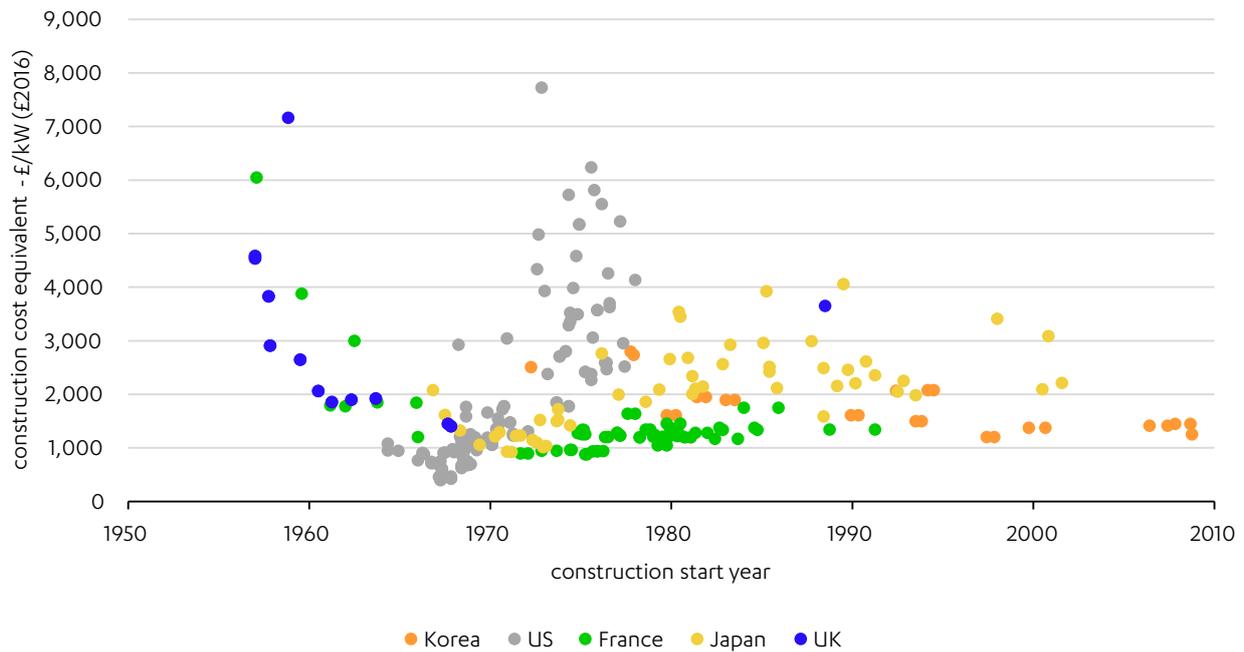
- **The analysis carried out for the Commission of future electricity system costs finds that systems with high penetrations of renewables are as cost effective as other systems** (Figure 1). This was true under the previous 2050 emissions target and it is still true with the new, more ambitious, net zero target. While there are uncertainties in any modelling, it is clear that ruling out the highest penetrations of renewables now would be counterproductive.
- **Renewable costs have consistently fallen faster than forecast.** The analysis summarised above uses informed and expert forecast of future technology costs, capturing a central view of how these costs could evolve. However, over the past decade renewables costs have consistently fallen faster than forecast. The latest Contracts for Difference auction once again demonstrated the rapid cost reductions in renewables (Figure 2), as the Commission suggested it might in its Assessment. Whilst this does not mean the Commission expects this to continue to happen, this presents an upside risk that renewables are even cheaper than currently expected. Other technologies that are key to low cost highly renewable systems, such as short term batteries, have also seen significant cost reductions over the past decade.<sup>8</sup>
- **In contrast, nuclear plants have not yet demonstrated consistent cost reduction.** Figure 3 shows the construction costs of nuclear power stations in various countries, by construction start date. With many decades of experience this data still shows no discernible trend in construction costs over time. This is true even for countries, such as France, that have built fleets of similarly designed reactors.
- **Emerging technologies, such as hydrogen, could further reduce the costs of highly renewable systems.** The Commission's latest analysis demonstrates that, if deployed, hydrogen, either generated from electrolyzers using curtailed generation or gas reforming with carbon capture and storage (CCS), has the potential to materially reduce the cost of highly renewable electricity mixes. In some scenarios costs are reduced by up to 30 per cent.
- **If bioenergy with carbon capture and storage (BECCS) is deployed in the power sector, it will likely displace other baseload technologies such as nuclear.** The Committee on Climate Change have set out that BECCS will likely be needed to generate negative emissions. If deployed in the power sector the Commission's analysis finds it will likely generate baseload and therefore displaces some nuclear capacity.
- **Keeping options open in a rapidly evolving sector is important and putting the UK on the pathway to a highly renewable system does just this.** Costs and operability of different technologies will continue to change rapidly, and the UK must be responsive to this. Policy decisions that lock the UK consumer into paying for large scale programmes with long construction times risk missing opportunities that may emerge. In contrast to other technologies renewables have short construction timelines. Therefore, if action is taken to put the UK power system on a highly renewable pathway, and evidence emerges that makes the case for alternative technologies, it will be possible to change course. The potential cost savings from hydrogen in the power sector is one example that underlines the importance of this.

- New low carbon capacity is needed over the next decade and renewables can deliver this.** As the Commission argued in the first Assessment, due to current plant retirements, in the 2020s there will be a gap in electricity generating capacity, that needs to be filled.<sup>9</sup> It must be the case that low carbon generation fills this gap. Given their short lead times, renewables are ideally placed to do this. With the exception of Hinkley Point C, nuclear power stations would likely only be able to deliver new capacity in the early 2030s. It therefore makes sense for government to take action to deploy renewables now.

**Figure 2: Price reductions in offshore wind in the UK<sup>10</sup>**



Note: Similar cost trajectories have been demonstrated for both onshore wind and solar. For example, *An analysis of the potential outcome of further ‘Pot 1’ CfD auction in GB estimated the price of onshore wind at around £45/MWh in £2012.*<sup>11</sup> However, this chart only covers prices agreed in signed Contracts for Difference in the UK. This trend is not just UK based, with cost reductions in onshore wind, offshore wind, and solar evidenced around the globe.<sup>12</sup>

Figure 3: Construction costs of nuclear power stations over time<sup>13</sup>

## The Commission's recommendations are robust to future change and uncertainty

The analysis presented in this paper makes estimates of the behavior of complex systems over long periods of time and in the context of rapid technological change. These estimates are inevitably uncertain. It is important to consider this uncertainty when drawing conclusions from any such modelling. Small differences in total costs in 2050 should not be used to justify the case for individual technologies, and significant policy decisions should not be taken on the basis of marginal differences in costs over the long term.

The Commission's recommendations are robust to this type of uncertainty. By focusing on high-level trends, and not on individual numbers or small cost differences, the Commission has accounted for the level of uncertainty to 2050. Moreover, the actions that the Commission recommends government take do maintain optionality and avoid excessive technological lock-in, allowing the UK to be reactive to future change.

### **Box 1: A level playing field for onshore wind**

The Commission recommended in the Assessment that cost competitive technologies such as offshore wind should be moved to pot 1 in the Contracts for Difference (CfD) auctions. A pipeline of pot 1 auctions should then be set out to deliver at least 50 per cent renewable generation by 2030, as part of the transition to a highly renewable generation mix. This would provide a genuine route to market for onshore wind and support the UK to deploy a low cost renewable generation mix.

Recently, the government has announced that it will once again run pot 1 auctions, giving onshore wind and solar a pathway to at scale deployment in the UK. This is positive progress towards meeting the Commission's recommendations on the power sector and is very welcome.

The additional challenge of a net zero target makes it even more crucial that government levels the playing field to enable all cost competitive renewable technologies to come forward. The modelling discussed in this paper shows that a significant increase in onshore capacity would support the least cost generation mix.

For each of the scenarios, there is a significant increase in onshore capacity by 2030 of between 2.8 – 4.3 GW, increasing from a 2020 baseline of 12.6 GW.

This is supported by a range of other analyses: Cornwall Insight's long-term power market model shows that the onshore wind capacity likely to be needed is between 16GW and 22GW by 2030 for net zero scenarios,<sup>14</sup> and the central scenario analysis commissioned for the Committee on Climate Change's net zero report from Vivid Economics shows 20GW onshore wind by 2025.<sup>15</sup>

With government support this is achievable. The government's Renewable Energy Planning Database, tracking renewable electricity projects, shows that there is 4.7 GW of onshore wind capacity awaiting construction having had planning permission granted.<sup>16</sup> The appropriate policy support would create a route to market for these projects that are ready to build in the 2020s.

# Modelling approach

The electricity system modelling carried out for the National Infrastructure Assessment has been updated to account for the net zero emissions target. The Commission has also used this updated modelling to investigate the impact that some emerging technologies could have if deployed in the power sector.

Aurora Energy Research was commissioned to carry out updated electricity system modelling. The approach taken is the same as was taken for the *National Infrastructure Assessment*. The modelling analyses the costs of delivering a net zero compatible electricity system with different levels of renewable generation.

The net zero target requires emissions, after accounting for greenhouse gas (GHG) removals, to be zero by 2050. It does not require each sector in and of itself to produce zero emissions. In its indicative net zero consistent scenario the Committee on Climate Change (CCC) allowed for 2.9 MtCO<sub>2</sub> (4.5gCO<sub>2</sub>/kWh) of emissions from the power sector.<sup>17</sup> This is used as a benchmark for the power sector in the analysis presented in this paper. Whilst there may be debate about the exact level of decarbonisation required in the power sector, the Commission considers that this accurately represents a very low emissions electricity system.

The Commission has investigated the cost of running an electricity system with different proportions of renewable generation. The modelling considered systems with 60, 80 and 90 per cent renewable penetrations in 2050. The least cost mix of renewables, between onshore wind, offshore wind and solar, is analysed in the modelling. The remaining generation is optimised economically based on profit maximisation, within the limits of emissions and operability constraints assumed. This modelling work involves analysing the electricity system for every half hour of the year and aggregating costs for meeting demand throughout.

The Commission has only considered renewable mixes above 50 per cent in this latest work. This approach is taken in light of recent government announcements on delivering 40 GW of offshore wind capacity and the Commission's recommendations to government that the UK should be running on at least 50 per cent renewable by 2030.

The modelling provides the following outputs for each scenario:

- total costs in £2016 of constructing and running the electricity systems, averaged over the years 2030 to 2050.
- capacity and generation for each type of technology.

The electricity system costs are further broken down into the following five categories:

- **Wholesale market costs:** The costs of electricity generation, including a carbon price. The carbon price is set at the value required to meet the emissions constraint under each scenario.

- **Capacity market costs:** Costs of procuring enough capacity to meet assumed security of supply constraints.
- **Balancing market costs:** These costs cover the actions required to ensure that the electricity system always balances supply and demand.
- **Network costs:** The cost of building new network cables to connect and support additional generation capacity.
- **Subsidy costs:** Any additional cost on top of the above four categories required to deploy the set amount of renewable capacity.

A more detailed overview of the modelling approach used by Aurora Energy Research is outlined in *Net zero electricity systems modelling* with the full data and assumptions from this analysis.<sup>18</sup> A table of key assumptions is set out in Annex 1.

## Demand scenarios

The future pathway for decarbonised heat in the UK is not yet set but it will have a significant impact on the demands on the power system. Uncertainties around cost, technology, and consumer behavior means that it is difficult to decide the cheapest way to replace natural gas to meet future climate targets now. But uncertainty is not an excuse for inaction in the near term. The Commission has previously made a number of recommendations for developing the evidence base on low carbon heating options. Doing so will give the government, industry, and others the confidence to invest in the best solution at the right time.

In the absence of a single pathway, the Commission's power sector analysis considers two heating pathways:

- **Electrification:** represents a future in which most of the heating sector has been decarbonised largely by using heat pumps.
- **Greener gas:** represents a future in which heat is primarily provided by low carbon hydrogen.

The approach used in this updated analysis is similar to the one used for the analysis underpinning the Assessment. The assumptions for the heating demand scenarios are based on *Cost analysis of future heat infrastructure options*.<sup>19</sup> The results for each scenario are presented separately in the following chapters.

## Emerging technologies for 21st century power systems

The net zero target will impact not just the electricity sector but the whole economy, changing which technologies are available and economic to use in the power sector. As the Committee on Climate Change set out in their report *Net zero: the UK's contribution to stopping global warming*,<sup>20</sup> action across all sectors is needed for the UK economy to fully decarbonise.

Hydrogen, a zero carbon energy carrier, could be used to decarbonise areas of transport, heating, industry and potentially aviation and shipping. The CCC have stated that "By 2050, a new low carbon industry is needed with UK hydrogen production capacity of comparable size to the UK's current fleet of gas-fired power stations".<sup>21</sup>

Similarly, bioenergy with carbon capture and storage (BECCS), with its ability to generate negative emissions, will also be needed to meet the net zero target. The CCC have argued that BECCS will be needed “whether for power generation, hydrogen production or production of biofuels for areas that cannot move away from hydrocarbon fuels (e.g. aviation)”.<sup>22</sup>

Given this, the Commission has now undertaken analysis of the impact that these two technologies could have if deployed in the power sector. This paper sets out that work. However, the paper does not consider the wider impact these technologies would have across the economy. Nor does it consider the case for using these technologies in the power sector compared to other sectors in the economy. It is only analysing the impact these technologies would have if deployed for electricity generation.

## Hydrogen technology in the power sector

The Commission has previously made recommendations on hydrogen for heating and use in fuel cells for heavy goods vehicles.<sup>23,24</sup> But the heightened ambition of moving to a net zero economy may mean that hydrogen is used in other sectors as well. The CCC included 270 TWh of low carbon hydrogen in its indicative net zero pathway.<sup>25</sup>

This paper uses two scenarios to analyse the impact that hydrogen could have if deployed in the power sector:

- **A flexible source of low carbon electricity to complement renewables:** hydrogen, generated from gas reforming with CCS, burning in hydrogen turbines where this lowers the costs of the electricity system.
- **Electrolysis in the power system:** hydrogen produced from electrolyzers using curtailed generation, which is then burned for electricity at a later date.

This analysis has not considered the impacts or costs of the transmission or storage of hydrogen gas. More detail on the approach is set out in Annex 2.

## Bioenergy with carbon capture and storage

Burning biomass combined with CCS technology has the potential to generate both electricity and negative emissions (see box 5). But due to the high capital and fuel costs this technology is unlikely to be cost-effective in the power sector unless it receives revenue for the negative emissions it generates or provides value to the system by running flexibly.<sup>26</sup>

This analysis considers the impact of deploying BECCS in the power sector. This analysis is separate from the hydrogen scenarios described above. The quantity of BECCS assumed is based on estimates of the required amount of negative emissions in the economy by 2050.<sup>27</sup> In the scenarios presented here around 50 MtCO<sub>2</sub> is captured by BECCS in power.\* This is equivalent to around 135 TWh primary of biomass feedstock – well within current estimates for available supply.<sup>28</sup>

More detail on the approach is set out in Annex 2.

\*This is not the full total of negative emissions that the CCC, and others, suggest the UK will need to generate. Additional negative emissions could be generated from other sources (see box 5).

# Net zero power systems with electrification of heat

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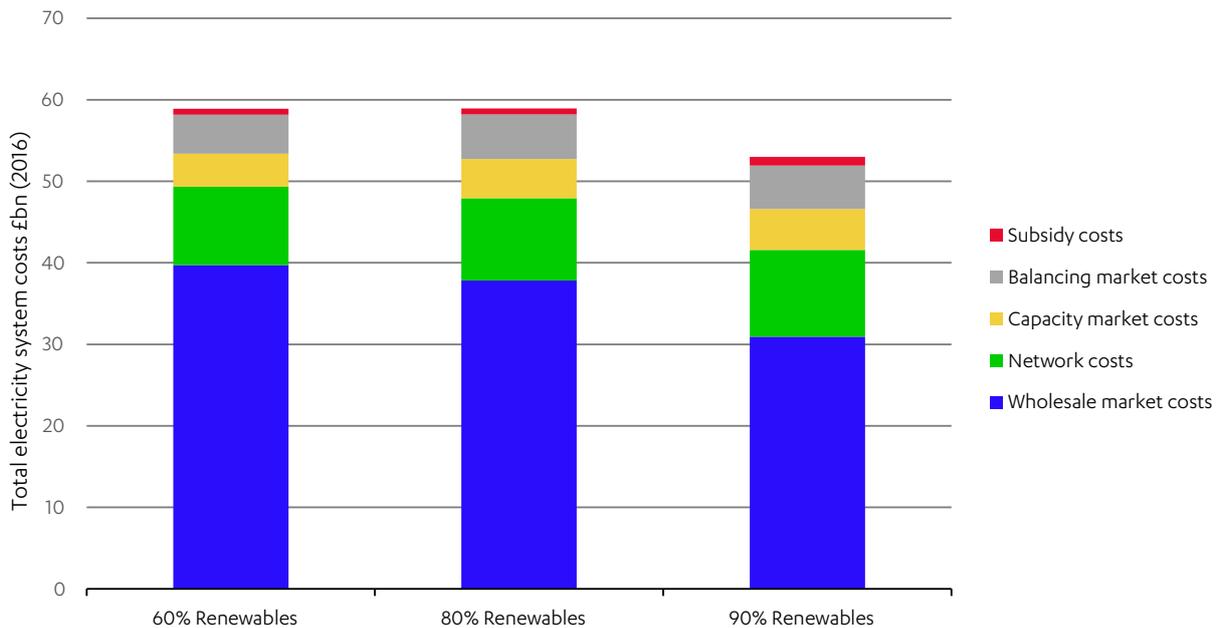
**This chapter presents the results of the power sector analysis with the electrification of heat demand scenario.**

## **Highly renewable systems are still a low cost option in a net zero world**

The modelled electricity system costs are lowest in the highest renewables scenarios (Figure 4). However, the cost difference is less than 10 per cent of total costs. This variability is well within reasonable tolerance levels given the uncertainty inherent in modelling out to 2050. The Commission has taken a prudent and sensible approach to uncertainty, not overly fixating on small 2050 cost differentials. Therefore the overall electricity system costs across the scenarios should be considered as broadly flat across the 60, 80 and 90 per cent scenarios. These estimates are similar to others in the literature.<sup>29</sup>

Scenarios with higher renewable deployment have lower wholesale market costs but this is largely offset through increases in other cost categories (Figure 4). As the renewables considered here are close to zero marginal cost, they significantly depress wholesale market prices, but some of this cost is shifted to increased subsidy levels. Higher balancing mechanism and network costs also occur. This is due to the inherent variability of renewables increasing the costs of balancing supply and demand, and the need for increased network capacity to connect more renewables.

Figure 4: Costs of net zero power systems



### Box 2: Intermittency cost estimates

Variable renewables, specifically wind and solar, are a low-cost technology option for supplying electricity. Indeed, the Commission believes that a highly renewable mix could be the lowest cost electricity system for meeting consumers' needs from 2030 onwards. However, each of these technologies relies on variable weather patterns, driving up uncertainty and placing additional strain on the electricity system.

This cost has often been calculated as the "intermittency cost" in the literature.<sup>30</sup> This cost can be broken down into components in several different ways. For example, the Committee on Climate Change have suggested that it can be understood as the interaction of the following four, albeit overlapping, components:<sup>31</sup>

- **Meeting peak demand:** costs of procuring back-up capacity for periods of peak demand and low renewable output.
- **Balancing requirements:** costs of paying for flexible technologies to be on the system that can ramp quickly to meet short-term electricity shortfalls.
- **Additional network costs:** costs of constructing additional transmission and distribution networks to connect renewable generation to demand.
- **Curtailment:** costs of generation that must be constrained due to too much surplus electricity. This should be distinguished from curtailment due to network constraints, which is not considered here.

The full system cost of intermittent generation will vary depending on the penetration of renewables on the system. Estimates range between £5/MWh to £50/MWh for renewable penetration up to around 65 per cent.<sup>32</sup> From this latest analysis the Commission can estimate the cost of renewable integration at 90 per cent penetration levels. This is set out in table 2 below.

The Commission's analysis does not find that these costs increase substantially with higher levels of renewable penetration. This is in line with the conclusion that highly renewable systems are at least as cost effective as those with lower proportions of renewables for providing the UK's long term electricity supply. As with all estimates for 2050 electricity systems, these are uncertain. As more renewables are deployed on the electricity system these costs will become more certain.

It is also the case that inflexible technologies, such as nuclear, or particularly large assets, such as interconnectors, may impose separate costs on the electricity system. These should also be considered.

**Table 2: Intermittency cost calculations**

Category	Methodology	Intermittency cost when moving from 60% to 90% renewables
Meeting peak demand	Calculated as the additional capacity market costs	£6/MWh
Balancing requirements	Calculated as the additional costs in the balancing mechanism	£3/MWh
Additional network costs	Calculated as the additional network costs	£6/MWh
Curtailment	Calculated as the total percentage of curtailed renewable generation. This should be applied as a cost uplift after other costs have been added to the baseline costs.	17% cost uplift, £9/MWh using the example of an offshore wind farm at £40/MWh
<b>Total</b>		<b>£24/MWh</b>

## Technology mixes in net zero power systems

The Commission's analysis of 2050 generation and capacity mixes has not significantly changed in light of the net zero target. The same technologies, in broadly similar quantities, are still likely to be needed in the long term (Figure 5, Figure 6). Across all scenarios, significant solar, onshore wind, and offshore wind capacity is needed:

- Between 129 – 237 GW of renewable capacity is in operation by 2050, generating between 360 – 530 TWh of electricity across the scenarios modelled. This includes 56 – 121 GW of solar, 18 – 27 GW of onshore wind, and 54 – 86 GW of offshore wind.
- To ensure security of supply there is still a significant capacity of unabated thermal plant on the system by 2050 (between 45 - 54 GW). However, this only provides around 3 – 4 TWh of annual generation as it is primarily deployed as back up capacity.
- At least 18 GW of gas CCS capacity is needed by 2050 across all scenarios, generating upwards of 23 TWh of electricity. By 2050 it is primarily playing a peaking role in the electricity system, with annual load factors of between 14 – 16 per cent. The residual emissions from not capturing 100 per cent of the CO<sub>2</sub> is likely to limit its role in providing bulk baseload generation in a net zero power system, unless higher capture rates are achieved.

- As little as 8 GW of nuclear capacity has been deployed in some scenarios, suggesting that it is possible to meet demand in electricity systems without significant capacity of inflexible baseload generation in the long-term. This is broadly equivalent to one additional nuclear plant beyond Hinkley Point C, in line with the Commission’s recommendation.
- All technologies deployed here fall within the maximum potential capacity deployable in the UK. This is further discussed in Annex 3.

Figure 5: Capacity mix of modelled scenarios in 2050

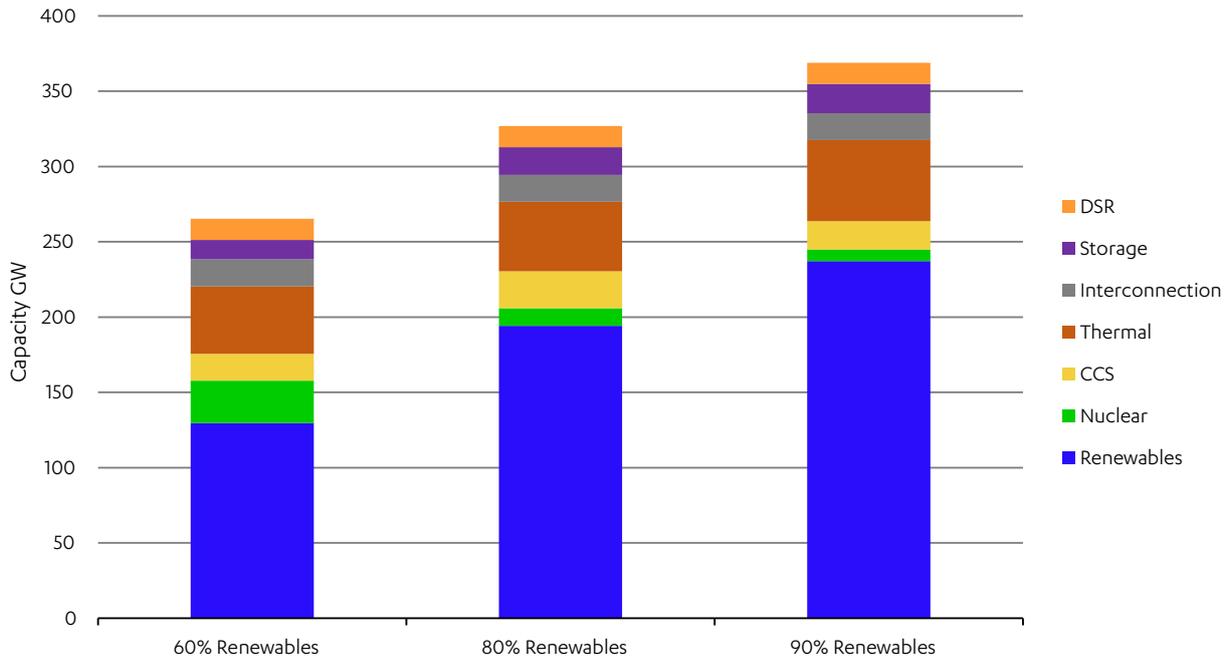
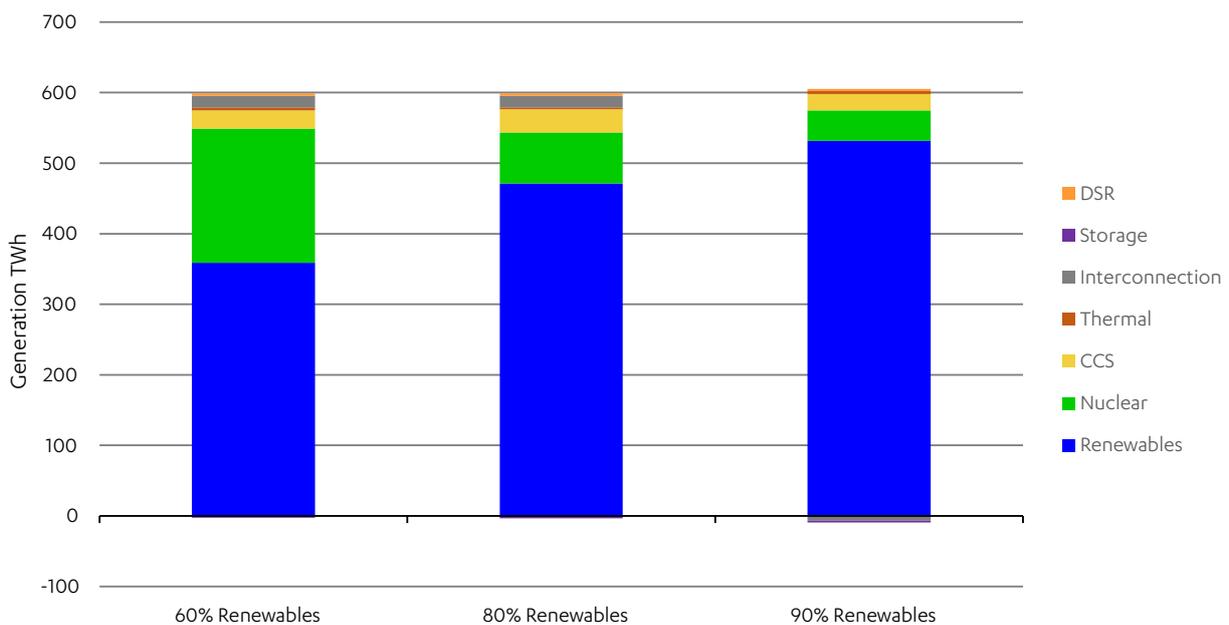


Figure 6: Generation mix of modelled scenarios in 2050

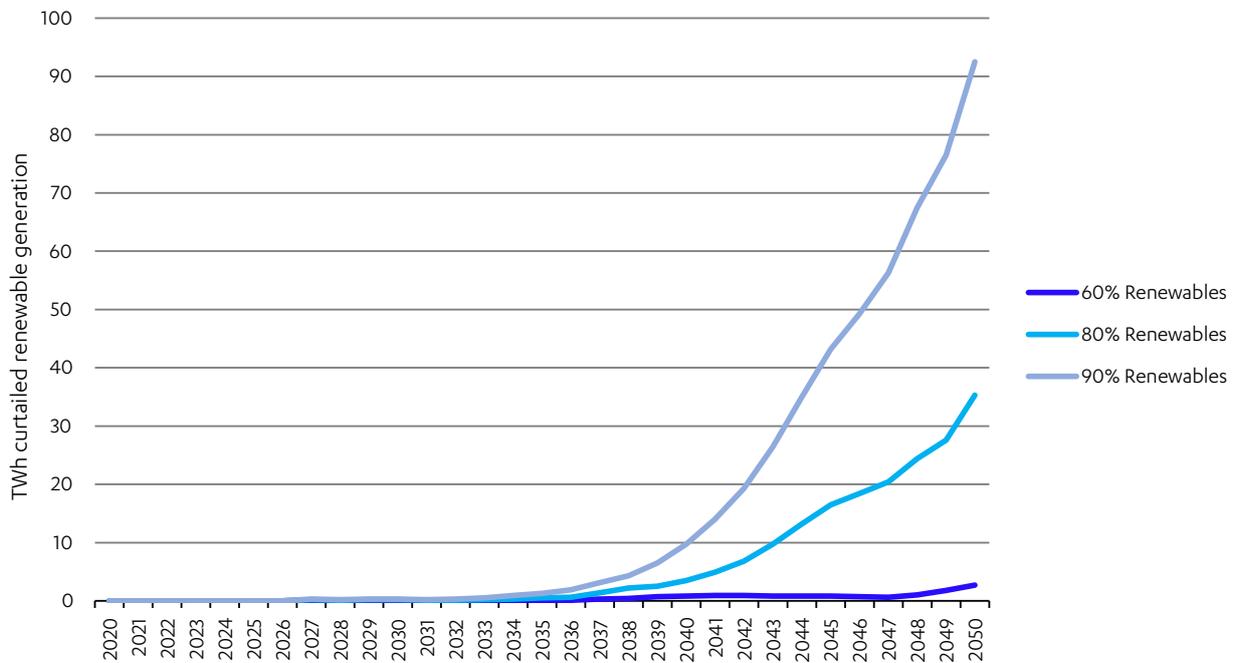


## Curtailment in highly renewable power systems

Increasing deployment of renewables is likely to result in more curtailment, but this does not stop highly renewable systems from being a low cost option. Due to their reliance on weather patterns renewables may generate at times when the electricity system already has enough electricity to meet demand. When this happens, the excess generation may need to be curtailed. This curtailment is different from curtailment in the current system which happens largely due to constraints on the transmission or distribution grid. The maximum level of curtailment in the scenarios modelled here is around 90 TWh (Figure 7). However, whilst this does increase the unit costs of renewables, capital and operating cost estimates are now low enough that highly renewable systems are still low cost.

It is unlikely that significant volumes of curtailed generation would go unused in the long run. New technologies or business models that will be able to make economic use of this curtailment are likely to be deployed. Therefore, it is better to see this curtailment not as a cost to the system but an opportunity. One technology that could take advantage of this opportunity is hydrogen production.

**Figure 7: Curtailment of renewables across modelled scenarios**



### Box 3: The role of system flexibility

Flexible technologies, those that can help balance supply and demand, will be integral to providing the UK with a power system fit for the 21st Century and securing low cost, low carbon electricity for UK consumers. The Commission recognised this in *Smart Power* published in 2016.<sup>33</sup> *Smart Power* set out a range of actions for government and regulators to take to position the UK as a world leader in electricity system flexibility. Analysis carried out for the Commission estimated that achieving a highly flexible electricity system could save UK consumers up to £8bn by 2030.<sup>34</sup> Subsequent analysis has reinforced this and argued that this saving is likely to be even higher by 2050.<sup>35</sup> The analysis presented in this paper further bolsters this case.

Specifically, the Smart Power report called for the UK to become a world leader in electricity storage systems, interconnection and demand side response. A significant capacity of these three technologies are deployed in the analysis presented here, highlighting their importance to the system:<sup>36</sup>

- Across all scenarios 17.9 GW of interconnection comes online, performing a key role in balancing the system, especially in periods of low renewable output. This is in line with the pipeline of interconnectors that are either in operation, under construction, or have been given regulatory approval from Ofgem.<sup>37</sup>
- Large volumes of storage, primarily lithium-ion batteries, and demand side response are included in the mix based on being able to make sufficient economic returns.

One key challenge for future electricity systems is the ability to meet peak demands, especially through the winter months. In the 60 per cent renewables scenario the higher capacity of baseload generation, in the form of nuclear and gas CCS, make these peaks relatively straightforward to meet (Figure 8). But a very highly renewables system can also meet these peaks. Figure 9 demonstrates how the peaks are met during the modelled 2050 January. With 90 per cent of annual generation coming from renewables they contribute the majority of this. However, when renewable output is low, nuclear, gas CCS, storage, interconnection and demand side response all stack up to meet the majority of these peaks. Some small amount of gas CCGT generation is still occasionally required but this only makes up around 4TWh of annual generation using 2MtCO<sub>2</sub><sup>38</sup> of 2.9MtCO<sub>2</sub> emissions constraint.

All future electricity systems need to be robust to extreme weather conditions, especially in a changing climate. The Commission recognised the importance of fully understanding weather impacts on electricity systems and has commissioned the Met Office to undertake research on this. An initial literature review conducted by the Met Office suggested that there are four key areas of uncertainty:<sup>39</sup>

**Peak winter residual demand:** a combination of low temperatures in winter driving high energy demands, combined with low windspeeds leading to low renewable wind energy, and potential limits on solar generation.

**Summer wind drought:** high pressure heatwaves in summer which could lead to a drought of wind supply, exacerbated by possible very low wind speeds, increasing the reliance on solar generation.

**Surplus solar:** combination of low demand and high solar generation output, leading to residual demand frequently dropping below zero and leading to surplus generating supply.

**Wind and solar ramping:** major changes in wind speed or solar irradiance over short time periods, both of which could lead to short term surplus and a requirement to curtail supply.

The review also highlighted the benefits of the UK having a diverse mix of renewables to help manage variable meteorological conditions. Additionally, ensuring that the UK's renewable generators are spread across the country to take advantage of complementary weather patterns could also be key.

The Commission will look to work with the Met Office, and others, to further build this evidence base in the coming years.

Figure 8: Model outputs for generation mix of January 2050 in 60% renewables electrification scenarios

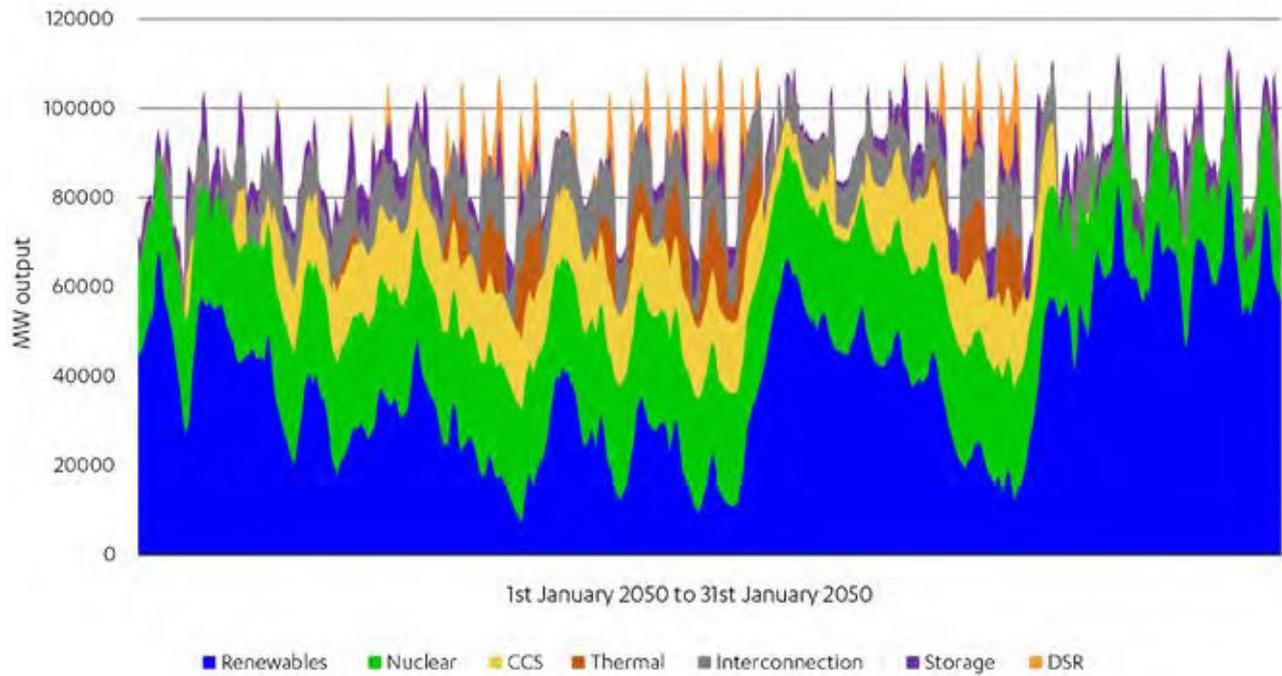
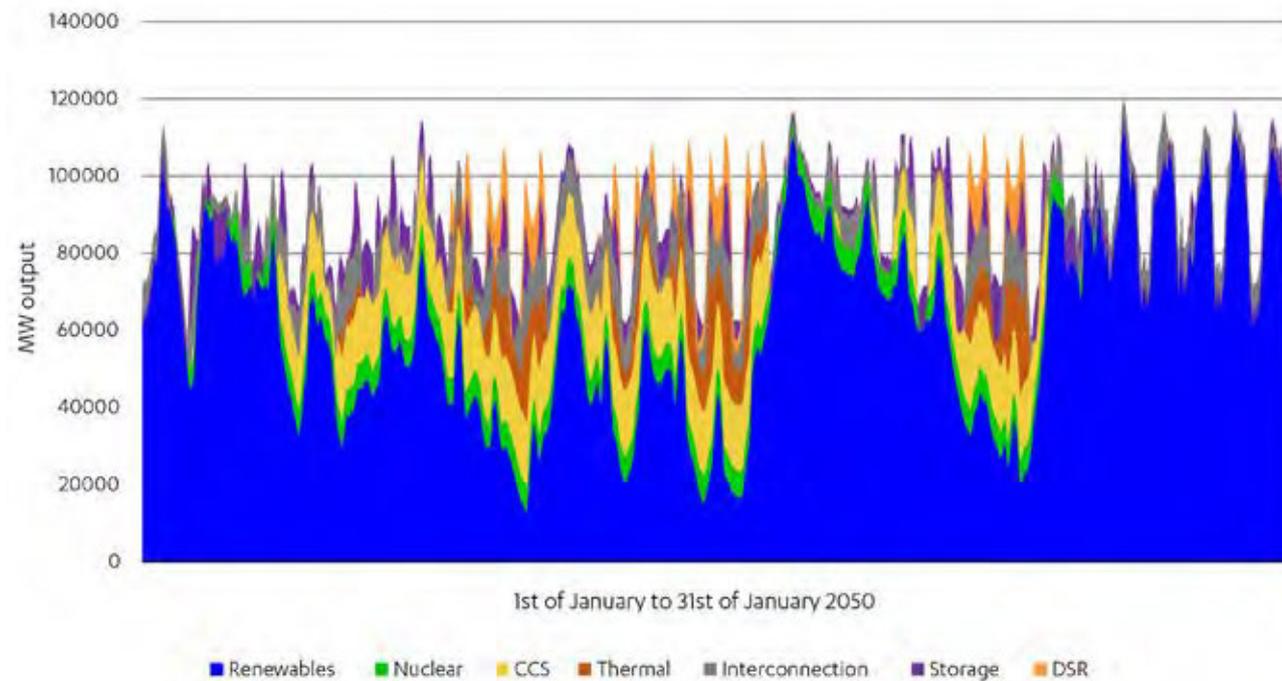


Figure 9: Model outputs for generation mix of January 2050 in 90% renewables electrification scenarios

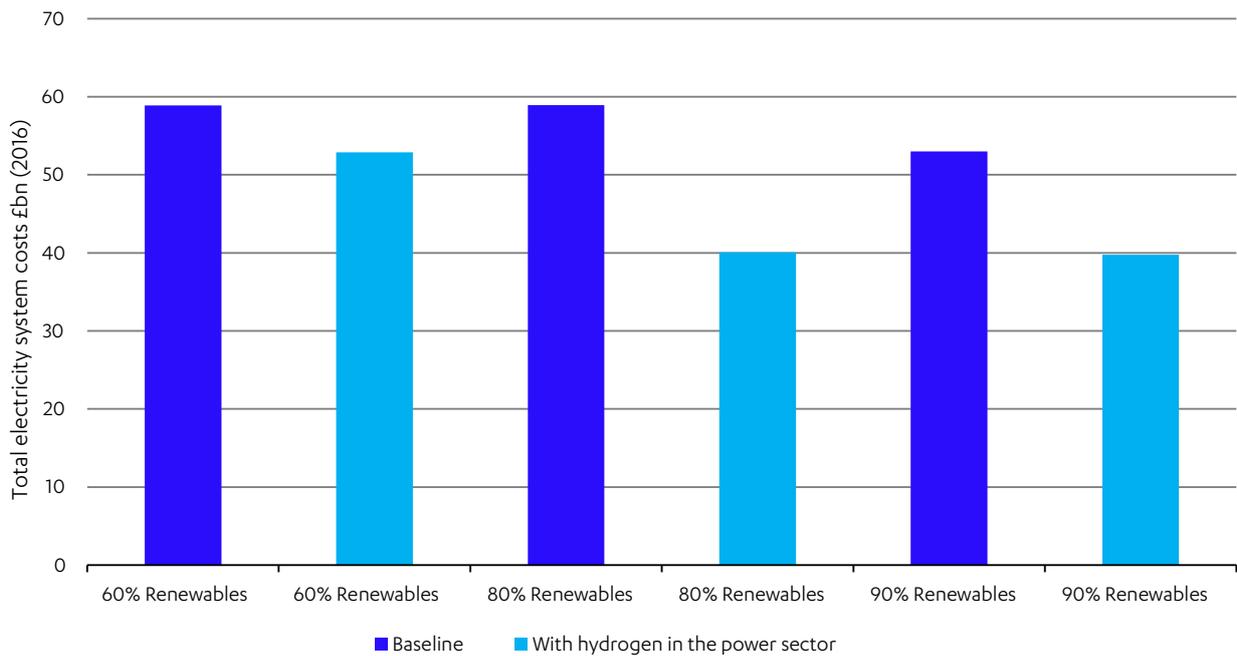


Note: the demand profiles differ across Figure 8 and Figure 9 due to when storage, interconnection and DSR are importing electricity from the system alongside different electric vehicle charging profiles.

## A flexible source of low carbon electricity to complement renewables

Deploying hydrogen turbines at scale, as a complement to renewable technologies, significantly reduces overall systems costs. Across the three different levels of renewable penetration, savings of between 10–30 per cent are seen (Figure 10). It is still the case that the higher penetration renewable scenarios are the cheapest, suggesting that a highly renewable mix is still likely to be at least as cost effective as those with higher baseload capacity. But deploying hydrogen turbines at scale could further lower costs.

**Figure 10: Electricity system costs with hydrogen from gas reforming in the power sector**



**The hydrogen turbines displace many other non-renewable forms of generation and flexibility, reducing the capacity of these technologies needed, and hence system costs** (Figure 11 and Figure 12). Specifically, hydrogen gas turbines:

- Displace nuclear by providing cheaper baseload generation. Nuclear capacity decreases by up to 11 GW with a low of around 5 GW across the scenarios.
- Completely displace all gas CCS from the scenarios. Hydrogen turbines provide both baseload generation and flexible supply at lower cost than gas CCS, completely replacing it in the modelling.
- Significantly decrease the amount of thermal back up capacity needed. As outlined earlier, the scenarios have a large capacity of traditional thermal generation which is needed for security of supply but very rarely runs. As hydrogen turbines also provide firm power, they replace much of this thermal plant. Capacity of thermal plant falls by between 13 – 16 GW across the scenarios.
- Decrease the amount of electricity that is imported from connected EU markets during high price periods. Net imported generation falls by up to 20 TWh across all scenarios.

- The hydrogen turbines provide low carbon baseload generation, low carbon flexibility and firm power, which are normally provided in the modelling by a range of different technologies. By combining all of these services in one technology, this significantly lowers the amount of capacity needed and therefore the capital investments required. This lowers overall system costs.

Figure 11: Capacity mix with hydrogen from gas reforming in the power sector in 2050

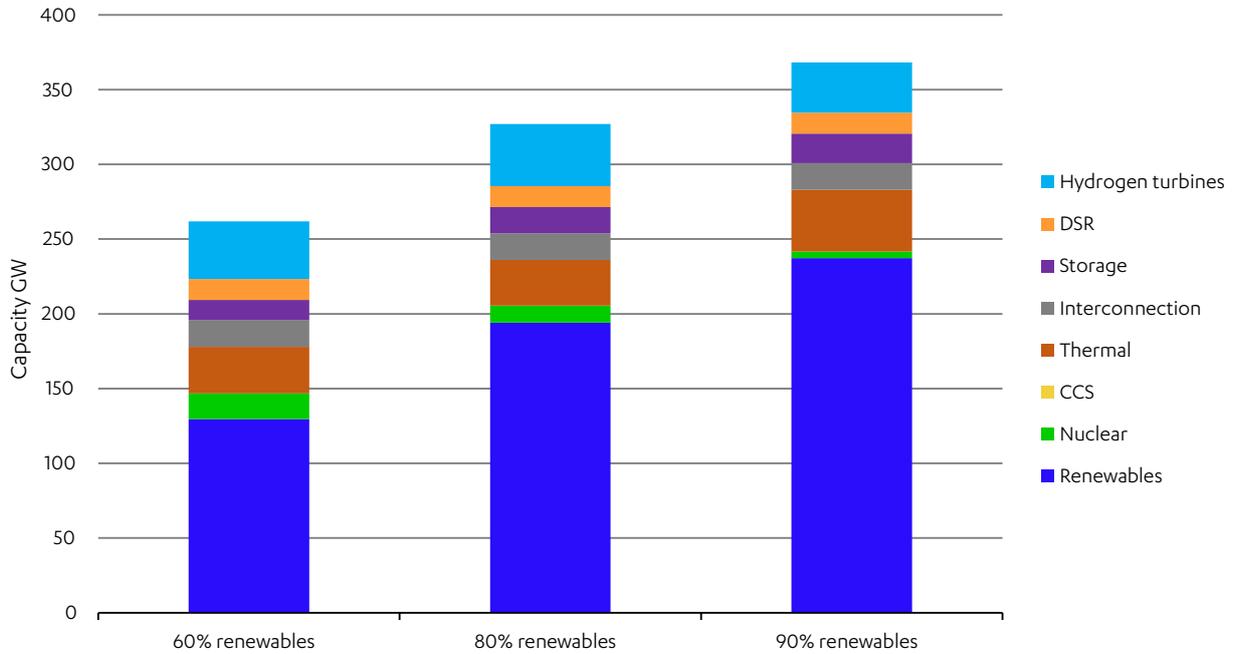
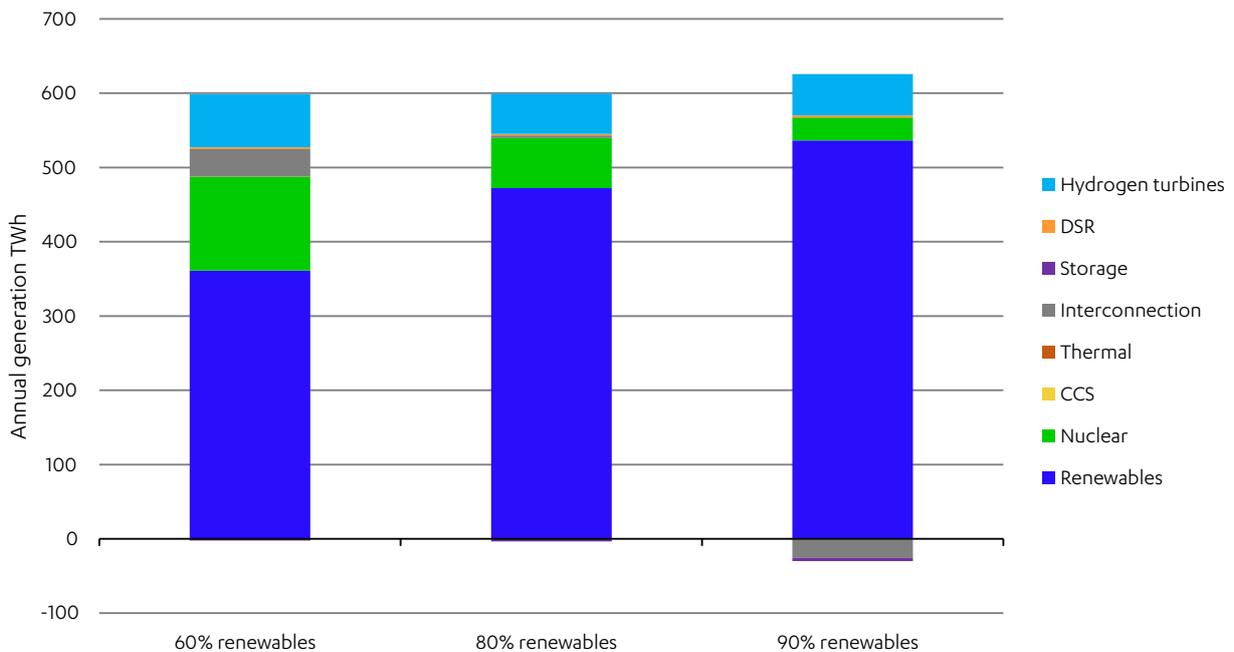


Figure 12: Generation mix with hydrogen from gas reforming in the power sector in 2050

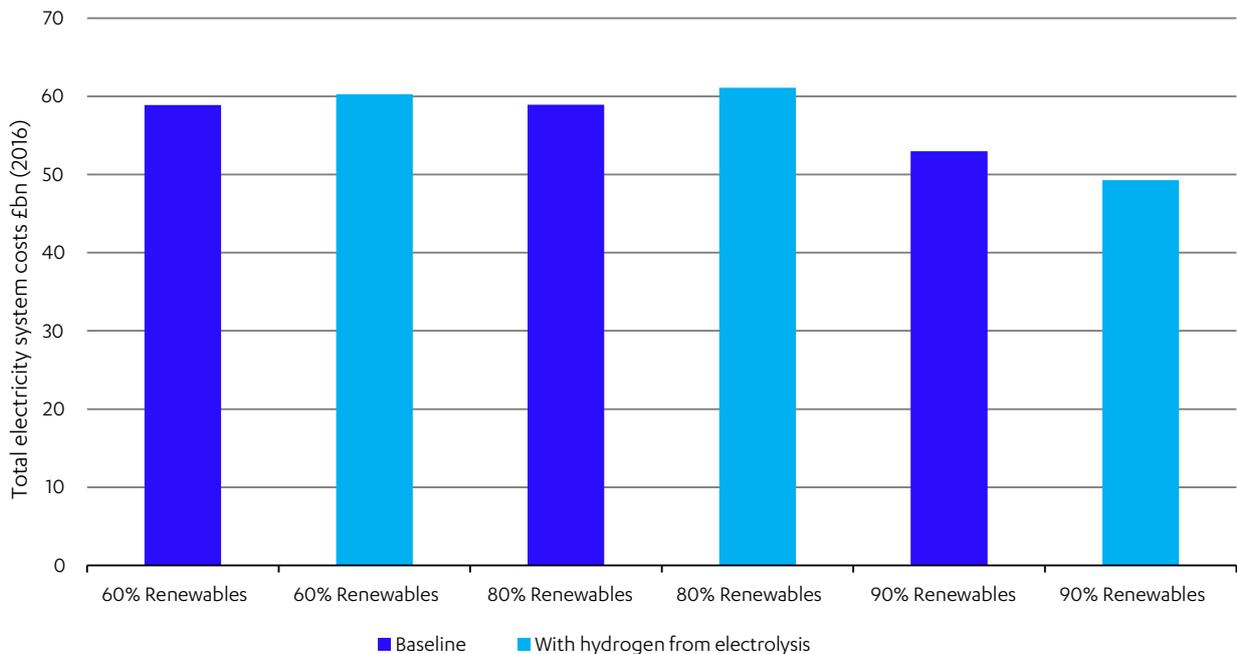


Note: If the UK is net exporting electricity this appears on the chart as a negative figure below the x-axis.

## Electrolysis in the power sector

The Commission's analysis finds that some electrolyser capacity does have the potential to reduce system cost, by up to 7 per cent (Figure 13), through using curtailed renewable generation. This is most likely in systems with higher renewables deployment and hence higher levels of curtailment, as this allows the electrolysers to achieve higher load factors.

**Figure 13: Electricity system costs with electrolysis in the power sector**

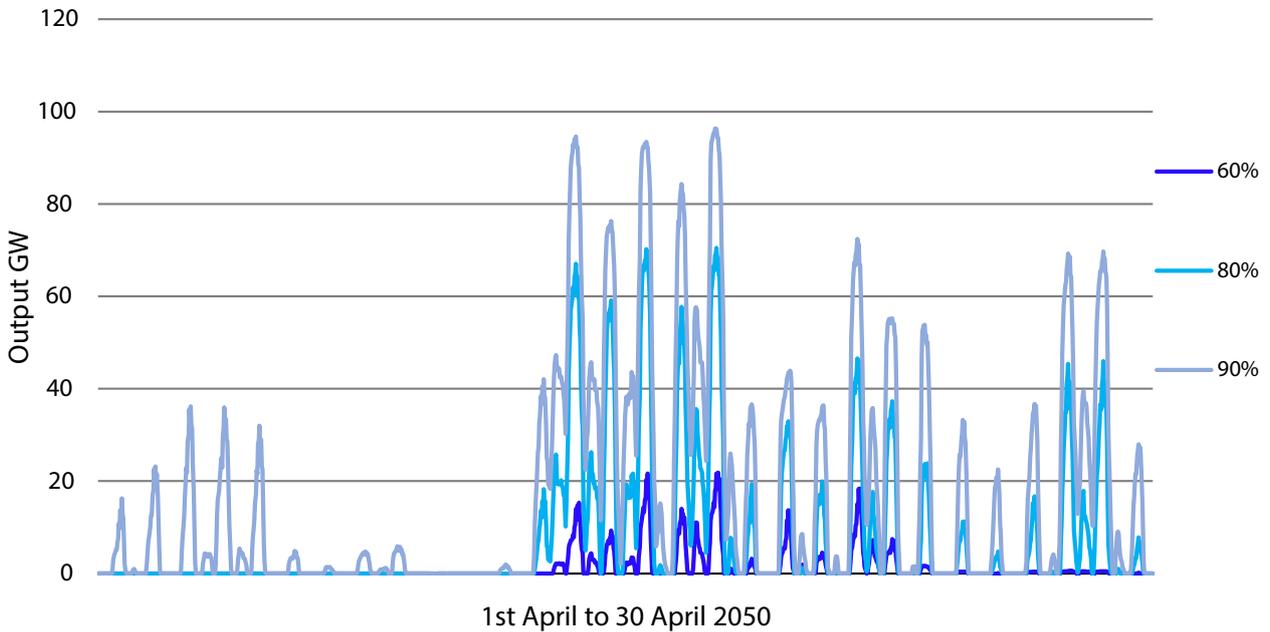


Electrolysers in this analysis capture 90 per cent of the curtailed renewable generation. In lower renewable penetration scenarios deployment of electrolysers is found to marginally increase costs as there is not enough curtailed generation to cover the capital investment required to build the electrolysers.

- The utilisation rate of the electrolysers has a significant impact on how cost-effective they are. Curtailment of renewables varies dramatically throughout the year (Figure 14). To capture all curtailed generation, including the largest of these peaks, would require around 95 GW capacity of electrolysers. But these would be achieving a utilisation rate of less than 1 per cent and would therefore be uneconomic. In this analysis, electrolysers are sized to capture 90 per cent of curtailed generation, leading to annual utilisation rates of around 15 per cent.
- The hydrogen produced from these electrolysers is burned in hydrogen compatible gas turbines. These hydrogen gas turbines then primarily displace nuclear and gas CCS generation.

This work only highlights one potential use of curtailed generation. Other technologies, for example inter-seasonal storage such as compressed air storage,<sup>40</sup> may find an economic use for curtailed generation. The value proposition for electrolytic hydrogen outside the power sector, such as for use in heavy goods vehicles, also needs to be fully understood. But this analysis highlights that curtailed generation should not be considered as a cost in isolation as it is highly likely that economic uses of it will emerge.

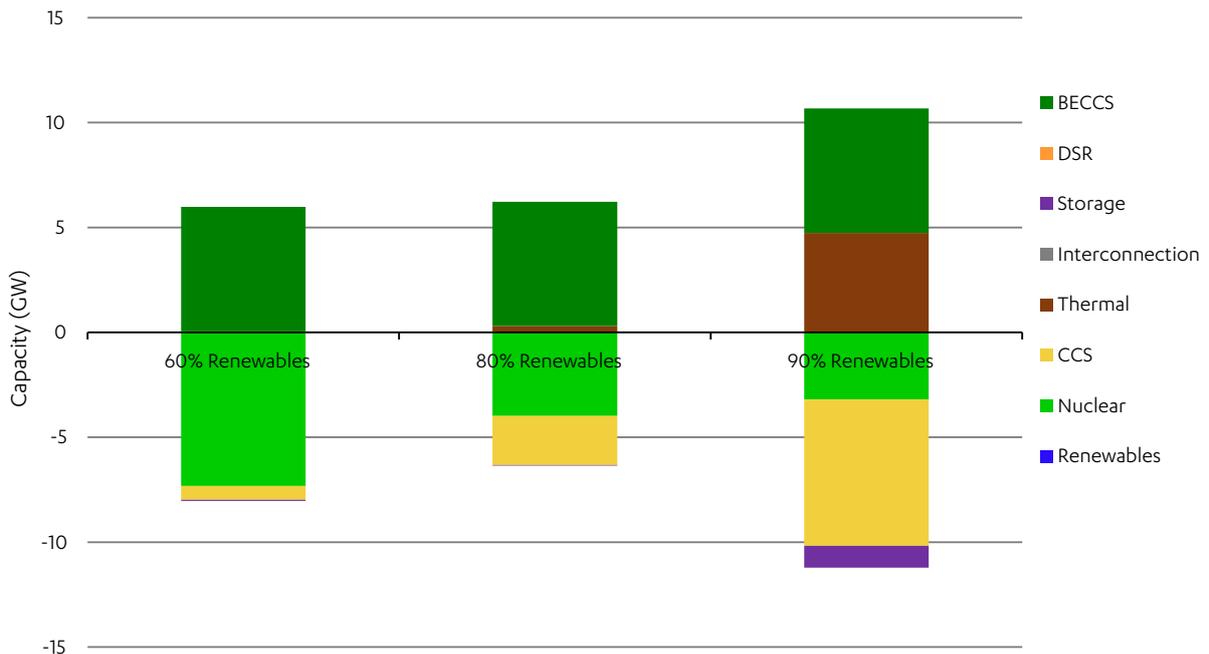
Figure 14: Profile of curtailed renewable generation in modelled April 2050



## Bioenergy with carbon capture and storage in power

The analysis concludes that deploying bioenergy with carbon capture and storage in the power sector has little impact on total electricity system costs, but that it would likely weaken the case for a large nuclear fleet in the long term.(Figure 15).

Figure 15: Change in capacity in 2050 when introducing BECCS into the electricity system



The modelling finds that BECCS will likely run baseload – meaning it would aim to generate constant output rather than flex to meet demand. As a result, it displaces other inflexible technologies such as nuclear that compete for baseload. Whilst BECCS has the technical capability of providing some system flexibility, the costs of building additional capacity outweigh the potential revenue from capturing peak prices. The Commission has not considered whether BECCS should be deployed in the power sector but sought to understand the impacts if it was:

- The BECCS deployed runs baseload in all scenarios. The analysis finds that the cost of building extra BECCS capacity to allow a plant to run flexibly, by ramping up and down to meet demand, exceeds any revenue gained from capturing peak prices. This is compounded as BECCS is unlikely to be as flexible as other technologies such as traditional CCS plants.<sup>41</sup>
- As a result, introducing BECCS into the generation mix reduces the capacity of nuclear by 3 – 7 GW across all scenarios, and reduces the capacity of gas CCS by up to 7 GW across all scenarios.
- There could be other sectors that BECCS may have more value in. Similar in depth analysis needs to be conducted on a sector by sector basis to provide insight into where BECCS has the highest value across the whole economy.

## Conclusions

**Highly renewable electricity systems are at least as cost effective as those with lower proportions of renewables.** This conclusion is unchanged from the analysis conducted for the Assessment. As is expected when carrying out modelling exercises there have been some changes at the margins, with capacity mixes and deployment timelines of various technologies changing slightly. But these have not affected the overall conclusion used to inform the Commission’s recommendations.

**The modelling also finds that there could be a role for either hydrogen or BECCS in the power system, with hydrogen offering the potential to lower electricity system costs:**

- Hydrogen gas turbines, with a plentiful supply of cheap low carbon hydrogen could play a major role in future power systems. They can act as a natural complement to renewables, helping to reduce whole system costs, but further action is required to demonstrate the technology at scale.
- Electrolysis, producing hydrogen from curtailed electricity, could help to reduce system costs in highly renewable mixes. However, it will be challenging to absorb all curtailed renewable generation at low cost due to the volatility of its production.
- Deploying BECCS in the power sector has little impact on costs, but it would likely displace other baseload generation such as nuclear.

# Net power systems with decarbonised gas heating

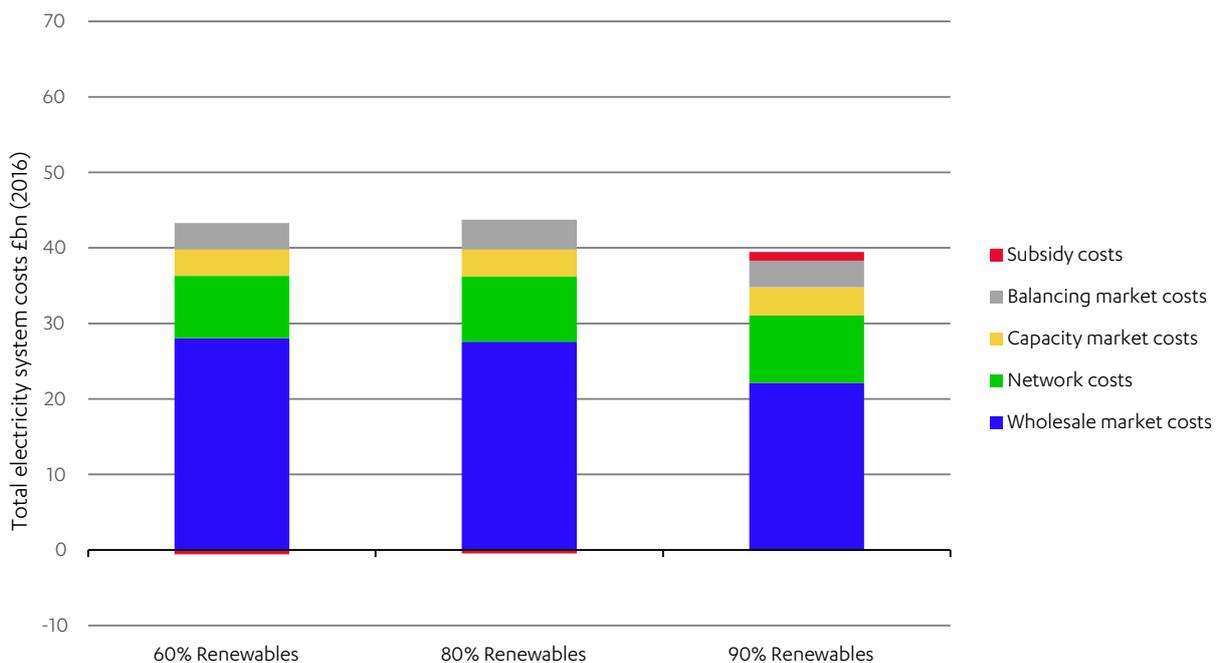
This chapter summarises the results from the power sector analysis with the Greener Gas demand scenario. As set out in table 1, the two primary changes are lower demand, at around 465 TWh, and a corresponding tighter emissions constraint of 1 MtCO<sub>2</sub>. All other assumptions, including technology costs, are held the same. The results in this section are similar to the results for the electrification of heat demand scenarios and therefore only the key results are presented.

## Power system in the Greener Gas scenario

The modelling finds that the costs of low carbon electricity systems, averaged between 2030 and 2050, are again broadly flat across the 60, 80 and 90 per cent renewables penetration scenarios (Figure 16).

- The overall system costs of the electrification of heat and greener gas scenarios should not be directly compared. The costs of providing low carbon electricity for heat are included in the electrification of heat analysis (Figure 4) but the costs of generating low carbon hydrogen for heating are not included in the greener gas scenario (Figure 16).

Figure 16: Costs of net zero power systems



The generation (Figure 18) and capacity (Figure 17) mixes in the Greener Gas scenario have similar proportions of technologies to the electrification of heat scenarios but lower overall levels. As the demand for electricity in these scenarios is lower, less capacity is built out to meet it:

- Across the three scenarios 57 – 124 GW of solar, 15 – 22 GW of onshore wind, and 41 – 62 GW of offshore wind are deployed by 2050.
- To ensure security of supply there is still a significant capacity of unabated thermal plants on the system by 2050. However, this only provides up to 2 TWh of annual generation as it is primarily deployed as back up capacity.
- At least 5 GW of gas CCS capacity is needed by 2050 across all scenarios. Similarly to the electrification scenarios this is primarily playing a peaking role by 2050 due to the residual emissions of generating baseload.
- Between 5 – 21 GW of nuclear capacity is deployed by 2050 across the three scenarios.
- The capacity of all technologies is lower in the Greener Gas scenarios than in the electrification of heat. The capacities therefore fall within the resource constraints discussed in Annex 3.

With a significantly smaller power sector there is less overall curtailed generation (Figure 19). However, there is little difference in the percentage levels of curtailed renewables. In the electrification of heat scenarios between 1 – 17 per cent of renewable generation is curtailed. In the Greener Gas scenario this is around 0 – 14 per cent.

**Figure 17: Capacity mix in 2050 of modelled scenarios**

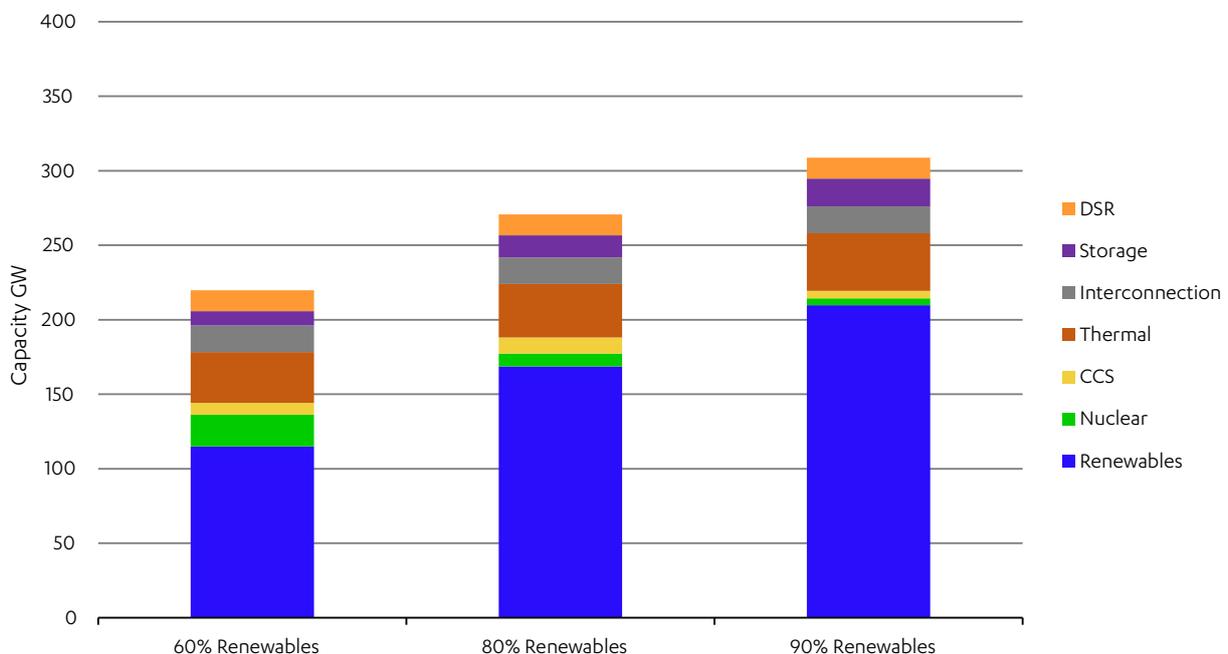


Figure 18: Generation mix in 2050 of modelled scenarios

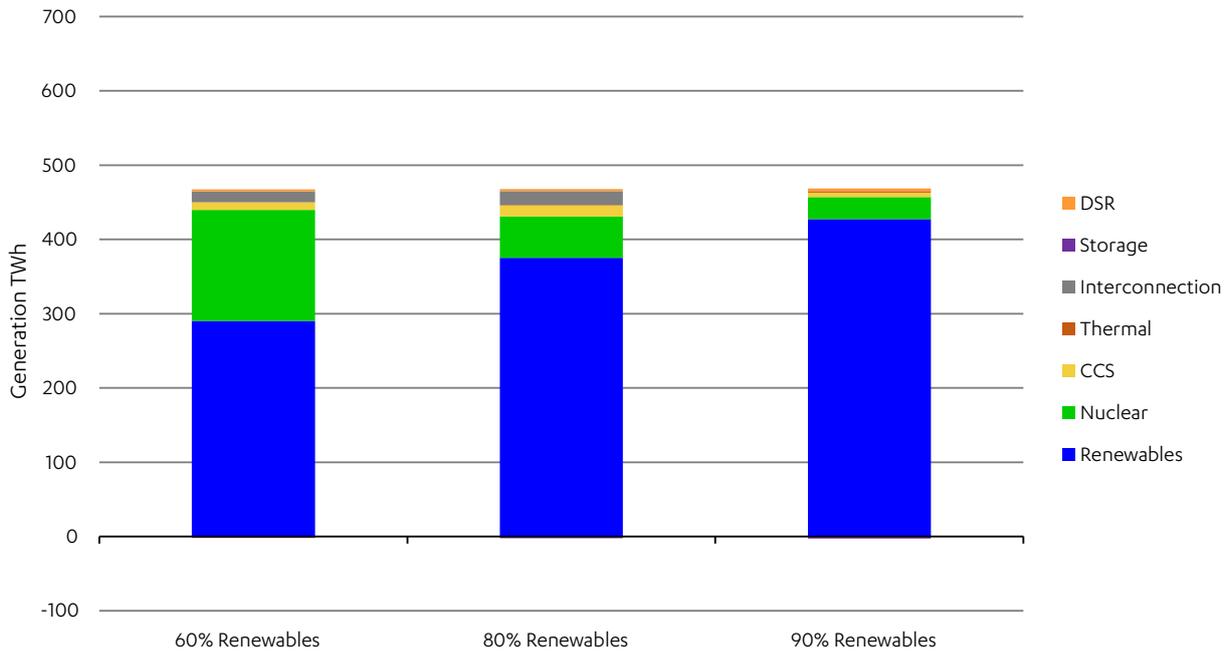
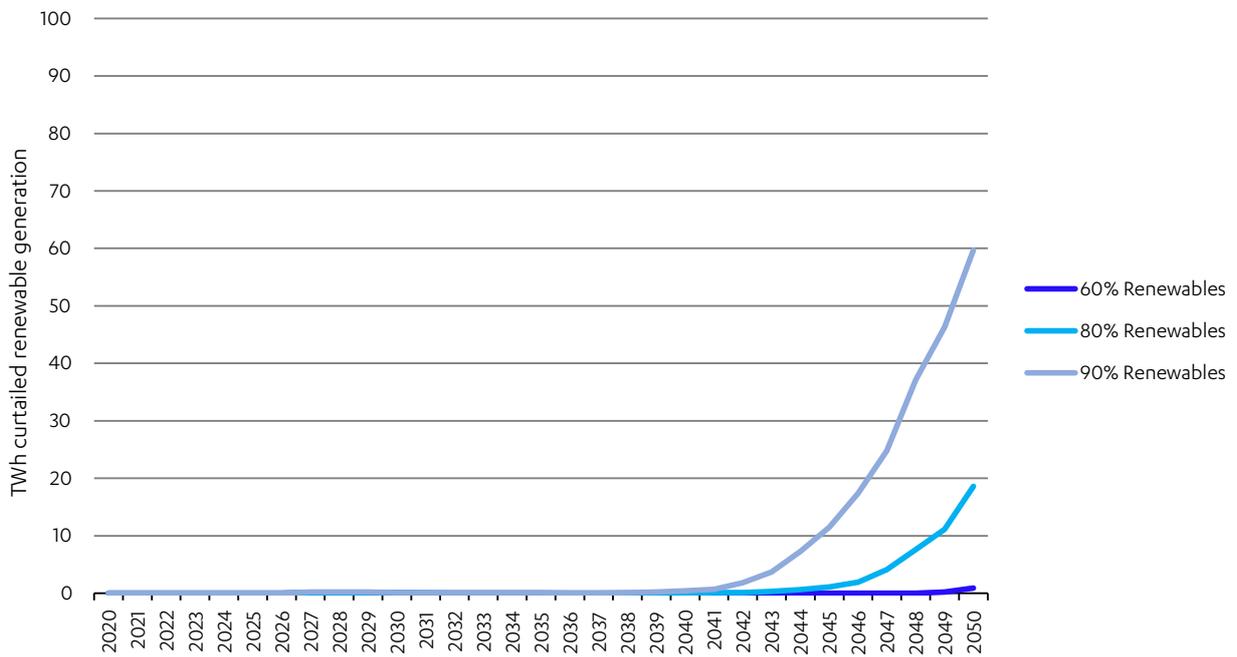


Figure 19: Curtailment of renewables across modelled scenarios



## Hydrogen technology in the power sector

Hydrogen technologies are once again found to have the potential to materially reduce overall electricity system costs:

- Gas reforming can significantly reduce costs by 21 – 28 per cent (Figure 20). However, costs still reduce with higher levels of renewables suggesting that at scale hydrogen is a complement to rather than replacement for renewables.
- Electrolysis reduces costs marginally at the highest levels of renewable deployment, by around 2 per cent, but at lower penetrations there is not enough curtailment to make it economic (Figure 21).
- The hydrogen generation displaces many other forms of non renewable generation and capacity (Figure 22, Figure 23). Up to 8 GW of nuclear capacity is displaced and all gas CCS capacity is replaced by hydrogen gas turbines.

**Figure 20: Electricity system costs with hydrogen from gas reforming in the power sector**

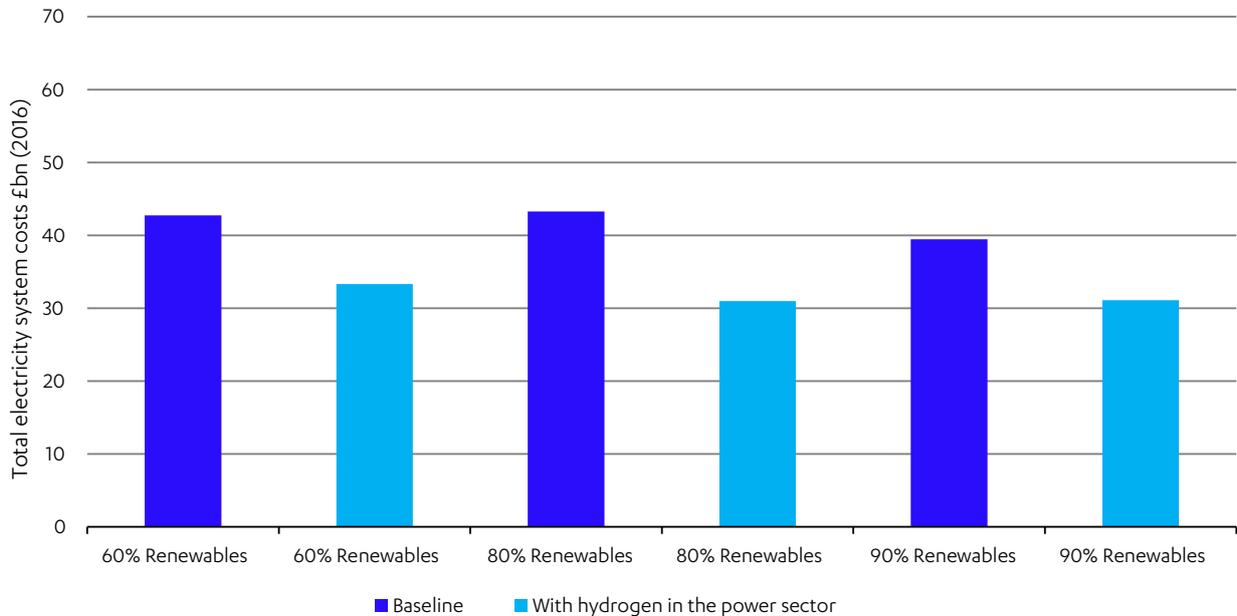


Figure 21: Electricity system costs with electrolysis in the power sector

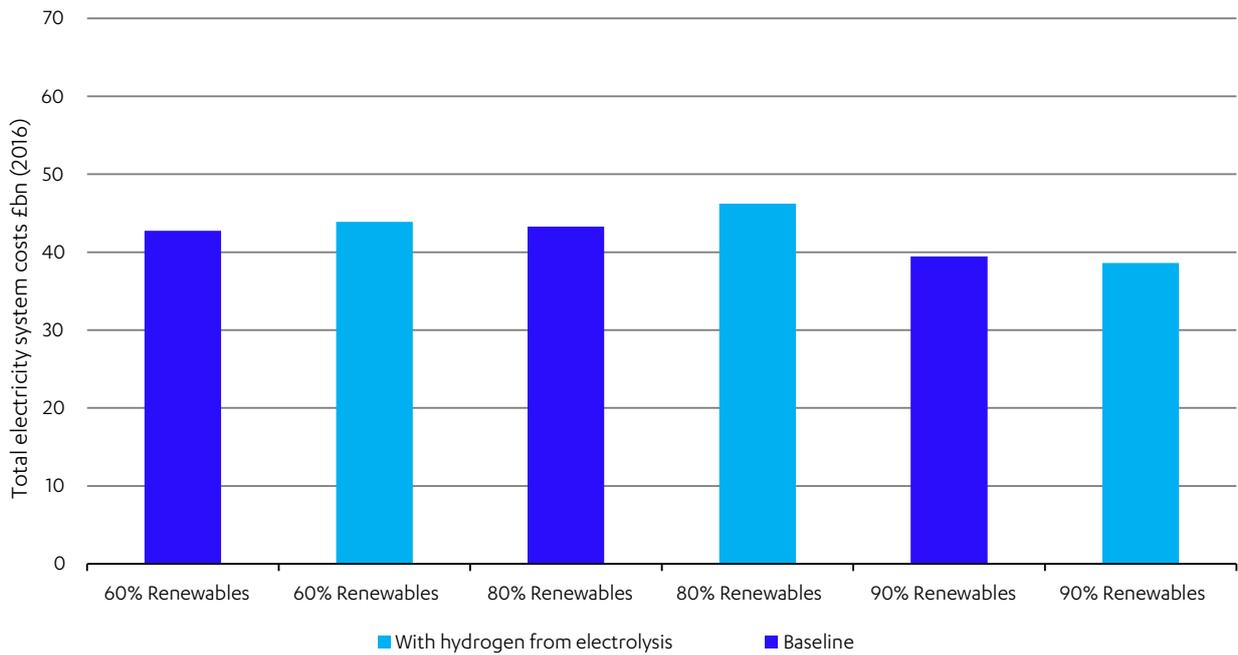


Figure 22: Capacity mix with hydrogen from gas reforming in the power sector in 2050

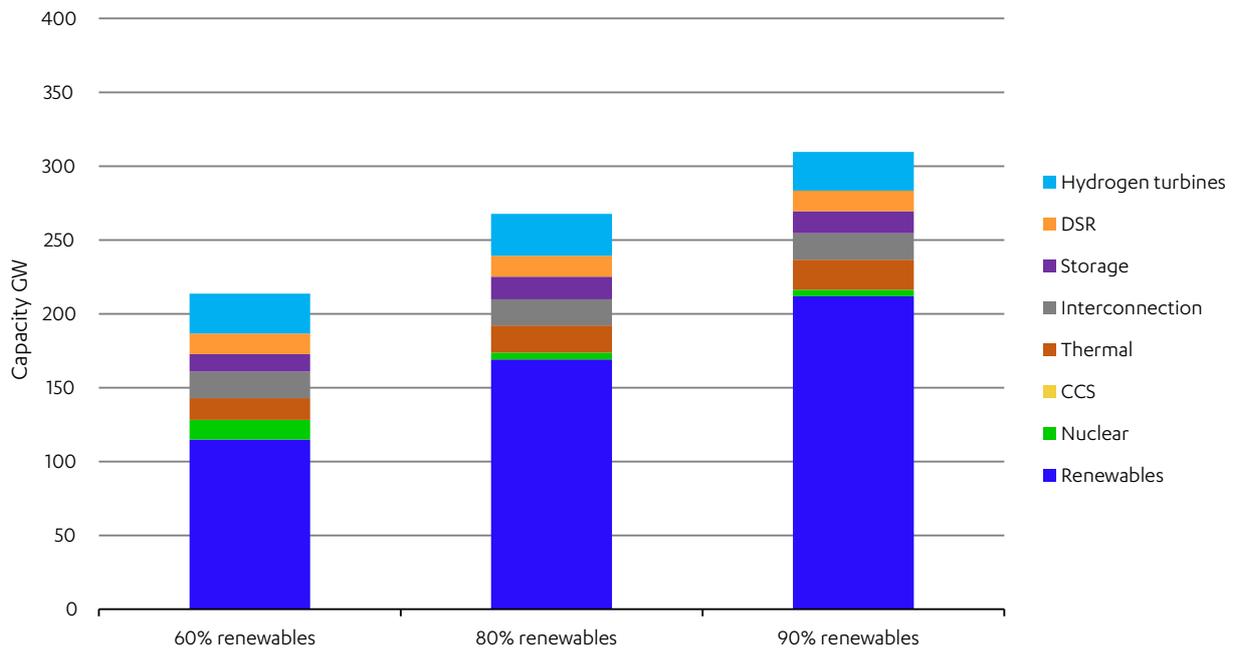
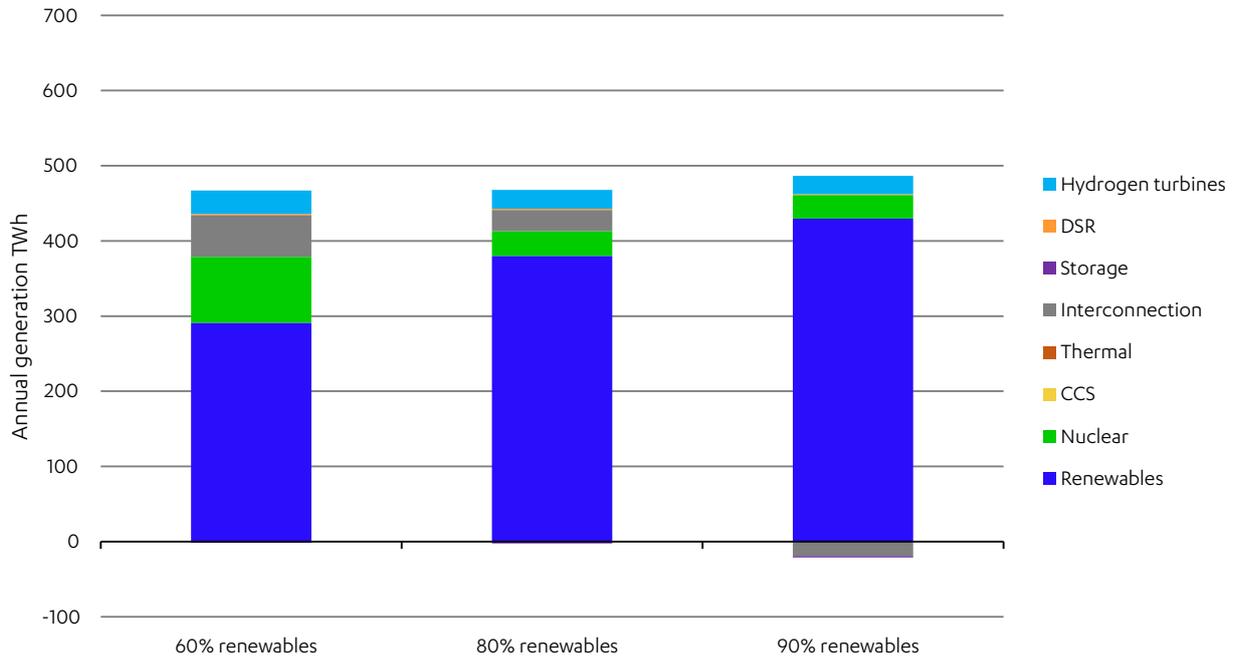


Figure 23: Generation mix with hydrogen from gas reforming in the power sector in 2050

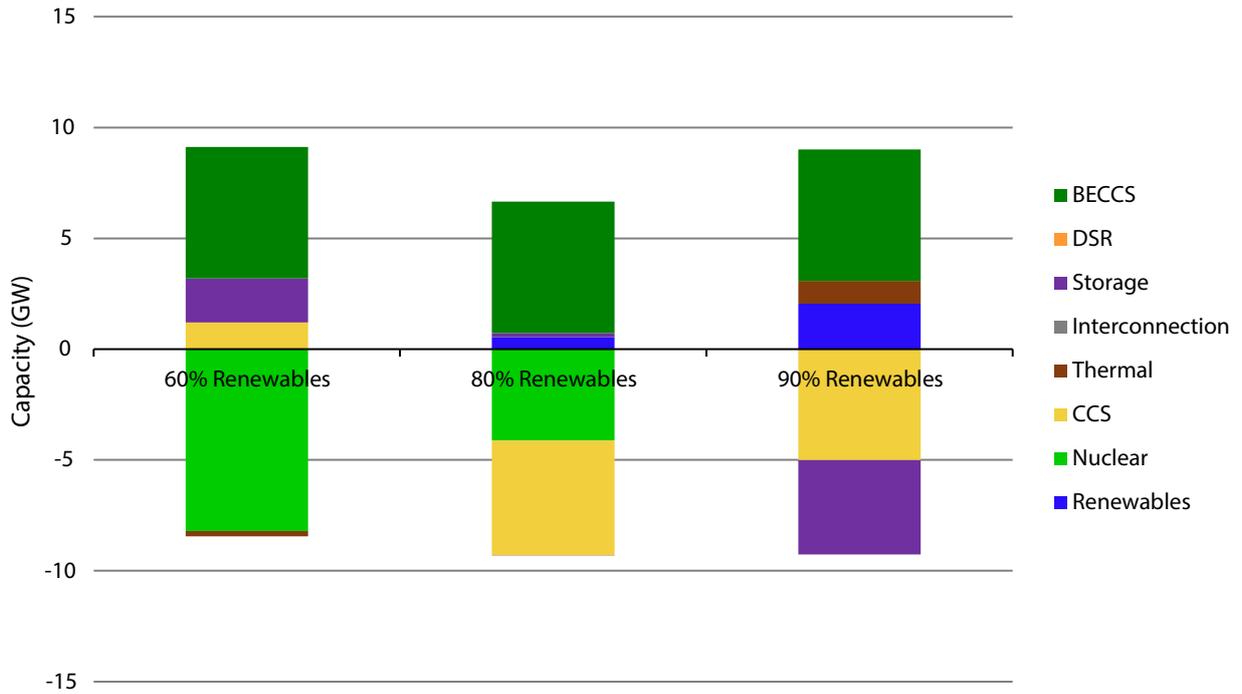


Note: If the UK is net exporting electricity this appears on the chart as a negative figure below the x-axis.

## Bioenergy with Carbon Capture and Storage in the Power Sector

The analysis finds that deploying BECCS in power will marginally increase overall power systems cost due to the relatively higher capital costs and again displaces nuclear capacity (Figure 24). Similarly to the electrification of heat scenarios, the BECCS capacity runs baseload in all scenarios.

Figure 24: Change in capacity in 2050 when introducing BECCS into the electricity system



## Annex 1: Key assumptions

Table 1: Key assumptions for the electrification scenario

Parameter/Scenario	Assumptions for electrification	Assumptions for Greener Gas	Comments
Annual generation (TWh)	595	465	These total demand scenarios are comparable to the demand in the CCC indicative net zero scenario (650 TWh) <sup>42</sup> and the National Grid ESO Future Energy Scenarios 2019 (400 – 450 TWh) <sup>43</sup>
Emissions constraint (MtCO <sub>2</sub> )	2.9	1	In the electrification scenarios as demand is similar to that in the CCC indicative net zero pathway a 2.9 MtCO <sub>2</sub> constraint is used, as the Greener Gas scenario has a smaller power sector a lower emissions constraint of 1 MtCO <sub>2</sub> is used.
Electric vehicle deployment	Assumed 100% new sales are EVs by 2030	Assumed 100% new sales are EVs by 2030	In line with recommendations made in the Assessment by 2030 100 per cent of new car sales are electric vehicles.
Number of heatpumps	33 million 4kW heatpumps are installed in homes	N/A	These assumptions are based on Cost analysis of future heat infrastructure option <sup>44</sup>
Energy efficiency measures	Heat demand is lowered by around 100 TWh against the counterfactual from energy efficiency measures.		These assumptions are based on Cost analysis of future heat infrastructure options <sup>45</sup>
Gas prices	BEIS central gas prices are assumed, reaching 63p/therm by 2050.		BEIS fossil fuel price assumptions <sup>46</sup>
Interconnector capacity assumed	17.9 GW	17.9 GW	This is based on the capacity of interconnectors either already in operation, under construction or with regulatory approval from Ofgem <sup>47</sup>
Baseline level of nuclear to 2050	4.6 GW	4.6 GW	Assuming Sizewell B and Hinkley Point C are both online in 2050

## Annex 2: Hydrogen and BECCS

### Hydrogen assumptions and methodology

In each of the two scenarios modelled the hydrogen generated is burned in a 100 per cent hydrogen compatible gas turbine to generate electricity. Gas turbines, specifically combined cycle gas turbines (CCGT), are a mature technology which generate a significant amount of the UK's electricity.<sup>48</sup> These plants burn natural gas to generate electricity. However, engineering assessments have suggested that natural gas could be replaced with up to 100 per cent hydrogen at little additional cost.<sup>49</sup> Whilst this may result in high NOx emissions, which have significant air quality impacts, NOx capture facilities or diluted fuels could likely be used to mitigate this impact.<sup>50</sup> A number of organisations have made public commitments to developing hydrogen turbines in the 2020s.<sup>51</sup> Siemens have already developed a prototype turbine capable of running on 100 per cent hydrogen.<sup>52</sup>

Given the lack of technical maturity of this technology similar costs and running parameters to a traditional CCGT plant are assumed in this analysis (Table 4). Further research, development and deployment is needed to increase confidence and certainty in the technical capability of this technology. The UK has the opportunity to be at the leading edge of this.

**Table 4: H2 CCGT running parameters in 2050**

Parameter	Value
Capital costs	£700/kW
Fixed operating costs	£25/kW
Variable operating costs	£1/MWh
Efficiency	50%

The costs and running parameters of low carbon hydrogen technology are highly uncertain. There is currently little hydrogen produced from gas reforming with CCS globally (see Box 4),<sup>53</sup> and no at scale deployment of 100 per cent hydrogen combusting gas turbines.<sup>54</sup> To fully assess the viability of a future power system with a significant role for hydrogen, and the cost savings it can bring, this must change. With near-term action the UK can be at the leading edge of proving the viability of this technology.

In the Assessment the Commission recommended that government support the development of a hydrogen production plant using gas reforming with carbon capture and storage by 2023, as part of a large scale trial to supply hydrogen for heating to at least 10,000 homes. Successful delivery of such a plant would significantly reduce levels of uncertainty and build confidence that future systems with hydrogen used at scale are realisable.

### A flexible source of low carbon electricity to complement renewables

Flexible low carbon generation is the ideal complement to renewable generation as it can respond to changing weather and demand patterns – hydrogen burning gas turbines could play this role. Baseload technologies, those that run at a near constant output throughout the year, are not as flexible.

The Commission has modelled a power sector which has both low carbon hydrogen available and hydrogen compatible gas turbines to burn this hydrogen. The work assumes that hydrogen is produced from gas reforming with CCS, as this is currently likely to be the cheapest source of hydrogen. To ensure this is consistent with economy wide decarbonisation, the emissions from producing the hydrogen used to generate electricity are accounted for in the power sector while maintaining net zero compliant emissions in the power sector.

### **Electrolysis in the power system**

Curtailed renewable generation could be used by electrolyzers to generate zero carbon hydrogen. At periods where generation significantly exceeds demand the surplus electricity can be absorbed by electrolyzers and turned into hydrogen for combustion in the power sector at a later date. Not only could this help to reduce wasted electricity, and hence costs, but it may also provide an effective long-term storage option for the power sector.

**Box 4: Producing low carbon hydrogen**

Hydrogen is a zero carbon gas capable of replacing natural gas, and other energy carriers, in a range of different processes. There is currently around 2000 TWh of hydrogen produced globally,<sup>55</sup> but this is largely made through high carbon emissions processes. There are two primary routes through which low carbon hydrogen can be produced:

- **Gas Reforming with CCS:** combines natural gas and water and converts these to hydrogen and carbon dioxide. Gas reformation is currently significantly cheaper than any other method of hydrogen production and is the most widely used method today. This production method needs to be paired with carbon capture and storage, otherwise it still emits significant amounts of carbon dioxide. Additionally, if the future costs assumptions used in this analysis are to be realised it is likely that novel reforming methods, such as Auto Thermal Reforming, would need to be developed and deployed at scale.<sup>56</sup>
- **Electrolysis:** uses an electric current to split water into hydrogen and oxygen. Provided that the electricity is from a low carbon source electrolysis has the potential to produce hydrogen with minimal carbon emissions. However, this is a more expensive and energy intensive method of hydrogen production than gas reformation.<sup>57</sup>

These assumptions for hydrogen production technologies are based on *Hydrogen Supply Chain Evidence Base*<sup>58</sup> and are similar to those used in other analysis.<sup>59</sup> Throughout, this analysis has, in order to better demonstrate the potential benefits of hydrogen in the power sector at scale, used ambitious cost assumptions for hydrogen technologies.

The overall cost of hydrogen production will also depend on gas prices, a globally traded commodity. If prices significant diverge from those assumed here, this could materially impact the conclusions of the analysis.

**Table 5: Assumptions for advanced gas reforming with CCS in 2050**

Parameter	Value
Capital costs	£338/kW
Fixed operating costs	£24/kW
Variable operating costs	£0/MWh, excluding the electricity price
Efficiency	84%
Gas price	63p/therm
Capture rate	90%

**Table 6: Assumptions for electrolysis in 2050**

Parameter	Value
Capital costs	£455/kW
Fixed operating costs	£49/kW
Variable operating costs	£0/MWh, excluding the electricity price
Efficiency	74%

## Bioenergy with carbon capture and storage methodology

Double counting negative emissions generated from biomass is a risk in a sector specific approach. It is likely that, if there is a limited supply of negative emissions, these will be needed to offset emissions in sectors other than power – some of which are outside the Commission’s remit. Therefore, the same net zero compliant emissions target for the power sector, used elsewhere in this analysis, is assumed. The negative emissions and any associated revenue streams are not included in this work. The implicit assumption is that the negative emissions are accounted for, and remunerated, elsewhere in the economy. Based on this, the modelling captures the lowest cost way to capture 50 MtCO<sub>2</sub> emission from BECCS used in the power system in 2050

### Box 5: Biomass with carbon capture and storage technology

Biomass, when considered in the context of generating energy, primarily refers to: crops grown specifically for energy, forest and agricultural residues, and organic wastes.<sup>60</sup> It can be used to generate electricity through combusting in a power plant. In 2018 biomass plants generated around 35 TWh of electricity in the UK.<sup>61</sup>

Carbon capture and storage is the process of capturing carbon from high carbon processes and storing it underground, instead of allowing it to be released into the atmosphere.

When combined with biomass, CCS technology can produce negative emissions, drawing down carbon from the atmosphere and storing it underground. Detailed consideration and lifecycle assessments would need to be made to ensure that this is creating a genuine carbon reduction – this is not the topic of this paper.

A key parameter when considering CCS technology is the capture rate, the amount of carbon dioxide that would have otherwise been released that is captured. This has a significant impact on the role that various CCS technologies could play in a net zero economy. For this analysis a 90 per cent capture rate is assumed – this is consistent with the range of current estimates.<sup>62</sup>

There are many other sources of generating negative emissions, including afforestation and reforestation, soil carbon sequestration, enhanced terrestrial weathering, and direct air capture.<sup>63</sup> However, these do not directly relate to the power sector and are therefore not the subject of this paper.

## Annex 3: Resource constraints

There will be an upper limit on the amount of each technology that can be deployed in the UK. For example, land or seabed availability will limit the amount of capacity of some technologies in the UK. The modelled levels of capacity fall within the current theoretical estimates of the total capacity of each technology that can be deployed in the UK. However, barriers may emerge in practice that need to be better understood going forward:

- A range of factors must be accounted for when considering resource constraints for renewables, these include land and seabed availability, solar irradiance, wind speeds, and water depths. The capacity of onshore wind, offshore wind and solar built across the full range of scenarios considered here fall well within current resource estimates.<sup>64</sup> However, in practice, more granular constraints may emerge. A better understanding of competing uses of the seabed and visual impacts of renewables will be needed to reach the upper end of capacity deployed in these scenarios.
- There are a range of different factors and constraints that need to be considered when assessing whether a specific location is viable and safe for a large scale nuclear plant to be deployed.<sup>65</sup> This limits the number of plants that could theoretically be constructed in the UK. Estimates suggest that currently identified nuclear sites could support up to 35 GW of nuclear capacity by 2050.<sup>66</sup> Nuclear capacity in all scenarios presented here falls within this limit.
- The primary resource constraint on deploying CCS in the UK is likely to be the capacity of CO<sub>2</sub> storage. CO<sub>2</sub> is likely to be stored offshore in depleted oil and gas fields or saline aquifers. Current estimates suggest the UK has between 1.5 – 78 GtCO<sub>2</sub> storage capacity<sup>67</sup> – significantly more than the upper limit of 7 MtCO<sub>2</sub> annually captured in any scenarios presented here.

## Endnotes

- 1 UK Government (2019), **UK becomes first major economy to pass net zero emissions law**
- 2 Department for Business, Energy and Industrial Strategy (2020), **Final UK greenhouse gas emissions national statistics: 1990 to 2018**
- 3 Ofgem (2020), **Bills, prices and profits**
- 4 Ofgem (2020), **Bills, prices and profits**
- 5 Ofgem (2018), **Energy spend as a percentage of total household expenditure (UK)**
- 6 Ofgem (2018), **Energy spend as a percentage of total household expenditure (UK)**
- 7 Aurora Energy Research (2020), **Net zero electricity systems modelling**
- 8 International Renewable Energy Agency (2019), **Renewable Power Generation Costs in 2018**, International Renewable Energy Agency (2015), **Battery Storage for Renewables: Market Status and Technology Outlook**
- 9 National Infrastructure Commission (2018), **National Infrastructure Assessment**
- 10 **Low Carbon Contracts Company**, Department for Energy and Climate Change (2015), **Contracts for Difference (CFD) Allocation Round One Outcome**, Department for Business, Energy and Industrial Strategy (2017), **Contracts for Difference Second Allocation Round Results**, Department for Business, Energy and Industrial Strategy (2019), **Contracts for Difference Allocation Round 3 Results**
- 11 Baringa (2017), **An analysis of the potential outcome of a further 'Pot 1' CfD auction in GB**
- 12 International Renewable Energy Agency (2019), **Renewable Power Generation Costs in 2018**
- 13 Constructed by the Commission using data from Lovering J. R; Yip A.; Nordhaus T. (2016), Historical construction costs of global nuclear power reactors. Costs calculated on an 'overnight' basis, rebased from 2010 prices
- 14 Cornwall Insight (2020), **A marathon and a sprint? What next for onshore renewables?**
- 15 Vivid Economics (2019), **Accelerated electrification and the GB electricity system**
- 16 BEIS (2020), **Renewable Energy Planning Database: December 2019**
- 17 Committee on Climate Change (2019), **Net zero technical report**
- 18 Aurora Energy Research (2020), **Net zero electricity systems modelling**
- 19 Element Energy and E4Tech (2018), **Cost analysis of future heat infrastructure options**
- 20 Committee on Climate Change (2019), **Net Zero The UK's contribution to stopping global warming**
- 21 Committee on Climate Change (2019), **Net Zero The UK's contribution to stopping global warming**
- 22 Committee on Climate Change (2019), **Net Zero The UK's contribution to stopping global warming**
- 23 National Infrastructure Commission (2018), **National Infrastructure Assessment**
- 24 National Infrastructure Commission (2019), **Better Delivery: The Challenge for Freight**
- 25 Committee on Climate Change (2019), **Net Zero Technical report**
- 26 Aurora –Energy Research (2020), **Net zero electricity systems modelling**
- 27 The Royal Society and Royal Academy of Engineering (2018), **Greenhouse gas removal**
- 28 Committee on Climate Change (2018), **Biomass in a low-carbon economy**
- 29 Imperial College London (2018), **Analysis of Alternative UK Heat Decarbonisation Pathways**
- 30 Committee on Climate Change (2019), **Technical Annex: Integrating variable renewables into the UK electricity system**
- 31 Committee on Climate Change (2019), **Technical Annex: Integrating variable renewables into the UK electricity system**
- 32 Imperial College London and NERA Economic Consulting (2015), **Value of Flexibility in a Decarbonised Grid and System Externalities of Low-Carbon Generation Technologies**, OECD and NEA (2019), **The Costs of Decarbonisation: System Costs with High Shares of Nuclear**, The UK Energy Research Centre (2017), **The costs and impacts of intermittency – 2016 update**
- 33 National Infrastructure Commission (2016), **Smart Power**
- 34 National Infrastructure Commission (2016), **Smart Power**
- 35 Carbon Trust and Imperial College London (2016), **An analysis of electricity system flexibility for Great Britain**
- 36 Aurora Energy Research (2020), **Net zero electricity systems modelling**
- 37 Department for Business Energy and Industrial Strategy (2019), **The UK's Draft Integrated National Energy and Climate Plan (NECP)**
- 38 Aurora Energy Research (2020), **Net zero electricity systems modelling**
- 39 Met Office (2019), **Weather and Climate Related Sensitivities and Risks in a Highly Renewable UK Energy System: A Literature Review**
- 40 International Energy Agency (2014), **Technology Roadmap – Energy Storage**
- 41 Viktor Johansson, Mariliis Lehtveer, Lisa Goransson (2019), **Biomass in the electricity system: A complement to variable renewables or a source of negative emissions? Energy**
- 42 Committee on Climate Change (2019), **Net Zero Technical report**
- 43 National Grid ESO (2019), **Future Energy Scenarios**

- 44 Element Energy and E4Tech (2018), **Cost analysis of future heat infrastructure options**
- 45 Element Energy and E4Tech (2018), **Costs analysis of future heat infrastructure options**
- 46 Department for Business, Energy and Industrial Strategy (2018), **BEIS 2018 Fossil Fuel Price Assumptions**
- 47 Department for Business, Energy and Industrial Strategy (2012) **The UK's Draft Integrated National Energy and Climate Plan (NECP)**
- 48 Department for Business, Energy and Industrial Strategy (2019), **DUKES 2019 Chapter 5: Electricity**
- 49 ETN Global (2020), **Hydrogen Gas Turbines**
- 50 ETN Global (2020), **Hydrogen Gas Turbines**
- 51 ETN Global (2020), **Hydrogen Gas Turbines**
- 52 ETN Global (2020), **Hydrogen Gas Turbines**
- 53 Committee on Climate Change (2018), **Hydrogen in a low-carbon economy**
- 54 ETN Global (2020), **Hydrogen Gas Turbines**
- 55 Committee on Climate Change (2018), **Hydrogen in a low-carbon economy**
- 56 Jacobs and Element Energy (2018), **Hydrogen supply chain evidence base**
- 57 Jacobs and Element Energy (2018), **Hydrogen supply chain evidence base**
- 58 Jacobs and Element Energy (2018), **Hydrogen supply chain evidence base**
- 59 **Imperial College London (2018), Analysis of Alternative UK Heat Decarbonisation Pathways** and Sustainable Gas Institute, Imperial College London (2017), **A Greener Gas Grid: What Are The Options?**
- 60 Committee on Climate Change (2018), **Biomass in a low-carbon economy**
- 61 Department for Business Energy and Industrial Strategy (2020), **Energy Trends: UK electricity**
- 62 Sara Budinis, Samuel Krevor, Niall MacDowell, Nigel Brandon, Adam Hawkes (2018), **An assessment of CCS costs, barriers and potential Energy Strategy Reviews**
- 63 The Royal Society and Royal Academy of Engineering (2018), **Greenhouse gas removals**
- 64 Vivid Economics and Imperial College London (2019), **Accelerated electrification and the GB electricity system**
- 65 Department of Energy and Climate Change (2011), **National Policy Statement for Nuclear Power Generation (EN-6) Volume 1 of 2**
- 66 Energy Technology Institute (2015), **Nuclear The role for nuclear within a low carbon energy system**
- 67 Energy Technologies Institute (2017), **Taking stock of UK CO<sub>2</sub> Storage**

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March 2020



HM Government



# The Clean Growth Strategy

Leading the way to a low carbon future

**Building our  
Industrial Strategy**

# The Clean Growth Strategy

## Leading the way to a low carbon future

Presented to Parliament pursuant to Sections 12 and 14 of the Climate Change Act 2008

Amended April 2018 from the version laid before Parliament in October 2017

October 2017

The Clean Growth Strategy can be found on the BEIS section of GOV.UK:

<https://www.gov.uk/government/publications/clean-growth-strategy>

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Any enquiries regarding this publication should be sent to us at [CleanGrowthStrategy@beis.gov.uk](mailto:CleanGrowthStrategy@beis.gov.uk).

Amendments to the version laid before Parliament in October 2017

The following corrections have been made:

p122, p142: The unit label for the metric “Biodegradable waste sent to landfill” has been corrected to read “Million Tonnes”.

p156: The text “(in real 2016 prices)” has been removed.

p156: Three values in table 11 have been corrected.

A few other minor typographic errors have also been corrected.

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# Foreword from the Prime Minister

**This Government is determined to leave our natural environment in a better condition than we found it. Clean growth is not an option, but a duty we owe to the next generation, and economic growth has to go hand-in-hand with greater protection for our forests and beaches, clean air and places of outstanding natural beauty.**

There is no conflict between this aspiration and our plan to create an economy that works for everyone. But to do this we need a clear strategy that brings Government, business and society together. This Strategy sets out the action we will take to cut emissions, increase efficiency, and help lower the amount consumers and businesses spend on energy across the country.

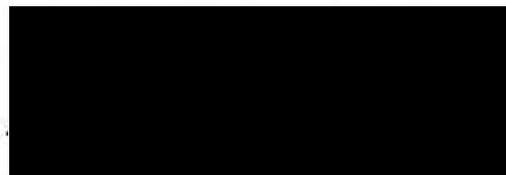
The United Kingdom has a proud record in this field. Britain was one of the first countries to recognise the challenge posed by climate change and we have led the world in taking action to reduce carbon emissions. Our investment in green energy has seen Britain produce record amounts of renewably-generated electricity. On the world stage, we were instrumental in driving through the landmark Paris Agreement.



Protecting our environment for the next generation also benefits our wider economic prosperity. The UK has helped new green industries to develop which have brought jobs and growth, even as we have taken decisive action to protect the world around us.

In this document, we set out the actions we are taking to put clean growth at the centre of our modern Industrial Strategy: changing the way we heat our homes, power our cars, and run our electricity grid. But we cannot achieve this through Government action alone. We must harness the ingenuity and determination of all our people and businesses across the country if we are to build a better, greener Britain. The Government will help British businesses and entrepreneurs to seize the opportunities which the global low carbon economy presents, from electric vehicles to offshore wind.

Success in this mission will improve our quality of life and increase our economic prosperity. It will mean cleaner air, lower energy bills, greater economic security and a natural environment protected and enhanced for the future.



## Seizing the clean growth opportunity

The move to cleaner economic growth is one of the greatest industrial opportunities of our time. This Strategy will ensure Britain is ready to seize that opportunity.

Our modern Industrial Strategy is about increasing the earning power of people in every part of the country. We need to do that while not just protecting, but improving the environment on which our economic success depends. In short, we need higher growth with lower carbon emissions. This approach is at the heart of our Strategy for clean growth.

The opportunity for people and business across the country is huge. The low carbon economy could grow 11 per cent per year between 2015 and 2030, four times faster than the projected growth of the economy as a whole.

This is spread across a large number of sectors: from low cost, low carbon power generators to more efficient farms; from innovators creating better batteries to the factories putting them in less polluting cars; from builders improving our homes so they are cheaper to run to helping businesses become more productive.

This growth will not just be seen in the UK. Following the success of the Paris Agreement, where Britain played such an important role in securing the landmark deal, the transition to a global low carbon economy is gathering momentum. We want the UK to capture every economic opportunity it can from this global shift in technologies and services.

### Greg Clark

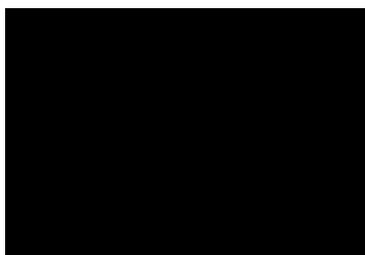
Secretary of State  
for Business, Energy  
and Industrial Strategy



Our approach to clean growth is an important element of our modern Industrial Strategy: building on the UK's strengths; improving productivity across the country; and ensuring we are the best place for innovators and new businesses to start up and grow.

A good example of this is offshore wind, where costs have halved in just a few years. A combination of sustained commitment – across different Governments – and targeted public sector innovation support, harnessing the expertise of UK engineers working in offshore conditions and private sector ingenuity, has created the conditions for a new industry to flourish, while cutting emissions. We need to replicate this success in sectors across our economy.

This Strategy delivers on the challenge that Britain embraced when Parliament passed the Climate Change Act. If we get it right, we will not just deliver reduced emissions, but also cleaner air, lower energy bills for households and businesses, an enhanced natural environment, good jobs and industrial opportunity. It is an opportunity we will seize.





# Executive Summary

Clean growth means growing our national income while cutting greenhouse gas emissions<sup>1</sup>. Achieving clean growth, while ensuring an affordable energy supply for businesses and consumers, is at the heart of the UK's Industrial Strategy. It will increase our productivity, create good jobs, boost earning power for people right across the country, and help protect the climate and environment upon which we and future generations depend.

## UK Leadership and Progress

Our Strategy for clean growth starts from a position of strength.

The UK was one of the first countries to recognise and act on the economic and security threats of climate change. The Climate Change Act, passed in 2008, committed the UK to reducing greenhouse gas emissions by

at least 80 per cent by 2050 when compared to 1990 levels, through a process of setting five year caps on greenhouse gas emissions termed 'Carbon Budgets'. This approach has now been used as a model for action across the world, and is mirrored by the United Nations' Paris Agreement.

We have been among the most successful countries in the developed world in growing our economy while reducing emissions. Since 1990, we have cut emissions by 42 per cent<sup>2</sup> while our economy has grown by two thirds<sup>3</sup>. This means that we have reduced emissions faster than any other G7 nation, while leading the G7 group of countries in growth in national income over this period<sup>4</sup>.

This progress has meant that we have outperformed the target emissions reductions of our first carbon budget (2008 to 2012) by one per cent<sup>5</sup> and we project that we will outperform against our second and third budgets, covering the years 2013 to 2022, by almost five per cent and four per cent respectively<sup>6</sup>. Our economy is expected to grow by 12 per cent over that time<sup>7</sup>. This will be a significant achievement.

We have made progress across every sector of our economy.

<sup>1</sup> There are several greenhouse gases (GHGs) that contribute to climate change, the most abundant of which is carbon dioxide. Because of this, we measure emissions of GHGs in terms of millions of tonnes of carbon dioxide equivalent (Mt). One tonne of carbon dioxide fills roughly the same space as a small house.

<sup>2</sup> BEIS (2017) BEIS provisional UK emissions statistics 1990-2016 <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2016>

<sup>3</sup> ONS (2016) Quarterly National Accounts Statistical bulletins (Series ABMI. Seasonally adjusted chained volume measures) <https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/abmi>

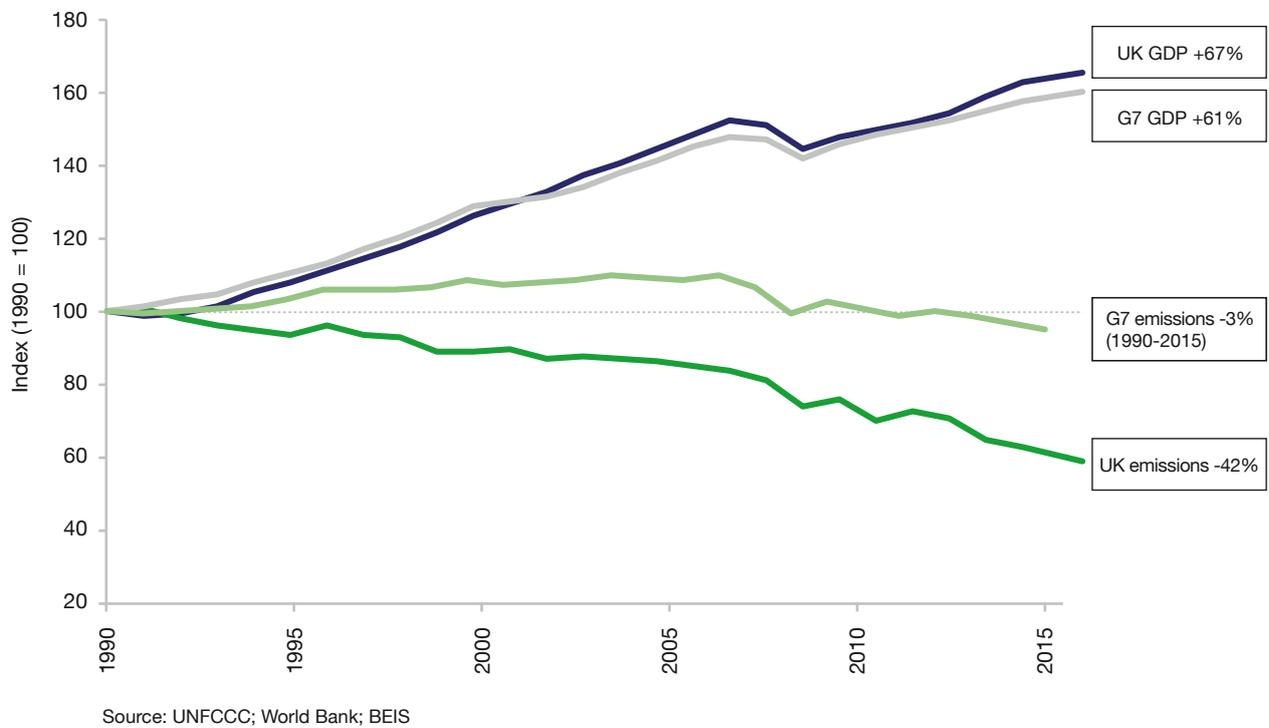
<sup>4</sup> Figures on per capita basis. OECD (retrieved September 2017) [http://stats.oecd.org/index.aspx?DataSetCode=PDB\\_LV](http://stats.oecd.org/index.aspx?DataSetCode=PDB_LV); World Resources Institute (2017) CAIT Climate Data Explorer <http://cait.wri.org>

<sup>5</sup> DECC (2014) <https://www.gov.uk/government/statistics/final-statement-for-the-first-carbon-budget-period>

<sup>6</sup> BEIS (2017) Energy and Emissions Projections 2016 <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016>

<sup>7</sup> OBR (March 2017) Economic and Fiscal Outlook <http://budgetresponsibility.org.uk/efo/economic-fiscal-outlook-march-2017/>; OBR (January 2017) Fiscal Sustainability Report <http://budgetresponsibility.org.uk/fsr/fiscal-sustainability-report-january-2017/>

**Figure 1: UK and G7 economic growth and emissions reductions<sup>8</sup>**



- In 2016, 47 per cent of our electricity came from low carbon sources, around double the level in 2010<sup>9</sup>, and we now have the largest installed offshore wind capacity in the world. Our homes and commercial buildings have become more efficient in the way they use energy which helps to reduce emissions and also cut energy bills, for example average household energy consumption

has fallen by 17 per cent since 1990<sup>10</sup>. Automotive engine technology has helped drive down emissions per kilometre driven by up to 16 per cent and driving a new car bought in 2015 will save car owners up to £200 on their annual fuel bill, compared to a car bought new in 2000<sup>11</sup>. England also recycles nearly four times more than it did in 2000<sup>12</sup>.

<sup>8</sup> UNFCCC Data Interface (retrieved September 2017) [http://di.unfccc.int/time\\_series](http://di.unfccc.int/time_series); World Bank, World Development Indicators (retrieved September 2017) <http://data.worldbank.org/indicator/NY.GDP.MKTP.PP.KD>; BEIS (2017) Final GHG Emissions Inventory Statistics <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>9</sup> BEIS (2017); Digest of UK Energy Statistics 2017 <https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes>

<sup>10</sup> BEIS (2017) Energy Consumption in the UK <https://www.gov.uk/government/statistics/energy-consumption-in-the-uk> Change in average consumption per household 1990-2016

<sup>11</sup> Annual average household saving from driving a car purchased new in 2015 (the latest year for which data is available) compared to driving a car purchased new in 2000. Fuel savings valued using 2015 prices. DfT (2017) National Travel Survey; DfT (2017) Vehicles Statistics; ICCT (2015) From Laboratory to Road; BEIS (2016) Green Book supplementary appraisal guidance

<sup>12</sup> Defra (2016) ENV18 - Local authority collected waste: annual results tables: <https://www.gov.uk/government/statistical-data-sets/env18-local-authority-collected-waste-annual-results-tables>

- This progress has been aided by the falling costs of many low carbon technologies: renewable power sources like solar and wind are comparable in cost to coal and gas in many countries<sup>13</sup>; energy efficient light bulbs are over 80 per cent cheaper today than in 2010<sup>14</sup>; and the cost of electric vehicle battery packs has tumbled by over 70 per cent in this time<sup>15</sup>.
- As a result of this technological innovation, new high value jobs, industries and companies have been created. And this is driving a new, technologically innovative, high growth and high value “low carbon” sector of the UK economy. Not only are we rapidly decarbonising parts of the domestic economy, but thanks to our world leading expertise in technologies such as offshore wind, power electronics for low carbon vehicles and electric motors, and global leadership in green finance, we are successfully exporting goods and services around the world – for example, one in every five electric vehicles driven in Europe is made in the UK<sup>16</sup>. This progress now means there are more than 430,000 jobs in low carbon businesses and their supply chains, employing people in locations right across the country<sup>17</sup>.

This progress has altered the way that we see many of the trade-offs between investing in low carbon technologies that help secure our future but that might incur costs today. It is clear that actions to cut our emissions can be a win-win: cutting consumer bills, driving economic growth, creating high value jobs and helping to improve our quality of life.

Of course, greenhouse gas emissions are a global problem and action is needed from all countries. The UK has played a key role in demonstrating international leadership on tackling climate change through its domestic action, climate diplomacy and financial support. The UK was among the first to recognise climate change as an economic and political issue as opposed to solely an environmental one and has used its world leading economic, science and technical skills to shape the global debate around climate change, for instance making the economic case for climate action in the landmark Stern Report in 2006<sup>18</sup>. The UK has also used its influence and resources to help developing countries with their own clean growth – and our actions to date are expected to save almost 500 million tonnes of carbon dioxide over the lifetime of the projects<sup>19</sup>, more than the entire annual emissions of France<sup>20</sup>. While we do not count these results against our domestic targets, we can be proud of the impact of the UK’s commitment to global climate action.

<sup>13</sup> New Climate Economy (2014) Better Growth, Better Climate <http://newclimateeconomy.report/>

<sup>14</sup> International Energy Agency (2016) Energy Efficiency Market Report [https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016\\_WEB.PDF](https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016_WEB.PDF)

<sup>15</sup> Bloomberg New Energy Finance (2016) 2016 lithium-ion battery price survey <https://www.bnef.com/core/insights/15597>

<sup>16</sup> European Alternative Fuels Observatory (2017) Top 5 selling BEV analysis: <http://www.eafo.eu/vehicle-statistics/m1>

<sup>17</sup> ONS (2016) UK Environmental Accounts: Low Carbon and Renewable Energy Economy Survey, Final estimates: 2015 <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2015results>

<sup>18</sup> HM Treasury (2006) Stern Review on the Economics of Climate Change

<sup>19</sup> DfID (2017) 2017 UK Climate Finance Results [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/625457/2017-UK-Climate-Finance-Results.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/625457/2017-UK-Climate-Finance-Results.pdf)

<sup>20</sup> UNFCCC 2015 data (retrieved September 2017) [http://di.unfccc.int/time\\_series](http://di.unfccc.int/time_series)

## The Opportunities and Challenges

The UK played a central role in securing the 2015 Paris Agreement in which, for the first time, 195 countries (representing over 90 per cent of global economic activity<sup>21</sup>) agreed stretching national targets to keep the global temperature rise below two degrees. The actions and investments that will be needed to meet the Paris commitments will ensure the shift to clean growth will be at the forefront of policy and economic decisions made by governments and businesses in the coming decades. This creates enormous potential economic opportunity — an estimated \$13.5 trillion of public and private investment in the global energy sector alone will be required between 2015 and 2030 if the signatories to the Paris Agreement are to meet their national targets<sup>22</sup>. The decision by the US to withdraw from the Paris Agreement served to bring together and bolster action internationally on climate change with many countries underlining their commitment to the Paris Agreement in the days and weeks that followed.

The UK is well placed to take advantage of this economic opportunity. Our early action on clean growth means that we have nurtured a broad range of low carbon industries, including some sectors in which we have world leading positions. This success is built upon wider strengths – our scientific research base<sup>23</sup>, expertise in high-value service and financial industries<sup>24</sup>, and a regulatory framework that provides long-term direction and support for innovation and excellence in the design and manufacturing of leading edge technology.

Capturing part of the global opportunity while continuing to drive down carbon emissions from our own activities could provide a real national economic boost. The UK low carbon economy could grow by an estimated 11 per cent per year between 2015 and 2030 – four times faster than the rest of the economy<sup>25</sup> – and could deliver between £60 billion and £170 billion of export sales of goods and services by 2030<sup>26</sup>. This means that clean growth can play a central part in our Industrial Strategy – building on our strengths to drive economic growth and boost earning power across the country.

Action to deliver clean growth can also have wider benefits. For example, the co-benefit of cutting transport emissions is cleaner air, which has an important effect on public health, the economy, and the environment.

But hitting our carbon budgets and expanding the low carbon economy will not be easy. We have achieved significant results in the power and waste sectors and now need to replicate this success across the economy, particularly in the transport, business and industrial sectors. We also need to reduce the emissions created by heating our homes and businesses, which account for almost a third of UK emissions. If done in the right way, cutting emissions in these areas can benefit us all through reduced energy bills, which will help improve the UK's productivity, and improved air quality, while the innovation and investment required to drive these emissions down can create more jobs and more export opportunities.

<sup>21</sup> World Bank (retrieved September 2017) <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD>

<sup>22</sup> International Energy Agency (2015) Climate pledges for COP21 slow energy sector emissions growth dramatically <https://www.iea.org/newsroom/news/2015/october/climate-pledges-for-cop21-slow-energy-sector-emissions-growth-dramatically.html>

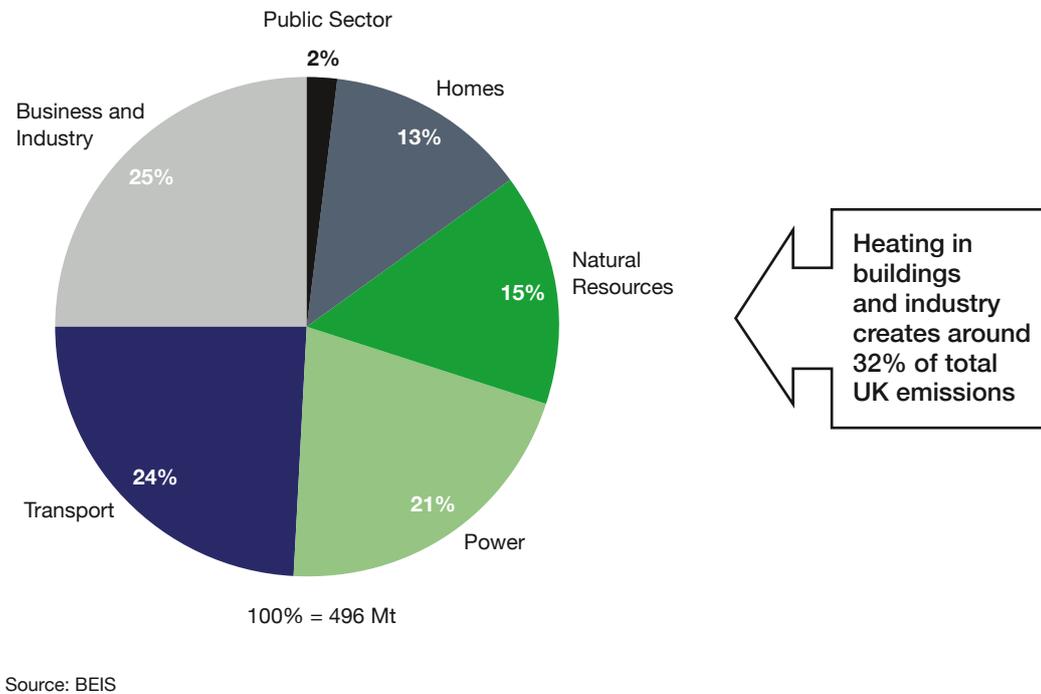
<sup>23</sup> BIS (2013) International Comparative Performance of the UK Research Base – 2013 <https://www.gov.uk/government/publications/performance-of-the-uk-research-base-international-comparison-2013>

<sup>24</sup> GreenAlliance (2016) Will the UK economy succeed in a low carbon world? [http://www.green-alliance.org.uk/UK\\_low\\_carbon.php](http://www.green-alliance.org.uk/UK_low_carbon.php)

<sup>25</sup> Ricardo Energy and Environment for the Committee on Climate Change (2017) UK business opportunities of moving to a low carbon economy <https://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/>

<sup>26</sup> Ricardo Energy and Environment for the Committee on Climate Change (2017) UK business opportunities of moving to a low-carbon economy (supporting data tables) <https://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/>

Figure 2: UK emissions by sector, 2015<sup>27</sup>



In order to meet the fourth and fifth carbon budgets (covering the periods 2023-2027 and 2028-2032) we will need to drive a significant acceleration in the pace of decarbonisation and in this Strategy we have set out stretching domestic policies that keep us on track to meet

our carbon budgets. However, we are prepared to use the flexibilities available to us to meet carbon budgets, subject to the requirements set out in the Climate Change Act, if this presents better value for UK taxpayers, businesses and domestic consumers.

<sup>27</sup> BEIS (2017) UK Greenhouse Gas Inventory Statistics (1990-2015) <https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics>; BEIS analysis

Every action that we take to cut emissions must be done while ensuring our economy remains competitive. As we set out in our Industrial Strategy Green Paper, we attach great importance to making sure our energy is affordable<sup>28</sup>. This is why the Government has commissioned an independent review into the cost of energy led by Professor Dieter Helm CBE. This review will recommend ways to deliver the Government's carbon targets and ensure security of supply at minimum cost to both industry and domestic consumers. Once Ministers have had the opportunity to consider the review's proposals, the Government will incorporate its recommendations into the further development of the Clean Growth Strategy as appropriate.

Another imminent challenge is to manage any impact of leaving the European Union as the Government fulfils its commitment to the British people. Leaving the EU will not affect our statutory commitments under our own domestic Climate Change Act and indeed our domestic binding emissions reduction targets are more ambitious than those set by EU legislation. The exact nature of the UK's future relationship with the EU and the long-term shape of our involvement in areas like the EU Emissions Trading System are still to be determined. There are also emerging opportunities to drive more action – for example by putting emission reductions and land stewardship at the heart of a post EU agricultural support policy. We will therefore carefully examine each area of common interest with our EU partners and work to deliver policies and programmes that are at least as beneficial as the current arrangements.

## Our Clean Growth Strategy

This Strategy sets out a comprehensive set of policies and proposals that aim to accelerate the pace of “clean growth”, i.e. deliver **increased** economic growth and **decreased** emissions.

### Our Approach

In the context of the UK's legal requirements under the Climate Change Act, the UK's approach to reducing emissions has two guiding objectives:

1. To meet our domestic commitments at the lowest possible net cost to UK taxpayers, consumers and businesses; and,
2. To maximise the social and economic benefits for the UK from this transition.

In order to meet these objectives, the UK will need to nurture low carbon technologies, processes and systems that are as cheap as possible.

We need to do this for several reasons. First, we need to protect our businesses and households from high energy costs. Second, if we can develop low cost, low carbon technologies in the UK, we can secure the most industrial and economic advantage from the global transition to a low carbon economy. Third, if we want to see other countries, particularly developing countries, follow our example, we need low carbon technologies to be cheaper and to offer more value than high carbon ones.

We cannot predict every technological breakthrough that will help us meet our targets. Instead, we must create the best possible

<sup>28</sup> BEIS (2017) Building our Industrial Strategy <https://www.gov.uk/government/consultations/building-our-industrial-strategy>

environment for the private sector to innovate and invest. Our approach will maintain that of our Industrial Strategy: building on the UK's strengths, improving productivity across the UK and ensuring we are the best place for innovators and new business to start-up and grow. We are clear about the need to design competitive markets and smart regulation to support entrepreneurs and investors who will develop the new technologies at the scale we need. This will help our wider aim of improving the UK's earning power.

It is only through innovation – nurturing better products, processes and systems – that we will see the cost of clean technologies come down. That is why this Strategy sets out for the first time how over £2.5 billion will be invested by the Government to support low carbon innovation from 2015 to 2021. More broadly, the National Productivity Investment Fund will provide an additional £4.7 billion, with an extra £2 billion a year by 2020-21, representing the largest increase in public spending on UK science, research and innovation since 1979<sup>29</sup>. The UK is also working collaboratively as a core member of “Mission Innovation”<sup>30</sup>, a group of leading countries which aims to drive forward clean energy innovation on a global scale.

In addition to supporting innovation, we are focused on policies that deliver social and economic benefits beyond the imperative to reduce emissions. Higher quality, more energy efficient buildings are healthier places to live and work. Reducing the amount of heat we waste will reduce bills. Accelerating the rollout of low emission vehicles contains a triple win for the UK in terms of industrial opportunity, cleaner air and lower greenhouse gas emissions. And crucially, many of the actions in the Clean Growth Strategy will enhance the UK's energy security by delivering a more diverse and reliable energy mix.

Actions taken by the Government on clean growth will be consistent with broader Government priorities, such as delivering clean air. All parts of the UK have a major role to play in delivering our ambitions on clean growth, and the Devolved Administrations have a range of plans and policies in place to deliver emission reductions. We will work closely with them, and with local leaders across the UK, as we develop the policies and proposals set out in this Strategy.

The changes to our infrastructure and the pace of innovation will require significant investment from the private sector. The first steps to support the growth of the green finance sector in the UK are set out in this Strategy. We are building on a position of global leadership in finance and investment. These steps will be followed by ambitious policy proposals to further accelerate investments to deliver our Clean Growth Strategy. To help develop this longer-term work, the Government has set up a new Green Finance Taskforce, comprising senior representatives from the finance industry and Government.

### **Key Policies and Proposals**

The key actions that this Government will take as part of our Strategy are set out below. While these policies and proposals will drive emissions down throughout the next decade, our focus is on the areas where we need to do more to achieve the fifth carbon budget through domestic action in the UK.

Through preparing this Strategy, we have identified areas where we will need to see the greatest progress, both through technological breakthroughs and large-scale deployment, if we are to meet the fifth carbon budget through domestic action.

<sup>29</sup> HM Treasury (2016) Autumn Statement 2016 <https://www.gov.uk/government/topical-events/autumn-statement-2016>

<sup>30</sup> Mission Innovation <http://mission-innovation.net/>

## Key Policies and Proposals in the Strategy

### Accelerating Clean Growth

1. Develop world leading **Green Finance** capabilities, including by:
  - Setting up a **Green Finance Taskforce** to provide recommendations for delivery of the public and private investment we need to meet our carbon budgets and maximise the UK's share of the global green finance market
  - Working with the British Standards Institution to develop a set of **voluntary green and sustainable finance management standards**
  - Providing up to £20 million to support a new **clean technology early stage investment fund**
  - Working with mortgage lenders to develop **green mortgage** products that take account of the lower lending risk and enhanced repayment associated with more energy efficient properties

### Improving Business and Industry Efficiency – 25% of UK Emissions

2. Develop a package of measures to **support businesses to improve their energy productivity**, by at least 20 per cent by 2030, including by:
  - Following the outcome of the independent review of Building Regulations and fire safety, and subject to its conclusions, we intend to consult on **improving the energy efficiency of new and existing commercial buildings**
  - Consulting on raising minimum standards of energy efficiency for **rented commercial buildings**
  - Exploring how **voluntary building standards** can support improvements in the energy efficiency performance of business buildings, and how we can improve the provision of information and advice on energy efficiency to SMEs
  - Simplifying the requirements for businesses to **measure and report on energy use**, to help them identify where they can cut bills
3. Establish an **Industrial Energy Efficiency scheme** to help large companies install measures to cut their energy use and bills
4. Publish **joint industrial decarbonisation and energy efficiency action plans** with seven of the most energy intensive industrial sectors
5. Demonstrate **international leadership in carbon capture usage and storage (CCUS)**, by collaborating with our global partners and investing up to £100 million in leading edge CCUS and industrial innovation to drive down costs
6. Work in partnership with industry, through a new CCUS Council, to put us on a path to meet our ambition of having the option of **deploying CCUS at scale in the UK**, and to maximise its industrial opportunity

7. Develop our strategic approach to **greenhouse gas removal technologies**, building on the Government's programme of research and development and addressing the barriers to their long term deployment
8. Phase out the installation of high carbon forms of fossil fuel heating in new and existing businesses **off the gas grid** during the 2020s, starting with new build
9. Support the **recycling of heat** produced in industrial processes, to reduce business energy bills and benefit local communities
10. **Innovation:**
  - Invest around £162 million of public funds in research and innovation in **Energy, Resource and Process efficiency**, including up to £20 million to encourage switching to lower carbon fuels
  - Support innovative energy technologies and processes with £14 million of further investment through the **Energy Entrepreneurs Fund**

### Improving Our Homes – 13% of UK Emissions

#### *Improving the energy efficiency of our homes*

11. Support around £3.6 billion of investment to **upgrade around a million homes** through the Energy Company Obligation (ECO), and extend support for home energy efficiency improvements until 2028 at the current level of ECO funding
12. We want all fuel poor homes to be upgraded to Energy Performance Certificate (EPC) Band C by 2030 and our **aspiration is for as many homes as possible to be EPC Band C by 2035** where practical, cost-effective and affordable
13. Develop a long term trajectory to improve the **energy performance standards of privately-rented homes**, with the aim of upgrading as many as possible to EPC Band C by 2030 where practical, cost-effective and affordable
14. Consult on how **social housing** can meet similar standards over this period
15. Following the outcome of the independent review of Building Regulations and fire safety, and subject to its conclusions, we intend to consult on **strengthening energy performance standards for new and existing homes** under Building Regulations, including futureproofing new homes for low carbon heating systems
16. Offer all households the opportunity to have a **smart meter** to help them save energy by the end of 2020

#### *Rolling out low carbon heating*

17. Build and extend **heat networks** across the country, underpinned with public funding (allocated in the Spending Review 2015) out to 2021
18. Phase out the installation of high carbon fossil fuel heating in new and existing **homes currently off the gas grid** during the 2020s, starting with new homes

***Rolling out low carbon heating (continued)***

- 19. **Improve standards** on the 1.2 million **new boilers** installed every year in England and require installations of control devices to help people save energy
- 20. Invest in **low carbon heating** by reforming the **Renewable Heat Incentive**, spending £4.5 billion to support innovative low carbon heat technologies in homes and businesses between 2016 and 2021
- 21. **Innovation:** Invest around £184 million of public funds, including two new £10 million innovation programmes to develop new energy efficiency and heating technologies to enable lower cost low carbon homes

**Accelerating the Shift to Low Carbon Transport – 24% of UK Emissions**

- 22. **End the sale** of new conventional petrol and diesel cars and vans by 2040
- 23. Spend £1 billion supporting the take-up of **ultra low emission vehicles (ULEV)**, including helping consumers to overcome the upfront cost of an electric car
- 24. Develop one of the best electric vehicle charging networks in the world by:
  - Investing an additional £80 million, alongside £15 million from Highways England, to support **charging infrastructure deployment**
  - Taking new powers under the **Automated and Electric Vehicles Bill**, allowing the Government to set requirements for the provision of charging points
- 25. Accelerate the uptake of low emission **taxis and buses** by:
  - Providing £50 million for the **Plug-in Taxi programme**, which gives taxi drivers up to £7,500 off the purchase price of a new ULEV taxi, alongside £14 million to support 10 local areas to deliver dedicated charge points for taxis
  - Providing £100 million for a national programme of **support for retrofitting and new low emission buses** in England and Wales
- 26. Work with industry as they develop an **Automotive Sector Deal** to accelerate the transition to zero emission vehicles
- 27. Announce plans for the **public sector** to lead the way in transitioning to zero emissions vehicles
- 28. Invest £1.2 billion **to make cycling and walking** the natural choice for shorter journeys
- 29. Work to enable cost-effective options for shifting more freight from **road to rail**, including using low emission rail freight for deliveries into urban areas, with zero emission last mile deliveries
- 30. Position the UK at the forefront of research, development and demonstration of **Connected and Autonomous Vehicle technologies**, including through the establishment of the Centre for Connected and Autonomous Vehicles and investment of over £250 million, matched by industry

31. **Innovation:** Invest around £841 million of public funds in innovation in low carbon transport technology and fuels including:

- Ensuring the UK builds on its strengths and leads the world in the design, development and manufacture of **electric batteries through investment of up to £246 million in the Faraday Challenge**
- Delivering trials of **Heavy Goods Vehicle (HGV) platoons**, which could deliver significant fuel and emissions savings

### Delivering Clean, Smart, Flexible Power – 21% of UK Emissions

32. **Reduce power costs for households and businesses by:**

- Implementing the **smart systems plan**, which will help consumers to use energy more flexibly and could unlock savings of up to £40 billion to 2050
- Working with Ofgem and National Grid to create a more **independent system operator** to keep bills low through greater competition, coordination and innovation across the system
- Responding to the forthcoming **independent review into the cost of energy** led by Professor Dieter Helm CBE
- Publishing a draft bill to require Ofgem to **impose a cap** on standard variable and default tariffs across the whole market

33. **Phase out the use of unabated coal** to produce electricity by 2025

34. Deliver **new nuclear power** through Hinkley Point C and progress discussions with developers to secure a competitive price for future projects in the pipeline

35. Improve the route to market for **renewable technologies** such as offshore wind through:

- **Up to £557 million for further Pot 2 Contract for Difference auctions**, with the next one planned for spring 2019
- Working with industry as they develop an ambitious **Sector Deal for offshore wind**, which could result in 10 gigawatts of new capacity, with the opportunity for additional deployment if this is cost effective, built in the 2020s

36. Target a total **carbon price** in the power sector which will give businesses greater clarity on the total price they will pay for each tonne of emissions. Further details on carbon prices for the 2020s will be set out in the Autumn 2017 Budget

37. **Innovation:** Invest around £900 million of public funds, including around:

- **£265 million** in smart systems to reduce the cost of electricity storage, advance innovative demand response technologies and develop new ways of balancing the grid
- **£460 million** in nuclear to support work in areas including future nuclear fuels, new nuclear manufacturing techniques, recycling and reprocessing, and advanced reactor design
- **£177 million** to further reduce the cost of renewables, including innovation in offshore wind turbine blade technology and foundations

### Enhancing the Benefits and Value of Our Natural Resources – 15% of UK Emissions

38. As we leave the EU, design a new system of **future agricultural support** to focus on delivering better environmental outcomes, including addressing climate change more directly
39. Establish a **new network of forests** in England including new woodland on farmland, and fund larger-scale woodland and forest creation, in support of our commitment to plant 11 million trees, and increase the amount of **UK timber** used in construction
40. Work towards our ambition for **zero avoidable waste** by 2050, maximising the value we extract from our resources, and minimising the negative environmental and carbon impacts associated with their extraction, use and disposal
41. Publish a new **Resources and Waste Strategy** to make the UK a world leader in terms of competitiveness, resource productivity and resource efficiency
42. Explore new and innovative ways to manage **emissions from landfill**
43. Support **peatland** through a £10 million capital grant scheme for peat restoration
44. **Innovation:** Invest £99 million in innovative technology and research for agri-tech, land use, greenhouse gas removal technologies, waste and resource efficiency

### Leading in the Public Sector – 2% of UK Emissions

45. Agree **tighter targets for 2020 for central government** and actions to further reduce greenhouse gas emissions beyond this date
46. Introduce a **voluntary public sector target of a 30 per cent** reduction in carbon emissions by 2020-21 for the wider public sector
47. Provide £255 million of funding for **energy efficiency improvements** in England and help public bodies access sources of funding

### Government Leadership in Driving Clean Growth

48. Work with businesses and civil society to introduce a **“Green Great Britain”** week to promote clean growth
49. Reinststate a regular **Clean Growth Inter-Ministerial Group** responsible for monitoring the implementation of this Strategy and driving ambitious clean growth policies
50. Report annually on our performance in delivering GDP growth and reduced emissions through an **“Emissions Intensity Ratio”**

# INVESTMENT IN INNOVATION FOR CLEAN GROWTH

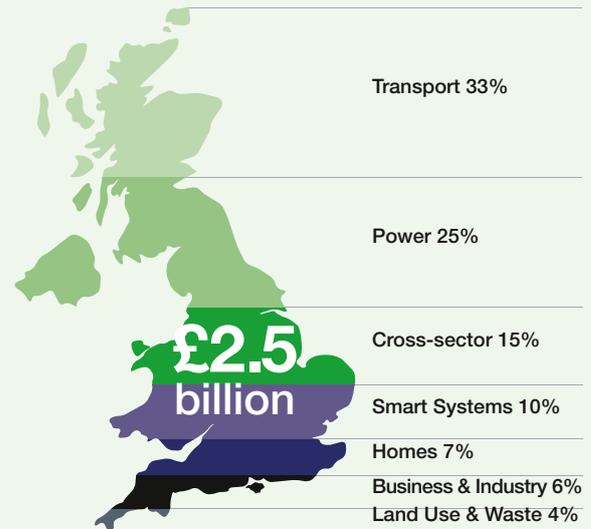
To achieve the clean growth we want, the UK will need to nurture low carbon technologies, processes and systems that are as cheap as possible.

It is only through innovation that we will see new technologies developed and the cost of clean technologies come down.

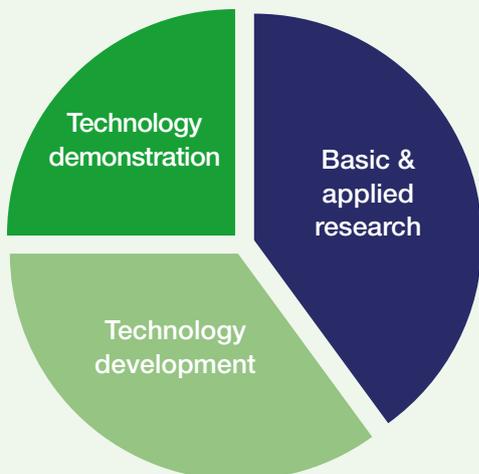
Government has significantly increased its investment in low carbon innovation



This strategy sets out, for the first time, where Government funding is targeted



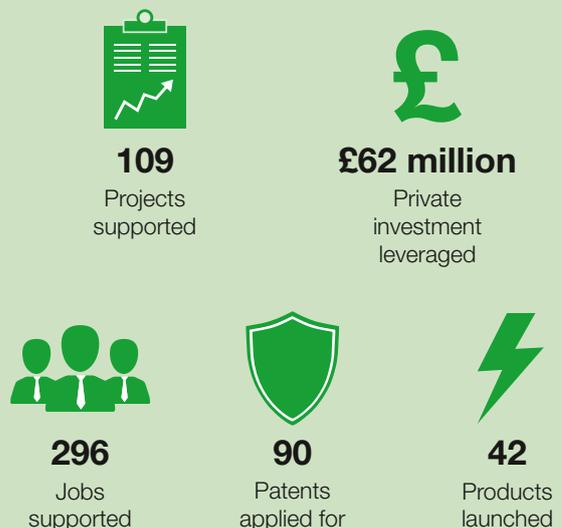
Investment will be made at all stages of technology development: from basic research to pre-commercial trials



Innovation creates jobs and helps companies grow

The Energy Entrepreneurs Fund is a competitive funding scheme to support the development and demonstration of state of the art technologies, products and processes.

The impact of Phases 1-5 is:



## Tracking Our Progress

We want to deliver increased economic growth and reduced emissions. We have developed an Emissions Intensity Ratio (EIR) to measure our clean growth performance which we will publish each year so we can track progress. To reach our 2032 targets we will need to drive the emissions intensity of the economy down by an average of five per cent per year to 2032, an acceleration in the four per cent annual fall since 1990<sup>31</sup>.

### The Emissions Intensity Ratio (EIR)

This measures the amount of greenhouse gases (tonnes of carbon dioxide equivalent) produced for each unit of Gross Domestic Product (GDP) created. Currently the EIR is 270 tonnes/£ million and it was 720 tonnes/£ million in 1990. By 2032, we expect the EIR will need to be nearly as low as 100 tonnes/£ million to meet our ambitions.

## Next Steps

This Strategy is not the end of the process. While this is an important milestone in our work to decarbonise the UK while growing our economy, our approach will develop and adapt to changing circumstances. We will update key elements of the Strategy in line with our annual statutory responses to the Committee on Climate Change's reports on progress, ahead of setting the sixth carbon budget by 30 June 2021.

We will also launch the following Government consultations during 2017 and 2018 on:

- The design of a new industrial heat recovery programme
- Making the private rented sector energy efficiency regulations more effective, and setting longer term energy performance standards across both the domestic private and social rented sectors
- A streamlined and more effective energy and carbon reporting framework for UK businesses to help them identify where they can cut bills
- A package of measures to support businesses to improve how productively they use energy
- Our strategic approach to the aviation sector in a series of consultations over the next 18 months.

A full list of the actions and milestones arising from this Strategy is set out at Annex B.

Many of the future actions the Government will be taking, expanding on the proposals above, will be set out in the 25 Year Environment Plan, which will be designed to be a sister document to this Strategy, and in a long term strategy for the UK's transition to zero road vehicle emissions. Taken together, these set out the Government's approach to fulfilling its commitment to leave the environment in a better state than it inherited. Along with the Industrial Strategy White Paper, to be published later in 2017, these will form a critical part of our future progress.

<sup>31</sup> BEIS analysis; ONS (2016) Quarterly National Accounts; BEIS (2017) UK Greenhouse Gas Inventory Statistics (1990-2015); OBR (March 2017) Economic and Fiscal Outlook; OBR (January 2017) Fiscal Sustainability Report

The Government cannot achieve the changes needed to our economy by itself. Outside action on public sector emissions, the Government's key role is to set the framework for action across the economy. Beyond that, clean growth has to be a shared endeavour between Government, business, civil society and the British people. Creating this supportive environment will help attract the domestic and international investment the UK wants. Therefore from 2018 we will work with private partners and NGOs to introduce a **Green Great Britain Week**.

We welcome views and comments on our approach and these should be sent to [CleanGrowthStrategy@beis.gov.uk](mailto:CleanGrowthStrategy@beis.gov.uk) by 31 December 2017. Views received in response to both this Strategy and the detailed policy proposals which will follow it, will be considered as we update key elements of our Strategy before setting the sixth carbon budget by 30 June 2021.



### Green Great Britain Week

An annual event to:

- Focus on climate and air quality issues across the UK
- Demonstrate our progress and successes on climate action
- Share the latest climate science
- Highlight and promote economic opportunities arising from clean growth especially to international investors.

# Chapter 1:

## UK Leadership and Progress



Our strategy for clean growth starts from a position of strength. The UK was one of the first countries to recognise and act on the threat of climate change and continues to play an important leadership role today.

In 2008, we became the first country to set a legally binding emissions reduction target through the Climate Change Act.

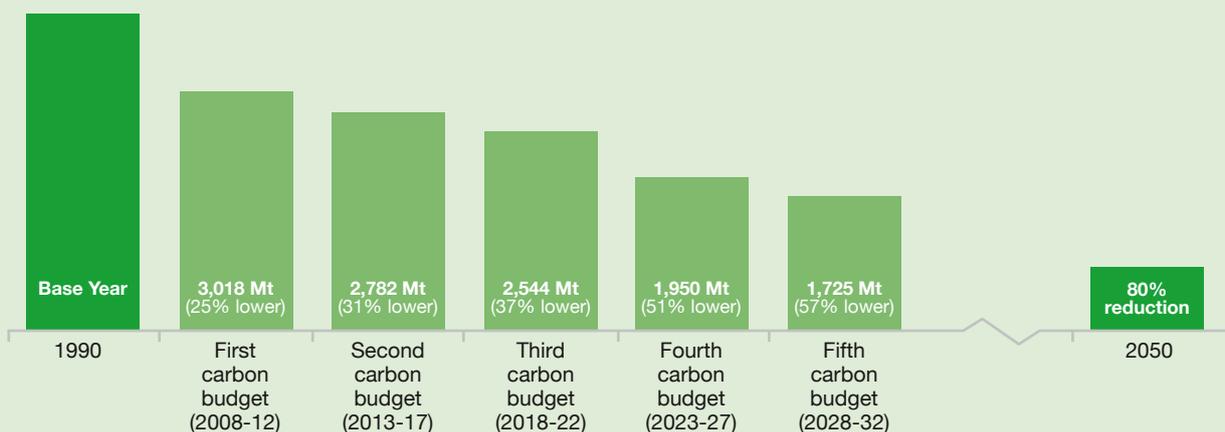
This has driven significant progress in cutting emissions. In 2016 alone UK emissions fell by six per cent compared to the year before<sup>32</sup>. Overall, between 1990 and 2016, the UK reduced emissions by 42 per cent<sup>33</sup>. Today, the Climate Action Network ranks the UK third in the world for action on climate change<sup>34</sup>.

### What the Climate Change Act Requires

The Climate Change Act requires the UK to reduce its emissions by at least 80 per cent by 2050<sup>35</sup>. This means greenhouse gas emissions falling from around 14 tonnes per person in 1990 to around 2 tonnes per person in 2050. To ensure steady progress towards our 2050 goal, the Climate Change Act requires the Government to set intermediate targets – ‘carbon budgets’. These are caps

on the greenhouse gas emissions that can be emitted across the UK during a five-year period. Five carbon budgets have been set to date, putting in place caps on greenhouse gas emissions from 2008 out to 2032. In July 2016, we set the fifth carbon budget, which requires a 57 per cent average reduction in emissions over 2028-32 across the UK compared to a 1990 baseline.

Figure 3: UK carbon budgets and 2050 target<sup>35</sup>



Source: UK legislation; BEIS

<sup>32</sup> BEIS (2017) Provisional UK greenhouse gas emissions national statistics 2016 <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2016>

<sup>33</sup> Ibid

<sup>34</sup> Climate Action Network (2017) Climate Change Performance Index Results 2017 <http://www.caneurope.org/docman/climate-energy-targets/3015-climate-change-performance-index-2017/file>

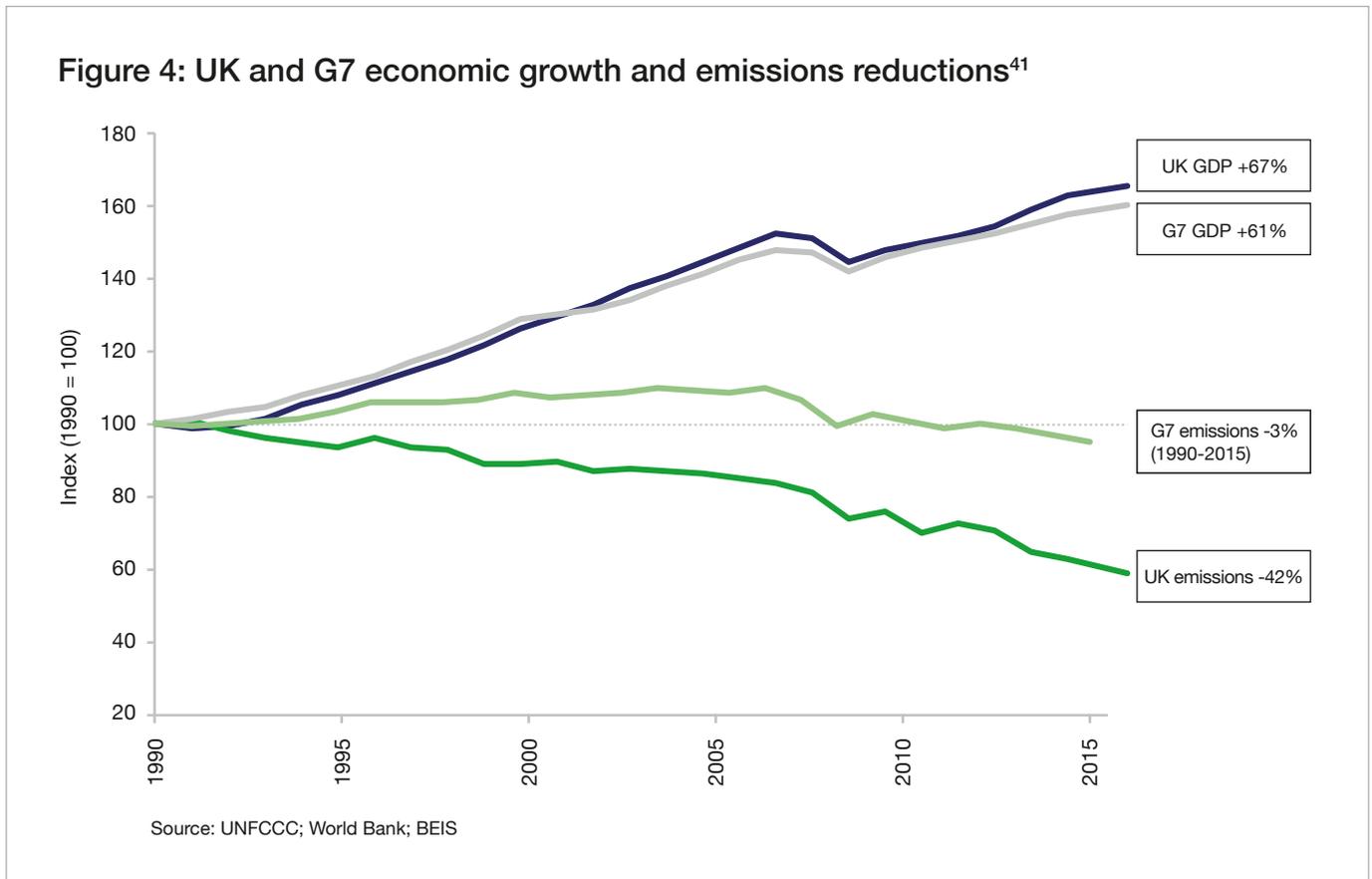
<sup>35</sup> On 1990 levels

<sup>36</sup> 1990 base year emissions 803 Mt, equivalent to 4,013 Mt over a 5-year period, BEIS (2017) UK Greenhouse Gas Inventory Statistics (1990-2015) <https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics>

This progress has not come at the expense of the economic growth we need to support our public services and invest in our future. Between 1990 and 2016, while the UK reduced its emissions by 42 per cent<sup>37</sup> the economy grew by 67 per cent<sup>38</sup>. The UK has reduced emissions per person faster than any other G7 nation (and indeed more than any other G20 nation<sup>39</sup>) while at the same time leading the G7 in GDP growth per capita since 1990<sup>40</sup>. PwC’s Low Carbon Economy Index shows that the UK was the fastest of any country in the G20 to decarbonise in 2016<sup>41</sup>.

### Progress Has Been Made Across the UK Economy

Some of the largest falls in emissions since 1990 have been seen in the power sector, where emissions have fallen by almost half<sup>43</sup> as the UK has switched away from coal and increased the share of renewables and gas in electricity generation. In 2016 nearly one quarter of the UK’s electricity generation was provided by renewables<sup>44</sup> and on 7 June this year renewable energy sources supplied over 50 per cent of UK electricity for the first time in history<sup>45</sup>.



<sup>37</sup> BEIS (2017) Provisional Greenhouse Gas Emissions Inventory Statistics 2016 <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2016>

<sup>38</sup> ONS (2016) Quarterly National Accounts Statistical bulletins (Series ABMI. Seasonally adjusted chained volume measures) <https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/abmi>

<sup>39</sup> World Resources Institute (retrieved September 2017) CAIT Climate Data Explorer <http://cait.wri.org> Data to 2013

<sup>40</sup> World Bank (retrieved September 2017) World Development Indicators, International Comparison Program database <http://data.worldbank.org/indicator/NY.GDP.MKTP.PP.KD>. Data to 2015

<sup>41</sup> PwC (2017) Low Carbon Economy Index <http://www.pwc.co.uk/services/sustainability-climate-change/insights/low-carbon-economy-index.html>

<sup>42</sup> UNFCCC Data Interface, [http://di.unfccc.int/time\\_series](http://di.unfccc.int/time_series); World Bank, World Development Indicators, <http://data.worldbank.org/indicator/NY.GDP.MKTP.PP.KD>; BEIS (2017) Final GHG Emissions Inventory Statistics (1990-2015) <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>43</sup> BEIS (2017) UK Greenhouse Gas Inventory Statistics (1990-2015) <https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics>

<sup>44</sup> BEIS (August 2017) Energy Trends <https://www.gov.uk/government/statistics/electricity-section-5-energy-trends>

<sup>45</sup> BBC (2017) Renewables provide more than half UK electricity for first time <http://www.bbc.co.uk/news/business-40198567>

**Table 1: Greenhouse gas emissions by sector, 1990-2015<sup>46</sup>**

Sector	Emissions (Mt)		Percentage change 1990-2015
	1990 base year <sup>47</sup>	2015	
Business and industry	231	123	-47%
Transport	122	120	-2%
Power	204	104	-49%
Natural resources	152	77	-50%
Homes	80	64	-20%
Public sector	13	8	-40%
<b>Total</b>	<b>803</b>	<b>496</b>	<b>-38%<sup>48</sup></b>

Source: BEIS

There have also been significant falls in emissions from waste and industry – driven partly by a change in the UK’s economic structure from manufacturing to services but also by a large reduction in waste being sent to landfill. This has been driven by initiatives like the Landfill Tax which helped reduce the amount of taxable waste sent to landfill by 76 per cent between 1997 and 2016<sup>49</sup>.

We have made progress in other sectors, including transport, where tighter regulations have helped drive down the average car’s carbon emissions per kilometre by up to 16 per cent since 2000<sup>50</sup> while hybrid and ultra low emission vehicles (ULEVs), such as electric and hydrogen fuel cell cars, accounted for a record

5.5 per cent of sales in July 2017<sup>51</sup>. In our homes, average household energy consumption has fallen by over 17 per cent since 1990, in part due to tighter standards and obligations on energy suppliers to improve energy efficiency<sup>52</sup>.

### Falling Costs and Rapid Technology Uptake

This progress has been aided by the falling costs of many low carbon technologies globally, coupled with accelerating momentum in the deployment of the technologies we need to reduce emissions, as a result of early policy action by the UK, other governments and substantial public and private sector investment.

<sup>46</sup> BEIS (2017) UK Greenhouse Gas Inventory Provisional Statistics (1990-2016) <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2016>

<sup>47</sup> In line with the Climate Change Act the base year is comprised of 1990 for carbon dioxide, methane and nitrous oxide, and 1995 for fluorinated compounds

<sup>48</sup> Provisional 2016 estimate: -42 change 1990-2016. BEIS (2017) UK Greenhouse Gas Inventory Statistics (1990-2015) <https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics>

<sup>49</sup> HMRC Landfill Tax bulletin <https://www.gov.uk/government/statistics/landfill-tax-bulletin>

<sup>50</sup> Fuel efficiencies are from DfT modelling using DfT (2017) Vehicle statistics; ICCT (2015) From Laboratory to Road: A 2015 update <http://www.theicct.org/laboratory-road-2015-update>

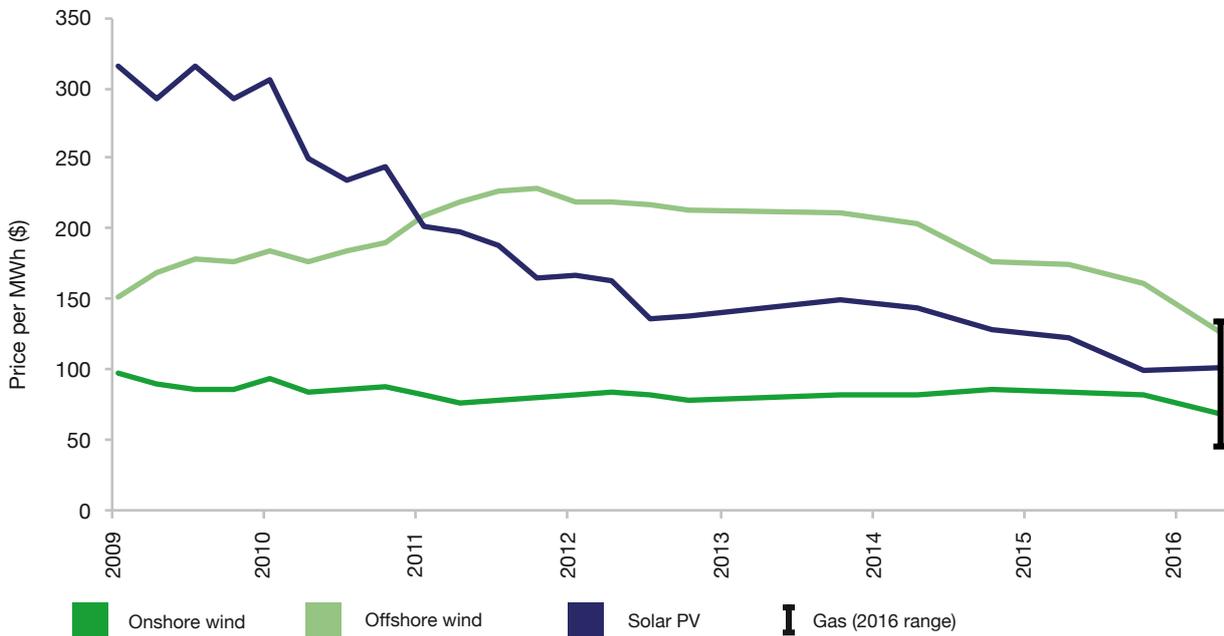
<sup>51</sup> SMMT (2017) EV & AFV Registrations, July 2017 and Year-to-Date <https://www.smmt.co.uk/vehicle-data/evs-and-afvs-registrations/>

<sup>52</sup> BEIS (2017) Energy Consumption in the UK <https://www.gov.uk/government/statistics/energy-consumption-in-the-uk> Change in average consumption per household 1990-2016

For example, the power sector has seen dramatic falls in the price of renewable energy due to government policies, with global investment estimated at \$2.8 trillion since 2007<sup>53</sup>. This has driven down the cost of solar cells by 80 per cent since 2008<sup>54</sup>, meaning we are now beginning to see solar deploying in the UK without government support, and onshore

wind power by 50 per cent since 2009<sup>55</sup>. The cost of offshore wind is falling even faster; in the UK, government investment has helped to deliver a 50 per cent drop in costs over just the last two years<sup>56</sup>. This means that wind and solar energy are increasingly cost competitive with coal and gas in many countries<sup>57</sup>.

Figure 5: Change in global renewable energy costs<sup>57</sup>



Source: Bloomberg New Energy Finance

<sup>53</sup> Bloomberg New Energy Finance (2017) Clean Energy Investment Trends 2Q 2017 <https://about.bnef.com/blog/clean-energy-investment-2q-2017-figures-2/>

<sup>54</sup> Bloomberg New Energy Finance (2016) Summit keynote presentation <http://www.bbhub.io/bnef/sites/4/2016/04/BNEF-Summit-Keynote-2016.pdf>

<sup>55</sup> Ibid

<sup>56</sup> Gov.uk (2017) New clean energy projects set to power 36 million homes <https://www.gov.uk/government/news/new-clean-energy-projects-set-to-power-36-million-homes>

<sup>57</sup> New Climate Economy (2014) Better Growth, Better Climate <http://newclimateeconomy.report/2014/>

<sup>58</sup> Bloomberg New Energy Finance (2016), H2 2016 Global Levelised Cost of Electricity Update <https://about.newenergyfinance.com/about/blog/h2-2016-lcoe-giant-fall-generating-costs-offshore-wind/>

Global investment in energy efficiency is also growing, having already reached \$221 billion in 2015, an increase of six per cent on the year before<sup>59</sup>. This included \$12 billion of investment in improving the efficiency of appliances and has led to an improvement in the average efficiency of major appliance categories<sup>60</sup> of more than 16 per cent between 2005 and 2015<sup>61</sup>.

The transport sector is seeing the beginnings of a rapid shift to clean technology. Between 2011 and 2016, the number of electric vehicles on the road globally increased thirtyfold<sup>62</sup>. This has been aided by the falling costs of the battery packs that power electric vehicles, which have come down by nearly 80 per cent since 2010<sup>63</sup>. In the future, the cost of electric vehicles is now forecast to fall below that of conventional vehicles in the early to mid-2020s<sup>64</sup>.

## A High Growth Low Carbon Economy

As a result of this technological innovation and investment, new high value jobs, industries and companies have been created. The UK low carbon economy – encompassing activities such as the design and building of low carbon power and heat projects, the manufacture of electric vehicles, the development of energy efficient products and systems for buildings, and green finance – already supports over 430,000 jobs directly and through supply chains<sup>65</sup>. We have developed world leading expertise in technologies such as offshore wind and power electronics for low carbon vehicles and electric motors, and we are a global leader in green finance.

This progress has altered the way that we see many of the trade-offs between investing in low carbon technologies that help secure our future but that might incur costs today. Actions to cut our emissions can be a win-win: cutting consumer bills, driving economic growth, creating high value jobs and helping to improve our quality of life.

<sup>59</sup> International Energy Agency (2016) Energy Efficiency Market Report [https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016\\_WEB.PDF](https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016_WEB.PDF)

<sup>60</sup> Refrigerators, freezers, washing machines, dishwashers, heating equipment, cooling equipment, water heating equipment and lighting (luminaires and lamps) and controls.

<sup>61</sup> International Energy Agency (2016) Energy Efficiency Market Report [https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016\\_WEB.PDF](https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016_WEB.PDF)

<sup>62</sup> International Energy Agency (2016) Global EV Outlook 2017 <https://www.iea.org/publications/freepublications/publication/global-ev-outlook-2017.html>

<sup>63</sup> McKinsey & Co (2017) Electrifying insights: How automakers can drive electrified vehicle sales and profitability <http://www.mckinsey.com/industries/automotive-and-assembly/our-insights/electrifying-insights-how-automakers-can-drive-electrified-vehicle-sales-and-profitability>

<sup>64</sup> OLEV analysis. This is based on the whole-life cost of electric vehicles. The up-front cost of these vehicles is expected to fall below that of conventional vehicles in the second half of the 2020s.

<sup>65</sup> ONS (2017) Low Carbon and Renewable Energy Economy Survey, final estimates: 2015 <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalesimates/2015results>

## The UK's Low Carbon Economy: Driving Regional Growth

The growth in the UK's low carbon economy has taken place across the country, with centres of excellence in many parts of the UK.

**Scotland:** Turnover of the low carbon economy was £5.5 billion in 2015, supporting 31,000 jobs and 20,000 businesses

**Northern Ireland:** Turnover was almost £1 billion, supporting 5,000 jobs and 4,000 businesses

**Midlands:** Leading region for the design and manufacture of low carbon vehicles, with more than £1.5 billion (more than 60 per cent) of UK automotive R&D carried out in the region

**Wales:** Turnover was £1.7 billion in 2015 with 11,000 jobs and 4,500 businesses

**South West:** The low carbon sector in Bristol employs over 9,000 people and over 19,000 in the whole of the West of England, generating £2.4 billion

**North:** Low carbon investment has encouraged innovation and generation of clean energy, and developed local supply chains, all of which has helped drive regeneration

**North East:** The Siemens offshore wind blade factory at Alexandra Dock in Hull directly supports 1,000 jobs with £310 million investment

**South East:** The low carbon economy in Oxfordshire has a turnover of £1.15 billion supporting 8,800 jobs, and is 7 per cent of the local economy

**Sources:**

**Scotland, Wales, Northern Ireland:** ONS (2016): Low Carbon and Renewable Energy Economy Survey. Direct activity only - excludes supply chains.

**North East:** DECC published news story (2014) Siemens to build major offshore wind manufacturing site in the UK

**South East:** Low Carbon Oxford and the Environmental Change Institute at the University of Oxford (2014) Joining the crowd: Growing a new economy for Oxfordshire

**South West:** Bristol City Council (2015) State of Bristol - Key Facts

**Midlands:** DIT (2017) <https://www.gov.uk/government/publications/midlands-engine-investment-portfolio/midlands-engine-investment-portfolio>

**North:** Aldersgate Group Report (2016) Setting the Pace: Northern England's Low Carbon Economy

## The UK's International Leadership and Actions to Reduce Emissions Overseas

Climate change is a global challenge requiring action from all countries. The UK has played a key role in demonstrating international leadership on reducing emissions and supporting other countries to do the same.

The UK was the first country in the world to introduce legally binding emissions reduction targets under the Climate Change Act, which has been used as a model around the world, including in France, Denmark, Sweden and Mexico. The UK was among the first to recognize that climate change is an economic and political issue not just an environmental one, and to put serious climate expertise in our embassies to influence and help countries to act.

We have used our world leading economic, science and technical skills to shape the debate around climate change and have been at the forefront of the debate through our world leading scientists at the Met Office, the landmark 2006 Stern Report<sup>66</sup> and the more recent New Climate Economy project<sup>67</sup>, having one of the first Foreign Secretary Special Representatives on

climate and arranging the first discussion of climate change in the UN Security Council.

We also played a critical role in securing the 2015 Paris Agreement, the first ever international climate change agreement where 195 countries (representing over 90 per cent of global economic activity<sup>68</sup>) made a commitment to reduce emissions with the long-term goal of limiting global temperature increases to “well below 2 degrees”, and to review progress every five years, mirroring the UK's ground-breaking processes.

The Agreement puts pressure on all countries to bring forward long-term emissions reduction strategies by 2020. The Clean Growth Strategy, as the UK's long-term emissions reduction strategy, shows the UK is leading the world in response to this important step. The UK also led the way in pledging to phase down the use of hydrofluorocarbons (HFCs) by 79 per cent by 2030, and following this lead 197 countries agreed a global phase down of HFCs – delivering an 85 per cent phase down by 2036 - under the United Nations Montreal Protocol in October 2016.

<sup>66</sup> HM Treasury (2006) Stern Review on the Economics of Climate Change [http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/sternreview\\_index.htm](http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/sternreview_index.htm)

<sup>67</sup> New Climate Economy (2014) <http://newclimateeconomy.report/>

<sup>68</sup> World Bank (retrieved September 2017) <https://data.worldbank.org/indicator/NY.GDPMKTP.CD>

### The UK's International Leadership and Actions to Reduce Emissions Overseas (continued)

The UK is among the largest contributors of climate finance, committing to provide at least £5.8 billion from 2016 to 2020, to help developing countries mitigate and adapt to the impacts of climate change, reduce deforestation and support cleaner economic growth. From 2011 we have used our International Climate Finance to install more than 400 megawatts of clean energy capacity, mobilised £2.7 billion of additional public and private finance, supported more than 34 million people in adapting to the impacts of climate change and helped resilient economic development in over 70 countries<sup>69</sup>.

This support takes many forms, for instance investment in the Climate Investment Funds, through which the UK has helped support renewable energy, climate resilience and forestry projects in 72 countries<sup>70</sup>. The UK has also been at the forefront of global action to halt deforestation – helping negotiate

international frameworks and mobilising partnerships to deliver on them – to meet shared goals such as ending forest loss by 2030, and eliminating deforestation from the production of key agricultural commodities by 2020. Together with Germany and Norway, we have collectively pledged \$5 billion between 2015 and 2020 to incentivise ambitious governments, companies and communities to protect our largest natural global carbon sinks. This includes supporting a 30 per cent reduction in deforestation in Colombia's Amazon, improving livelihoods in conflict-affected areas<sup>71</sup>.

Our actions to date are expected to save nearly 500 Mt over the lifetime of the projects<sup>72</sup>, more than the entire annual emissions of France<sup>73</sup>. And while we do not count these results against our domestic budgets, we can be proud of the impact of the UK's commitment to global climate action.

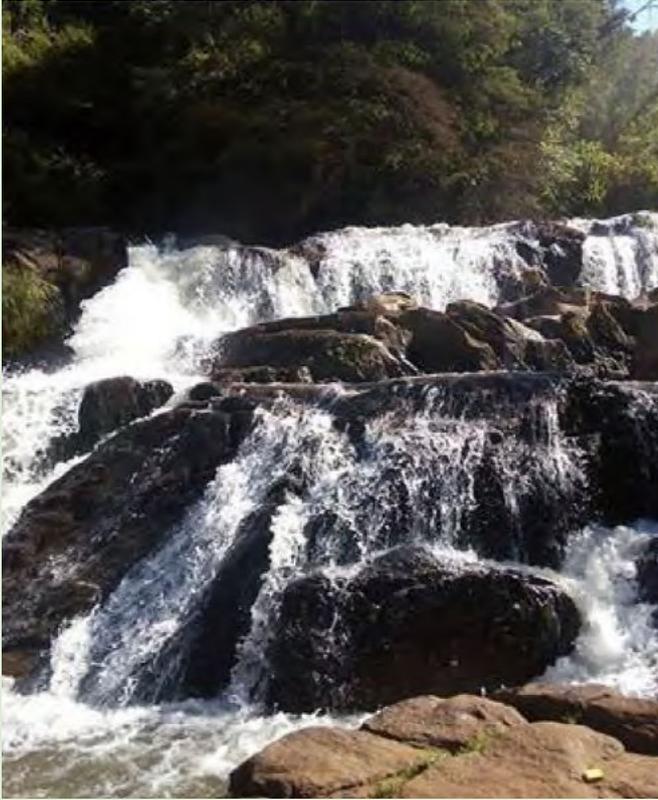
<sup>69</sup> DfID (2017) 2017 UK Climate Finance Results [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/625457/2017-UK-Climate-Finance-Results.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/625457/2017-UK-Climate-Finance-Results.pdf)

<sup>70</sup> The Climate Invest Funds (CIFs) <https://www.gov.uk/government/case-studies/the-climate-investment-funds-cifs>

<sup>71</sup> BEIS assessment

<sup>72</sup> DfID (2017) 2017 UK Climate Finance Results [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/625457/2017-UK-Climate-Finance-Results.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/625457/2017-UK-Climate-Finance-Results.pdf)

<sup>73</sup> UNFCCC (retrieved September 2017) [http://di.unfccc.int/time\\_series](http://di.unfccc.int/time_series), 2015 data



*The Renewable Energy Performance Platform supports small to medium-sized renewable energy projects throughout sub-Saharan Africa. In West Kenya, two mini-hydro power plants will provide electrification to local rural communities, helping to stimulate rural economic growth. Importantly, after 20 years of operation the project will be fully transferred to the local community.*

# Chapter 2:

## The Opportunities and Challenges



## The Size of the Clean Growth Opportunity

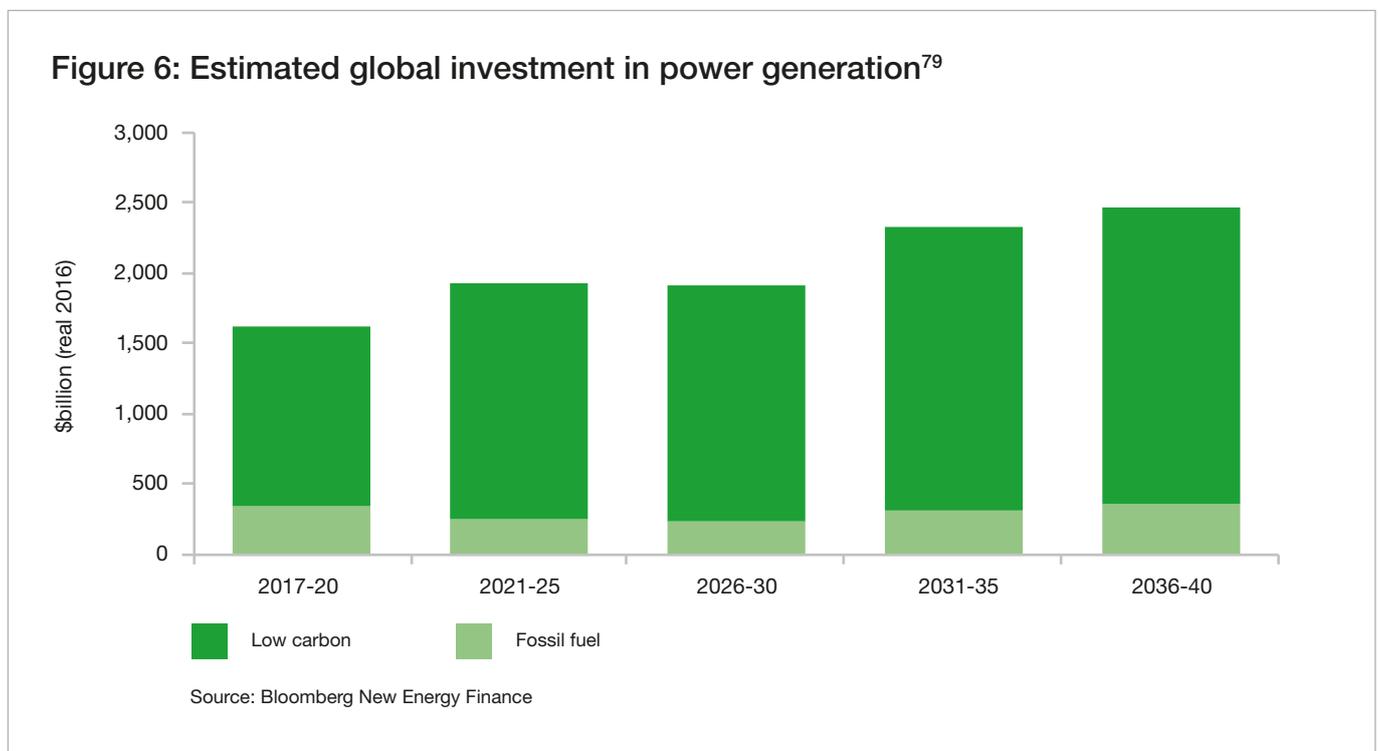
The commitments made in the Paris Agreement – shifting to cleaner, low carbon technologies in power, transport, heating and cooling, industrial processes and agriculture – will require enormous investment of public and private capital. An estimated \$13.5 trillion of public and private investment will be required in the energy sector alone<sup>74</sup>.

We have a high degree of confidence that these investments will be made given the scale of political support and the transformational impact of investment to date – indeed decarbonisation is cited as one of the ‘megatrends’ that will reshape the global economy over the years to come<sup>75</sup>.

We are determined to ensure that this trend works to the advantage of the UK economy and that we embed it at the core of our Industrial Strategy.

Looking across sectors, to assess the size of the opportunity, highlights several key areas.

The **power sector** has seen some of the most significant early action on climate change, given its status as the largest source of emissions in most countries. Annual new global investment in renewable electricity grew more than threefold since 2005, reaching over \$240 billion in 2016<sup>76</sup>. This trend is happening everywhere. In Europe, over 80 per cent of new power generating capacity built in 2016 was from renewables<sup>77</sup>. Globally, clean energy technologies are estimated to account for over 85 per cent of the \$10.2 trillion investment in power generation projected between now and 2040<sup>78</sup>.



<sup>74</sup> IEA (2015) Climate pledges for COP21 slow energy sector emissions growth dramatically <https://www.iea.org/newsroom/news/2015/october/climate-pledges-for-cop21-slow-energy-sector-emissions-growth-dramatically.html>

<sup>75</sup> World Economic Forum, OECD, World Bank, PwC, Ernst & Young

<sup>76</sup> FS-UNEP Collaborating Centre (2017) Global Trends in Renewable Energy Investment 2017 <http://fs-unesp-centre.org/sites/default/files/publications/globaltrendsrenewableenergyinvestment2017.pdf>

<sup>77</sup> REN21 (2017) Renewables 2017 Global Status Report [http://www.ren21.net/wp-content/uploads/2017/06/170607\\_GSR\\_2017\\_Full\\_Report.pdf](http://www.ren21.net/wp-content/uploads/2017/06/170607_GSR_2017_Full_Report.pdf)

<sup>78</sup> Bloomberg New Energy Finance (2017) New Energy Outlook 2017 <https://about.bnef.com/new-energy-outlook/>

<sup>79</sup> Bloomberg New Energy Finance (2017) New Energy Outlook 2017 <https://about.bnef.com/new-energy-outlook/>

## Clean Growth in China and India

Both China and India are driving the global transition to the low carbon economy, supported by political will<sup>80,81</sup>, falling technology costs<sup>82</sup> and a desire to seize the economic opportunity<sup>83,84</sup>.

China has put 'Green Development' at the heart of its current five year economic strategy<sup>85</sup> and committed to reduce its level of carbon emissions per unit of economic activity by 60 per cent to 65 per cent by 2030 compared to 2005.

India's targets commit to reducing emissions by 33 to 35 per cent over the same period, and Prime Minister Modi has plans to make India a leader in solar and renewable energy<sup>86</sup>.

These ambitions have translated into impressive plans. India plans to increase its renewable power fivefold to 175 gigawatts by 2022<sup>87</sup>, including 60 gigawatts of wind and 100 gigawatts of solar; and China has committed to invest \$360 billion in low carbon power by 2020<sup>88</sup>, increasing its renewable energy capacity by around 40 per cent.

This ambition extends to the transport sector. China currently has an electric car market share close to 1.5 per cent<sup>89</sup> and is aiming for ten per cent of its manufacturing output in the country to be either low or zero emission from 2019, rising to 12 per cent in 2020. India has stated an aspiration for all new cars sold to be electric by 2030<sup>90</sup>.

The **transport sector** is also seeing the acceleration of a rapid shift to clean technology supported by government leadership and global investment.

Between 2011 and 2016, the number of electric vehicles (EVs) on the road globally increased thirtyfold<sup>91</sup> and governments are announcing increasingly ambitious targets that are driving even more rapid changes. The Government has announced an end to the sale of all new conventional petrol and diesel cars and vans by 2040<sup>92</sup>. France has also announced the end of

petrol and diesel car sales by 2040<sup>93</sup>, Norway is aiming for 100 per cent ultra low emissions vehicle sales by 2025<sup>94</sup>, and China has recently announced a requirement for at least 10 per cent of auto manufacturers' output in the country to be either low or zero emission from 2019, rising to 12 per cent in 2020<sup>95</sup>.

Meanwhile auto manufacturers are rapidly expanding their plans for new ultra low emission vehicle models, from just ten in 2010 to more than 200 in 2020<sup>96</sup>.

<sup>80</sup> LSE Grantham Institute (2015) China's "new normal": structural change, better growth, and peak emissions <http://www.lse.ac.uk/GranthamInstitute/publication/chinas-new-normal-structural-change-better-growth-and-peak-emissions/>

<sup>81</sup> Government of India (2017) Draft National Energy Policy

<sup>82</sup> Bloomberg New Energy Finance (2017) LCOE Comparison and Visualisation database

<sup>83</sup> LSE Grantham Institute (2016) China's 13th Five-Year Plan <http://www.lse.ac.uk/GranthamInstitute/law/13th-five-year-plan/>

<sup>84</sup> Government of India (2017) Draft National Energy Policy

<sup>85</sup> LSE Grantham Institute (2016) China's 13th Five-Year Plan <http://www.lse.ac.uk/GranthamInstitute/law/13th-five-year-plan/>

<sup>86</sup> Government of India (2017) Draft National Energy Policy

<sup>87</sup> Government of India Ministry of New and Renewable Energy (2016) Draft National Wind-Solar Hybrid Policy: <http://tinyurl.com/mwfgwyp>

<sup>88</sup> Reuters (2017) China to plow \$361 billion into renewable fuel by 2020 <https://www.reuters.com/article/us-china-energy-renewables/china-to-plow-361-billion-into-renewable-fuel-by-2020-idUSKBN14P06P>

<sup>89</sup> International Energy Agency (2017) Global EV Outlook 2017 <https://www.iea.org/publications/freepublications/publication/global-ev-outlook-2017.html>

<sup>90</sup> Financial Times (2017) India power minister promotes renewables and 'cleaner' coal <https://www.ft.com/content/a106c468-3567-11e7-99bd-13beb0903fa3>

<sup>91</sup> International Energy Agency (2017) Global EV Outlook 2017 <https://www.iea.org/publications/freepublications/publication/global-ev-outlook-2017.html>

<sup>92</sup> Defra, DfT (2017) Air quality plan for nitrogen dioxide (NO<sub>2</sub>) in UK (2017) <https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017>

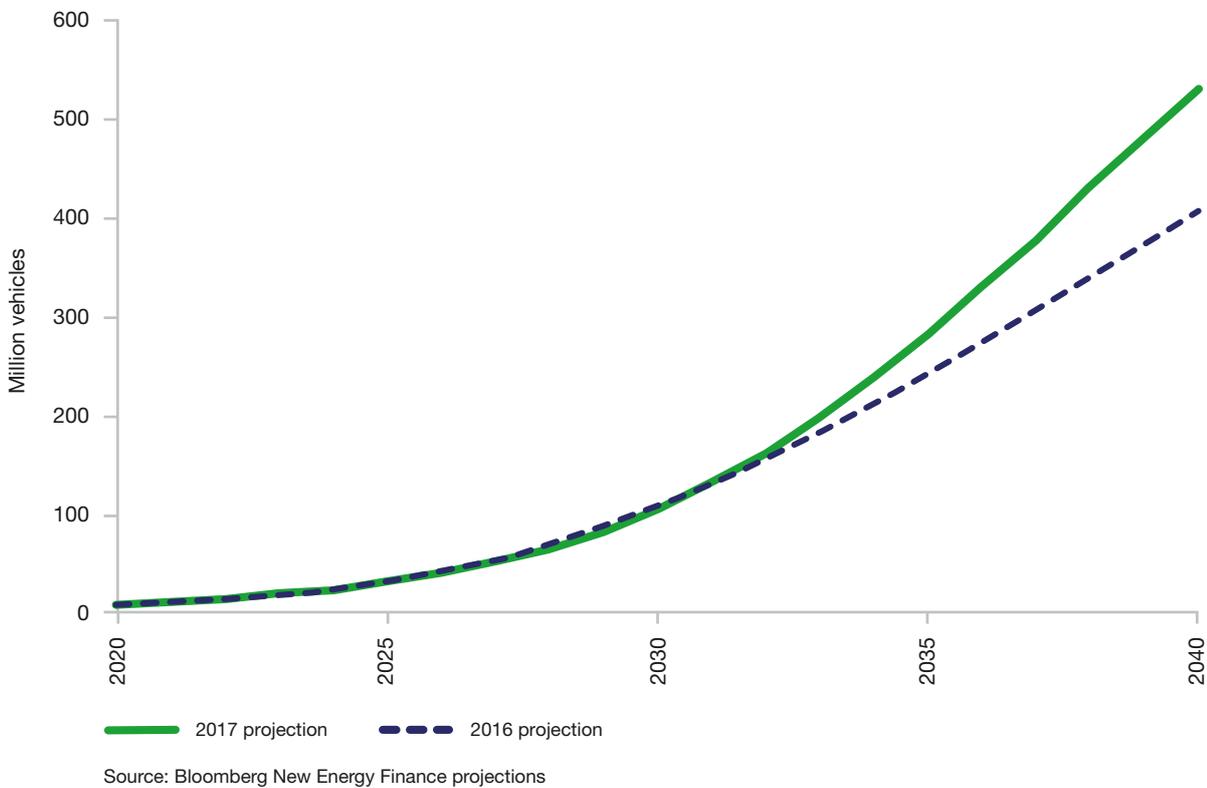
<sup>93</sup> Financial Times (2017) France plans to end sale of petrol and diesel cars by 2040 <https://www.ft.com/content/af2fccb0-a29e-3347-bd0f-7597186b5a2a>

<sup>94</sup> Norsk Elbilforening (2017) Norwegian EV Policy <http://elbil.no/english/norwegian-ev-policy/>

<sup>95</sup> Bloomberg (2017) <https://www.bloomberg.com/news/articles/2017-09-28/china-to-start-new-energy-vehicle-production-quota-from-2019>

<sup>96</sup> Bloomberg New Energy Finance (2017) Global EV and charging policy support database

Figure 7: Global deployment forecasts for electric vehicles have been improving over time<sup>97</sup>



Globally, sales of EVs are expected to be five times higher in 2020 compared to 2015<sup>98</sup> and to take a rapidly increasing share of the market in an industry whose revenue in 2016 was more than \$2 trillion<sup>99</sup>.

The global **construction** sector will also be boosted by investment in sustainable infrastructure to meet decarbonisation goals.

Global markets for energy efficient buildings, and for low carbon heating and cooling, are already growing and the market for investment in buildings that reduce emissions and are resilient to climate change in just six key emerging economies in Asia has been estimated at more than \$15 trillion up to 2030<sup>100</sup>.

There is also a significant expansion in the use of innovative **green finance** to support the investment needed to realise these opportunities with the global markets for green bonds growing rapidly from \$7.2 billion in 2012 to over \$80 billion in 2016 and expected to break these records in 2017<sup>101</sup>.

<sup>97</sup> Bloomberg New Energy Finance (2017) Comparison of Long-Term EV Adoption Forecasts <https://www.bnef.com/core/insights/16595>

<sup>98</sup> Bloomberg New Energy Finance (2017) Annual long-term forecast of the world's electric vehicle market. [https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF\\_EVO\\_2017\\_ExecutiveSummary.pdf](https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF_EVO_2017_ExecutiveSummary.pdf)

<sup>99</sup> IBISWorld (2017) Global Car & Automobile Manufacturing: Market Research Report <https://www.ibisworld.com/industry-trends/global-industry-reports/manufacturing/car-automobile-manufacturing.html>

<sup>100</sup> International Finance Corporation (2016) Climate Investment Opportunities in Emerging Markets

<sup>101</sup> Climate Bonds Initiative <https://www.climatebonds.net/>

## Opportunities for the UK

Just as the UK has led the world diplomatically in addressing climate change, we are also well-placed to take advantage of the global shift to a clean energy economy as we benefit from significant economic competitive advantages, including:

- The most productive science base<sup>102</sup> of the G7 countries – a critical asset, given the extensive innovation required for decarbonisation in many sectors;
- World leading expertise in high-value services<sup>103</sup>, with strengths in areas such as finance, law, consultancy, software and data services – all important to enabling the low carbon transition;
- Excellence in the design and manufacture of products based on advanced technologies as in the automotive and aerospace sectors<sup>104</sup>; and

- A policy and regulatory environment that provides long-term direction and supports innovation, with some of the most liberalised gas and electricity markets; a long-term policy framework set by the Climate Change Act and carbon budgets; and an energy regulator which is pioneering in its approach to encouraging companies to innovate<sup>105</sup> with programmes like the ‘regulatory sandbox’<sup>106</sup>.

We have already capitalised on these strengths to take a leadership position in some important emerging low carbon sectors:

- **Power:** The UK has the most offshore wind generation built anywhere in the world, with around 40 per cent of the global installed capacity<sup>107</sup>. British companies are now benefiting from exports in areas such as cable installation, repairing equipment, construction work and consulting<sup>108</sup>.
- **Electric vehicles:** In 2016, one in five battery electric cars driven in Europe was built in the UK<sup>109</sup> and low emission vehicle exports were estimated to be worth nearly £2.5 billion in 2015<sup>110</sup>.

<sup>102</sup> BIS (2013) International Comparative Performance of the UK Research Base – 2013 <https://www.gov.uk/government/publications/performance-of-the-uk-research-base-international-comparison-2013>

<sup>103</sup> Green Alliance (2016) Will the UK economy succeed in a low carbon world? [http://www.green-alliance.org.uk/UK\\_low\\_carbon.php](http://www.green-alliance.org.uk/UK_low_carbon.php), citing : World Trade Organisation (2015) World trade report 2015 [https://www.wto.org/english/res\\_e/booksp\\_e/world\\_trade\\_report15\\_e.pdf](https://www.wto.org/english/res_e/booksp_e/world_trade_report15_e.pdf) (Data table, ‘Leading exporters and importers of commercial services, 2014’, p28); ONS (2016) International trade in services 2014 (‘Total trade in services, all industries (excluding travel, transport, and banking) analysed by product 2014’)

<sup>104</sup> BEIS (2017) Building our Industrial Strategy <https://www.gov.uk/government/consultations/building-our-industrial-strategy>

<sup>105</sup> OECD (2002) Reviews of Regulatory Reform, Regulatory Reform in the United Kingdom, Regulatory Reform in Gas and Electricity and the Professions <https://www.oecd.org/regreform/2766184.pdf>

<sup>106</sup> Ofgem (2017) Innovation Link – Open Letter: [https://www.ofgem.gov.uk/system/files/docs/2017/02/open\\_letter\\_regulatory\\_sandbox\\_6\\_february\\_2017.pdf](https://www.ofgem.gov.uk/system/files/docs/2017/02/open_letter_regulatory_sandbox_6_february_2017.pdf)

<sup>107</sup> IRENA (retrieved September 2017) <http://www.irena.org/home/index.aspx>

<sup>108</sup> Energy UK (2017) Response to Industrial Strategy consultation <http://www.energy-uk.org.uk/press-releases/370-2017/6150-energy-uk-comments-on-the-industrial-strategy-consultation.html>

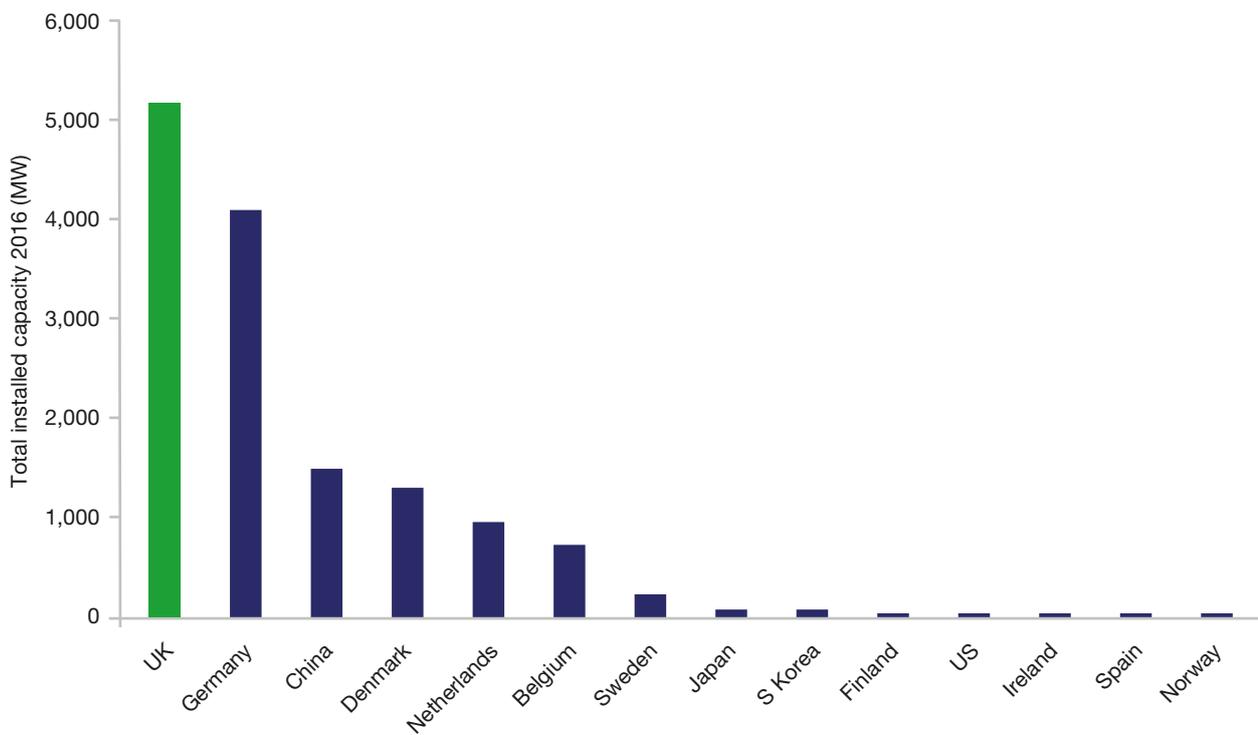
<sup>109</sup> European Alternative Fuels Observatory (2017) Top 5 selling BEV analysis <http://www.eafo.eu/vehicle-statistics/m1>

<sup>110</sup> ONS (2017) Low Carbon and Renewable Energy Economy Survey, final estimates: 2015 <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalesimates/2015results>

- Low carbon financial and professional services:** London is emerging as a leader in low carbon finance, the centre of global carbon trading, and with 50 green bonds listed on the London Stock Exchange, raising a combined \$14.8 billion<sup>111</sup> across seven currencies. It has been estimated that UK legal and finance advice was

behind a third of new clean energy projects globally between 2007 and 2012<sup>112</sup>. The UK is home to the largest speciality insurance market in the world<sup>113</sup>, and is a leading provider of insurance cover for climate-related risks and for large-scale low carbon infrastructure projects.

**Figure 8: Offshore wind installed capacity by country<sup>114</sup>**



Source: International Renewable Energy Agency

<sup>111</sup> London Stock Exchange 2017

<sup>112</sup> Green Alliance (2016) Will the UK economy succeed in a low carbon world? [http://www.green-alliance.org.uk/resources/UKeconomy\\_lowcarbonworld](http://www.green-alliance.org.uk/resources/UKeconomy_lowcarbonworld) Bloomberg New Energy Finance (2017) Clean energy and energy smart technologies league tables, 2007-2012 <https://about.bnef.com/blog/2016-league-tables-clean-energy/>

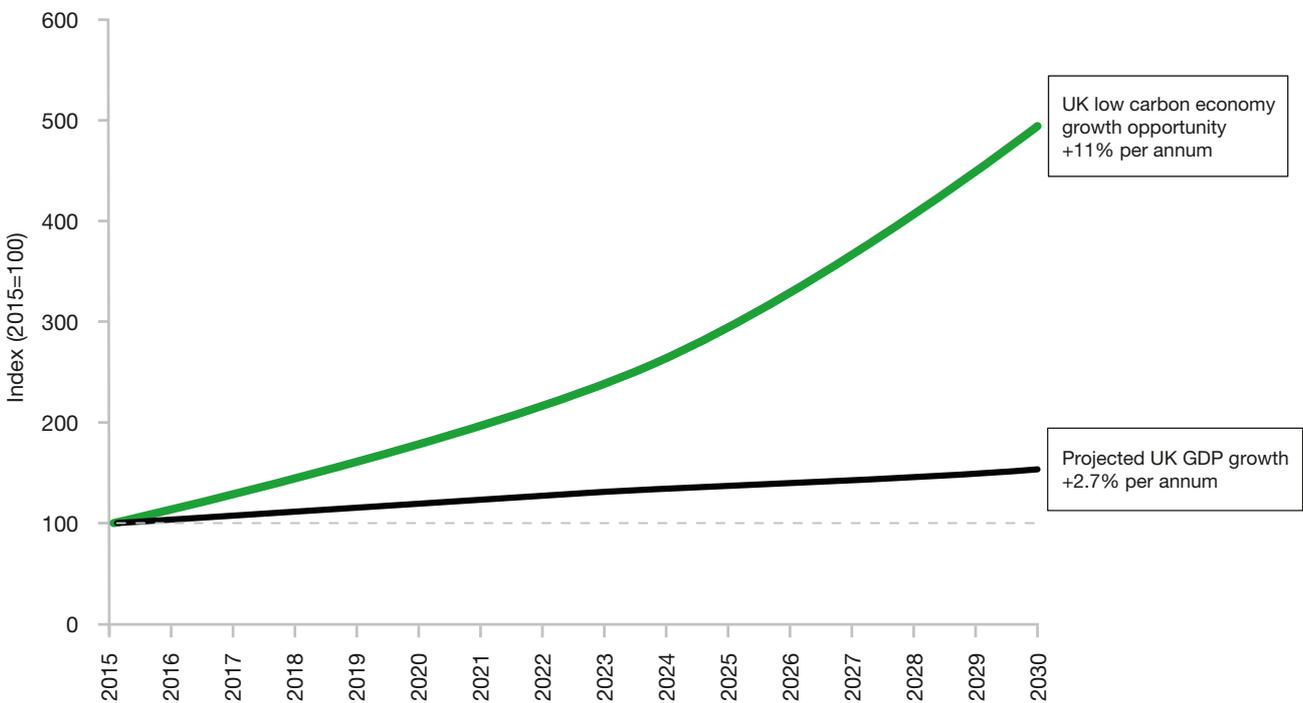
<sup>113</sup> Boston Consulting Group (2017) London Matters: The competitive position of the London Insurance market <https://www.londonmarketgroup.co.uk/lm-2017>

<sup>114</sup> IRENA (retrieved September 2017) <http://www.irena.org/home/index.aspx>

Analysis for the Committee on Climate Change has suggested that if we continue to develop and build on our strengths we can capture significant economic benefits from these decarbonising trends. The UK’s low carbon economy could grow at around 11 per cent a year between 2015 and 2030, some four times faster than the average growth rate for the UK

economy overall which would mean the low carbon economy would increase from around two per cent of the UK’s total output at present to around eight per cent by 2030<sup>114</sup>. The same study estimates that UK exports of low carbon goods and services could be worth between £60 billion and £170 billion by 2030.

**Figure 9: Potential growth in UK low carbon economy<sup>116</sup>**



Source: Ricardo-AEA for the CCC; OECD

<sup>115</sup> Ricardo Energy and Environment for the Committee on Climate Change (2017) UK business opportunities of moving to a low carbon economy <https://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/>

<sup>116</sup> Ricardo Energy and Environment for the Committee on Climate Change (2017) <https://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research/>; OECD Long-term GDP forecast <https://data.oecd.org/gdp/gdp-long-term-forecast.htm>

## Clean Growth and the UK Industrial Strategy

As we form our Industrial Strategy, we will aim to maximise the UK industrial advantages from the global shift to a low carbon economy. We will build and link together the strengths we already have, while nurturing new ones, so that our whole economy can seize the opportunities presented by this global economic trend.

We have already committed to the **largest increase in public spending for investment in science, research and innovation** in almost 40 years<sup>117</sup>. We will ensure that this is invested to catalyse low carbon innovation across multiple sectors of the economy.

We have also committed to **upgrading our digital, energy, transport, housing, water and flood defence infrastructure**, including through investment in the National Productivity Investment Fund, with annual central government infrastructure investment rising each year from around £2 billion in 2016/17 to over £5 billion in 2020/21<sup>118</sup>. We will ensure that these investments strengthen market demand for the innovative new clean energy technologies and services that our businesses are creating.

We have announced **significant reforms to technical education**, with the creation of new qualifications (T-levels), high-quality work

placements, and Institutes of Technology to deliver higher education in STEM subjects. We will ensure that these reforms help train our innovators of the future and provide businesses with the skilled professionals they need to thrive in the clean energy economy<sup>119</sup>.

We have welcomed early work on **sector deals** in nuclear, auto manufacturing and industrial digitalisation, all of which are central to productivity in the low carbon economy, and we will challenge businesses in all sectors to increase their competitiveness in relation to the shift to clean energy.

In return, and to maximise the domestic and international opportunities for the UK, we will **strengthen our support for businesses** as part of the transition to the low carbon economy. We have added billions of pounds in potential support for UK exporters, doubling the capacity of UK Export Finance and increasing available cover for individual markets by up to 100 per cent<sup>120</sup>, and will dedicate resources within the Department for International Trade to promote investment into the UK renewable energy landscape, develop this supply chain further and support UK exports. So far this has helped to secure investments across the country: into a turbine blade manufacturing plant in Hull<sup>121</sup>, a transition pieces yard in Teesside<sup>122</sup> and an MHI Vestas investment into the Isle of Wight<sup>123</sup>, which collectively support over 1,400 new jobs.

<sup>117</sup> HM Treasury (2016) Autumn Statement 2016 <https://www.gov.uk/government/topical-events/autumn-statement-2016>

<sup>118</sup> Ibid

<sup>119</sup> HM Government (2016) Post-16 skills plan and independent report on technical education <https://www.gov.uk/government/publications/post-16-skills-plan-and-independent-report-on-technical-education>

<sup>120</sup> HM Government (2016) Autumn Statement 2016 <https://www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016>

<sup>121</sup> Siemens <http://www.siemens.co.uk/en/wind/hull.htm>

<sup>122</sup> 4C Offshore (2015) Offshore Structures (Britain) opens its doors <http://tinyurl.com/m3yn5px>

<sup>123</sup> MHI Vestas Offshore Wind commences hiring for over 200 jobs on the Isle of Wight, UK <http://tinyurl.com/l5nrs25>

We are committed to **making the most of the diverse strengths of all of Britain's cities and regions**, to grasp the opportunities that could drive faster growth and increased earning power in each of them. To support this, we have allocated an additional £1.8 billion from the Local Growth Fund for a new set of Growth Deals between Government and Local Enterprise Partnerships (LEPs)<sup>124</sup>. Each region of the UK differs in its local energy resources, its industrial and domestic energy needs, and its expertise. We will ensure that local communities and LEPs are empowered to make the best

use of their local skills and resources, so that through the clean energy economy they can drive productivity, job creation and growth.

And we will set out our plans to build on this progress in the Industrial Strategy White Paper, to be published later in 2017, positioning the UK as a leader in the low carbon economy, investing in the foundations required for economic success and ensuring our industries succeed in an economic transition that we are helping to shape and lead.



<sup>124</sup> HM Government (2016) Autumn Statement 2016 <https://www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016>

## The Challenges to Delivering Clean Growth

We have high aspirations and are committed to delivering clean growth. But we face three significant challenges that we must overcome if we are to continue progress: ensuring we deliver affordable energy for households and businesses; decarbonising “harder to reach” parts of the UK economy; and establishing a post-EU emissions and environmental framework that is at least as beneficial as current arrangements.

### Decarbonising Harder to Reach Sectors and the Use of Flexibilities

As a result of our actions so far we have already driven emissions per head down by nearly half since 1990. This progress meant that we exceeded the target emissions reductions of our first carbon budget (2008 to 2012) by one per cent<sup>125</sup> and we project that we will outperform against our second and third budgets covering the years 2013 to 2022 by almost five per cent and four per cent respectively<sup>126</sup>. This will be a significant achievement.

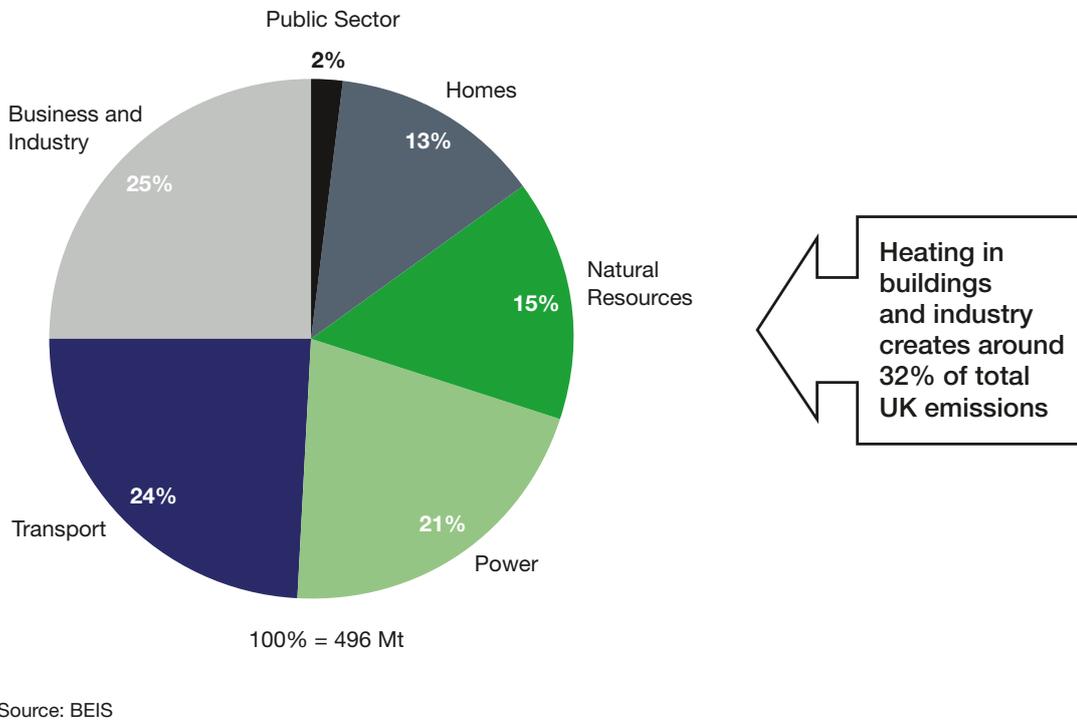
Our achievements to date have been substantially driven by significant decarbonisation of the power and waste sectors and we now need to replicate this success across the economy, particularly in the transport, business and industry sectors which account for almost half of current emissions. And we need further action on heating across key sectors, which is responsible for around a third of emissions.

These are the “harder to reach” parts of the economy requiring more investment, concerted joined up working between government, industry and consumers, or big technological breakthroughs to drive substantial shifts down in carbon emissions. This Strategy sets out how we plan to address some of these difficulties, including how we will target our innovation investment. Cutting emissions in these areas can benefit us all through cleaner air and reduced energy bills which will help improve the UK’s productivity. In addition, the innovation and investment required to drive these emissions down can create more jobs and more export opportunities.

<sup>125</sup> DECC (2014) Final statement for the first carbon budget period <https://www.gov.uk/government/statistics/final-statement-for-the-first-carbon-budget-period>

<sup>126</sup> BEIS (2017) Energy and Emissions Projections 2016 <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016>

**Figure 10: UK emissions by sector, 2015<sup>127</sup>**



Our approach is pragmatic. Given how much uncertainty underlies projections, we need an approach that is flexible in response to shifting evidence, not least about the impact of policies. It is also right, in our economic circumstances, to be rigorous in examining the costs and benefits of action to reduce emissions, and the right pace of change. The Climate Change Act permits us to use “flexibilities”, such as surplus from previous carbon budgets or the purchase of good quality international carbon credits<sup>128</sup>, to meet carbon budgets. We are prepared to use the flexibilities available to us to meet carbon budgets, subject to the requirements set out in the Climate Change Act, if this presents better value for UK taxpayers, businesses and domestic consumers.

Our current estimated projection for the fourth and fifth carbon budgets suggests that we could deliver 94 per cent and 93 per cent of our required performance against 1990 levels – for carbon budgets which will end in ten and fifteen years’ time respectively<sup>129</sup>. While we have the option to use flexibilities to fully meet our carbon budgets, the ambitious policies and proposals set out in this Strategy, and the rapid progress and accelerating pace of changes in low carbon technologies so far, suggest that we may not need to use this option. We will decide whether to use flexibilities following consultation with the Devolved Administrations, and having obtained and taken into account advice from the Committee on Climate Change.

<sup>127</sup> BEIS (2017) UK Greenhouse Gas Inventory Statistics (1990-2015) <https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics>; BEIS analysis

<sup>128</sup> A good quality carbon credit is one with its emission reduction and sustainability credentials assured.

<sup>129</sup> This includes an initial estimate of 30 Mt and 80 Mt of additional savings in the fourth and fifth carbon budgets respectively from the more advanced policies and proposals in the Clean Growth Strategy. As we move forward and develop the full range of policies and proposals, we will publish individual impact assessments as appropriate with updated analysis.

**Table 2: Performance against carbon budgets<sup>130</sup>**

		Carbon Budget				
		1 2008-12	2 2013-17	3 2018-22	4 2023-27	5 2028-32
Budget, cumulative emissions, Mt		3,018	2,782	2,544	1,950	1,725
Average reduction vs 1990 emissions, %		-25%	-31%	-37%	-51%	-57%
Existing policies	Projected emissions, cumulative emissions, Mt	2,982 actual	2,650 E	2,453 E	2,096 E	1,972 E
	Result vs. Budget, %	-1.2%	-4.7%	-3.6%	+7.5%	+14.3%
Existing and new policies and proposals <sup>131</sup>	Projected emissions, cumulative emissions, Mt	2,982 actual	2,650 E	2,453 E	2,066 E	1,892 E
	Result vs. Budget, cumulative emissions, Mt	-36	-132	-91	+116	+167
	Result vs. Budget, %	-1.2%	-4.7%	-3.6%	+6.0%	+9.7%
	Cumulative surplus (+) or deficit (-), Mt		+132	+223	+107	-60

### The Climate Change Act 2008<sup>132</sup>

The Act allows Government some flexibility on when and how to reduce UK emissions on route to 2050 but before doing so the Government must obtain and take into account the advice of the Committee on Climate Change and consult the Devolved Administrations. There are three options:

**1. Carry forward over-achievement from earlier budgets:** The Act allows for Government to carry forward over-achievement from one carbon budget to the next, so that early action to reduce emissions increases the following budget<sup>133</sup>.

**2. Carry back from later carbon budgets:** The Act allows for the Government to increase the carbon budget in one period with a corresponding tightening of the next carbon budget. This ‘borrowing’ is limited to one per cent of the later carbon budget.

**3. Use international carbon credits:** The Act allows for the purchase of good quality international carbon credits to contribute to meeting carbon budgets but with a limit on the use of these credits set 18 months in advance of the relevant carbon budget.

<sup>130</sup> BEIS (2017) Energy and Emissions Projections 2016 <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016>

<sup>131</sup> BEIS initial estimates of a subset of new early stage policies and proposals show an additional potential reduction of up to 30 Mt and 80 Mt over the fourth and fifth carbon budget periods respectively; these and other policies will be developed building on the proposals outlined in the Strategy.

<sup>132</sup> The Act sets out specific requirements to follow before deciding to use a particular flexibility (such as seeking advice from the Committee on Climate Change before banking) or when creating a framework for a decision to be taken within (such as setting a limit on the amount of carbon units which can be used to meet carbon budgets). Any use of flexibilities needs to be consistent with keeping the UK on track to meet its long term target in 2050 having regard to domestic action.

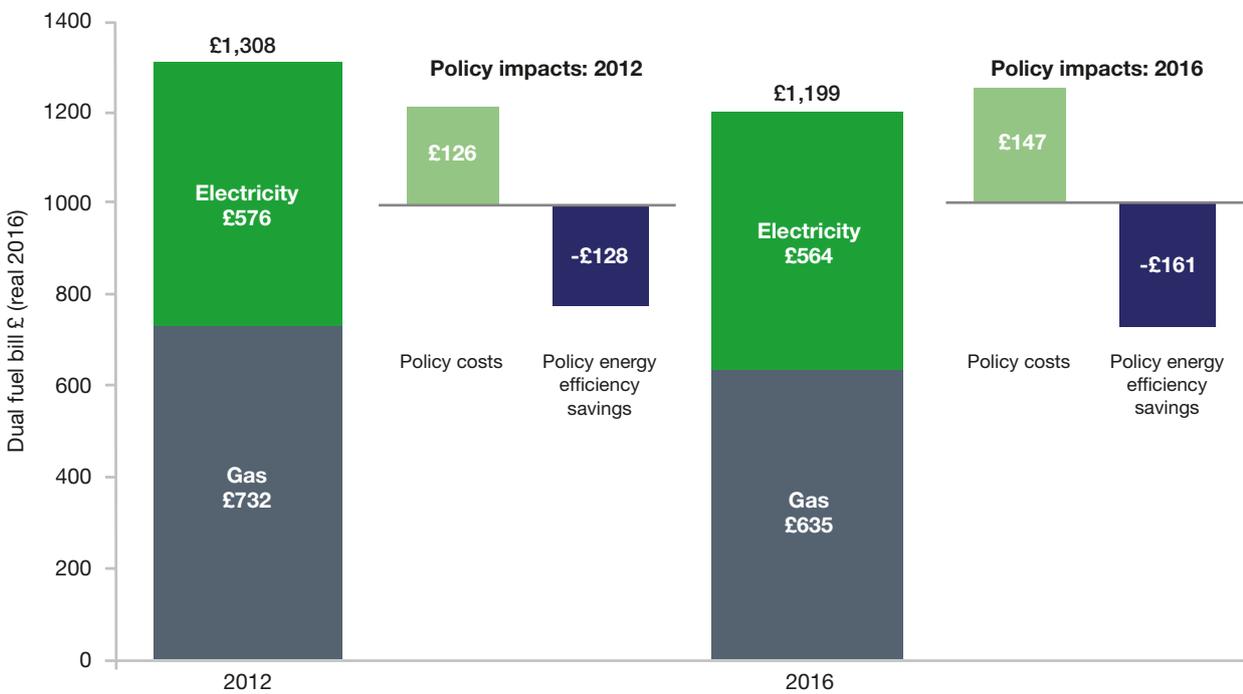
<sup>133</sup> Government will take a decision on whether to bank any surplus from the second to third carbon budget by May 2019 and from the third to the fourth carbon budgets in May 2024. The decision will be made after taking into account advice from the Committee on Climate Change and consulting with the Devolved Administrations.

### Delivering Affordable Energy

Actions taken to tackle emissions have helped to reduce average energy bills for households as efficiency savings have more than offset the cost of financial support provided for developing low carbon technologies. The cost of policies delivering cleaner energy, support for vulnerable

households and investing in upgrading our buildings accounts for around 12 per cent of an average gas and electricity bill. However, these costs are on average more than offset by savings from improvements to the energy efficiency of people’s homes, delivering a saving of £14 on average in 2016 (see figure 11).

**Figure 11: Average annual household dual fuel bill, 2012 and 2016**



Source: BEIS

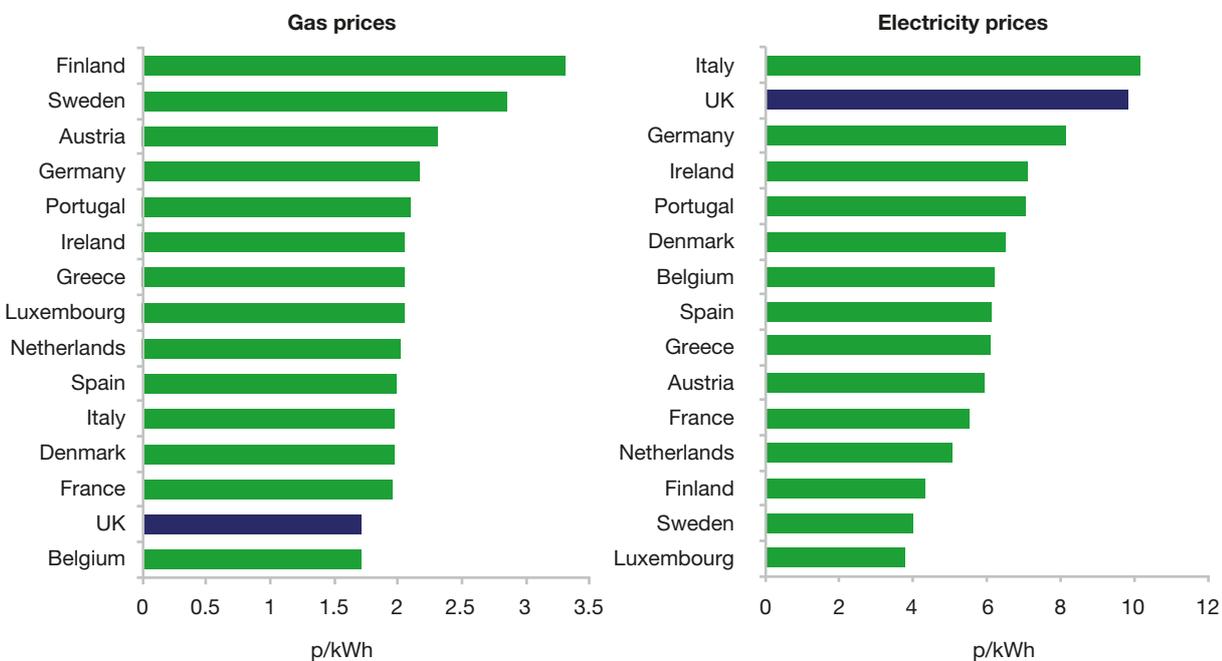
Going forward, our efforts to decarbonise will require increased investment across the energy system. However, our focus on innovation will ensure we minimise the costs of this investment as much as possible and further improvements in energy efficiency will continue to drive down bills. We have already seen the costs of offshore wind projects fall 50 per cent since 2015 and we are now seeing investment in solar without government support. We will also make sure that those least able to pay are protected through our work on fuel poverty, and are publishing a draft bill to require Ofgem to impose a cap on standard variable and default tariffs across the whole market.

On industrial energy, there is more to be done. The UK has some of the lowest gas prices in the EU, including for industry. However, our

electricity prices are less competitive for large industrial users.

Every action to cut emissions must be taken while ensuring our economy remains competitive. As we have set out in our Industrial Strategy Green Paper, we attach great importance to making sure our energy is affordable. The Government has already supported UK businesses to help them with energy costs through various programmes. For instance the Government has taken steps to reduce the cumulative impact of energy and climate change policies on industrial electricity prices for key Energy Intensive Industries (EII) in sectors such as steel, plastics, cement and chemicals. This includes a package of relief for EIIs worth £260 million in 2016 and over £500 million since 2013<sup>134</sup>.

**Figure 12: Industrial electricity and gas prices for large consumers in the EU15 in 2016, including taxes<sup>135</sup>**



Source: BEIS

<sup>134</sup> BEIS analysis. Figure includes compensation for indirect costs from EU Emissions Trading System, Carbon Price Support, Renewables Obligation, and Feed in Tariffs

<sup>135</sup> BEIS (2017) Quarterly Energy Prices <https://www.gov.uk/government/collections/quarterly-energy-prices>. Notes: Large gas consumers are those consuming 27,778 - 277,777 MWh per annum; large electricity consumers are those consuming 20,000 - 69,999 MWh per annum.

But we want to continue to do everything we can to ensure our energy prices are competitive. This is why the Government has commissioned an independent review into the cost of energy led by Professor Dieter Helm CBE which will recommend ways to deliver the Government's carbon targets and ensure security of supply at minimum cost to both industry and domestic consumers. The review will report on the full supply chain of electricity generation, transmission, distribution and supply, and consider the opportunities to reduce costs in each part. It will set out options for a long term roadmap for the power sector. Once Ministers have considered the review's proposals, the Government will incorporate its recommendations into the further development of the Clean Growth Strategy as appropriate.

## Leaving the EU

The British people have voted to leave the European Union and the Government is working to get the best deal for the UK. Leaving the EU offers a unique opportunity to shape our environment and economy for the benefit of all – to have the freedom to make our own decisions on a whole host of matters.

And whatever our future relationship with the EU, the UK's commitment and leadership role in tackling climate change remains undimmed and working closely with the EU on this global challenge will remain important. Leaving the EU will not change any of our statutory commitments to reduce our emissions according to our Climate Change Act – indeed those targets are more ambitious and challenging than those set by EU legislation. There is also no need to change our domestic targets under the Act as a result of leaving the EU, as these targets are rooted in climate science. The UK remains strongly committed to the Paris Agreement and whatever the form of our future partnership with the EU we will satisfy our international obligations under the Agreement.

But there are extremely important current arrangements between the UK and the EU that bring material benefits for all the countries involved and it is critical that we get the detail of our exit negotiations right.

There are four main areas where the UK's current emissions policies rely on EU mechanisms:

- The EU Emissions Trading System (EU ETS) covering the “traded sector” (power, heavy industry and intra EEA aviation) which collectively account for around 40 per cent of UK emissions under carbon budgets. We remain committed to reducing emissions in these sectors and the UK already has a range of domestic policies in place to support this. We will seek to ensure that our future approach is at least as ambitious as the existing scheme and provide a smooth transition for the relevant sectors.
- For sectors not covered by the EU ETS, two sector policies operate at EU rather than UK level and are particularly important for driving emissions reductions – new car and van CO<sub>2</sub> regulations, and EU fluorinated gas quotas. We remain committed to reducing emissions in these areas and will offer certainty to industry as soon as possible on our future relationship with the EU. We will seek to ensure our future approach is at least as ambitious as the current arrangements.
- EU products policy which sets minimum standards for a range of products such as white goods and lighting, which improve energy efficiency. We continue to support these policy measures, which cut energy bills, increase energy security, reduce emissions and help customers make informed choices, and we will keep step with equivalent standards wherever possible and appropriate, or even exceed them where it is in the UK's interest to do so. This may include products not yet covered by European legislation, such as smart appliances.

- Non-energy and climate EU frameworks and policies which affect the UK, such as the Common Agricultural Policy. For instance, we will take the opportunity of leaving the Common Agricultural Policy to address climate change more directly by designing a new system to support the future of farming and the countryside, with a strong focus on delivering better environmental outcomes, including tackling climate change.

Detailed future policies will emerge as we negotiate the exact form of the UK's exit from the EU but while the UK is a member of the European Union, existing rules still apply and we will continue to engage constructively on new and existing EU legislation. Our Clean Growth Strategy therefore uses existing policy as the basis for the UK's emissions projections.

### Carbon Pricing and Emissions Trading

Pricing emissions provides a cost-effective and technology neutral way of reducing carbon emissions and mobilising the private sector and in the UK pricing policies like Carbon Price Support (CPS), and the EU Emissions Trading System (EU ETS) have already helped to drive a switch from coal to gas generation in the power sector.

The UK is a pioneer in developing carbon pricing. In 2002 the UK launched the UK ETS, which served as a pilot for the EU ETS, giving businesses early experience of emissions trading and establishing London as its global centre.

The EU ETS is the largest cap-and-trade system for carbon emissions in the world. Each year, every participant must surrender one allowance for each tonne of carbon dioxide (or equivalent) emitted, and allowances are auctioned or allocated between participants. The cap on allowances is reduced annually in line with the EU's climate ambition.

However, a surplus of allowances in the EU ETS has caused the price to fall and it currently provides little incentive for low carbon investment. As a result the UK introduced CPS in April 2013 which acts as a top up to the EU ETS price in the power sector. The UK also supports measures to strengthen the EU ETS, with notable success in recent negotiations. We will continue to drive for ambitious reform for the next phase of the system.

The Government is considering the UK's future participation in the EU ETS after our exit from the EU and we remain firmly committed to carbon pricing as an emissions reduction tool whilst ensuring energy and trade intensive businesses are appropriately protected from any detrimental impacts on competitiveness.

Specifically in relation to the power sector and CPS, starting in 2021/2022, the Government will target a total carbon price which will give businesses greater clarity on the total price they will pay for each tonne of emissions, and we will set out more detail on carbon prices for the 2020s in the 2017 Autumn Budget.

# Chapter 3:

## Our Clean Growth Strategy



## Our Approach

In the context of the UK's legal requirements under the Climate Change Act, our approach to reducing emissions has two guiding objectives:

1. To meet our domestic commitments at the lowest possible net cost to UK taxpayers, consumers and businesses.
2. To maximise the social and economic benefits for the UK from this transition.

In order to meet these objectives, the UK will need to nurture low carbon technologies, processes and systems that are as cheap as possible. We need to do this for several reasons. First, we need to protect our businesses and households from high energy costs. Second, if we can develop the low cost, low carbon technologies in the UK, we can secure the most industrial and economic advantage from the global transition to a low carbon economy. Third, if we want to see other countries, particularly developing countries, follow our example, we need low carbon technologies to be cheaper and to offer more value than high carbon ones.

We cannot predict every technological breakthrough that will help us meet our targets. Instead, we must create the best possible environment for the private sector to innovate and invest. Our approach will mirror that of our Industrial Strategy: building on the UK's strengths (see Chapter 2 and below on green finance); improving productivity across the UK; and ensuring we are the best place for innovators and new business to start up and grow. We are clear about the need to design competitive markets and smart regulation to

support entrepreneurs and investors who will develop the new technologies at the scale we need. It is only through innovation – nurturing better products, processes and systems – that we will see the cost of clean technologies come down. This Strategy sets out how more than £2.5 billion will be invested by the Government to support low carbon energy innovation from 2015-2021. These actions will help our wider aim of improving the UK's earning power.

In addition to supporting innovation, we are focused on policies that deliver social, environmental and economic benefits beyond the imperative to reduce emissions. Better buildings are healthier places to live and work. Reducing the amount of heat we waste will reduce bills. High ambition on electric cars and other low emission vehicles contains a triple win for the UK in terms of industrial opportunity, cleaner air and lower greenhouse gas emissions. Crucially, many of the actions included here will enhance the UK's energy security.

Alongside these actions, we are laying the groundwork for major decisions in the areas where we face greatest uncertainty and challenge: in how we reduce the emissions that result from heating our homes and businesses; how we decarbonise our transport system; and how we work with industry to make carbon capture, usage and storage (CCUS) a viable future option. This has been shaped by our analysis of plausible pathways out to 2050, reflecting the huge uncertainties. In every section of the Strategy, we also explore the opportunity to shape new commercial opportunities for the UK that can help improve skills and create good jobs.

## Building on the UK's Strengths: Green Finance

Private sector investment in low carbon technology and infrastructure will be key to meeting our carbon budgets and realising the economic opportunities from the low carbon transition. Around £180 billion of investment is already in the pipeline to build the power stations needed in the UK to produce clean and secure supplies of electricity and the networks to deliver this to homes and businesses<sup>136</sup>.

To meet our decarbonisation challenge we will need to mobilise more private capital in sustainable projects and develop more innovative risk sharing financial structures for investment in domestic and commercial low carbon technology. This is a major business and export opportunity for the UK and could cement the UK's position as the leading hub for global low carbon investment.

### UK Leadership in Green Finance

We already demonstrate global leadership on green finance around the world through initiatives like the G20 Green Finance Study Group, which we co-chair; the Green Finance Initiative, a partnership between the financial and professional services sector, academics and civil society, which promotes the UK as a leading global centre for green finance; and through participation in senior global multilateral fora such as the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD), which recently published its final recommendations.

The first offshore green bond issued by an Indian entity and the first green bond issued by a Chinese bank were listed on the London Stock Exchange and 50 green bonds denominated in seven currencies with a value of \$14.8 billion are now listed in the UK<sup>137</sup>.

On 31<sup>st</sup> July 2017, Anglian Water released the first ever public utility Sterling Green Bond on the London Stock Exchange.

Improving the energy performance of homes is vital in decarbonising our economy. Mortgage lenders have a significant financial stake in these properties, their future value, and their customers' ability to make their repayments. This is why the Government supported the LENDERS<sup>138</sup> project with funding from Innovate UK. We want to see the project recommendations implemented, including improving mortgage affordability assessments on energy bills, and lenders to develop a range of innovative new "green mortgage" products to encourage consumers to purchase more efficient homes, or improve their efficiency.

<sup>136</sup> Figure is total for electricity generation, electricity distribution and electricity transmission. Real 2015/16 prices. Gov.uk (2016) National Infrastructure and Construction Pipeline <https://www.gov.uk/government/publications/national-infrastructure-and-construction-pipeline-2016>

<sup>137</sup> London Stock Exchange 2017

<sup>138</sup> UKGBC (2017) Lenders core report <https://www.ukgbc.org/ukgbc-work/lenders-core-report/>

To capture and exploit this opportunity we need to go further. This is why we have set out in this Strategy a series of policies and proposals to develop our expertise in, as well as the opportunity from, new green finance solutions. These include:

- Setting up a Green Finance Taskforce<sup>139</sup>, comprising senior representatives from the finance industry and Government, to develop ambitious policy proposals which could further accelerate private sector investments to deliver our Clean Growth Strategy.
- Endorsing the recommendations put forward by the Financial Stability Board's Task Force on Climate-related Financial Disclosures and encouraging publicly-listed companies to implement these recommendations.
- Working with the British Standards Institution (BSI) to develop a set of voluntary green and sustainable finance management standards to promote responsible investment practices globally. The BSI will have completed the necessary standards scoping exercises and have the first standard in production by the first half of 2018.
- Providing up to £20 million of new investment to support clean technology early stage funding, alongside creating an online platform to showcase UK businesses which have received innovation support from the Government. This will make this information easily accessible for early stage investors to help increase the flow of investment into innovative businesses in the UK.
- Working with mortgage lenders to develop green mortgage products that take account of the lower lending risk associated with more efficient properties and the reduced outgoings for customers living in more efficient homes.

## Ensuring the UK is the Best Place for Low Carbon Innovators

Our Industrial Strategy Green Paper made clear that, for the UK economy to flourish, it must do things other advanced economies cannot do, or do them in better ways. This is the essence of innovation. This is a core part of our approach to decarbonising the UK's economy where investment in innovation will help us to:

- Drive down the cost of key technologies, systems and processes and increase the value they deliver to consumers (such as with batteries and electric vehicles);
- Lay the groundwork for decisions where the right technology choices are currently less clear (such as how we will heat our homes and businesses in the future); and
- Nurture technologies and businesses where the UK is a global leader, leveraging private sector investment and building international partnerships to create export opportunities.

Innovation involves incremental improvements, cross-sector knowledge sharing, and "breakthroughs". It results from competition within the private sector and from collaboration between the private sector and Government, as well as other organisations; each has a role in producing, spreading and adopting novel technologies and approaches. The Government is often more active at earlier stages of innovation, through investment in research, education and skills. Later on, private firms play a bigger role, bringing new technologies to market. However, there is no single, linear route for innovations to progress from concept to commercialisation and often innovation in one area has applications in others.

We want to use the power of Government to support innovation in a low carbon economy using all the tools available to us, including market design, taxation and regulation, as well as investment in our education system, our

<sup>139</sup> The list of members can be found at <https://www.gov.uk/guidance/green-finance>

science base and innovative companies. Our aim is to become one of the best places in the world for low carbon innovation. We understand the need for Government funding that is accessible to private, public and community sector organisations with all playing key roles in supporting and harnessing innovation.

Government funding can be key to stimulating private sector investment from the UK and overseas, both through direct leverage and by creating confidence in the potential to attract follow-on investment for particular innovations. Public investment brings in around 30 per cent additional private funding over the short term, with this increasing in the longer term<sup>140</sup>.

The Government has significantly increased its investment in low carbon innovation. Between 2015 and 2021 we expect to invest more than £2.5 billion in research, development and demonstration of low carbon energy, transport, agriculture and waste. This includes:

- Up to £505 million from BEIS's Energy Innovation Programme<sup>141</sup>, which aims to accelerate the commercialisation of innovative clean energy technologies and processes.

- Up to £1.2 billion of funding from the combination of UK Research Councils and Innovate UK – now being brought into one organisation with the creation of UK Research and Innovation. These investments include funding for the Energy Systems Catapult and the Offshore Renewable Energy Catapult.
- Up to £246 million for the Faraday Challenge, which will ensure the UK builds on its strengths and leads the world in the design, development and manufacture of electric batteries<sup>142</sup>.
- Up to £620 million from a range of Departments, including BEIS, DfT, DfID and Defra and additional Industrial Strategy Challenge Fund (ISCF) support.

In addition to this Government funding, Ofgem is making up to £720 million of regulated expenditure available to gas and electricity network companies in Great Britain, to support smarter, more flexible, efficient, and resilient networks. The Government is also stimulating industry-academia collaboration, for example through the Agri-tech catalyst, which will help improve agricultural productivity and contribute to more environmentally sustainable agricultural systems.

### BEIS Energy Innovation Programme

New projects announced as part of the BEIS Energy Innovation Programme in the Clean Growth Strategy include:

- Up to £10 million for innovations that provide low carbon heat in domestic and commercial buildings
- Up to £10 million for innovations that improve the energy efficiency of existing buildings
- An extra £14 million for the Energy Entrepreneurs Fund, including a new sixth fund
- Up to £20 million in a carbon capture and utilisation demonstration programme
- Up to £20 million to demonstrate the viability of switching to low carbon fuels for industry
- Up to £7 million to develop further the capability of nuclear regulators who support and assess advanced nuclear technologies
- Up to £20 million to support clean technology early stage funding

<sup>140</sup> BIS (2014) Analysis Paper 04 Estimating the effect of UK direct public support for innovation <https://www.gov.uk/government/publications/innovation-effect-of-public-support>

<sup>141</sup> The £505 million BEIS Energy Innovation Programme will invest around £70 million in smart systems, around £90 million in the built environment (energy efficiency and heating), £100 million in industrial decarbonisation and carbon capture, usage and storage (CCUS), around £180 million in nuclear innovation, around £15 million in renewables innovation, and around £50 million in support for energy entrepreneurs and green financing.

<sup>142</sup> BEIS press release (2017) <https://www.gov.uk/government/news/business-secretary-to-establish-uk-as-world-leader-in-battery-technology-as-part-of-modern-industrial-strategy>

Last November, the Prime Minister announced £4.7 billion of additional research and development funding<sup>143</sup> – a bigger increase than in any Parliament since 1979. This funding aims to kick start the development of disruptive technologies, including low carbon technologies, that have the potential to transform the UK economy<sup>144</sup>. It includes the Faraday Challenge and £93 million for Robotics and Autonomous Systems, and we are exploring the scope to fund further clean growth innovation challenges.

Internationally, governments around the world are investing around \$15 billion a year in low carbon innovation, and this figure is set to rise significantly<sup>145</sup>. A key component of our innovation strategy is identifying opportunities for global partnership. In particular, the UK is committed to clean energy innovation as a member of ‘Mission Innovation’. This initiative

aims to reinvigorate and accelerate global clean energy innovation and to make clean energy widely affordable. As part of our commitment within Mission Innovation, the UK will invest at least £100 million in 2020-21 on projects that will help to address the clean energy needs of developing countries<sup>146</sup>.

How we spend money is just as important as how much we spend. To ensure a strategic approach, a new Energy Innovation Board was launched in 2016<sup>147</sup>, to bring together senior representatives from across the Government, Innovate UK, Research Councils, and Ofgem, to align public investments in low carbon innovation. The Board aims to co-ordinate the UK’s domestic and international clean energy and low carbon innovation activities to maximise their impact, and to ensure that those investments leverage increased private sector investment.

### Energy Entrepreneurs Fund

The Government is also launching a sixth round of the Energy Entrepreneurs Fund, which has been running since 2012, and aims to support, through capital grants, the development and demonstration of innovative energy technologies and processes, with a particular focus on assisting small and medium sized enterprises. This sixth round will offer up to £10 million in funding. Alongside this, a further £4 million has been offered to companies who applied for the fifth funding round, bringing the total to £14 million across the projects supported<sup>148</sup>.

Over phases one to five of the Energy Entrepreneurs Fund, we have invested £47.2

million in 102 companies, which leveraged a further £35 million from the private sector. For those companies that have completed their projects, over £63 million in follow-on private investment has been secured.

For instance Vantage Power in West London retrofit buses to a low carbon standard. This is done at a fraction of the cost of purchasing new hybrid buses, and means that operators can reduce their fuel consumption and emissions. Vantage Power were beneficiaries of the Energy Entrepreneurs Fund, and the buses they have retrofitted have reported up to 40 per cent lower fuel consumption and 92 per cent lower emissions of nitrogen oxides.

<sup>143</sup> HM Treasury (2016) Autumn Statement 2016: <https://www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016> Section 4.1

<sup>144</sup> BEIS press release (2017) <https://www.gov.uk/government/news/business-secretary-announces-industrial-strategy-challenge-fund-investments> Investment subject to business case approval.

<sup>145</sup> Mission Innovation website, Baseline and Doubling Plans: <http://tinyurl.com/mkgyvix>

<sup>146</sup> DECC press release (2015) UK joins international clean energy initiative: <https://www.gov.uk/government/news/uk-joins-new-international-clean-energy-initiative>

<sup>147</sup> Further information on the Energy Innovation Board available here: <https://www.gov.uk/government/groups/energy-innovation-board>

<sup>148</sup> The Energy Entrepreneurs Fund is funded through the £505 million BEIS Energy Innovation Programme

**Table 3: Government investments in clean growth technology 2015-2021<sup>149</sup>**

	Forecast Clean Technology Innovation Spend £ million (across Innovate UK, Research Councils, BEIS, DfT, DfID, Defra)			
	Basic & Applied Research	Technology Development	Technology Demonstration	Total
Innovation in Smart Systems (including energy storage)	175	43	47	265
Innovation in the Power Sector (including renewables)	209	276	154	638
Innovation in Homes (including heat and energy efficiency)	100	31	53	184
Innovation in the Transport Sector (including electric vehicles and batteries)	296	413	132	841
Innovation for Business and Industry, including carbon capture, usage and storage (CCUS)	57	47	58	162
Innovation in Natural Resources	69	30	0	99
Cross-sector Clean Tech Innovation (including for entrepreneurs)	234	62	91	387
<b>Total (£ million)</b>	<b>1,140</b>	<b>902</b>	<b>534</b>	<b>2,576</b>

NB All figures are indicative and are subject to competitive bidding processes across sectors and value for money tests.

<sup>149</sup> Final spending commitments are subject to competitive bidding processes across sectors and value for money tests. Excludes £720 million of regulated expenditure being made available by Ofgem to support innovation in gas and electricity networks.

## Clean Growth Innovation Challenges

To get the clean growth we want, we need breakthroughs in clean technologies. Government funding and innovations in universities are crucial, but such breakthroughs also need the creativity and energy of the private sector. We have identified the key challenges we believe need to be overcome if we are to meet future carbon budgets:

### Hydrogen and bioenergy

Clean fuels such as hydrogen and bioenergy could be used for transport, industry, and to heat our homes and businesses. We need to test how they work in the existing gas network, whether they can fire industrial processes, and how they could be used in domestic appliances. These options need to work as well and as cheaply as current technologies.

### Homes

We need energy efficiency and heat technologies that are less costly and easier to install, and commercial innovation to ensure retrofits are attractive for homeowners. To build lower cost, lower carbon homes, we need to use innovative construction methods including factory production and off-site manufacturing.

### Batteries

To rapidly decarbonise transport, including rail and EVs, we need innovation in batteries: to extend their range and lifetime, bring down their cost, and ensure they can be disposed of sustainably. New methods for charging are needed to make electric vehicles easier to use, including super-fast charge points, wireless charging and dynamic charging.

### Smart energy system

Clean technologies such as electric vehicles, batteries, fuel cells and renewable energy are all falling in cost. We need to ensure

these technologies can integrate smoothly in the energy system, including finding local solutions, so that consumers benefit from lower energy and transport costs.

### Power

We need to bring down the costs of nuclear power through developing new materials and manufacturing processes, and exploring the opportunities of new fuels and reactor designs. To further reduce the cost of offshore wind, we need to deliver larger turbines, extend existing asset life, optimise performance and reduce operational maintenance.

### Industry

We need to find alternatives to industrial fuels which are energy intensive to produce, without increasing cost or reducing performance. The cost of CCUS technologies will need to fall.

### Waste

We need to minimise the impacts of anaerobic digestion, particularly in relation to air quality. This includes developing improved digestion and ammonia and phosphate extraction technologies and reducing methane emissions. Innovative techniques are also needed to reduce the impact of landfills at the end of their use.

### Land use

To support greater productivity of agricultural land, we need to: increase carbon storage through fertilising crops more effectively, develop new animal and plant breeding technologies, use precision farming technologies on smaller scale farms, and develop robotics and new sensor technologies. We also need to reduce plant and tree disease and investigate methods to improve soil health and carbon stocks.

## Getting to 2032

We cannot predict the exact technological changes that will help us deliver on the fourth and fifth carbon budgets (and beyond). Some technologies will develop faster than expected, making it easier to reduce emissions in particular sectors. Some technologies may develop less quickly than we hope.

To explore this uncertainty, we test different potential versions of the future based on current knowledge. These are not firm predictions of the future and should not be taken as sectoral targets. However, they allow us to identify areas where progress is most needed to meet our future carbon budgets, especially the fifth carbon budget, and where action now is unlikely to be wasted. The policies and proposals set out in this Strategy reflect that understanding.

Our Clean Growth Strategy sets out in detail a possible pathway for meeting the fifth carbon budget through domestic action, including many of the policies and proposals set out here. The route we ultimately take to meeting our targets will depend on a range of factors, in particular ensuring we are mindful of any impact on energy costs for households and businesses, and changes in costs as a result of innovation.

The approach could involve<sup>150</sup>:

- Emissions from business and the public sector falling by 30 per cent on today's levels, through significant improvements in energy efficiency, reducing energy use per unit of output as well as reducing the carbon content of industrial energy use by at least 14 per cent through switching to cleaner fuels. Our proposals will contribute to this, for example improving business energy efficiency and standards for commercial buildings, and agreeing tighter targets to reduce central government emissions.
- Emissions from homes falling by 19 per cent from today, with household energy use falling nine per cent, through a combination of switching low-carbon heating and greater energy efficiency which in turn will help to reduce bills. We will also need to bring down the cost of low carbon alternatives to the gas boiler. This is supported by the proposals set out in this Strategy, including investments in upgrading homes and proposals to improve energy performance standards across the housing sector.
- Emissions from transport falling by 29 per cent from today, largely achieved by accelerating the shift to electric and other low emission vehicles. This transition could involve reducing the energy and emissions intensity of road transport<sup>151</sup> by 30 per cent and 44 per cent respectively. Our proposals, such as those to encourage uptake of ULEVs, will contribute to this.
- Emissions from power falling by 80 per cent on today's levels, by increasing the share of clean electricity generation to over 80 per cent of demand and moving to a smarter, more flexible system and reducing demand by improving the efficiency of appliances. The proposals set out in this Strategy, for example providing further funding for Contract for Difference auctions for renewable technologies, will help to deliver this.
- Emissions from land use and agriculture falling by 26 per cent on today's levels. This could mean that woodland cover increases by up to 16 per cent and the emissions intensity of agricultural outputs could improve by 27 per cent. Emissions from waste and F-gases fall to around 14 Mt by 2032, 53 per cent lower than today. This could mean that the amount of biodegradable waste sent to landfill in 2032 is around 45 per cent lower than that seen in 2015. This is supported by the proposals in this Strategy, such as those to reduce emissions from waste and to establish a new network of forests.

<sup>150</sup> Total sector emissions reductions are compared against estimated 2017 levels. Supplementary metrics, where relevant, compared the 2032 pathway with 2015 official statistics. See Table 4 in Annex D, and Table 6 in the Technical Annex for details.

<sup>151</sup> Covering cars, van and freight

## BBOXX

BBOXX was formed by students at Imperial College London in 2010. In addition to \$2 million in private funding, since 2013 BBOXX received £1.2 million, including from the EPSRC and DfID, to tackle the challenges and opportunities arising from unreliable electrical supplies in rural Africa. By providing households with off-grid electric lighting, children can do their homework and families can run a business without incurring threats to their health from paraffin smoke. Since 2006, BBOXX has created a sustainable non-subsidised business model. Rapidly expanding from three founders to a global staff of 140, BBOXX products have already saved energy worth over \$2 million and offset over 40,000 tonnes of CO<sub>2</sub>. BBOXX aims to provide up to 20 million people with electricity by 2020.



Innovation can deliver dramatic results, as we have seen with the rapid falls in the costs of some clean technologies over the past ten years, and this Strategy sets out ambitious proposals on funding innovation to further reduce costs. We take a cautious approach towards quantifying the contribution of current and future innovation to emissions savings. As we cannot say precisely how our investments today will impact on the UK's emissions in the future, we have omitted any estimates from this analysis.

We estimate the combination of existing policies and new measures in this Strategy that can be quantified could deliver 93 per cent of the required level of emissions savings for the fifth carbon budget, against our 1990 baseline. As well as setting out policies within this Strategy, we identify areas where we will need to drive further progress through future consultations, innovation spend and policy design. This is set out in more detail at Annex A.

## Beyond the Fifth Carbon Budget, Towards 2050

There is even greater uncertainty about which technologies will help us reduce emissions by at least 80 per cent by 2050<sup>152</sup>. It is even more challenging to predict what the UK economy will look like in 2050 than in 2032. However, exploring the plausible potential pathways to 2050 helps us to identify low-regrets steps we can take in the next few years common to many versions of the future, as well as key technologies and uncertainties. To demonstrate this, we present three illustrative long-term pathways in this Strategy:

<sup>152</sup> On a 1990 baseline.

- **Electricity pathway:** Under this pathway, electricity is the main source of energy in 2050. There are many more electric vehicles (EVs), we replace our gas boilers with electric heating and industry moves to cleaner fuels. Altogether this means we use around 80 per cent more electricity than today, and virtually all of it comes from clean sources (renewables and nuclear). In this pathway, CCUS is not used in the UK by 2050.
- **Hydrogen pathway:** Under this pathway, we use hydrogen to heat our homes and buildings, as well as to fuel many of the vehicles we drive in 2050 and power the UK's industry. We adapt existing gas infrastructure to deliver hydrogen for heating and a national network of hydrogen fuelling stations supports the use of hydrogen vehicles. A large new industry supports hydrogen production using natural gas and capturing the emissions with CCUS.
- **Emissions removal pathway:** Under this pathway, sustainable biomass power stations are used in tandem with CCUS technology. Carbon is removed from the atmosphere by plants (biomass) as they grow and, when the biomass is used to generate electricity, emissions are captured and stored instead of returning to the atmosphere. There is still a significant clean transition in other sectors but successful innovation in emissions removal allows more time for some of these changes.

These illustrative pathways should not be seen as predictions, as we are continuing to build our understanding of the best approach. The ultimate way forward might in fact be some combination of these, or another approach

that builds on further innovation. This approach will also be consistent with Government's commitments on clean air out to 2050.

The purpose of these illustrations is to demonstrate a range of practical ways in which emission reduction aims can be delivered with technology known today, and to underline some of the steps common to all. These include:

- making our homes and commercial buildings more energy efficient;
- shifting to low carbon sources of heating, such as through more district heating;
- continuing to decarbonise electricity;
- ensuring our electricity system is smart and flexible to respond to changes in demand and decarbonise at least cost;
- increasing the number of ultra low emission vehicles in the UK; and
- working with industry on how to improve efficiency and transition to clean fuels.

### Greenhouse Gas Removal Technologies

As the UK approaches 2050, its remaining emissions will likely be in the sectors where it is the most difficult to cut them – in industry, agriculture, aviation and shipping. Under the Paris Agreement, as well as seeking to limit warming to well below 2 degrees, and to pursue 1.5 degrees, the UK is committed to working with other countries to achieve global net zero emissions in the second half of the century<sup>153</sup>. This will require a step change in action to tackle climate change and has strong links to how the Sustainable Development Goals will be achieved.

<sup>153</sup> This means that global GHG emissions will not be greater than the amount of GHGs which are absorbed through natural processes or technology.

As highlighted by the Committee on Climate Change<sup>154</sup>, greenhouse gas removal (GGR) technologies are likely to have an important role to play in offsetting difficult-to-cut emissions, by removing greenhouse gases from the air. As we learn more about how GGRs could be developed and deployed, we want the UK's entrepreneurs, universities and engineering industries to be well placed to exploit the advantages of global demand for these new technologies.

There is a diverse set of GGR technologies with varying potential scale and at varying stages of development. These include afforestation, bio-energy with carbon capture and storage (BECCS), direct air capture (capturing carbon dioxide from the air and storing it), enhanced weathering (crushing suitable rocks that react with carbon dioxide and spreading over land), and methods for storing carbon in the oceans, such as ocean liming.

We are therefore taking active steps to strengthen our understanding of these technologies and, where appropriate, move forward with deployment. The Government's strategic approach to GGR has two main elements:

- A Government programme of research and development**, which aims to improve our understanding of GGR technologies, to help overcome the uncertainties around their costs, deployment potential, and impacts on the environment. We have been working with the Research Councils, who launched a new £8.6 million research programme looking at all GGR technologies in April 2017. We will also develop robust estimates of sustainable biomass resource available to the UK, reporting during 2018, and consider Royal Society scientific views on GGR.
- The Government will consider the scope for removing barriers and strengthening incentives to support the deployment of GGR**, to position the UK at the leading edge of GGR development. This includes, for example, considering options for developing a carbon offset market and exploring how UK timber could be used in construction. We are also considering how best to take forward CCUS, as set out in 'Improving Business and Industry Efficiency and Supporting Clean Growth'. We will conduct a study on how GGR activity can be incentivised, in the UK and in other countries, which will help us develop policy and accounting frameworks fit for the future. And we will also consider how legal, financial and regulatory frameworks could support the rollout of GGR technologies at scale.

We will develop our strategic approach for GGR technologies, including consideration of whether to reprioritise existing innovation spend, in light of these pieces of work.

### Global Net Zero Emissions

As well as seeking to limit warming to well below 2 degrees, and to pursue 1.5 degrees, the Paris Agreement includes an aim of achieving net zero global greenhouse gas emissions in the second half of the century. Our obligations under the Climate Change Act only take us to 2050, and the Government agrees with the Committee on Climate Change that now is not the right time to set a post-2050 net zero goal. We need to understand more about the global path to net zero emissions, and believe that our focus should be on meeting our existing targets. However, the Government believes the UK will need to legislate for a net zero emissions target at an appropriate point in the future, to provide legal certainty on where the UK is heading.

<sup>154</sup> Committee on Climate Change (2016) UK climate action following the Paris agreement: <https://www.theccc.org.uk/publication/uk-action-following-paris/>

### Measuring the Delivery of the Clean Growth Strategy

This Strategy sets out a comprehensive set of policies and proposals that will allow us to accelerate the pace of clean growth. We want to continue the UK’s strong economic growth while achieving that growth in a way that sees emissions fall. Between 1990 and 2016 emissions fell by 42 per cent whilst GDP grew by 67 per cent which meant that the “emissions intensity” of our economy – the

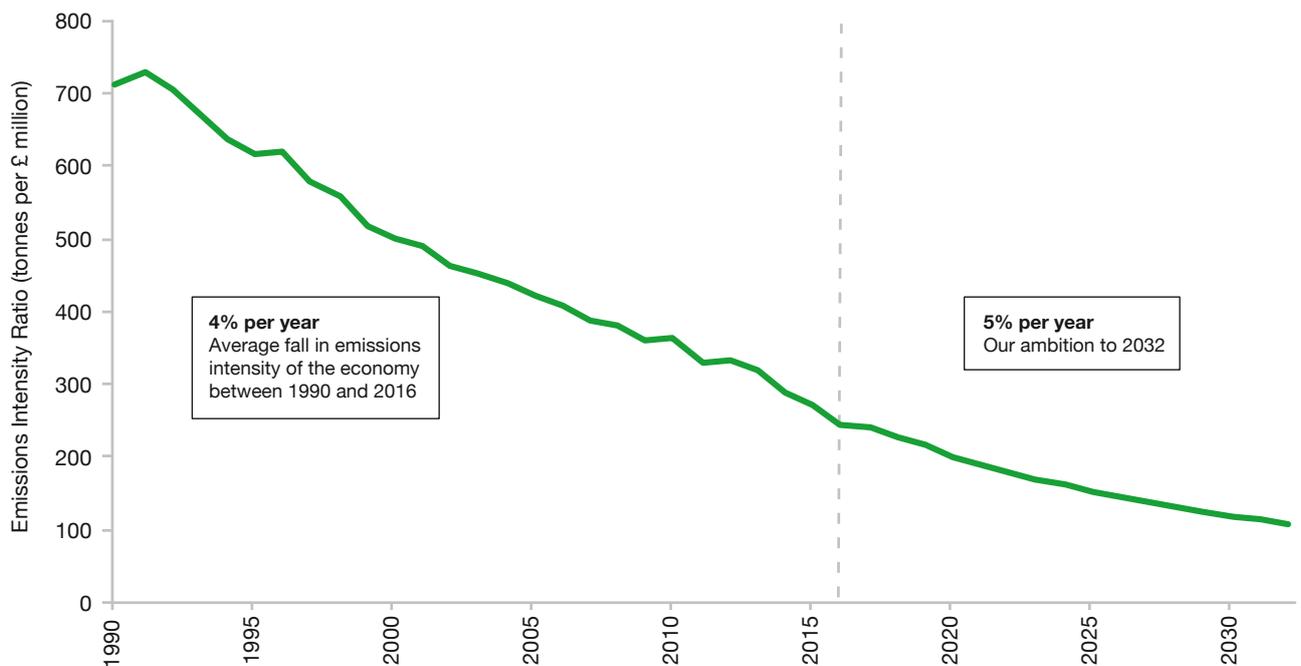
amount of carbon emitted for each pound of national income generated - fell by four per cent per year on average. We want to build on this success and accelerate clean growth. To reach our targets, the emissions intensity will have to fall by an average five per cent per year to 2032. We will therefore introduce a new measure of progress, the Emissions Intensity Ratio (see below) and publish our performance against this intensity ratio on an annual basis.

### The Emissions Intensity Ratio (EIR)

This will measure the amount of greenhouse gases (tonnes of carbon dioxide equivalent) produced for each unit of Gross Domestic Product (GDP) created. Currently the EIR is

270 tonnes/£ million and it was 720 tonnes/£ million in 1990. By 2032, we expect the EIR will need to be nearly as low as 100 tonnes/£ million to meet our ambitions.

**Figure 13: Historic and projected Emissions Intensity Ratio (EIR)**



Source: BEIS

## Government Leadership

To maintain cross-Government progress on clean growth, we will reinstate a regular Clean Growth Inter-Ministerial Group, which will be responsible for monitoring the implementation of this Strategy and driving ambitious clean growth policies.

The Government cannot achieve the changes needed to our economy by itself. Outside action on public sector emissions, the Government's key role is to set the framework for action across the economy. Beyond that, clean growth has to be a shared endeavour between Government, business, civil society and the British people.

Creating this supportive environment will help attract the domestic and international investment the UK wants. Therefore, from 2018, we will work with private partners and NGOs to introduce a **Green Great Britain Week**, to engage as many people as possible in the importance of tackling climate change and improving air quality. A week of high profile activity, this will be an opportunity to both celebrate UK leadership on climate change and look ahead to explore how we can continue to drive ambitious action in the future. This annual event will be an important moment to bring together all parts of society, from business through to the general public, to better understand the different ways the UK can further harness clean growth to boost economic performance, reduce emissions and create a cleaner environment.

### Green Great Britain Week

An annual event to:

- Focus on climate and air quality issues across the UK, demonstrating how all parts of the country and sectors of the economy are working towards a cleaner future.
- Demonstrate our progress and successes by showcasing how taking action on climate change and air quality can provide opportunities for UK businesses and citizens.
- Share the latest climate science, providing a platform for the latest research on the impacts of climate change and the importance of taking ambitious action.
- Promote UK leadership on tackling climate change and air quality across our economy, and how we are driving forward innovation to create economic opportunities from reducing emissions, especially to international investors.

# Chapter 4: Sectors



# Improving Business and Industry Efficiency and Supporting Clean Growth



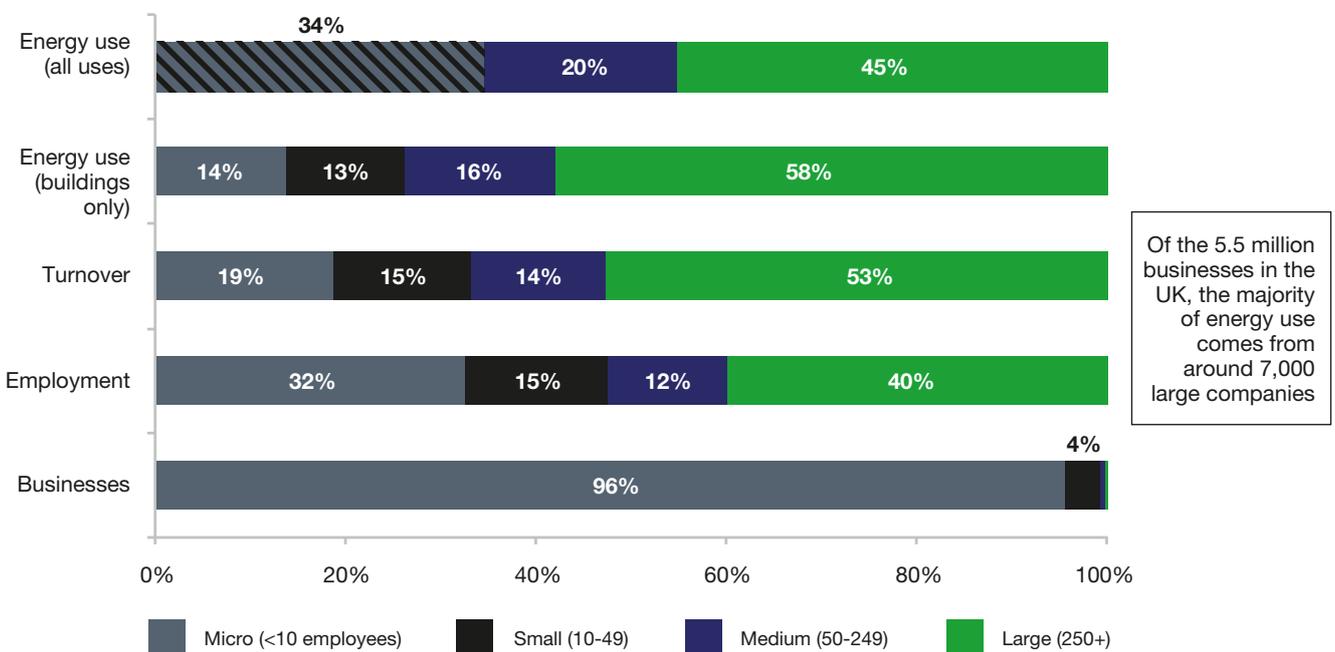
## Progress

Since 1990, emissions from business and industry have almost halved, mainly due to efficiency gains and a shift in manufacturing to cleaner fuels, as well as changes to the industrial structure of the UK economy. Much of this reduction has taken place in the most energy intensive industries. For instance, each tonne

of steel produced in the UK requires 40 per cent less energy to produce than 40 years ago<sup>155</sup>.

In addition, we have also improved the energy efficiency of non-domestic buildings since 1990 with emissions 18 per cent lower in 2015<sup>156</sup>. The number of properties registering as having the lowest Energy Performance Certificates (EPC Bands F and G) has dropped from 19 per cent to 13 per cent between 2010 and 2016<sup>157</sup>.

**Figure 14: Distribution of energy use, turnover, and employment by business size (2016)<sup>158</sup>**



Of the 5.5 million businesses in the UK, the majority of energy use comes from around 7,000 large companies

Source: Derived from Business population estimates, Non-Domestic National Energy Efficiency Data-Framework and Business Energy Efficiency Survey

<sup>155</sup> WSP and Parsons Brinckerhoff & DNV GL (2015) Report prepared for DECC & BIS: Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050 <https://www.gov.uk/government/publications/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050>

<sup>156</sup> BEIS (2017) Final UK greenhouse gas emissions national statistics: 1990-2015 <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>157</sup> DCLG (2017) Live tables on Energy Performance of Buildings Certificates <https://www.gov.uk/government/statistical-data-sets/live-tables-on-energy-performance-of-buildings-certificates>

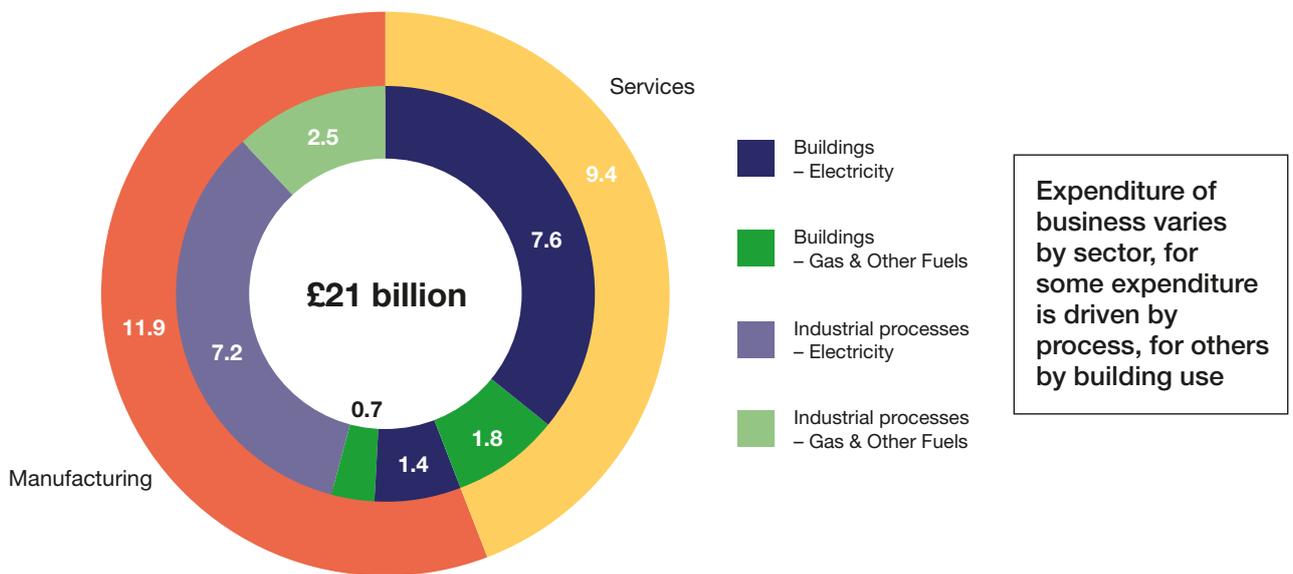
<sup>158</sup> BEIS (2016) Business population estimates 2016 <https://www.gov.uk/government/statistics/business-population-estimates-2016>; BEIS (2014) Non-domestic National Energy Efficiency Data-Framework (ND-NEED) <https://www.gov.uk/government/statistics/non-domestic-national-energy-efficiency-data-framework-energy-statistics-2006-12>

Overall, business and industry now account for approximately 25 per cent of the UK’s emissions (excluding fluorinated gases or F-gases)<sup>159</sup>, with around two thirds of industrial emissions coming from a small number of energy intensive sectors (for example chemicals, iron and steel)<sup>160</sup>. Businesses and industry are also major users of electricity, accounting for over 50 per cent of electricity use<sup>161</sup>.

We now have a much greater understanding of the potential for cost-effective energy efficiency in the commercial and industrial sector. Our analysis says that up to £6 billion<sup>162</sup> could be saved in 2030 through investment in

cost-effective energy efficiency technologies. Roughly half of these savings are available through improving the efficiency of buildings and processes, including by fitting better insulation and smarter energy controls. The other half can be realised through eliminating electricity waste in business for example using better lighting and energy management systems. This is consistent with research from EEF, the manufacturers’ trade association, which found that a 14 per cent reduction in electricity consumption could be made across the manufacturing sector, equivalent to over £1 billion a year in savings<sup>163</sup>.

**Figure 15: 2015 final energy expenditure<sup>164</sup> on energy by end use and fuel, £ billion, 2016 prices.**



**Expenditure of business varies by sector, for some expenditure is driven by process, for others by building use**

Source: Energy Consumption in the UK & Building Energy Efficiency Survey

<sup>159</sup> BEIS (2017) Final UK greenhouse gas emissions national statistics: 1990-2015 <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>160</sup> BEIS (2017) Final UK greenhouse gas emissions national statistics: 1990-2015 <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>161</sup> BEIS (2017) Digest of UK Energy Statistics 2017 <https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes>

<sup>162</sup> Total energy efficiency potential across business and Industry

<sup>163</sup> EEF (2016) Upgrading Power: Delivering a flexible electricity system <https://www.eef.org.uk/resources-and-knowledge/research-and-intelligence/industry-reports/upgrading-power-report>

<sup>164</sup> Excluding expenditure on energy used for raw material extraction or transformation to other fuels (e.g. oil extraction and refining) and excluding energy used for transportation

## CRESS Systems

CRESS Systems, based in Darlington, have developed a flywheel to reduce the energy required to drive cranes at shipping ports. They received Energy Entrepreneurs Fund grants of £800,000 to build and test the first system at the Port of Felixstowe. Since then, they have secured investment from Enterprise Ventures' Northern Powerhouse Investment Fund and private investors to finalise the product and make first sales into the port market world-wide.



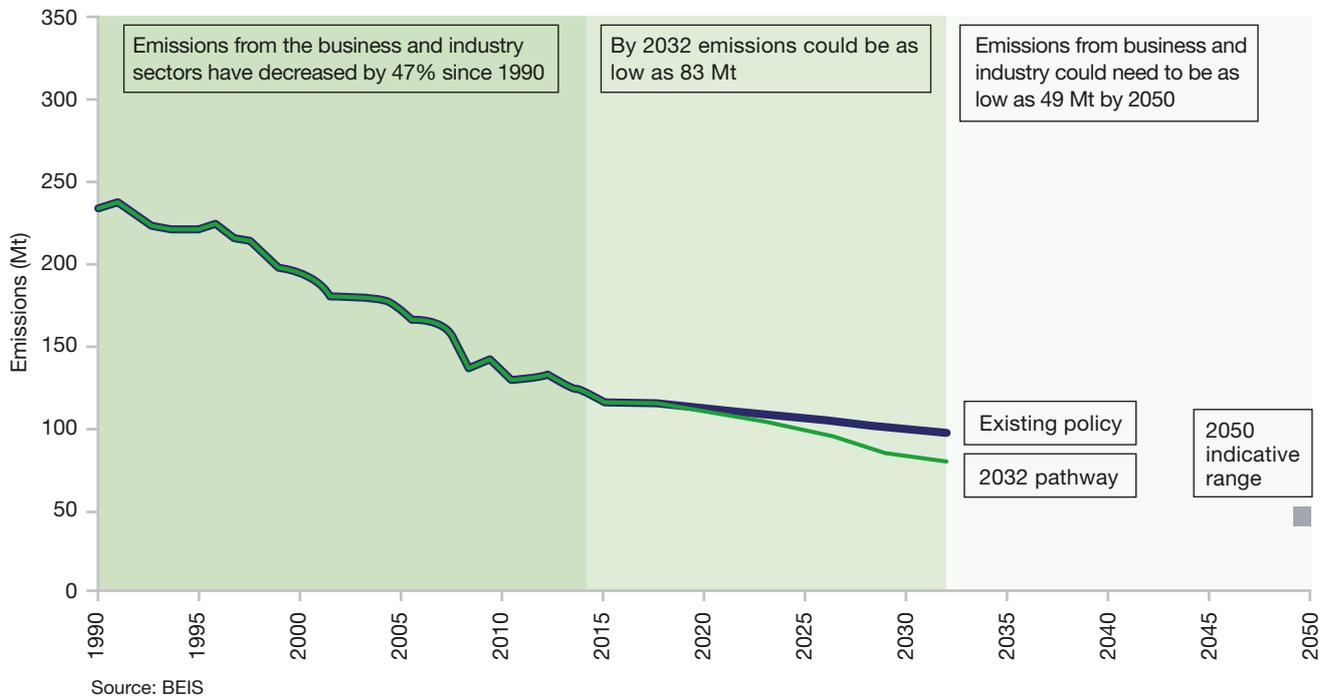
## Ambition

The Government is determined to help businesses improve their productivity and competitiveness as part of our Industrial Strategy. This includes working together to unlock any potential energy savings to help keep bills as low as possible.

Our goal is to enable businesses and industry to improve energy efficiency by at least 20 per

cent by 2030. This will contribute to overall economic growth by reducing the amount of energy required per unit of output. We will take a final decision on the level of this goal and how best to measure progress toward it in 2018, taking into account the recommendations of the independent review into the cost of energy, led by Professor Dieter Helm CBE.

**Figure 16: Actual and projected emissions in business and industry, taking into account the clean growth pathway, 1990-2050**

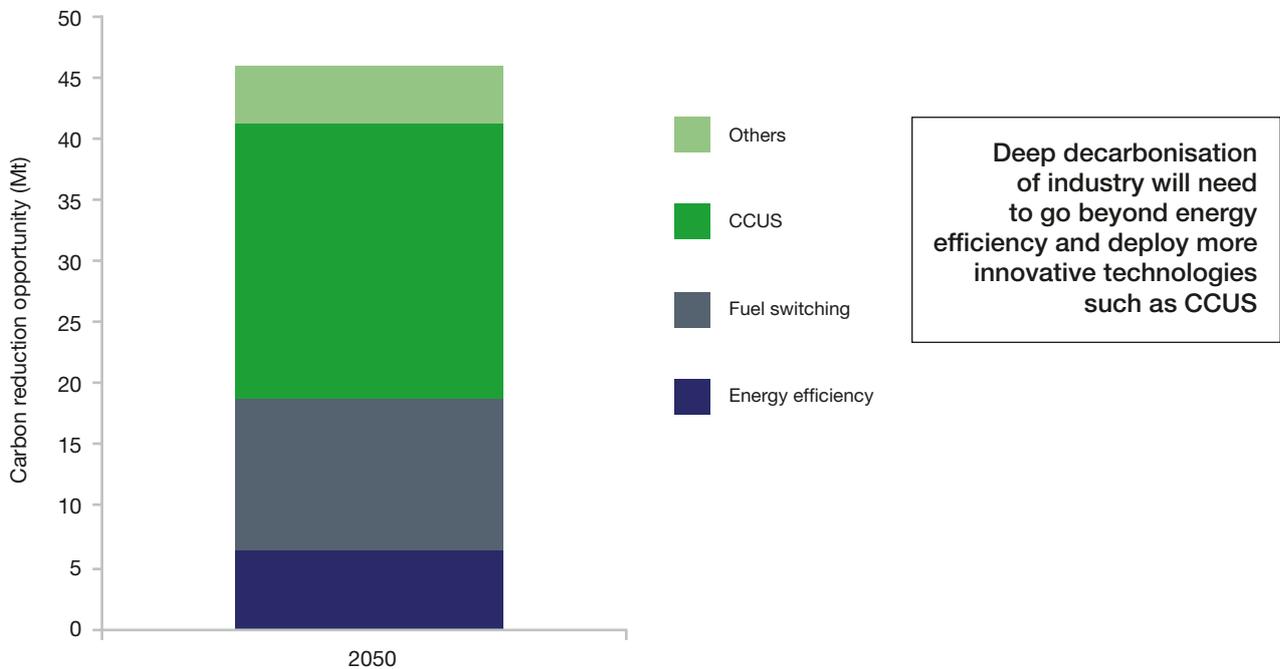


The Government will put in place a simpler, more ambitious and long-term policy and regulatory framework. This will:

- Make it easier for businesses to identify where they can save energy by simplifying the energy and carbon reporting framework.
- Ensure that those who lease premises to businesses, including in the service sector, continue to refurbish and improve the performance of their buildings. In parallel, all new commercial and industrial buildings should be more energy efficient.
- Help to understand how we can encourage greater investment in energy efficiency measures and technologies, including establishing an Industrial Energy Efficiency scheme to help large companies install measures to cut their energy use, and working with the financial sector to identify how such measures can be taken forward.

Energy intensive industries will require steps beyond energy efficiency. Out to 2030, this will require industry to make progress in switching from fossil fuel use to low carbon fuels such as sustainable biomass, in line with broader Government priorities on delivering clean air, and clean electricity. Beyond 2030, this switching will need to substantially increase in scale and be coupled with the deployment of new technologies, for example carbon capture, usage and storage (CCUS). Over the course of this Parliament, we will therefore also develop a framework to support the decarbonisation of heavy industry. Overall, one possible pathway to 2032 could involve emissions from business and industry falling by around 30 per cent on today's levels to as low as 83 Mt by 2032.

**Figure 17: Carbon reduction opportunities across industry (2050)<sup>165</sup>**



Source: 2050 Roadmaps Cross-Sector Summary report (2015). This illustrates the technical potential for emissions savings in the report's 'MAX TECH' pathway.

### Opportunities

The UK energy efficiency sector already turns over £20.3 billion, employs 144,000 people and sells exports worth over £1 billion<sup>166</sup>. We know the potential for further energy efficiency in businesses and industry is significant - up to £6 billion could be saved by 2030 through investment in cost-effective energy efficiency technologies in buildings and industrial processes. As well as reducing bills across

the UK, building the energy efficiency market would place UK businesses and industry in a prime position to further increase the export of knowledge, skills and products to other countries. It would also involve greater flows of external finance, a sector where the UK is already a market leader. For example, the UK energy services market is estimated to have a potential annual size of €1 billion per year and would require significantly more third party finance than we see currently<sup>167</sup>.

<sup>165</sup> BIS, DECC (2017) Industrial Decarbonisation and Energy Efficiency Roadmaps to 2050 <https://www.gov.uk/government/publications/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050> 'Fuel switching' includes a small amount of bioenergy used for feedstock

<sup>166</sup> ONS (2017) Low Carbon and Renewable Energy Economy Survey, final estimates: 2015 <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2015results>

<sup>167</sup> EC (2014) The European ESCO Market Report 2013 <https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/european-esco-market-report-2013>

## Policies and Proposals

### Unlocking Business Energy Efficiency

1. The Government will develop a package of measures to support businesses to improve how productively they use energy and will consult on this in 2018, with the aim of improving energy efficiency by at least 20 per cent by 2030.
2. The Government will ensure incentives for investment in energy efficiency are regularly reviewed, for instance the list of products that qualify for enhanced capital allowances tax relief.
3. We will continue with plans to close the CRC Energy Efficiency Scheme following the 2018-19 compliance year. We will drive energy efficiency by implementing the previously announced increase to the main rates of the Climate Change Levy from 2019.
4. We will undertake an evaluation of the Climate Change Agreements to inform any successor scheme from 2023.
5. The Government will build on existing schemes such as the Energy Savings Opportunity Scheme (ESOS), undertaking a comprehensive assessment of its effectiveness and consider any future reforms.
6. The Government will work with stakeholders to improve the market for energy services, building confidence across commercial and industrial customers.
7. Alongside this Strategy, we are consulting on a new and streamlined energy and carbon reporting framework to replace some existing schemes, such as the reporting element of the CRC Energy Efficiency Scheme, and align with mandatory annual greenhouse gas reporting by UK quoted companies. This will improve the way in which businesses report their energy use, and provide businesses with the information needed to identify how they can reduce energy bills.
8. The Government will establish an Industrial Energy Efficiency scheme to help large companies install measures to cut their energy use and their bills.
9. We are consulting on the design of a new industrial heat recovery programme. This £18 million fund will encourage investment by manufacturers to recover and reuse heat from industrial processes that would otherwise be wasted.
10. The Government will explore with stakeholders how we can improve the provision of information and advice to SMEs to encourage the uptake of energy efficiency technologies.

## Anglian Water

Anglian Water's 'Love Every Drop' campaign aims to significantly reduce carbon emissions, including in their supply chain, and encourage customers to be more resource efficient and cut down their carbon emissions. Their manifesto, published in 2015, aims to raise awareness about how essential water is to life, to people and the environment, and to a vibrant and growing economy too. This helped to save £2.5 million in energy costs in 2016. They have also issued the first ever public utility green bond this year, raising £250 million to finance a range of sustainable projects and support the company's vision of sustainability, carbon reduction, water efficiency and environmental stewardship.



### More Energy Efficient Commercial and Industrial Buildings

11. The Government has commissioned an independent review of Building Regulations and fire safety, being led by Dame Judith Hackitt. The review will report in spring 2018. Subject to the conclusions of that review, the Government intends to consult on making improvements to Building Regulations requirements for new and existing commercial buildings where there are cost-effective and affordable opportunities, and it is safe and practical to do so. This will look to promote low carbon and higher energy efficiency heating, ventilation and air conditioning systems in new commercial buildings.

12. 42 per cent of business buildings' energy use is in the private rented sector<sup>168</sup>. We will consult in 2018 on how best to improve the energy performance of these buildings through tighter minimum energy standards.

13. The Government will explore how voluntary building standards can support future improvements in business building performance.

14. As we work to understand different options for the long term decarbonisation of heat, we will need to tackle the challenge of those business properties off the gas grid, particularly those heated by oil boilers and facing volatile costs. Beyond support through the Renewable Heat Incentive (RHI), our ambition is to phase out the installation of high carbon fossil fuel heating in new and existing business buildings off the gas grid during the 2020s, starting with new buildings as these lend themselves more readily to other forms of low carbon heating. We will involve businesses and industry in developing our new policy, in line with broader Government priorities on delivering clean air.

<sup>168</sup> BEIS (2016) Building Energy Efficiency Survey (BEES) <https://www.gov.uk/government/publications/building-energy-efficiency-survey-bees>

## Transforming Manufacturing and Heavy Industry

15. Alongside this Strategy, we have published joint industrial decarbonisation and energy efficiency action plans with seven of the most energy intensive industrial sectors, building on three years of joint industry-Government co-operation. These action plans identify steps by industry and Government that can be taken now to support long term low carbon growth, energy efficiency and emissions reductions on a sector by sector basis. These include the sharing of best practice and innovation opportunities, including through a new online portal, facilitating dialogue to improve access to finance and cross-sector consideration of the best uses of biomass across industry.
16. The Government remains committed to using carbon pricing as an emissions reduction tool and will ensure that a clear price signal continues to incentivise industrial emissions reduction.
17. We will develop a framework to support the long term low carbon development of energy intensive industrial processes, such as CCUS and electrification.

## Government Innovation Investment

The Government expects to invest around £162 million<sup>169</sup> of innovation funding out to 2021, in research, development and demonstration of energy, resource and process efficiency alongside better low carbon fuels and CCUS. This includes:

- **Energy efficiency:** We need to drive down the cost of new technologies to integrate them into existing processes and improve performance without affecting reliability. The Government is providing £9.2 million for an Industrial Energy Efficiency Accelerator, to help reduce the emissions from UK industry by increasing the commercially viable options available.
- **Processes, resource and material efficiency:** Over time we will need to replace materials which are energy intensive to produce with lower carbon ones at competitive prices, known as “advanced materials”. Government will work through Industrial Strategy sector deals and the Industrial Strategy Challenge Fund to stimulate innovation in advanced materials. We will also need to encourage more resource efficient business models, extend product life and reduce waste volumes. The Industrial Digitalisation Review will investigate how the design, development and deployment of digital technologies can drive increased national productivity.

<sup>169</sup> All figures are indicative and are subject to competitive bidding processes across sectors and value for money tests

- **Fuel Switching:** Firing industrial processes with low carbon fuels (such as hydrogen) is currently viewed as prohibitively expensive and disruptive. Innovation can prove the viability of these fuels without impacting

operations. Government will invest up to £20 million in competitions from 2018, initially for research followed by competitions for demonstrator projects across industry.

## Carbon Capture, Usage and Storage

There is a broad international consensus that carbon capture, usage and storage (CCUS) has a vital future role in reducing emissions. This could be across a wide range of activities such as producing lower-emission power, decarbonising industry where fossil fuels are used and/or industrial processes as well as providing a decarbonised production method for hydrogen which can be used in heating and transport. This makes CCUS a potentially large global economic opportunity for the UK. The International Energy Agency estimates there will be a global CCUS market worth over £100 billion - with even a modest share of this global market, UK GVA could increase to between £5 billion and £9 billion per year by 2030<sup>170</sup>.

However, the current technology is expensive and there are only 21 large-scale plants operating, or in construction, across the world – of which 16 rely on revenue from providing carbon dioxide for enhanced oil recovery<sup>171</sup>.

Our Clean Growth Strategy is underpinned by three commitments: to reduce our emissions in the most cost-effective way; to maximise innovation to develop world leading

technologies and to seek the maximum possible benefits from investment for improving the productivity of the UK economy. While we have explored ways to deploy CCUS at scale in the UK since 2007, the lack of a technological breakthrough to reduce the cost of CCUS and the cost structures and risk sharing that potential large-scale projects have demanded has been too high a price for consumers and taxpayers. It is clear from the relative lack of deployment of the technology that other governments have reached a similar conclusion.

However, we have continued to invest in innovation and technology development both in the UK and overseas. To date we have invested over £130 million in R&D and innovation support to develop CCUS in the UK, supporting the development of technologies including NET Power's Allam cycle, Carbon Clean Solutions and C-Capture. We are also one of the leaders in providing aid support to CCUS internationally through our support to CCUS pilot projects in countries with a fossil fuel-intensive energy sector, such as Mexico, South Africa, and Indonesia.

<sup>170</sup> CCSA & TUC (2014) The economic benefits of carbon capture and storage in the UK <http://www.ccsassociation.org/press-centre/reports-and-publications/>

<sup>171</sup> Large-scale CCS facilities <http://www.globalccsinstitute.com/projects/large-scale-ccs-projects>

## Carbon Capture, Usage and Storage (continued)

### **Investing in cutting edge technology to achieve global cost reductions in CCUS**

*As a global leader in supporting the development of cutting edge technologies, the Government provided £7.5 million for the early development support to the UK invented Allam cycle technology used by NET Power. This technology has the potential to capture 100 per cent of the carbon dioxide emitted at a cost similar to that of an unabated Combined Cycle Gas Turbine (CCGT).*

*This early support from the Government in a cutting edge technology has been critical to developing the technology and for the 8 Rivers NET Power project to reach demonstration scale. In March 2016, construction began on the NET Power pilot project, a 50 MWth first-of-its-kind natural gas-fired power plant located in Texas and the plant is expected to start operations in late 2017. The pilot project also includes significant UK content with two UK companies – Goodwins Steel Castings Ltd and Heatric involved in the project.*

We now see a new opportunity for the UK to become the global technology leader for CCUS, working internationally with industry and governments to bring about global cost reductions. We will do this through:

#### Re-affirming our commitment to deploying CCUS in the UK subject to cost reduction:

We will build on the success of the Offshore Wind Cost Reduction Taskforce<sup>172</sup> and convene a CCUS Cost Challenge Taskforce to deliver a plan to reduce the cost of deploying CCUS. This will then underpin



a deployment pathway for CCUS in 2018, setting out the steps needed to meet our ambition of deploying CCUS at scale during the 2030s, subject to costs coming down sufficiently. This will include looking at the options for permanent storage of carbon dioxide domestically as well as elsewhere via international shipping.

Following the advice from the Parliamentary Advisory Group on CCUS the Government will review the delivery and investment models for CCUS in the UK to understand how the barriers to deployment can be reduced, and how the private and public sectors can work together to deliver the Government's ambition for CCUS.

We will work with the ongoing initiatives in Teesside, Merseyside, South Wales and Grangemouth to test the potential for development of CCUS industrial decarbonisation clusters.

We will set up a new Ministerial-led CCUS Council with industry to review our progress and priorities. Through the CCUS Council we will also monitor costs and deployment potential with the option of revising our deployment path accordingly.

<sup>172</sup> Offshore Wind Cost Reduction Taskforce <https://www.gov.uk/government/groups/offshore-wind-cost-reduction-task-force>

International collaboration: The Government will convene and lead a new international working group to drive down the cost and accelerate deployment of CCUS, including by:

- Participating in Mission Innovation and its Carbon Capture Challenge and working closely with private-sector led initiatives such as the Oil and Gas Climate Initiative;
- Developing closer collaborative working with countries such as Norway, the United States, Canada and Australia including joint working on innovation and carbon dioxide transport and storage solutions and working multi-laterally through the Carbon Sequestration Leadership Forum and North Sea Basin Task Force;
- Continuing to be a global leader in CCUS investments through the UK's £60 million international CCS programme which has been running since 2012, by investing a further £10 million in the programme. This will further strengthen international action on CCUS and draw on UK technical and commercial expertise; and
- Organising an international Global Carbon Capture Usage and Storage Conference in 2018 with international partners.

Innovation: The Government will spend up to £100 million from the BEIS Energy Innovation Programme to support Industry and CCUS innovation and deployment in the UK including £20 million of funding available for a carbon capture and utilisation demonstration programme to invest in new innovative technologies that capture and utilise carbon

dioxide. The programme will also support next generation capture technologies, with an aim to lower the cost of capture compared to the current best performing technologies; and small-scale industrial capture demonstrations to reduce the risks associated with carbon capture on an industrial site. We also intend to support the application of CCUS in low carbon hydrogen production; develop our understanding of the role of GGR technologies, including bio-energy with carbon capture and storage; and support innovations that reduce the cost of transporting and storing carbon dioxide. The Government intends to set out further detail in 2018.

#### ***Investing in supporting new UK CCUS technologies and companies***

*The Government has provided over £4 million to support Carbon Clean Solutions Ltd, a UK headquartered company. This has supported the research, development and deployment of their novel carbon capture solvent technologies contributing to cost reductions in both the capital and operating costs of the technologies.*

*In early 2017, building on this early support from the UK Government, Carbon Clean Solutions launched an innovative carbon capture and utilisation project in India. In March 2017 Carbon Clean Solutions signed a partnership agreement with the global resource management company, Veolia, for a large-scale rollout of Carbon Clean Solution's carbon capture technology in a number of industrial processes.*

# Improving Our Homes



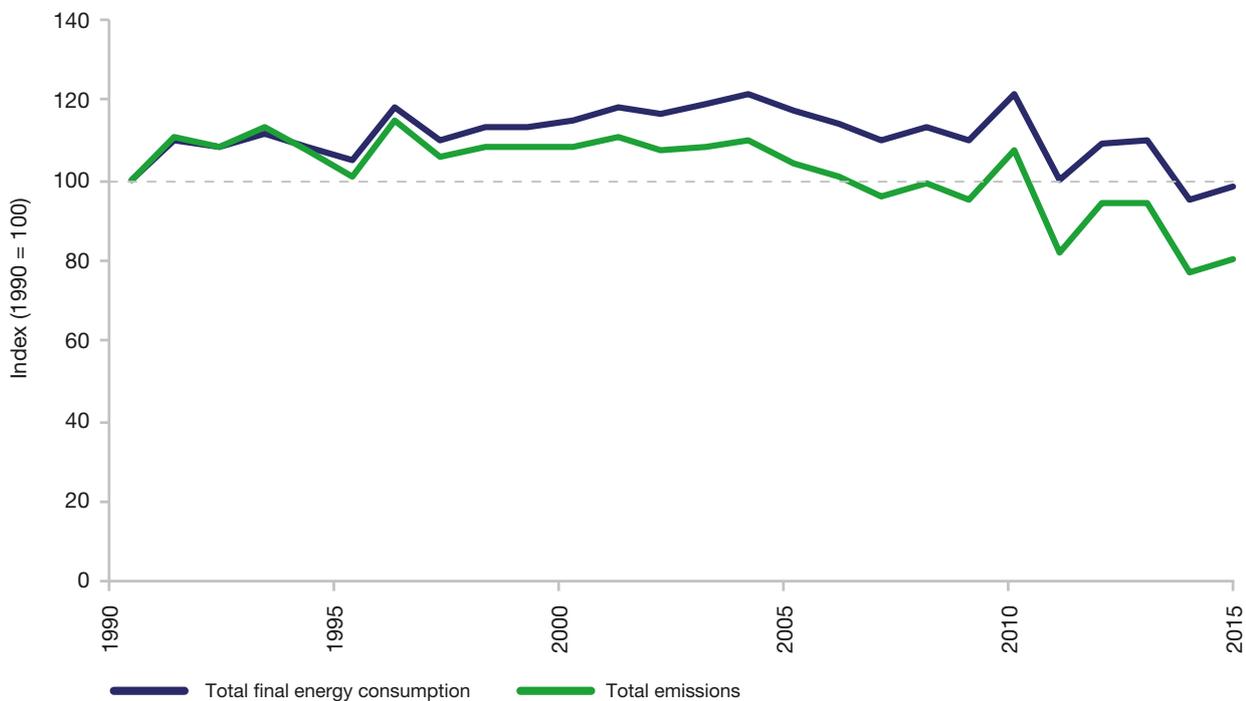
## Progress

Homes now account for 13 per cent<sup>173</sup> of the UK’s emissions (rising to 22 per cent once electricity use is taken into account<sup>174</sup>). The average household’s energy consumption has fallen by over 17 per cent since 1990<sup>175</sup>. This has been driven by a combination of: tighter building and products standards, in particular

better boilers; the uptake of insulation and other energy efficiency measures, mainly delivered through obligations on energy suppliers; and greater awareness of potential energy savings.

While there are now approximately a quarter more homes than in 1990, the overall total of emissions from the sector has reduced by about a fifth over this period<sup>176</sup>.

**Figure 18: Total energy consumption and emissions of UK homes, 1990-2015**



Source: BEIS Energy Consumption in the UK, 2017

<sup>173</sup> BEIS (2017) UK Greenhouse Gas Emissions <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>174</sup> BEIS (2017) Annex 1990 – 2015 Final emissions by end user and fuel type [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/604354/Annex\\_1990-2015\\_Final\\_emissions\\_by\\_end\\_user\\_and\\_fuel\\_type.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/604354/Annex_1990-2015_Final_emissions_by_end_user_and_fuel_type.pdf) A minor adjustment for fluorinated gases has been made, which are accounted with the Natural Resources sector

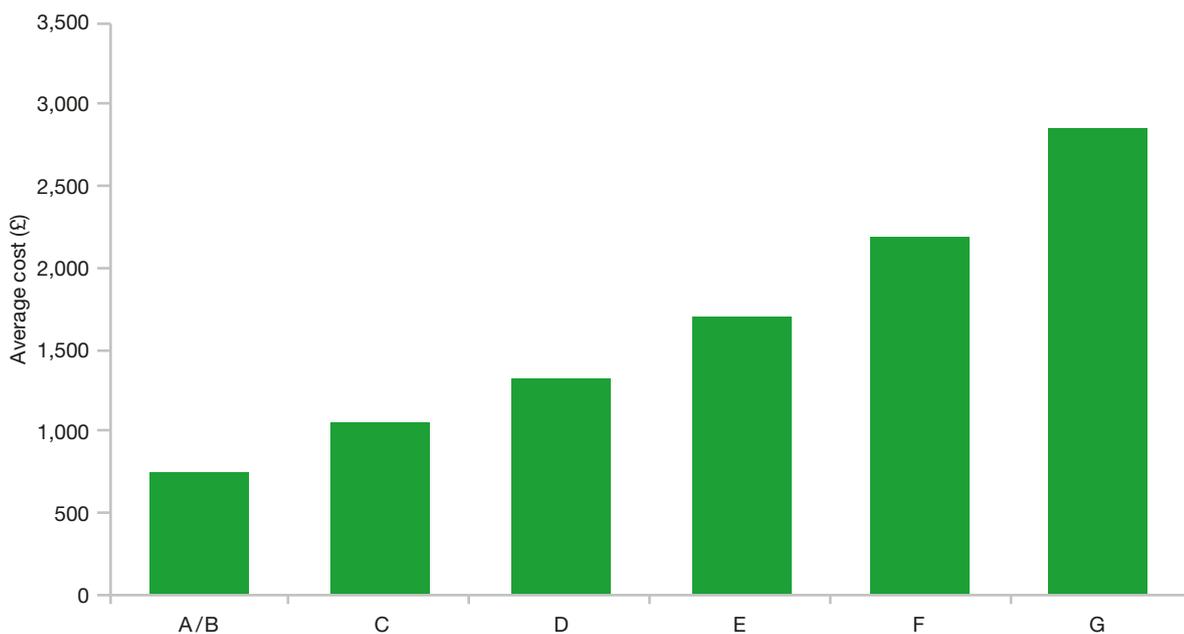
<sup>175</sup> BEIS (2017) Energy Consumption in the UK <https://www.gov.uk/government/statistics/energy-consumption-in-the-uk> Change in average consumption per household 1990-2016.

<sup>176</sup> BEIS (2017) UK Greenhouse Gas Emissions <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

Reducing emissions through the measures listed above not only creates better quality homes but cuts the costs of heating them. Almost 79 per cent of homes in England in 2015 had an Energy Performance Certificate (EPC) rating of Band D or better compared to 39 per cent in 2005<sup>177</sup>. Upgrading energy efficiency from an EPC Band E to an EPC Band D reduces energy costs by £380 per year on average. For example, the annual running cost of a Band C rated home are £270 lower than the average Band D rated home and £650 less than the average Band E rated home<sup>178</sup>.

Improved energy efficiency also offers substantial health benefits. There is a clear link between cold homes and ill-health, where existing conditions (such as respiratory illnesses or mental health conditions) are exacerbated. The Building Research Establishment (BRE) has estimated, conservatively, that the cost of cold and damp homes to the NHS is approximately £760 million per year<sup>179</sup>. Increasing resilience to rising temperatures is also a potentially significant climate change challenge and we are undertaking research into whether further measures on overheating are necessary for new homes.

**Figure 19: Average annual cost of energy in homes by energy efficiency rating, 2014<sup>180</sup>**



Source: DCLG

<sup>177</sup> DCLG (2017) English Housing Survey 2015 to 2016

<sup>178</sup> BEIS analysis based on English Housing Survey data

<sup>179</sup> Building Research Establishment (2011) The cost of poor housing to the NHS BEIS analysis based on English Housing Survey data

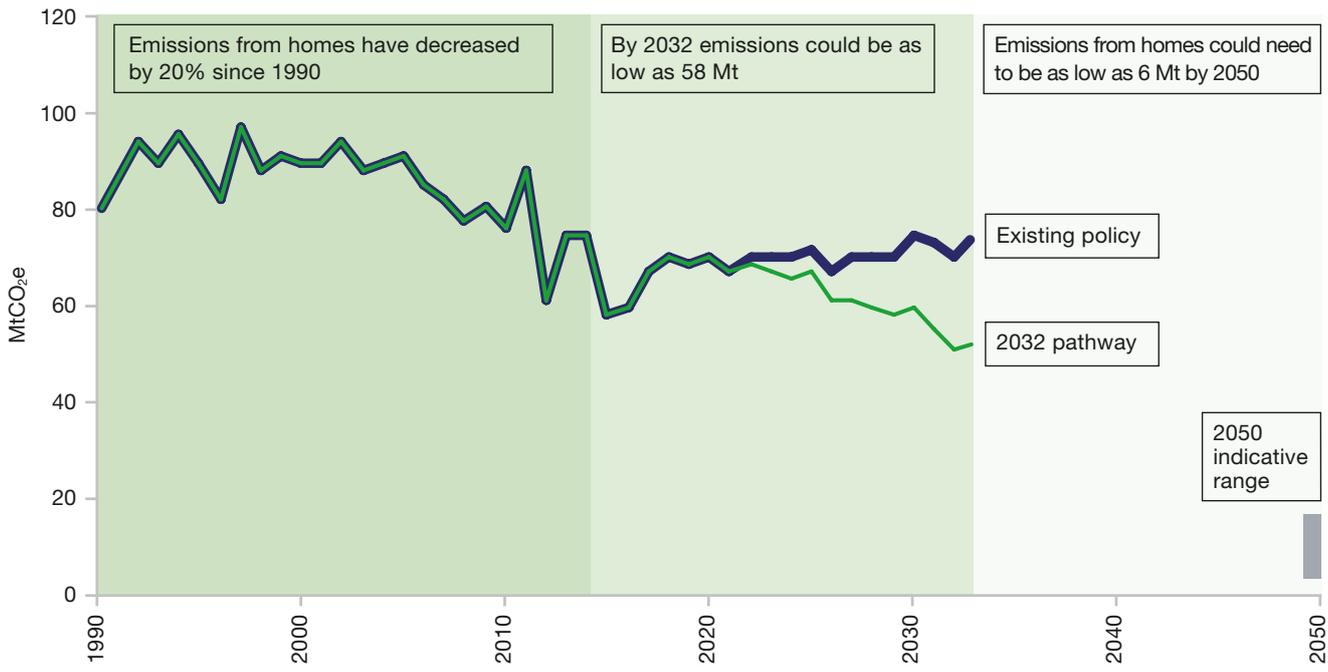
<sup>180</sup> BEIS analysis based on English Housing Survey data

Obligations on energy suppliers such as the Energy Company Obligation (ECO) are estimated to have reduced dual fuel customers' bills by over £800 million across the UK in 2016<sup>181</sup>. Since 2013, ECO has driven the installation of 2.1 million energy efficiency measures in 1.7 million properties<sup>182</sup>. Separately, the Domestic Renewable Heat Incentive has enabled householders to install over 55,000 low carbon heating technologies such as heat pumps, biomass boilers and solar water heating<sup>183</sup>.

In particular, progress has been made to upgrade the homes of those living in fuel poverty: the number of fuel poor households in England living in homes at energy efficiency rating E or below reduced from 1.8 million in 2010 to 920,000 in 2015<sup>184</sup>.

In parallel, the roll-out of smart meters is helping to give households more control over their energy use, based on near real-time information. As of June 2017, 7.7 million smart and advanced meters were operating in homes and small business sites across the country<sup>185</sup>.

**Figure 20: Actual and projected emissions in homes, taking into account the clean growth pathway, 1990-2050**



Source: BEIS

<sup>181</sup> BEIS analysis

<sup>182</sup> BEIS (August 2017) Household Energy Efficiency National Statistics <https://www.gov.uk/government/collections/household-energy-efficiency-national-statistics>

<sup>183</sup> BEIS (July 2017) Renewable Heat Incentive Statistics <https://www.gov.uk/government/collections/renewable-heat-incentive-statistics>

<sup>184</sup> BEIS (2017) Fuel Poverty Trends <https://www.gov.uk/government/statistics/fuel-poverty-trends-2017>

<sup>185</sup> BEIS (Quarter 2 2017) Smart Metering Statistics <https://www.gov.uk/government/statistics/statistical-release-and-data-smart-meters-great-britain-quarter-2-2017>

## Ambition

We want to further reduce emissions from homes while ensuring that everyone has a home that is comfortable, healthy and affordable to run. Our objective is to ensure our policies will encourage people to improve their homes where it is cost effective and affordable for them to do so. One possible pathway to 2032 could involve emissions from homes falling by almost one fifth compared to today, to around 58 Mt by 2032.

To achieve this 2032 pathway, we will need to ensure existing buildings waste even less energy. This pathway could see a further six to nine million properties insulated, especially focusing on those in fuel poverty where we are aiming to have the 2.5 million fuel poor homes in England improved to energy efficiency rating C or better by 2030<sup>186</sup>. More broadly, our aspiration is that as many homes as possible are improved to EPC Band C by 2035, where practical, cost-effective and affordable.

Reducing demand for energy will not be enough on its own to meet our ambitions for homes. By 2050, we will also likely need to fully decarbonise how we heat our homes. There are a number of low carbon heating technologies with the potential to support the scale of change needed, including heat pumps,

using low carbon gases (such as hydrogen) in our existing gas grid and district heat networks. However, at present it is not certain which approaches or combination of them will work best at scale and offers the most cost-effective long-term answer. Decarbonising heat is our most difficult policy and technology challenge to meet our carbon targets.

We will therefore need to lay the groundwork this Parliament so we are ready to make decisions in the first half of the next decade about the long term future of how we heat our homes, including the future of the gas grid (please see box below on the Future of Heat Decarbonisation). This includes support for innovation to test and bring down the cost of low carbon heating technologies, many of which are currently too expensive.

Ahead of these decisions, we can take further action to reduce emissions from heating the 850,000 homes<sup>187</sup> currently not connected to the gas grid in England and that use oil for heating. We also need to avoid new homes needing to be retrofitted later and ensure that they can all accommodate low carbon heating. This could involve all new homes off the gas grid from the mid-2020s being heated by a low carbon system, such as a heat pump.

<sup>186</sup> Conservatives (2017) <https://www.conservatives.com/manifesto>

<sup>187</sup> BEIS analysis based on English Housing Survey data

## Opportunities

The energy efficiency industry already contributes substantially to the low carbon economy, supporting 144,000 direct employees<sup>187</sup>. In 2016, investment in energy efficiency globally grew by nine per cent with substantial levels of global investment in energy efficiency predicted to deliver on the Paris Agreement. This is coupled with a potentially substantial domestic market of 27 million homes. The UK, therefore, has

the opportunity to become a trusted leader in the quality, service and installation of low carbon and energy efficiency products and an exporter of knowledge, skills and products to other countries. These markets can build on the success of the UK gas boiler market – the biggest boiler market in the world, in terms of value and volume (the annual market value for boilers in the UK is around £2.5-£3 billion<sup>188</sup>) with some of the most experienced manufacturers and installers.

### Exeter Road Project

Enfield's award-winning Exeter Road Project combined energy efficiency measures with the installation of a ground source heat pump system to provide a new heating and hot water system to 185 flats. The new heating system is estimated to reduce fuel costs

by 80 per cent per flat, saving residents as much as £500 a year. Exeter Road resident **Ms Adeleke** says: "I am very happy with the heating, it keeps my home warm all of the time. My old heating didn't work properly all day and wasn't in every room. It is cheaper to run than the other heating so far this winter."

<sup>187</sup> ONS (2017) Low Carbon and Renewable Energy Economy Survey, final estimates: 2015 <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2015results>

<sup>188</sup> Delta Energy & Environment (2016) Heat Insight Service, August 2016 Briefing note

## Policies and Proposals

### Improving People's Homes and Reducing Bills

1. ECO will upgrade around a million homes, supporting £3.6 billion of investment. We have changed the scheme so it is more focused on households with low incomes. We will extend support for home energy efficiency out to 2028 at least at the current level of ECO funding. We will review the best form of support beyond 2022 recognising the need to both save carbon and meet the Government's commitment to upgrade all fuel poor homes to EPC Band C by 2030.
2. For privately rented homes, we have legislated so that from April 2018, landlords of the worst performing properties will need to improve those properties to a minimum of EPC Band E before they can be let, lowering bills for some of the most vulnerable private tenants while ensuring costs of improvements are reasonable and affordable. We will consult shortly on steps to make these regulations more effective.
3. The Government will look at a long term trajectory for energy performance standards across the private rented sector, with the aim of as many private rented homes as possible being upgraded to EPC Band C by 2030, where practical, cost-effective and affordable. We will consider options with a view to consulting in 2018. In addition, the Government will also look at how social housing can meet similar standards on the same timetable. When looking at this we will need to take account of the findings of the independent public inquiry into the fire at Grenfell Tower<sup>189</sup> and the Government's separate work looking at wider social housing policy issues<sup>190</sup>.
4. We want all fuel poor homes to be upgraded to EPC Band C by 2030, and our aspiration is that, across the whole housing stock, as many homes as possible reach a similar standard by 2035, where practical, cost-effective and affordable.
5. To build the market for energy efficiency, we need to make it as easy as possible for people to pay for and make home energy efficiency improvements. We are publishing a call for evidence on additional measures to encourage energy performance improvements, including a focus on:
  - Working with mortgage lenders to incorporate energy efficiency into their lending decisions, alongside developing innovative "green mortgage" products. The Government is now exploring ways that it could support the launch of more products, and further details are included in our call for evidence.
  - Looking at incentives and other levers that could encourage homeowners to invest in energy efficiency improvements.

<sup>189</sup> Grenfell Tower Inquiry (2017) Terms of Reference <https://www.grenfelltowerinquiry.org.uk/news/prime-minister-announces-inquiry-terms-reference/>

<sup>190</sup> Prime Minister's response of 15th August 2017 <https://www.grenfelltowerinquiry.org.uk/key-documents/>

6. We will work with industry to implement the independent, industry-led *Each Home Counts*<sup>191</sup> review to improve quality and standards for all retrofit energy efficiency and renewable energy installations.
7. We will replace the existing, telephone-only Energy Saving Advice Service with a digitally-led service by spring 2018, working closely with the *Each Home Counts* implementation, offering tailored advice on improving the energy performance of people's homes.
8. Homeowners expect building work that improves the energy efficiency of a property to be high quality, helping them reduce energy bills and making their homes more comfortable. The Government has commissioned an independent review of Building Regulations and fire safety, being led by Dame Judith Hackitt. The review will report in spring 2018. Subject to the conclusions of that review, the Government intends to consult on making improvements to Building Regulations requirements, so that any new work (i.e. extensions to a property and other building work) to existing properties meets a high standard of energy efficiency, where the evidence shows there are cost-effective and affordable opportunities and that it is safe and practical to do so. Any improvements would focus on the standards of the work carried out on properties itself, and would not include any wider "consequential" improvements to other parts of the property.
9. Following the sale of the Green Deal Finance Company, the Government is publishing a call for evidence on how to reform and streamline the Green Deal framework to make the "Pay as You Save" system more accessible to businesses, while ensuring adequate protection for consumers.
10. It could be possible to extend EPCs to other trigger points and we will issue a Call for Evidence by spring 2018 seeking views in this area, as well as wider views on how EPCs could be further improved, in light of new sources of data and capabilities. As the EPC requirements derive from the Energy Performance of Buildings Directive, any future changes will need to be considered in the context of leaving the European Union.
11. Energy performance improvements installed in both new build and existing properties can fall short of expectations. The Government has commissioned an independent review of Building Regulations and fire safety, being led by Dame Judith Hackitt<sup>192</sup>. The review will report in spring 2018. Following the outcome of this review and subject to its conclusions we will look at the potential for any further action on compliance and enforcement related to energy performance. We will also continue to explore innovative solutions to this problem, such as measuring actual building performance using data from smart meters, and working with the industry to develop a 'quality mark' to drive up standards.

<sup>191</sup> DCLG (2016) *Each Home Counts: Review of Consumer Advice, Protection, Standards, and Enforcement for Energy Efficiency and Renewable Energy* <https://www.gov.uk/government/publications/each-home-counts-review-of-consumer-advice-protection-standards-and-enforcement-for-energy-efficiency-and-renewable-energy>

<sup>192</sup> Grenfell Tower Inquiry (2017) Terms of Reference <https://www.gov.uk/government/news/independent-review-of-building-regulations-and-fire-safety-publication-of-terms-of-reference>

12. We will ensure every home is offered a smart meter by the end of 2020 and we expect energy suppliers to make every effort to provide smart meters to all their customers. We will:

- Continue to work with suppliers to ensure that people are provided with tailored advice when a smart meter is installed;
- Trial the provision of regular information about their energy use to encourage long-term energy savings; and
- Explore how the data available through the national smart metering platform can, with customers' consent, support personalised recommendations for saving energy, more targeted policy interventions and help businesses develop energy saving offers.

13. Alongside this Strategy, the Government has published *Boiler Plus*, improving standards for the 1.2 million new boilers<sup>193</sup> installed in England every year and ensuring control devices are included with every installation so people can more easily control comfort in their own homes for less fuel from April 2018.

### Encouraging the Take-up of Cleaner Heating Systems

14. Through the Renewable Heat Incentive (RHI), we are spending £4.5 billion between 2016 and 2021 to support innovative low carbon heat technologies in homes and businesses, such as heat pumps, biomass boilers and solar water heaters. We are also reforming the RHI to focus the scheme towards long-term decarbonisation through greater uptake of technologies such as heat pumps and bio methane (biogas to grid)<sup>194</sup>.

15. Beyond the RHI, our ambition is to phase out the installation of high carbon fossil fuel heating in new and existing off gas grid residential buildings (which are mostly in rural areas) during the 2020s, starting with new homes as these lend themselves more readily to other forms of low carbon heating. In line with broader Government priorities on delivering clean air, we are considering a range of policy options to support this, and are investing £10 million in an innovation challenge fund to support low carbon heating systems. We will involve consumers and industry in developing our new policy so that it is straightforward for people to get new technologies installed. The Government will also explore the use of the £200 million package of Growth Programme and Countryside Productivity offers to support renewable energy projects in rural areas<sup>195</sup>.

16. In the Spending Review 2015, we allocated funding out to 2021 to grow the UK heat networks market so it is self-sustaining in the longer term. This could support significant investment of private and other capital by 2021. This will enable the construction of heat networks in areas of high heat demand density such as urban centres, campuses and business parks, including in rural locations. Following recommendations from an industry taskforce, we will also examine the measures necessary to create an effective long-term market framework for the sector beyond 2020.

<sup>193</sup> BEIS (2017) Boiler Standards IA <https://www.gov.uk/government/consultations/heat-in-buildings-the-future-of-heat>

<sup>194</sup> BEIS (2016) The Renewable Heat Incentive: A reformed and refocused scheme <https://www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme>

<sup>195</sup> Defra (2017) £200 million boost for rural England <https://www.gov.uk/government/news/200-million-boost-for-rural-england>

17. The Government has commissioned an independent review of Building Regulations and fire safety, being led by Dame Judith Hackitt. The review will report in Spring 2018. Following the outcome of the independent review, and subject to its conclusions, the Government intends to consult on improving requirements for new homes where the evidence suggests that there are cost-effective and affordable opportunities, and it is safe and practical to do so. This will look to ensure that new homes are future-proofed for the installation of lower carbon heating systems where this is cost-effective and affordable. This will help to phase out high carbon fossil fuels in the future, starting with homes off the gas grid.

### Government Innovation Investment

The Government expects to invest £184 million<sup>196</sup> out to 2021 in research, development and deployment of innovative energy efficiency and heating technologies, and the gas network. These will address the key innovation challenges to meet our long-term goals, including:

- **Developing better energy efficiency and heating technologies.** We need innovation in products, supply chain capacity and skills, and new business models to reduce the expense and challenge of retrofit solutions. To deliver this the Research Councils

are investing over £70 million in energy efficiency, including £22 million in buildings research. In addition, we will run:

- A new £10 million grant fund for the innovation of new insulation materials, installation methods and business models for existing buildings.
- A further £10 million grant fund will focus on making low carbon heating technologies more affordable, better performing, and attractive to the consumer.
- We also need to ensure that existing regulation does not impede the development of new low cost energy efficiency technologies. This will be considered as part of our call for evidence on additional measures to encourage energy improvements alongside this Strategy.
- **Building lower cost, low carbon homes.** New methods in construction including factory production and off-site manufacturing may help us build new energy efficient homes more quickly and more cheaply. The Government is currently tendering a £1.4 million three-year research project to address the drivers, barriers, and challenges of new low carbon homes.

<sup>196</sup> All figures are indicative and are subject to competitive bidding processes across sectors and value for money tests.

## Econovate

Econovate, based in Hemel Hempstead produce construction ‘blocks’ made from recycled waste which might otherwise end up in landfill. They received an Energy Entrepreneurs Fund grant of £800,000, and their product is now fully certified for use. Econovate have subsequently raised over £645,000 capital funding to grow the manufacturing of their award winning product which has a high level of performance, saving more than 300kg of CO<sub>2</sub> per cubic metre compared to standard concrete, and which is four times stronger than current blocks.



- **Behaviour change.** Innovation can help overcome non-financial barriers, in particular behavioural barriers, to energy efficiency. Research Councils are planning to invest around £19 million to research how people’s energy choices can help them stop wasting as much energy. Government is investing in smart ways of developing heating services, with work led by the Energy Systems Catapult.
- **Network solutions.** To inform the decisions that will be needed on our long term approach to decarbonising heat (please see box below on the Future of Heat Decarbonisation), we will run a £25 million project on using hydrogen as an alternative to natural gas<sup>197</sup>, including looking at regulatory standards and the development of appliances.
- **Supporting innovation through policy instruments.** We recognise that the way in which Government policies are designed can have an impact on the rate of deployment of new, innovative low carbon and energy efficient technologies. As such, we will explore ways in which we could make it easier for innovative approaches or products to be installed under our consumer-facing schemes such as ECO – potentially reducing costs, improving the overall performance of the technologies, and building a stronger evidence base on the savings they deliver.
- Ofgem is making available up to £195 million for gas network companies in Great Britain to develop and demonstrate new technologies as well as new operating and commercial arrangements.

<sup>197</sup> BEIS (July 2017) Funding for innovative approaches to a low carbon built environment <https://www.gov.uk/government/publications/funding-for-innovative-approaches-to-using-hydrogen-gas-for-heating>

## The Future of Heat Decarbonisation

Heating our homes, businesses and industry accounts for nearly half of all energy use in the UK and a third of our carbon emissions. Nearly 70 per cent of our heat is produced from natural gas. Meeting our target of reducing emissions by at least 80 per cent by 2050 implies decarbonising nearly all heat in buildings and most industrial processes. Reducing the demand for heat through improved energy efficiency will have an important role to play but will not by itself suffice to meet our 2050 target.

We need to lay the groundwork in this Parliament to set up decisions in the first half of the next decade about the long term future of heat. The demands on our energy infrastructure will change as low carbon heating technologies take over from fossil fuels, with a greater dependence on electricity and potentially new infrastructure needed for system balancing and the generation of low carbon gases. Supply chains will need time to grow to provide products and services consumers across the country will need.

There is a range of low carbon heating technologies with the potential to support the scale of change needed. These include the electrification of heating with households moving away from gas or oil boilers, to electric

heat pumps; decarbonising the gas grid by substituting natural gas with low carbon gases like biogas and hydrogen; and heat networks (which are likely to be particularly effective in dense urban areas). At present, it is not clear which approach will work best at scale and offer the most cost-effective, long term answer. We will work with industry, network operators, manufacturers, and consumers to achieve a clear and shared understanding of the potential as well as the costs and benefits and implications of different pathways for the long term decarbonisation of heat. This includes modelling the costs and benefits of different approaches, establishing the likely level of change for households and demands on the electricity grid building on the work of others in this field.

Government has commissioned research into different heat demand scenarios, the use of hydrogen, what changes might be needed to the electricity grid in response to large scale uptake of heat pumps, the role that bioenergy might play in decarbonising heat and international activity. We plan to publish initial findings from a number of studies later this year, and a full report on our review of the evidence by summer 2018.

# Accelerating the Shift to Low Carbon Transport

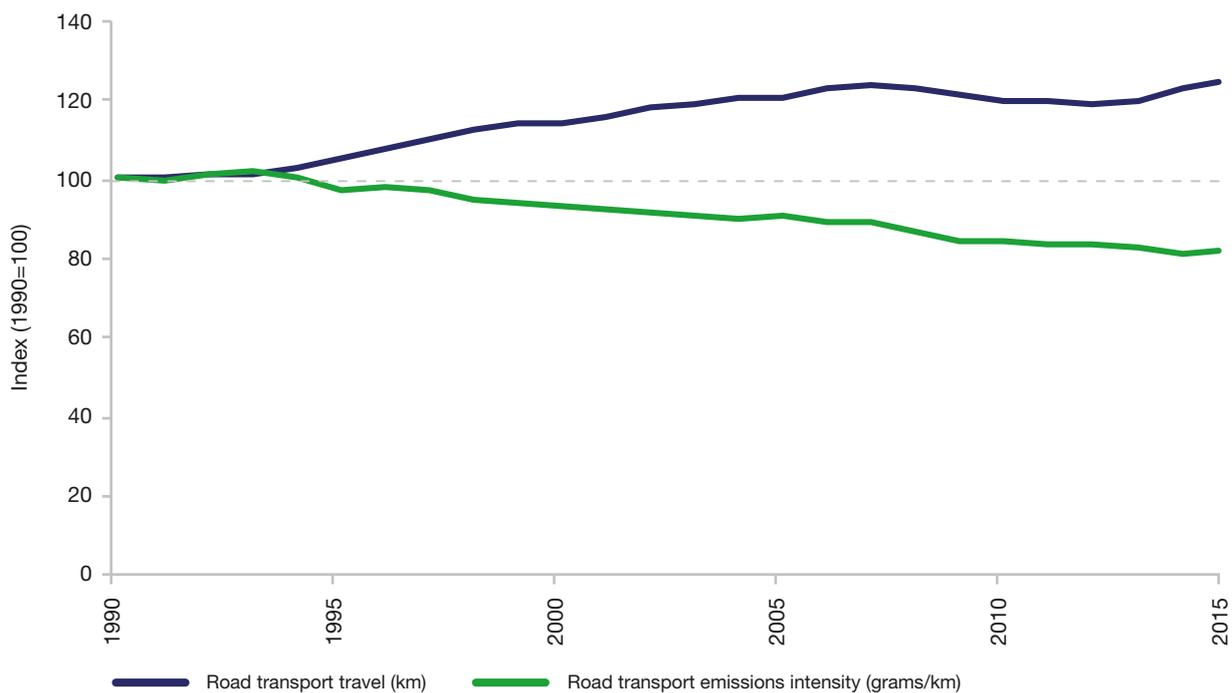


## Progress

Transport emissions in 2015 were down two per cent compared to 1990<sup>198,199</sup>. While new cars in the UK are up to 16 per cent more efficient than they were in 2000<sup>200</sup>, this improvement has

been largely offset by a nine per cent increase in road traffic to 2015<sup>201</sup>, with the number of registered vehicles increasing over the same period from 28.9 million to 36.5 million<sup>202</sup>. The transport sector now accounts for 24 per cent of the UK's emissions<sup>203</sup>.

**Figure 21: Emissions intensity of road transport (cars, vans and HGVs) 1990-2015**



Source: DfT, BEIS

<sup>198</sup> BEIS (2017) Final UK greenhouse gas emissions statistics 1990-2015 <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>199</sup> Provisional statistics suggest that GHG emissions from transport may show an increase 1990-2016. BEIS (2017) Provisional UK greenhouse gas emissions statistics 2016 <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2016>

<sup>200</sup> Fuel efficiencies are from DfT modelling using DfT (2017) Vehicle statistics; ICCT (2015) From Laboratory to Road: A 2015 update <http://www.theicct.org/laboratory-road-2015-update>

<sup>201</sup> DfT (2016) Road traffic estimates in Great Britain: 2015 <https://www.gov.uk/government/statistics/road-traffic-estimates-in-great-britain-2015>. Measured in 'vehicle miles' which combines the number of vehicles on the road and how far they drive.

<sup>202</sup> DfT (2017) Licensed vehicles and new registration tables <https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01> VEH0102

<sup>203</sup> BEIS (2017) Final UK greenhouse gas emissions statistics 1990-2015 <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

Improvements by manufacturers in the fuel efficiency of vehicles have largely been driven by tighter regulation, mainly set at EU level<sup>204</sup>. Driving a new car bought in 2015 would have saved car owners up to £200 on their annual fuel bill, compared to a car bought new in the year 2000<sup>205</sup>.

The fuel we use in our cars is also lower carbon, with the Renewable Transport Fuel Obligation (RTFO) driving the greater use of biofuels. Biofuels now account for around three per cent of fuel sales, with around half of that derived from wastes<sup>206</sup>. Average greenhouse gas savings from biofuels are around 70 per cent compared to petrol and diesel<sup>207</sup>. The RTFO has stimulated around £1 billion of investment in UK production facilities<sup>208</sup> including, for instance, Argent Energy's £75 million production plant in Cheshire which is using innovative technology to turn sewage waste into biodiesel<sup>209</sup>.

We are now seeing greater innovation from carmakers, beyond the internal combustion engine, as the world accelerates towards mass adoption of zero emission vehicles. The UK now has over 115,000 ULEVs on the road<sup>210</sup>. ULEV uptake has been driven through a combination of grants, which reduce the upfront costs of ultra low emission cars by up to £4,500<sup>211</sup>, together with improved charging infrastructure<sup>212</sup> and new approaches like the £40 million Go Ultra Low Cities scheme, through which eight local authority areas are trialling local initiatives including city centre charge point hubs, free parking and access to bus lanes for ULEVs<sup>213</sup>.

On public transport, Government has invested £37 billion in the public transport system between 2011 and 2016<sup>214</sup>. Rail passenger journeys are now at their highest level since the 1920s<sup>215</sup>.

<sup>204</sup> With a target of 95g/km for cars in 2021 (down from 146g/km in 2009) - Reducing CO<sub>2</sub> Emissions from passenger cars, [https://ec.europa.eu/clima/policies/transport/vehicles/cars\\_en](https://ec.europa.eu/clima/policies/transport/vehicles/cars_en)

<sup>205</sup> Annual average household saving from driving a car purchased new in 2015 (the latest year for which data is available) compared to driving a car purchased new in 2000. Fuel savings valued using 2015 prices. DfT (2017) National Travel Survey; DfT (2017) Vehicles Statistics; ICCT (2015) From Laboratory to Road; BEIS (2016) Green Book supplementary appraisal guidance

<sup>206</sup> DfT (2017) Renewable Transport Fuel Obligation statistics: <https://www.gov.uk/government/collections/biofuels-statistics> Period 9 2016/17, report 2

<sup>207</sup> DfT (2017) Renewable Transport Fuel Obligation statistics: <https://www.gov.uk/government/collections/biofuels-statistics> Period 8 2015/16, report 6

<sup>208</sup> DfT (2014) Renewable Transport Fuel Obligation: Post Implementation Review <https://www.gov.uk/government/consultations/renewable-transport-fuel-obligation-a-draft-post-implementation-review>

<sup>209</sup> DfT press release (2016) Transport Minister views plans to boost Port of Liverpool <https://www.gov.uk/government/news/transport-minister-views-plans-to-boost-port-of-liverpool>

<sup>210</sup> DfT (2017) Vehicles registered for the first time by body type, monthly: Great Britain and United Kingdom <https://www.gov.uk/government/statistical-data-sets/allvehicles-veh01> Table VEH0150

<sup>211</sup> Currently up to £4,500 for cars, £1,500 for motorcycles, £8,000 for vans, £7,500 for taxis, and through competitive funding support for low emission buses and taxis.

<sup>212</sup> Currently up to £500 for home charge-points, up to £300 per socket for workplace charging and up to £7,500 per charge points for local authorities putting charging in residential areas.

<sup>213</sup> £40 million to drive green car revolution across UK cities <https://www.gov.uk/government/news/40-million-to-drive-green-car-revolution-across-uk-cities>

<sup>214</sup> HM Treasury (2016) Country and regional analysis: 2016 <https://www.gov.uk/government/statistics/country-and-regional-analysis-2016>

<sup>215</sup> DfT (2017) Rail Trends Factsheet 2016 <https://www.gov.uk/government/statistics/rail-factsheets-2016>

### Ambition

We want a more modern transport system – one that is clean, affordable and easy to use. That means cutting our carbon dioxide emissions, and improving our air quality – clean air is one of the most basic requirements of a healthy environment for us all to live, work and bring up families.

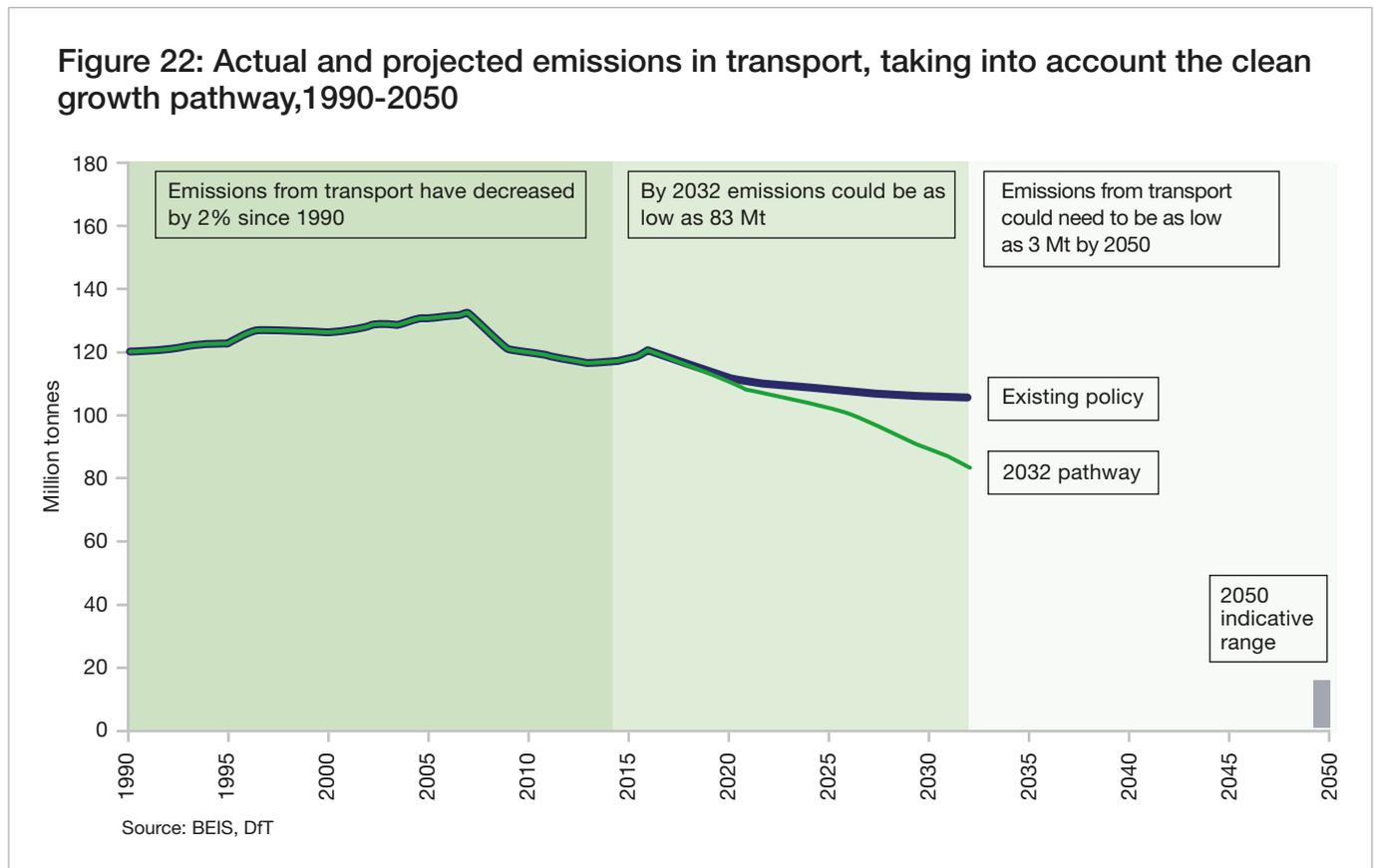
To meet our 2050 target, almost every car and van will need to be zero emission by 2050. The Government has announced an end to the sale of all new conventional petrol and diesel cars and vans by 2040.

Emissions from heavy goods vehicles (HGVs) will also need to reduce significantly to make a meaningful contribution towards meeting the

UK’s overall 2050 target. Walking and cycling will be made easier for many shorter journeys. By 2040, we want cycling and walking to be the natural choices for shorter journeys, or as part of a longer journey.

We will continue to modernise our aviation and shipping sectors, both through international action, such as standards and offsetting schemes, and domestically, for example through support for sustainable alternative fuels, improved efficiency and new technologies<sup>216</sup>.

One possible pathway to 2032 could involve emissions from transport falling by almost 30 per cent compared to today (to around 83 Mt by 2032).



<sup>216</sup> Although emissions from international aviation and shipping are not currently included in the UK’s targets under the Climate Change Act, our carbon budgets put the UK on a trajectory consistent with a 2050 target that includes these emissions. The Government has not reached a final view on the appropriate level of aviation emissions in 2050. For details on modelling assumptions, please see the technical annex.

To achieve this 2032 pathway, we need to further upgrade our transport system:

- ULEVs on the market today are already an attractive proposition for a significant proportion of motorists given the significantly lower running costs, but we can do more to accelerate ULEV development and uptake. ULEVs should become progressively more affordable as economies of scale are realised and they could provide savings for consumers compared to equivalent internal combustion engine cars by the mid-2020s or sooner<sup>217</sup>. As a result, at least 30 per cent of new car sales are expected to be ULEVs by 2030, and possibly as many as 70 per cent. For new vans, up to 40 per cent of sales could be ULEVs by 2030.
- There needs to be significant improvement in the efficiency of HGVs, with new HGVs needing to be up to 15 per cent more efficient by 2030. We also need to take steps to encourage the industry in moving towards low emission technologies.
- We need a cleaner public transport system. Low emission buses now represent 13 per cent of all buses in the UK<sup>218,219</sup>, but we want to go well beyond this to achieve significant uptake of ultra low and zero

emission buses. We will seek more use of electric, bi-mode (electric and diesel hybrid) and alternative fuel traction on the railway, and will continue to invest in route electrification where it benefits passengers<sup>220</sup>.

- It will be important to reduce the number of shorter journeys made by car, by supporting people to use alternative forms of transport for these trips such as cycling and walking.
- We want to see a near doubling of sustainable bioenergy used in the transport sector.

## Opportunities

The UK already has a thriving automotive sector, producing 1.7 million cars annually, employing over 160,000 people and generating £40 billion in exports<sup>221</sup>. The sector's skilled workforce, established manufacturing bases and high productivity ideally place it to be a world leader in the low emission vehicle market. In 2015, low emission vehicle exports were already estimated to be worth £2.5 billion to the UK economy<sup>222</sup>. With 80 per cent of UK produced vehicles already exported across the world<sup>223</sup> and increasing global demand for low emission vehicles the UK industry has real opportunity to further expand.

<sup>217</sup> This is based on the whole-life cost of electric vehicles. The up-front cost of these vehicles is expected to fall below that of conventional vehicles in the second half of the 2020s. Bloomberg New Energy Finance (2015) Are the economics of EVs competitive with conventional cars?; Element Energy (2016) Low carbon cars in the 2020s; International Council on Clean Transportation (2016) Evolution of incentives to sustain the transition to a global electric vehicle fleet.

<sup>218</sup> Low Carbon Vehicle Partnership (retrieved August 2017): <http://www.lowcvp.org.uk/Hubs/leb/Home.htm>

<sup>219</sup> DfT (2016) Vehicle stocks technology and equipment <https://www.gov.uk/government/statistical-data-sets/bus06-vehicle-stocks-technology-and-equipment> BUS0601

<sup>220</sup> DfT (2017) Written Statement to Parliament: Rail update: bi-mode train technology <https://www.gov.uk/government/speeches/rail-update-bi-mode-train-technology>

<sup>221</sup> Automotive Council (2017) The UK Automotive Sector: core briefing, <http://www.automotivecouncil.co.uk/wp-content/uploads/sites/13/2017/03/UK-Automotive-Sector-Core-Briefing-March-2017.pdf>

<sup>222</sup> ONS (2017) Low Carbon and Renewable Energy Economy Survey, final estimates: 2015 <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalesimates/2015results>

<sup>223</sup> Automotive Council UK (2017) The UK Automotive Sector: core briefing, <http://www.automotivecouncil.co.uk/wp-content/uploads/sites/13/2017/03/UK-Automotive-Sector-Core-Briefing-March-2017.pdf>

## Health Benefits

The Government has pledged to be the first generation to leave the environment in a better state than it inherited. As well as significantly reducing greenhouse gas emissions, wide-scale adoption of ULEVs will improve our health and quality of life by making the air cleaner in our towns and cities.

While air quality in the UK has been improving in recent decades and will continue to do so due to Government action and investment of over £3 billion in air quality and cleaner transport, there are some parts of the country where there are unacceptable levels of air pollution. Poor air quality remains the largest environmental risk to public health in the UK.

The most immediate challenge is the problem of nitrogen dioxide concentrations around some roads, due mainly to conventional road vehicles, and the Government has published a plan to address this<sup>224</sup>. As part of this plan, the Government announced a £255 million Implementation Fund to help local authorities develop and deliver targeted action to improve air quality, and committed to establishing a new Clean Air Fund.

In 2018, the Government will also publish a wider Clean Air Strategy, setting out how it will significantly reduce the emissions of five damaging air pollutants by 2020 and 2030.

## Policies and Proposals

### Accelerating Take up of Ultra Low Emission Vehicles

1. The Government has announced an end to the sale of all new conventional petrol and diesel cars and vans by 2040.
2. We are spending £1 billion to drive the uptake of ULEVs. If battery prices continue to fall there will be less need for Government subsidies for new vehicles in the future. We will provide support for ULEVs to help the development of a mature and self-sufficient market.
3. We will encourage ULEV uptake through schemes that build on our experience in delivering initiatives - for example the £40 million 'Go Ultra Low Cities' scheme.
4. We want to have one of the best electric vehicle (EV) charging networks in the world. We will set out our strategy to achieve this using regulation, funding and private investment. To support this:
  - In addition to workplace and residential charging support, the Government has also allocated an additional £80 million to support charging infrastructure deployment, alongside £15 million from Highways England to ensure rapid charge points every 20 miles across 95 per cent of England's Strategic Road Network<sup>225</sup>.
  - New powers under the Automated and Electric Vehicles Bill<sup>226</sup> will allow the Government to set specific requirements for the provision of EV charge points or hydrogen refuelling infrastructure at motorway service stations and large fuel retailers, as well as ensuring that charge points are convenient to access and work seamlessly right across the UK.

<sup>224</sup> DEFRA (2017) UK plan for tackling roadside nitrogen dioxide concentration: Detailed plan. See: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/633270/air-quality-plan-detail.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633270/air-quality-plan-detail.pdf)

<sup>225</sup> UK Parliament (2017) Electric Vehicles: Written question – 59924 <http://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2017-01-13/59924/>

<sup>226</sup> Cabinet Office (2017) Queen's Speech Background Briefing Notes 2017 [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/620838/Queens\\_speech\\_2017\\_background\\_notes.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/620838/Queens_speech_2017_background_notes.pdf)

## Electric Cars

**Sue Bentley from Runcorn, Cheshire:** “When I purchased an electric car I was the only one in my neighbourhood at that time. I believe electric vehicles are the way forward, they’re easy to run, reliable and good for the planet. Now seven people in my neighbourhood have one and they love them!”.



- The Bill will also allow the Government to require all new charge points sold or installed in the UK to be ‘smart’ enabled. This will help shift charging away from peak times of the day, reducing demand on the electricity system and keeping costs lower for everyone.
  - We will consider the role of regulation to accelerate the UK’s transition to widespread provision of ULEV infrastructure.
5. The Government has provided £4.8 million through the Hydrogen for Transport Advancement Programme to create a network of 12 hydrogen refuelling stations, and £2 million through the Fuel Cell Electric Vehicle Fleet Support Scheme to increase uptake of hydrogen fuel cell cars and vans in the public and private sector. A new £23 million fund was recently announced to boost the creation of hydrogen fuel infrastructure and encourage roll-out of hydrogen vehicles<sup>227</sup>.
  6. We will announce plans for the public sector to lead the way in transitioning to zero emission vehicles, with an ambitious uptake requirement for central government and new Buying Standards to encourage procurers to choose the cleanest, low emission vehicle.
  7. We will support the uptake of low emission taxis:
    - The Government will provide £50 million for the Plug-in Taxi programme, which gives taxi drivers up to £7,500 off the purchase price of a new ULEV taxi, alongside £14 million to support ten local areas to deliver dedicated charge points for taxis<sup>228</sup>.
    - We will consider whether our revised best practice guidance to local taxi and private hire vehicle (PHV) licensing authorities in England should recommend zero emission capability in urban areas by 2032. In considering the Law Commission’s recommendation for national taxi and PHV standards in England, we will examine the potential for Government to make this target mandatory.

<sup>227</sup> DfT (2017) £23 million boost for hydrogen-powered vehicles and infrastructure <https://www.gov.uk/government/news/23-million-boost-for-hydrogen-powered-vehicles-and-infrastructure>

<sup>228</sup> BEIS, DfT (2017) 1,000 jobs created at new £325 million factory for electric taxis <https://www.gov.uk/government/news/1000-jobs-created-at-new-300-million-factory-for-electric-taxis>

8. 'Go Ultra Low'<sup>229</sup> brings the Government and leading vehicle manufacturers together to explain the benefits of ULEVs to motorists and businesses, and its success has been internationally recognised. We will continue to work with industry on consumer communications on ULEVs until at least 2020.
9. The Government will set out further detail on a long term strategy for the UK's transition to zero road vehicle emissions by March 2018.

### **Enabling our Automotive Industry to Become a World Leader in Zero Emission Technologies**

10. The Automotive Council is now developing an Industrial Strategy Sector Deal, building on the £1 billion Advanced Propulsion Centre, which is seeking to establish the UK as a world leader in zero emission vehicle technologies<sup>230</sup>. The Sector Deal will aim to accelerate the transition to zero emission vehicles, complemented by Automotive Council research to determine UK priorities for the EV supply chain.

### **Developing a More Efficient and Low Carbon Freight System**

11. Low emission vans and HGVs between 3.5 and 44 tonnes have been eligible since late 2016 for plug-in grants worth up to £20,000 for the first 200 vehicles bought using the grant<sup>231</sup>.

12. We are consulting on proposals to allow category B (car) licence holders to drive slightly heavier vans if they are powered by a low emission technology, effectively offsetting the additional weight of the powertrain<sup>232</sup>. This will encourage further uptake of cleaner goods vehicles.

13. The Government's Freight Carbon Review<sup>233</sup>, published in February 2017, identified a range of measures to help fleet operators reduce their emissions, including through improved fuel efficiency. The Energy Saving Trust is piloting a scheme to advise HGV fleet operators on reducing fuel consumption. The Government will set out further measures to support the pathway to low emission freight by March 2018, as part of a long term strategy for the UK's transition to zero vehicle emissions.

14. Our 2016 Rail Freight Strategy<sup>234</sup> highlighted the potential to reduce emissions by growing rail freight and reducing HGV journeys. We will accelerate our activity to enable cost-effective options for shifting more freight from road to rail, including using low emission rail freight for deliveries into urban areas, with zero emission last mile deliveries.

<sup>229</sup> Go Ultra Low <https://www.goultralow.com/>

<sup>230</sup> Advanced Propulsion Centre: Background <http://www.apcuk.co.uk/about-apc/background/>

<sup>231</sup> DfT, BEIS (2016) £4 million boost to help businesses switch vans and trucks to electric <https://www.gov.uk/government/news/4-million-boost-to-help-businesses-switch-vans-and-trucks-to-electric>

<sup>232</sup> DfT (2017) Consultation: Regulatory changes to support the take-up of alternatively-fuelled light commercial vehicles <https://www.gov.uk/government/consultations/category-b-driving-licence-derogation-for-alternatively-fuelled-commercial-vehicles>

<sup>233</sup> DfT (2017) Freight Carbon Review 2017: Moving Britain Ahead [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/590922/freight-carbon-review-2017.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/590922/freight-carbon-review-2017.pdf)

<sup>234</sup> DfT (2016) Rail Freight Strategy: Moving Britain Ahead [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/552492/rail-freight-strategy.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/552492/rail-freight-strategy.pdf)

### University of Cambridge – Centre for Sustainable Road Freight

The Centre for Sustainable Road Freight at the University of Cambridge has developed a new trailer design for articulated vehicles that makes the vehicle more aerodynamic. They were awarded £4.4 million in funding from the Engineering and Physical Sciences Research Council and £1.4 million in joint funding from an industrial consortium comprising freight operators such as DHL, John Lewis Partnership, Tesco and Wincanton, as well as vehicle industry partners including Firestone, Goodyear, Haldex and Volvo. Their innovation cuts fuel consumption and pollution by articulated vehicles by around seven per cent. Waitrose has already added 36 of the modified trucks to its fleet and Warburtons will use the new design for all future fleet purchases.



### Encouraging Low Carbon Alternatives to Car Journeys

- 15. We will continue to invest in our public transport network, and help people to cycle, walk or travel by bus or train.
- 16. Our Cycling and Walking Investment Strategy<sup>235</sup> identifies £1.2 billion which may be invested in cycling and walking from 2016-21. Under this new strategic approach, Local Cycling and Walking Infrastructure Plans identify improvements required at the local level, and enable a long-term approach to developing local cycling and walking networks, ideally over a ten year period.
- 17. As announced in the 2016 Autumn Statement, the Government will provide £100 million for a national programme of support for retrofitting and new low emission buses in England and Wales, including hundreds of new low emission buses and retrofitting of thousands of older buses.

- 18. The Government will seek more use of electric, bi-mode (electric and diesel hybrid) and alternative fuel traction on the railway. We will continue to invest in route electrification where it provides benefits to passengers. The industry is also developing trains powered by alternative fuels, for example using battery and hydrogen power.

### More Efficient Vehicles and Driving Behaviour

- 19. As we leave the EU, we want the UK to continue to be a world leader in low carbon transport, and we will look for opportunities to strengthen further the controls on vehicle CO<sub>2</sub> emissions. We will pursue an approach which offers certainty to industry, and is at least as ambitious as current arrangements.

<sup>235</sup> DfT (2017) Cycling and Walking Investment Strategy [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/603527/cycling-walking-investment-strategy.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/603527/cycling-walking-investment-strategy.pdf)

20. We will continue to help promote and support efficient driving behaviours amongst fleets and private drivers, seeking to maximise the potential of new technologies including early adoption in public sector fleets and close working with other programmes to improve driver standards.

### Lower Carbon Fuels

21. We will promote sustainable alternative fuels, which reduce the carbon emissions from petrol and diesel vehicles, and we will set targets to support development of advanced fuels suitable for HGVs and aviation.

22. We have recently relaunched the Future Fuels for Flight and Freight Competition – a £22 million industry competition to encourage development and deployment of low carbon HGV and aviation fuels.

### Modernising the Domestic Aviation and Shipping Sectors

23. We will set out our strategic approach to the aviation sector in a series of consultations over the next 18 months<sup>236</sup>, including a paper on how to support growth while tackling the environmental impacts of aviation. This will culminate in the publication of a new Aviation Strategy for the UK by the end of 2018.

24. Industry and the Government have made a joint £3.9 billion commitment between 2013 and 2026 to the development of new aircraft technology with the Aerospace Technology Institute<sup>237</sup>. We have announced that we will extend the RTFO to include incentives to use biofuels in aviation.

25. On domestic shipping, the Government will continue to work with industry to develop improved fuel efficiency technologies, including new propulsion systems, hull design and aerodynamic structures.

26. We will work with ship owners and ports to identify the barriers faced in supplying and using sustainable alternative fuels and cleaner emissions technologies, to explore possible solutions. In addition, we expect operational improvements to play a role, including better use of ship capacity.

### Government Innovation Investment

The Government expects to invest around £841 million out to 2021 in innovation in low carbon transport technology and fuels, primarily through programmes run by DfT, OLEV, the Research Councils, Innovate UK, and BEIS<sup>238</sup>.

The Government will build on this investment to make the UK one of the world's leading innovators in new low carbon technologies. Investments include:

- **Electric vehicle and battery technology.** Government investment will help bring down the cost of EVs and increase their range. Through the Industrial Strategy Challenge Fund (ISCF), we will invest £246 million over four years in the design, development and manufacture of batteries for the electrification of vehicles, as part of the 'Faraday Challenge'<sup>239</sup>. The Government has also awarded £10 million to build UK capability in the development and commercialisation of automotive battery packs.

<sup>236</sup> HM Government (2017) Beyond the Horizon: The future of UK aviation – a call for evidence on a new strategy <https://www.gov.uk/government/consultations/a-new-aviation-strategy-for-the-uk-call-for-evidence>

<sup>237</sup> Aerospace Technology Institute <http://www.ati.org.uk/>

<sup>238</sup> All figures are indicative and are subject to competitive bidding processes across sectors and value for money tests.

<sup>239</sup> BEIS (2017) Business Secretary announces Industrial Strategy Challenge Fund investments <https://www.gov.uk/government/news/business-secretary-announces-industrial-strategy-challenge-fund-investments>

- **Charging and grid support.** We will provide at least £70 million over the next five years to support innovation in energy storage, demand side response and other smart energy technologies, including up to £20 million for vehicle-to-grid products and services<sup>240</sup>. This is focused on how an expanded fleet of EVs could provide network flexibility and system balancing while potentially offering benefits to bill payers.
- **Advanced fuels.** There are fewer options for reducing emissions in the freight and aviation sectors, and here innovation in fuel technology can play an important role. We are providing £40 million out to 2021, to fund the development of advanced low carbon fuels derived from wastes or industrial and agricultural by-products. In August 2017 we relaunched the Future Fuels for Flight and Freight Competition - a £22 million industry competition to encourage development and deployment of low carbon HGV and aviation fuels.
- **Zero emission HGVs.** In January 2017, we announced the winners of over £20 million for the Low Emission Freight and Logistics Trial<sup>241</sup>. Twenty different projects are receiving funding to demonstrate and trial low and zero emission vehicles in UK fleets, for example using hydrogen, electric and biogas technologies. In the longer term, there is an opportunity to take forward projects to support innovative technologies such as 'dynamic charging' as a potential solution to decarbonising freight.
- **HGV platoons.** HGV platooning, using advanced vehicle technologies, enables lorries to move in a group and could deliver significant fuel and emissions savings. We will be delivering trials of HGV platoons, with joint funding from Highways England, to assess the feasibility and potential costs and benefits of this technology on UK roads. In August 2017, we announced a trial of HGV platoons, jointly funded with Highways England, which will see up to three HGVs travelling in convoy, with acceleration and braking controlled by the lead vehicle, and with a driver ready to take control at any time in all the HGVs. Platooning trials have been conducted across Europe and the USA, and these trials will assess whether the technology is appropriate and beneficial on UK roads.

Government has also established the Centre for Connected and Autonomous Vehicles (CCAV) and invested over £250 million, matched by industry, to position the UK at the forefront of research, development, and demonstration. These technologies have the potential to smooth traffic flows and increase efficiency of road transport. CCAV is also coordinating engagement with the wider research base and industry, identifying and reducing barriers to innovation or business expansion.

<sup>240</sup> BEIS (2017) Funding for innovative smart energy systems <https://www.gov.uk/guidance/funding-for-innovative-smart-energy-systems>

<sup>241</sup> DfT (2017) Low emission freight and logistics trial competition winners announced <https://www.gov.uk/government/news/low-emission-freight-and-logistics-trial-competition-winners-announced>

# Delivering Clean, Smart, Flexible Power



## Progress

Power sector emissions have fallen 49 per cent since 1990 as we have switched from coal to gas and renewable power such as wind and solar, with biomass conversions also playing an important transitional role, alongside improvements in the efficiency of

our economy<sup>242</sup>. Last year, 47 per cent of our electricity came from low carbon sources, with the rest mainly coming from coal and gas<sup>243</sup>. Coal use fell to record low levels last year, and on 21 April 2017, for the first time since 1882, we did not use any coal for a 24-hour period<sup>244</sup>. At the same time, we have ensured a secure supply of electricity.

**Figure 23: UK electricity generation by fuel type, 2000-2016<sup>245</sup>**



Source: BEIS

<sup>242</sup> BEIS (2017) Final UK greenhouse gas emissions national statistics: 1990-2015 <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>243</sup> BEIS (2017): Digest of UK Energy Statistics 2017 <https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes>

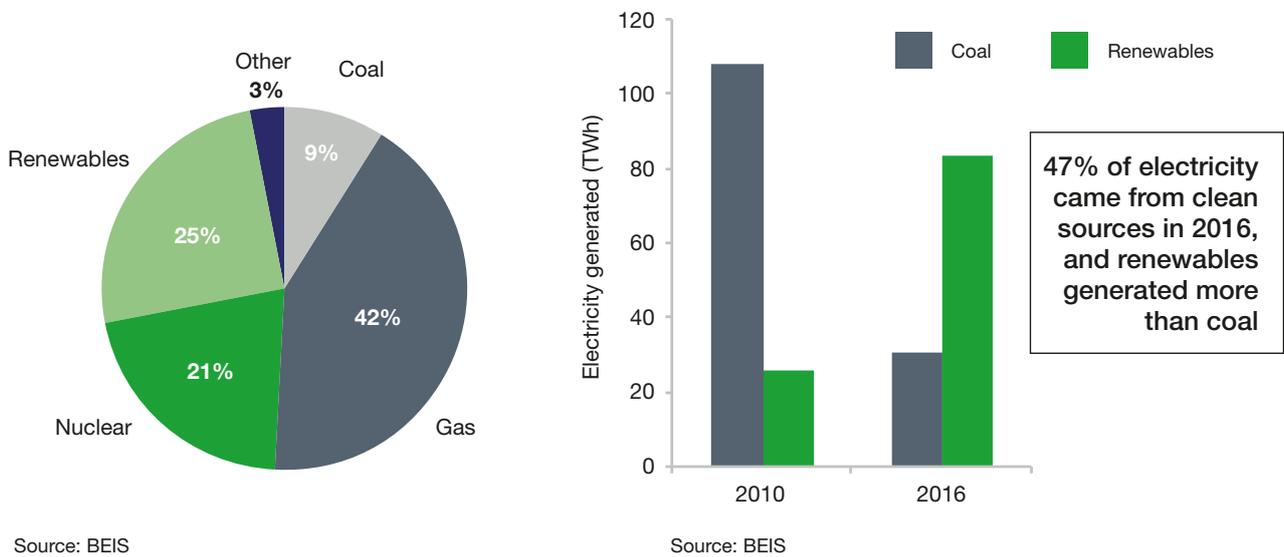
<sup>244</sup> Financial Times (2017) Britain passes historic milestone with first days of coal-free power <https://www.ft.com/content/fc2c8d12-191d-11e6-bb7d-ee563a5a1cc1>

<sup>245</sup> BEIS (2017) Energy Trends June 2017 <https://www.gov.uk/government/collections/energy-trends>

The costs of low carbon and more efficient technologies have fallen significantly since 2010 through a series of innovations and growth in deployment. Solar photovoltaic modules are now almost 80 per cent cheaper<sup>246</sup>, LED lightbulbs over 80 per cent cheaper<sup>247</sup>, and batteries for electric vehicles (EVs) over 70 per cent cheaper<sup>248</sup>. Average household electricity

bills in 2016 were around 10 per cent lower than in 2008, when the Climate Change Act was introduced<sup>249</sup>. While policy costs on bills have increased over this period, this has been more than offset by reduced electricity use, thanks in part to tightening standards on electrical products.

**Figure 24: UK electricity generation mix, 2016 (left) and UK electricity generation from coal and renewables 2010-16 (right)**<sup>250</sup>



<sup>246</sup> IRENA & IEA (2017) Perspectives for the energy transition: Investment needs for a low carbon energy system [http://www.irena.org/DocumentDownloads/Publications/Perspectives\\_for\\_the\\_Energy\\_Transition\\_2017.pdf](http://www.irena.org/DocumentDownloads/Publications/Perspectives_for_the_Energy_Transition_2017.pdf)

<sup>247</sup> International Energy Agency (2016) Energy Efficiency Market Report [https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016\\_WEB.PDF](https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016_WEB.PDF)

<sup>248</sup> Bloomberg New Energy Finance (2016) 2016 lithium-ion battery price survey <https://www.bnef.com/core/insights/15597>

<sup>249</sup> CCC (2017) Energy prices and bills report <https://www.theccc.org.uk/publication/energy-prices-and-bills-report-2017/>

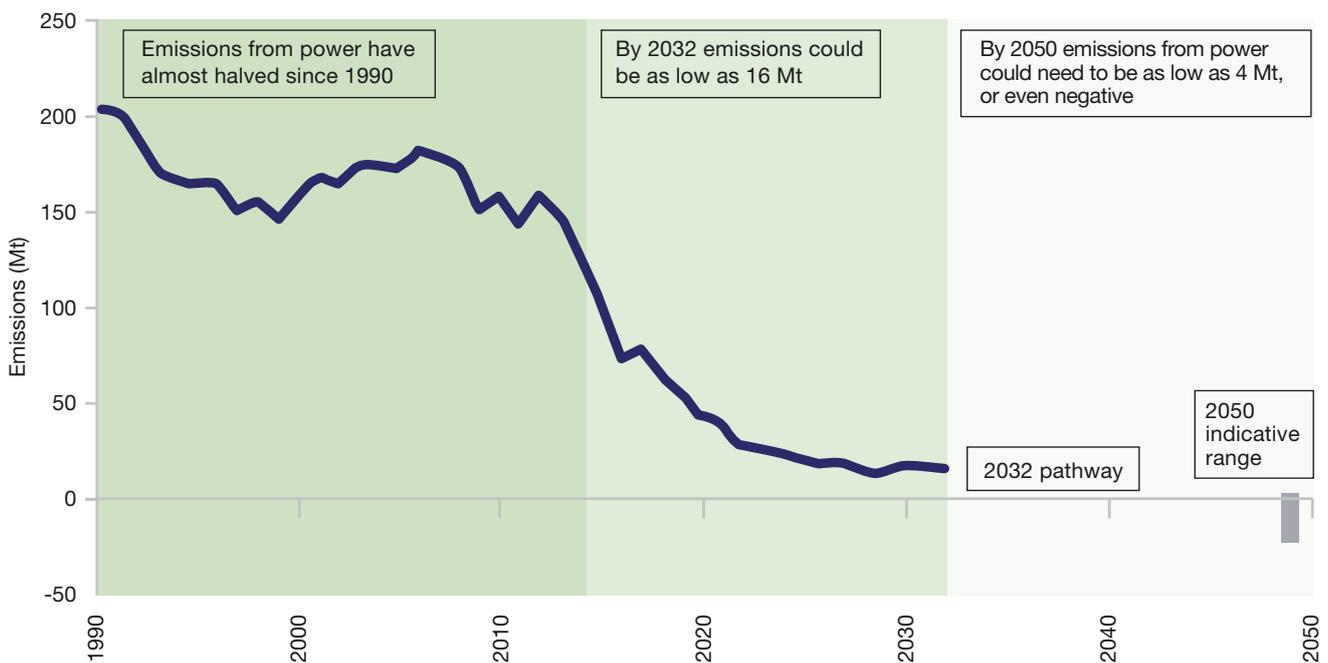
<sup>250</sup> BEIS (2017) Energy Trends <https://www.gov.uk/government/collections/energy-trends>

### Ambition

We want a diverse electricity system that supplies our homes and businesses with secure, affordable and clean power. That means developing low carbon sources of electricity that are both cheap and clean, taking into account wider system impacts for all sources of generation. It also means upgrading our electricity system so it is smarter (using data to provide greater control), more flexible (providing energy when it is needed) and takes advantage of rapidly developing technologies such as energy storage.

By 2050, we anticipate that emissions from the power sector could need to be close to zero<sup>251</sup>. Indeed, we may even see negative emissions – that is, greenhouse gases being removed from the atmosphere – from the sector if sustainable bio-energy and carbon capture and storage are used together. At the same time, many more people are expected to drive EVs, many homes and offices may have efficient electric heating and cooling, and more industrial sites could be powered by clean electricity. There are however alternatives to electrification, such as hydrogen, which could mean that electricity demand is more similar to today.

**Figure 25: Actual and projected power sector emissions, taking into account the clean growth pathway, 1990-2050**



Source: BEIS

<sup>251</sup> BEIS internal analysis of 2050 pathways

One possible pathway to 2032 could see power emissions fall by 80 per cent compared to today, to around 16 Mt<sup>252</sup>. This could be achieved by:

- Growing low carbon sources such as renewables and nuclear to over 80 per cent of electricity generation, and phasing out unabated coal power.
- Enabling a smarter, more flexible system, unlocking significant expansion of interconnection, electricity storage, and demand side response, the first steps of which are set out in the Smart Systems and Flexibility Plan<sup>253</sup>. For consumers, this could mean smart appliances and smart tariffs which help balance the grid in return for lower bills.

- Keeping costs down for consumers by reducing any wasted energy, including more efficient electrical products.

To achieve this we need to continue bringing down the costs of low carbon generation from renewables and nuclear power, and ensure that the UK can deploy CCUS at scale during the 2030s, subject to costs coming down sufficiently. We also need to remove barriers and improve price signals for smart energy innovations which improve the efficiency and flexibility of the system.

### Oxis Energy

OXIS energy, based in Oxfordshire has developed a high performing rechargeable battery which is lighter, more efficient and cheaper than competitor products. The company has received £2.7m in funding from Innovate UK and has grown to employ 60 staff. Their most recent grant is supporting them to produce a revolutionary electric vehicle battery.



<sup>252</sup> BEIS internal analysis of 2032 pathway

<sup>253</sup> BEIS and Ofgem (2017) Upgrading our energy system: smart systems and flexibility plan <https://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan>

### Powering Electric Vehicles and Heating

Electric vehicles, electric heating and energy efficiency are key options for reducing emissions in transport and buildings. The impacts of these measures on the power sector are taken into account in our 2032 pathway and summarised below. It shows a net increase of around 3 per cent in the electricity

demand and around 4 per cent in peak demand in 2032, and how this can be met through a mix of technologies. In practice, we do not yet know exactly how quickly costs will fall and take-up will increase for electric vehicles, or the role that electrification could play in the long-term decarbonisation of heat.

	Generation (2032)	Capacity (2032)
Impact of the 2032 pathway (compared to BEIS reference case)	Extra demand: 10 TWh (+3%)	Extra peak demand: 2.8 GW (+4%)
	Extra supply: Clean generators 3 TWh Interconnection 4 TWh Fossil fuels 4 TWh	Extra capacity and flexibility: Demand-side response 4.9 GW Storage 0.3 GW Clean generators 0.5 GW Fossil fuels 1.2 GW

Source: BEIS internal analysis of GB power system

Note: The impact of the 2032 pathway is assessed against an updated version of the published BEIS 2016 reference case<sup>254</sup>. Not all extra capacity and flexibility is available to help meet peak demand. Numbers may not sum due to rounding.

For this analysis, we took into account the potential for smart charging of electric vehicles and smart use of heat pumps. For example, we assumed potential to shift charging of most electric vehicles to overnight, which could reduce bills for consumers on a smart

tariff<sup>255</sup>. This ‘demand-side response’ – adjusting energy consumption to when it is plentiful and cheap – would help to balance the grid and reduce peak demand. Our Smart Systems and Flexibility Plan is about unlocking this potential<sup>256</sup>.

<sup>254</sup> BEIS (2017) Energy and Emissions Projections 2016 <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016> A number of model updates and improvements have been made regarding the electricity demand profiles of key technologies and how this demand might be shifted, the availability of electricity storage technologies, and assumed system operability requirements.

<sup>255</sup> Fisher, J., Gammon, R. and Irvine, K.N. (2015) My Electric Avenue <https://www.dora.dmu.ac.uk/xmlui/handle/2086/12180> There is considerable uncertainty on the extent to which customers will change their behaviours and we will be monitoring the evidence here.

<sup>256</sup> BEIS and Ofgem (2017) Upgrading our energy system: smart systems and flexibility plan <https://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan>

## Opportunities

The UK is well placed to benefit from the transition to a cleaner, smarter power sector and we already see jobs, regional investment and export sales flowing from UK supply chains for clean power technologies. In 2015, the low carbon electricity sector generated over £12 billion in turnover and directly supported 47,000 jobs, with more in supply chains<sup>257</sup>.

There is an opportunity for the UK to become one of the most advanced economies for smart energy and technologies, which is a core component of our Industrial Strategy, while upgrading our power infrastructure will improve energy security and air quality. Consumers will benefit from a smarter, more flexible power system to keep down costs, and will have more control of their energy through smart meters, with near real-time information on energy use and cost.

### Clayhill solar farm

Clayhill solar farm and energy storage facility is the first in the UK to be built without subsidy. Consisting of over 30,000 solar panels, it can generate enough power for 2,500 homes. Five onsite batteries allow electricity to be stored and utilised when needed, providing services for the electricity grid, such as frequency response. Co-locating storage at new renewable sites, combined with significant reductions in generation and storage technology costs, may allow more subsidy free sites to be built – providing services that help to maintain the reliability of the grid and clean electricity at low cost.



<sup>257</sup> ONS (2016) Low Carbon Economy and Renewable Energy Economy Survey <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2015results>

## Policies and Proposals

### Growing Low Carbon Sources of Electricity

1. We confirm the Government's intention to phase out unabated coal generation by 2025, and we will shortly publish the Government's detailed response to the consultation.
2. We are delivering new nuclear capacity through the final investment decision on Hinkley Point C, and will progress discussions with developers to secure a competitive price for future projects in the pipeline.
3. We will work with industry as they develop an ambitious Sector Deal for offshore wind. Provided costs continue to fall, this could result in 10 gigawatts of new capacity built in the 2020s, with the potential to support high value jobs and a sustainable UK industry exporting goods and services around the world. We will also consider whether there could be opportunities for additional offshore wind deployment in the 2020s, if this is cost-effective and deliverable. This would mean up to £557 million for further Pot 2 Contract for Difference auctions, with the next one planned for spring 2019. We will work with the Crown Estate and the Crown Estate (Scotland) to understand the potential for deployment of offshore wind in the late 2020s and beyond and it is our current intention that wind projects on the remote islands of Scotland that directly benefit local communities will be eligible for the next Pot 2 auction, subject to obtaining State aid approval.

4. We want to see more people investing in solar without government support and are currently considering options for our approach to small scale low carbon generation beyond 2019, and will provide an update later this year. More nascent technologies such as wave, tidal stream and tidal range, could also have a role in the long-term decarbonisation of the UK, but they will need to demonstrate how they can compete with other forms of generation.
5. We remain committed to carbon pricing to help reduce emissions in the power sector. Further details on carbon prices for the 2020s will be set out in the autumn 2017 Budget.

### Delivering Smarter, More Efficient Energy

6. The Government will ensure that every household is offered a smart meter by their energy supplier by the end of 2020, and we expect energy suppliers to make every effort to provide smart meters to all their customers.
7. The Government, Ofgem and industry will implement the 29 actions set out in the Smart Systems and Flexibility Plan published on 24 July. These will enable technologies such as energy storage and demand side response to compete effectively within the energy market, help integrate more low carbon generation such as solar into our energy system, and deliver secure, smart appliances and smart tariffs to allow consumers to benefit from using energy at times when it is cheaper. Innovations and other steps to increase flexibility could unlock up to £40 billion in energy cost savings up to 2050<sup>258</sup>.

<sup>258</sup> BEIS and Ofgem (2017) Upgrading our energy system: smart systems and flexibility plan <https://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan>

8. We will continue to work with Ofgem and the National Grid to create a more independent system operator which will help to keep household bills low through greater competition, coordination and innovation across the system.
9. We will work with Ofgem to ensure the necessary regulatory and market arrangements evolve to support the development of a clean, smart and flexible energy system as outlined in their strategy for regulating the future energy system<sup>259</sup>.
10. We will work to ensure significant private investment in new electricity interconnectors, which will help keep prices low for consumers, ensure a more secure grid and help integrate clean generation. Project assessments indicate the potential for at least 9.5 gigawatts more interconnection by the early-to-mid 2020s, in addition to the 4 gigawatts today and the 4.4 gigawatts under construction<sup>260,261</sup>.
11. Ofgem's price control regime will enable up to £26 billion of investment in upgrading and operating our electricity distribution networks from 2015-23<sup>262</sup> and we will work closely with industry to capitalise on the opportunities for smart integration of electric vehicles into the electricity system.
12. We confirm that when an installer installs solar panels with a battery in residential accommodation, this can attract a reduced VAT rate of 5 per cent if the installation conditions are met<sup>263</sup>. We will keep the tax treatment of technologies such as solar, storage and heat networks under review.

## Keeping Energy Costs Down for Businesses and Households

13. The Government has commissioned an independent review into the cost of energy led by Professor Dieter Helm CBE which will recommend ways to deliver the Government's carbon targets and ensure security of supply at minimum cost to both industry and domestic consumers. Once Ministers have had the opportunity to consider the Helm review's proposals, the Clean Growth Strategy will incorporate its recommendations into our further policy development as appropriate.
14. We are publishing a draft bill to require Ofgem to impose a cap on standard variable and default tariffs across the whole market.
15. The existing Levy Control Framework will be replaced by a new set of controls beyond 2020/21. These will be set out later this year.
16. We are evaluating the results of the Electricity Demand Reduction Pilot, which has offered organisations £5.4 million of funding for projects that could reduce bills and improve security of supply through making energy savings at peak times.

## Government Innovation Investment

The Government expects to invest around £900 million<sup>264</sup> of public funds between 2015 and 2021 in research and innovation in the power sector.

- **Power and smart systems:** Ensuring that the power system is smart and resilient to new demands and new sources of supply

<sup>259</sup> Ofgem (2017) Our strategy for regulating the future energy system <https://www.ofgem.gov.uk/publications-and-updates/our-strategy-regulating-future-energy-system>

<sup>260</sup> Ofgem <https://www.ofgem.gov.uk/electricity/transmission-networks/electricity-interconnectors>

<sup>261</sup> Ofgem (2017) Cap and floor regime: Initial Project Assessment of the GridLink, NeuConnect and NorthConnect Interconnectors <https://www.ofgem.gov.uk/publications-and-updates/cap-and-floor-regime-initial-project-assessment-gridlink-neuconnect-and-northconnect-interconnectors>

<sup>262</sup> Ofgem (2017) RIIO ED1 Annual Report 2015-16 <https://www.ofgem.gov.uk/publications-and-updates/riio-electricity-distribution-annual-report-2015-16>

<sup>263</sup> Each case will be considered on the specific facts. If batteries are sold separately and retrofitted to existing solar systems, VAT will be charged at the standard rate of 20%.

<sup>264</sup> All figures are indicative and are subject to competitive bidding processes across sectors and value for money tests. Numbers may not sum due to rounding.

will be important for energy security, cost and industrial opportunities. The Government, in partnership with the Research Councils and Innovate UK, expects to invest around £265 million in research, development and deployment in this area which will help to reduce the cost of electricity storage, advance innovative demand response technologies and develop new ways of balancing the grid, for example using EVs.

- **Nuclear:** We need to bring down the costs of nuclear power while maintaining safety by investing in innovation that will help plants to be built to time and budget. The Government, in partnership with the Research Councils and Innovate UK, expects to invest around £460 million to support work in areas including future nuclear fuels, new nuclear manufacturing techniques, recycling and reprocessing, and advanced reactor design. The Government has asked the Nuclear Innovation and Research Office (NIRO) to convene a new advisory Board, building on the success of the Nuclear Innovation and Research Advisory Board (NIRAB). The Board will provide independent expertise and advice to support and inform the Government's Nuclear Innovation Programme. The Government is also announcing that it will invest £7 million to further develop the capability and capacity of the nuclear regulators to support the development of advanced technologies. Industry is developing a potential nuclear sector deal as part of the Government's Industrial Strategy, co-ordinated around the objective of achieving cost reductions.
- **Renewables:** The UK already has a world leading offshore wind sector and is well placed to benefit from further investment in renewables innovation to accelerate cost reduction. The Government, in partnership with the Research Councils and Innovate UK, expects to invest around £177 million to further reduce the cost of renewables, including innovation in offshore wind turbine blade technology and foundations. New innovation opportunities are likely to arise in a number of areas, including floating offshore wind platforms, and advanced solar PV technologies.
- **Carbon capture, usage and storage:** CCUS could reduce the cost of meeting our 2050 target by supporting emissions reductions in industry, power, heating and transport<sup>265</sup>. Our new approach to CCUS is set out in the Business chapter.
- Ofgem is making available to GB electricity network companies up to £525 million of regulated expenditure between 2016 and 2021<sup>266</sup>. The goal is to support smarter, flexible networks, from enabling the integration of clean generation through to customer-focussed energy efficiency measures. This builds on previous network company innovation which delivered 4.5 – 6.5 times more benefits for consumers than it cost<sup>267</sup>.

<sup>265</sup> BEIS internal analysis of 2050 pathways

<sup>266</sup> Ofgem internal analysis

<sup>267</sup> Poyry and Ricardo Energy & Environment (2016) An independent evaluation of the LCNF [https://www.ofgem.gov.uk/system/files/docs/2016/11/evaluation\\_of\\_the\\_lcnf\\_0.pdf](https://www.ofgem.gov.uk/system/files/docs/2016/11/evaluation_of_the_lcnf_0.pdf)

## Enhancing the Benefits and Value of Our Natural Resources



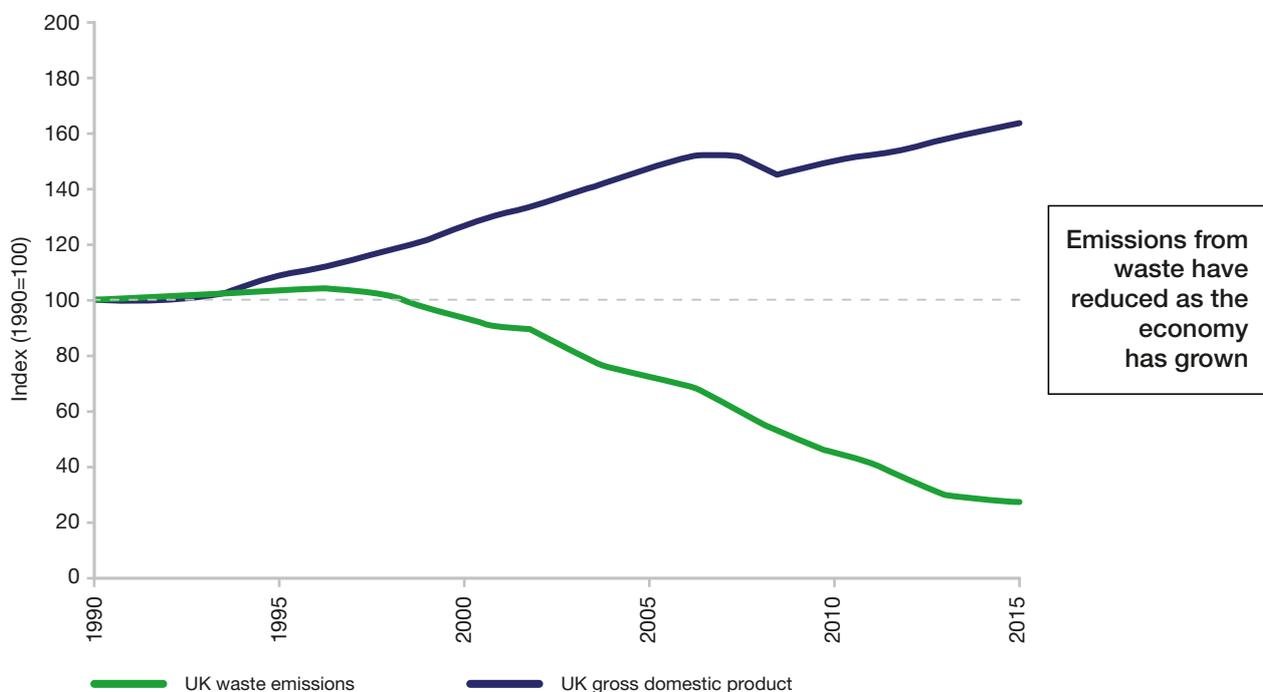
### Progress

The UK is generating more value from the use of our natural resources (covering livestock, crops, trees, land use and waste) while also cutting emissions. We have halved our emissions from these sectors since 1990 and they now only account for 15 per cent of total UK emissions<sup>268</sup>.

During this time emissions from the waste sector have decreased by 73 per cent. This

has been driven by taxing waste to landfill, increased recycling and more and better waste infrastructure. We have seen household recycling rates increase from 11 per cent to 44 per cent between 2000/1 and 2015/16<sup>269</sup>. At the same time, the UK waste sector has become an important contributor to electricity generation. Waste helped to generate 14 per cent of UK renewable electricity in 2015, enough to power 2.3 million homes<sup>270</sup>.

**Figure 26: Changes in emissions from waste and economic growth, 1990-2015**



Source: ONS, BEIS

Emissions from waste have reduced as the economy has grown

<sup>268</sup> BEIS (2017) Final UK greenhouse gas emissions national statistics: 1990-2015 <https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics>

<sup>269</sup> Defra (2016) ENV18 - Local authority collected waste: annual results tables <https://www.gov.uk/government/statistical-data-sets/env18-local-authority-collected-waste-annual-results-tables>

<sup>270</sup> BEIS (2017) Energy Trends: Renewables <https://www.gov.uk/government/statistics/energy-trends-section-6-renewables>

This shift in resource efficiency has also been seen in agriculture – since 1990 emissions from producing a kilogram of pork have decreased by 30 per cent and by 16 per cent for a litre of milk. Many of our farms are using more efficient agricultural practices, for example improving crop nutrient and crop health management.

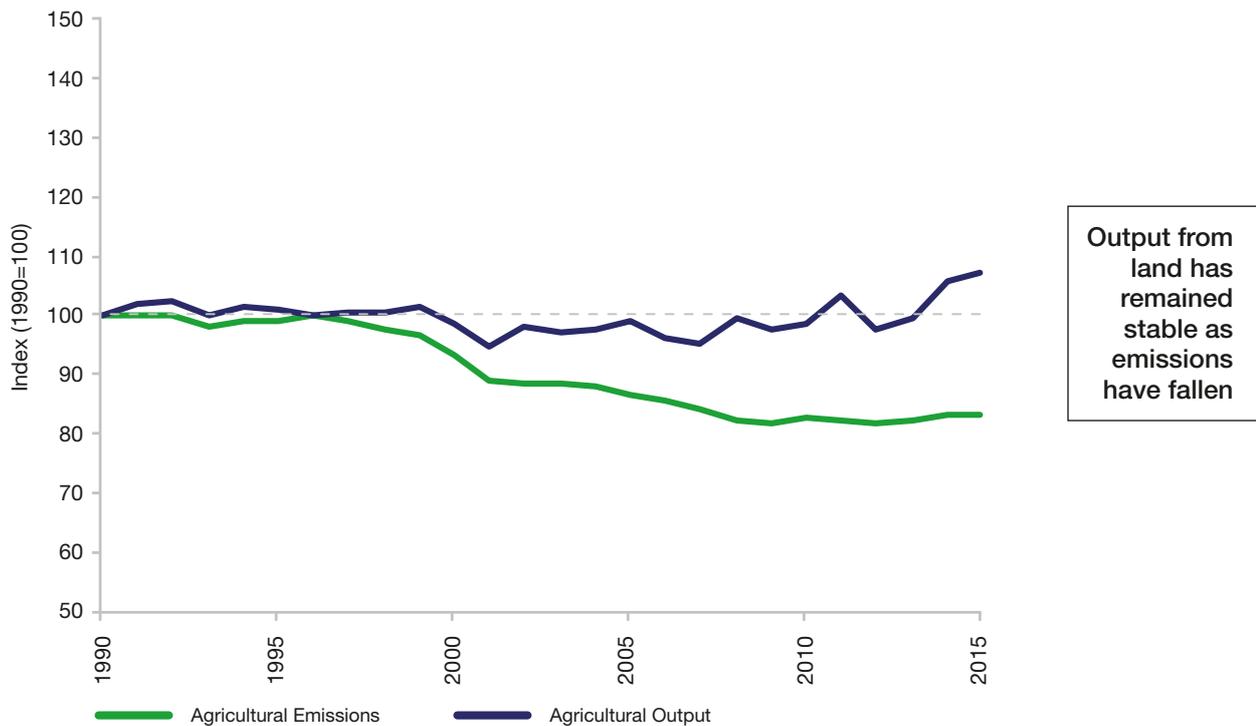
**Ambition**

We want low emission, highly productive land while ensuring we hand our environment on to the next generation in a better state than we found it. As part of this, we want the UK to become a world leader in terms of competitiveness, resource productivity and resource efficiency: maximising the value we extract from our resources, and minimising the negative environmental and carbon impacts associated with their extraction, use and disposal. We will work toward achieving zero avoidable waste by 2050.

Reducing emissions from natural resources will be important for meeting the 2050 target cost-effectively. Emissions from natural resources could fall by 30 per cent, with tree cover in England increasing by 180,000 hectares from 9.8 per cent to 11 per cent, as they are nurtured from saplings into maturity, providing essential spaces for our communities and enhancing our carbon sink.

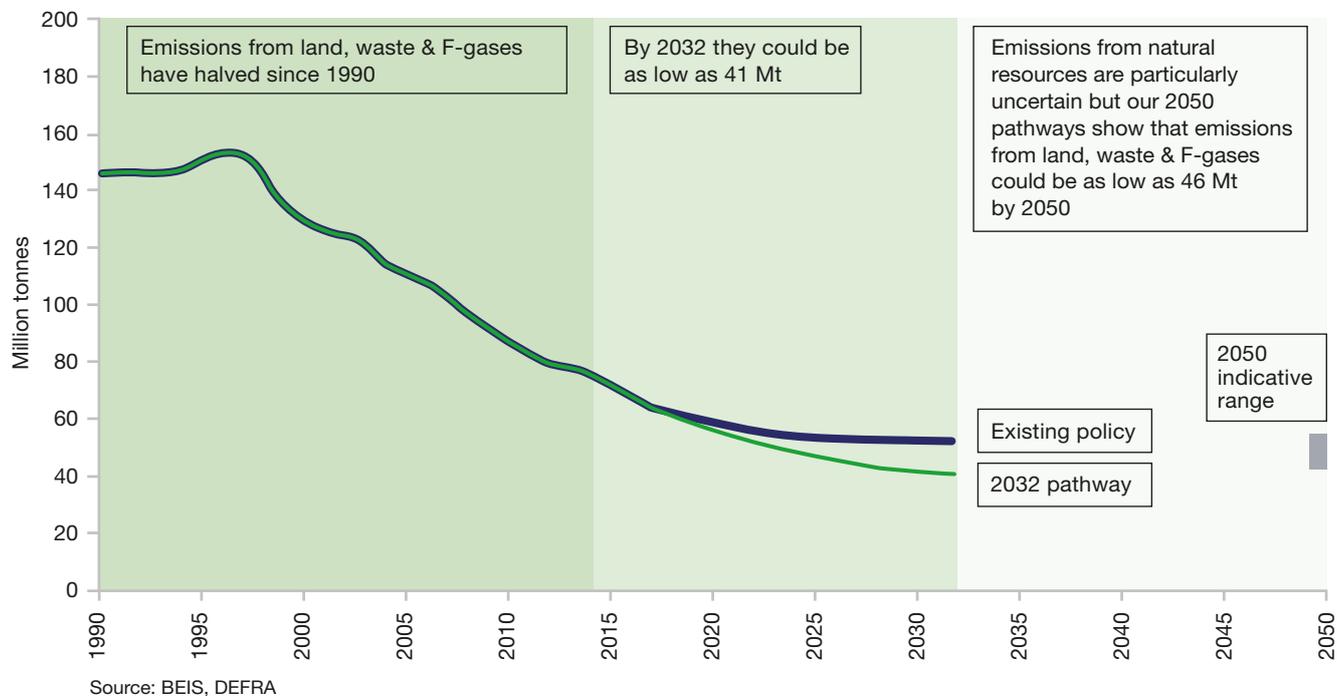
One possible pathway to 2032 could involve emissions from our natural resources falling by almost two fifths compared to today, and is consistent with meeting the Government's 2060 aspiration, to increase England's woodland cover from 10 per cent to 12 per cent. The pathway ramps-up planting in the 2020s recognising the significant contribution trees make to later carbon budget periods.

**Figure 27: Changes in emissions from agriculture and agricultural outputs, 1990-2015<sup>271</sup>**



<sup>271</sup> ONS (2016) Annual and quarterly low level aggregates of UK output gross value added (GVA), <https://www.ons.gov.uk/economy/grossdomesticproductgdp/datasets/ukgdpolowlevelaggregates/current>

**Figure 28: Actual and projected emissions in natural resources, taking into account the clean growth pathway, 1990-2050**



To achieve this 2032 pathway, we need to ensure that our farmers and land managers have the right incentives to promote environmental improvement while encouraging consumers, businesses and industry to further reduce waste and improve their resource efficiency, resulting in reduced bills. This means:

- Leaving the Common Agricultural Policy and designing a new system of future agricultural

support will give us the opportunity to address climate change more directly. We will design a new system to support the future of farming and the countryside, with a strong focus on delivering better environmental outcomes, including tackling climate change. An Agriculture Bill was announced in the Queen’s Speech following the 2017 general election, the details of which will be announced shortly.

- Our indicative pathway could involve planting up to 130,000 hectares of new woodland and implement plans for farmers to plant more trees across England, providing not just carbon reduction but recreational space for our growing communities and timber for our bioeconomy.
- We will develop new ambitious plans for the sustainable management of our natural environment including capturing more carbon by our plants and soil.
- Action to divert more food waste than ever before from landfill, to support resource productivity and avoid further emissions by preventing food waste in the first place.

## Opportunities

The UK has some of the most dynamic and innovative businesses working on using our natural resources more efficiently. Government will work with them to deliver smart and ambitious regulation and targets to help us meet new environmental demands while also driving growth from these sectors.

There are clear economic benefits to be gained from driving resource productivity, a more efficient farming sector and developing the UK's land use sector. Forestry is a growth sector, with forestry and wood processing providing 43,000 jobs in the UK and contributing £2 billion to the economy<sup>272</sup>. This, in turn, provides an important carbon sink – the doubling of woodland cover over the past century means UK forests currently absorb 20 million tonnes of carbon dioxide a year.

Analysis from the Waste and Resources Action Programme (WRAP) suggests progress to a more resource efficient economy has the potential to create up to 205,000 jobs<sup>273</sup>. Some 54,000 of these jobs could be created in regions and at pay grades where there is spare capacity, making a net contribution to UK employment.

## Manchester City of Trees

Manchester City of Trees is an urban community partnership focussed on tree planting, woodland management and re-connecting communities to green spaces. The goals of the project are 3 million trees planted, one for every man, woman and child across Greater Manchester, 2,000 hectares of unmanaged woodland brought back into a productive state, and to connect people to the trees and woods around them.



<sup>272</sup> Forestry Commission (2016) Forestry Statistics 2016 [https://www.forestry.gov.uk/pdf/Ch8\\_Finance\\_FS2016.pdf/\\$FILE/Ch8\\_Finance\\_FS2016.pdf](https://www.forestry.gov.uk/pdf/Ch8_Finance_FS2016.pdf/$FILE/Ch8_Finance_FS2016.pdf); [https://www.forestry.gov.uk/pdf/Ch7\\_Employment\\_FS2016.pdf/\\$FILE/Ch7\\_Employment\\_FS2016.pdf](https://www.forestry.gov.uk/pdf/Ch7_Employment_FS2016.pdf/$FILE/Ch7_Employment_FS2016.pdf) Estimate of economic value and jobs relates to forestry and primary wood processing; National Atmospheric Emissions Inventory (2017) Projections of emissions and removals from the LULUCF sector to 2050 [http://naei.beis.gov.uk/reports/reports?report\\_id=927](http://naei.beis.gov.uk/reports/reports?report_id=927)

<sup>273</sup> Waste and Resources Action Programme (2015) Employment and the Circular Economy <http://www.wrap.org.uk/content/employment-and-circular-economy>

## Policies and Proposals

The Government's 25 Year Environment Plan will set out the Government's approach to improving our natural environment, including reducing both carbon emissions and other dangerous pollutants. In meeting carbon budgets we are committed to policy development that enhances our natural assets, helps prepare for the impacts of climate change and supports our commitments on clean air.

### Farmers and Rural Businesses Benefit from Clean Growth Opportunities

We want our land and agriculture sectors to play a significant role in low carbon growth, supported through a system of incentives to improve efficiency and improve our natural environment:

1. The Government will introduce a new agri-environment system to support the future of farming and the countryside, with a strong focus on delivering better environmental outcomes, including mitigation of and adaptation to climate change.
2. We aim to support industry in strengthening farm biosecurity to improve productivity, reduce reliance on veterinary medicines and reduce emissions. To begin this, we are developing a scheme to directly tackle endemic diseases in beef and dairy herds.
3. We will work with industry to encourage the use of low-emissions fertiliser. We will review the levels of take up over the next five years using data from the British Fertiliser Practice Survey. This will provide evidence to shape our future policies.
4. We will work with industry to produce a UK Bioeconomy Strategy that will bring together biological industries, academia and innovators, linking up farmers and land managers with high tech industries. Through a thriving innovation-based bioeconomy, we will develop less carbon intensive products such as bio-based chemicals, plastics and other materials.
5. We will develop a new incentive structure to harness the potential for growth in forestry and renewables being supplied from within the UK, including on bioenergy, as part of our ambitions for strengthening the rural economy and encouraging diversification of farm businesses.
6. Funding from the £200 million package of Rural Development Plan for England (RDPE)<sup>274</sup> Growth Programme and Countryside Productivity Offers, announced in July 2017, could be used to support renewable energy projects, such as solar panels or small wind turbines linked to battery storage.

<sup>274</sup> Rural Development Programme for England (RDPE), which works to make England's agriculture and forestry sectors more competitive, to improve the quality of life in rural areas and to diversify rural economies.

## Natural Capital

**What is natural capital?** Natural capital enables us to think about our natural environment and the countryside as a set of valuable assets (for example, forests, clean air, soils, species, freshwaters, oceans and minerals). Like any asset, natural capital, if maintained and invested in, provides flows of services to the economy and society. These include food, energy, carbon sequestration, pollutant removal, flood risk reduction, recreational and educational opportunities, health benefits and many others. Many of these benefits do not have a direct market value.

**Why is natural capital relevant for reducing carbon emissions?** The Climate Change Act requires that our plan for reducing emissions contribute to sustainability. As part of this work we have looked at how measures and policies could have impacts on our natural assets, including the impact of reducing carbon emissions. Natural capital can also contribute significantly to reducing levels of greenhouse gases through land use and land use change. This is described in the Technical Annex. The Government's wider work on natural capital will be set out in the 25 Year Environment Plan.

### Making Sure Our Land Plays a Central Role in Capturing Carbon and Enhancing Natural Capital

7. During the 2020s we need to accelerate the rate of tree planting, working towards our 12 per cent tree cover aspiration by 2060. To do this will require investment by the private and charitable sectors, not just government. A number of our policy proposals will create the conditions for that investment to come forward. We will need new skills in forest design, a reliable supply of resilient planting stock, new opportunities for domestic timber, and a new generation of skilled people helping to enhance our towns, cities and countryside. Recently published natural capital accounts by the Office for National Statistics show that Britain's woodlands provide services of £2.3 billion per year to the economy in terms of recreation, carbon sequestration, timber and air pollutant removal<sup>275</sup>.
8. We will develop a new network of English forests with the right incentives and rules to establish and support new regional and national community woodlands to help reach 12 per cent woodland cover in England by 2060. We have allocated funding to woodland planting to support our commitment to plant 11 million trees<sup>276</sup>.
9. We will set up a stronger and more attractive domestic carbon offset market that will encourage more businesses to support cost-effective emissions reductions, such as through planting trees. We will also explore how we could extend this market to include other land activities.
10. We will unlock private finance to invest in forestry by establishing forestry investment zones to offer investors streamlined decision making and more certainty, within shorter timelines.
11. We will fund larger-scale woodland and

<sup>275</sup> ONS (2017) UK natural capital: ecosystem accounts for freshwater, farmland and woodland <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapital/landandhabitatecosystemaccounts>

<sup>276</sup> Forestry Commission and Natural England (2017) Countryside Stewardship opens for 2017 <https://www.gov.uk/government/news/countryside-stewardship-opens-for-2017>

forest creation, and we will design woodland creation incentives that attract more landowners and farmers to plant on marginal land, including through agroforestry and bioenergy production, to help diversify land-based businesses and enhance the farmed environment.

12. Peatland, like woodland, forms a key part of the UK's natural capital, but is widely degraded. We launched a £10 million capital grant scheme for peat restoration in July 2017 to target peatlands in England. Funds are available from April 2018 for three years<sup>277</sup>.
13. We will work with industry to increase the amount of UK timber used in construction, creating a conveyor belt of locked-in carbon in our homes and buildings.

### **The UK will work towards being a Zero Avoidable Waste economy by 2050**

14. Zero avoidable waste equates to eliminating all waste where it is technologically, environmentally and economically practicable to do so and working to support innovation in new materials, products and processes that extend the range of materials covered by this categorisation.
15. Working in partnership with business and civil society toward our shared zero avoidable waste ambition, we will support the transition to a highly productive and competitive economy where we unlock the environmental and economic benefits associated with greater resource productivity without imposing negative costs on business or society.
16. By working in partnership with industry, we will be able to seek out opportunities to achieve even greater levels of recycling, improve the utilisation of our food and bio-waste and incentivise activities such as reuse, repair and remanufacturing – protecting our environment and strengthening our economy in the long-term.
17. We will work towards no food waste entering landfill by 2030. Many local authorities have introduced separate collection of food waste and we will work to support more so that the amount of food waste sent to landfill continues to decline.
18. We will set out a new Resources and Waste strategy which seeks to maximise resource productivity, reduce waste in our energy and resource systems, promote well-functioning markets for secondary materials and incentivise producers to design better products. The strategy will focus on three key areas:
- Maximising resource productivity - through more efficient manufacturing processes
  - Maximising the value we get from resources throughout their lifetimes - by designing products more smartly to increase longevity and enable recyclability
  - Managing materials at end of life – by targeting environmental impacts

<sup>277</sup> Defra press release (2017) New £10 million fund to restore peatland <https://www.gov.uk/government/news/new-10-million-fund-to-restore-peatland>

19. We will explore how data can support the development of a network of resource efficiency clusters led by Local Enterprise Partnerships (LEPs), whereby LEPs would develop local level strategies to drive greater resource efficiency, supporting processes such as industrial symbiosis and the development of new disruptive business models that challenge inefficient practice.
20. We will explore how we can better incentivise producers to manage resources more efficiently through producer responsibility schemes.
21. We will take action through the Courtauld 2025 Agreement to reduce the amount of food that is wasted in the UK. This could deliver up to £20 billion worth of savings to the UK economy between 2015 and 2025<sup>278</sup>. We will also divert more food from landfill to support resource productivity and avoid further emissions.

22. We will explore new and innovative ways to manage emissions from landfill, undertaking research and analysis to support new approaches such as optimising surface methane oxidation. We will also investigate accelerating the breakdown of waste in landfill to improve the quantity and quality of landfill gas captured. This research should identify innovation to bring down the costs of low carbon technologies and lay the groundwork for future decisions.

### Government Innovation Investment

The Government expects to invest £99 million out to 2021 on innovation in natural resources. The Government wants the UK to be at the forefront of land-based innovation – ensuring our industry remains at the cutting edge of agricultural and bio-based technology development through the forthcoming bioeconomy strategy and through the existing £160 million Agri-Tech Strategy<sup>279</sup>:

### Recycling Technologies

Recycling Technologies, based in Swindon, has developed a new process that can recycle mixed plastic waste, which normally goes to landfill or is incinerated, into a clean fuel. With the support of an Energy Entrepreneurs Fund grant of around £700,000, testing has shown that this product can be used in industrial burners or marine engines. As an alternative, the product could be distilled and used as feedstock to make more new plastics, paints, polishes or lubricants. Recycling Technologies recently raised £5 million in private investment and are now actively on the lookout for further manufacturing sites.



<sup>278</sup> WRAP (2016) The Courtauld Commitment 2025 to transform UK food and drink <http://www.wrap.org.uk/content/courtauld-commitment-2025-transform-uk-food-and-drink>

<sup>279</sup> Defra (2015) Agricultural technologies (agri-tech) strategy <https://www.gov.uk/government/collections/agricultural-technologies-agri-tech-strategy>

- **Innovative technology:** The Government has supported research on innovative technologies in agriculture via the Agri-Tech Catalyst, to accelerate the translation of research into practical solutions to improve agricultural productivity, whilst reducing the environmental impact of agricultural production, some of which has additional low carbon benefits.
- **Centres for Agri-tech Innovation:** Four centres have been funded in partnership with industry, academia and Government:
  - **Agrimetrics** - £11.8 million for a ‘big-data’ centre of excellence for Agrimetrics to utilise data science and modelling to build a more productive, sustainable and efficient food system.
  - **Agricultural Engineering Precision Innovation Centre (Agri-EPI)** - £17.7 million on precision agriculture to help the UK’s agri-food sector develop more productive and sustainable UK agriculture and export markets.
  - **Centre for Crop Health and Protection (CHAP)** - £21.3 million to revolutionise how farmers manage crop threats including pests and disease, both in the UK and overseas.
  - **Centre for Innovation Excellence in Livestock (CIEL)** - £29.1 million to create new livestock technology and products to boost the profitability and productivity of livestock farming.

To complement this early action on innovation, the Government believes there are further opportunities for innovation linked to natural resources. In determining these we have focused where the Government can add the most value and develop UK opportunities. The main innovation challenges that could be unlocked are below, with detail on opportunities for UK investment.

## Land

Improving productivity and management skills on farms, coupled with technological innovation, will provide the tools for achieving a step change in the level of carbon savings.

- **Fertiliser:** We will develop affordable low carbon fertiliser products to reduce and replace fertilisers; explore the potential for bio-stimulants to improve nutrient use efficiency; and explore the viability of fertiliser production by recovering nutrients from wastes and other organic materials.
- **Soil health:** We will aim to target new sustainable land management techniques to overcome the decline in soil quality in the UK and the impact on productivity. We are already funding UK research into soils to deliver greenhouse gas removals (GGR) and abatement technologies as part of the £8.6 million research on GGRs<sup>280</sup>.
- **Crops and livestock genetics:** We will explore the mitigation potential of new breeding technologies and any barriers to their deployment to improve agricultural and forestry productivity and resilience.

<sup>280</sup> The National Environment Research Council (2017) £8.6 million UK research programme on greenhouse gas removal <http://www.nerc.ac.uk/press/releases/2017/09-greenhousegas/>

- **Low emission farming techniques:** We will reduce the costs of resource use in crop and livestock production by: improving our understanding of crop soil interactions; explore the potential of robotics and the latest sensor technologies; precision farming technologies more viable on smaller scale farms, investigate the potential of improving soil health and carbon stocks.
- **Forestry innovation:** We need to improve the resilience and productivity of our forests such as through greater understanding of how tree genetics can contribute to GGRs, especially as we approach 2050.
- **Resource efficiency.** We will encourage the development of business models which encourage resource efficiency, extend product life, conserve resources, and prevent material from becoming waste. Innovate UK's £15 million Manufacturing and Materials Competition will support the development of more flexible and efficient processes and materials.
- **Energy recovery processes.** We will work with the waste sector to ensure that different waste materials going into energy recovery processes are treated in the best possible way, to minimise environmental impact and maximise their potential as a resource. The National Infrastructure Commission's work on different pathways for the treatment of waste will feed into this. We will also work with businesses to explore the use of bio-based materials and to promote recyclable packaging so that more is recycled.

Innovate UK will also ensure that future rounds of its health and life science calls encourage bids which directly or indirectly support practices that may have a positive impact on climate change.

## **Waste**

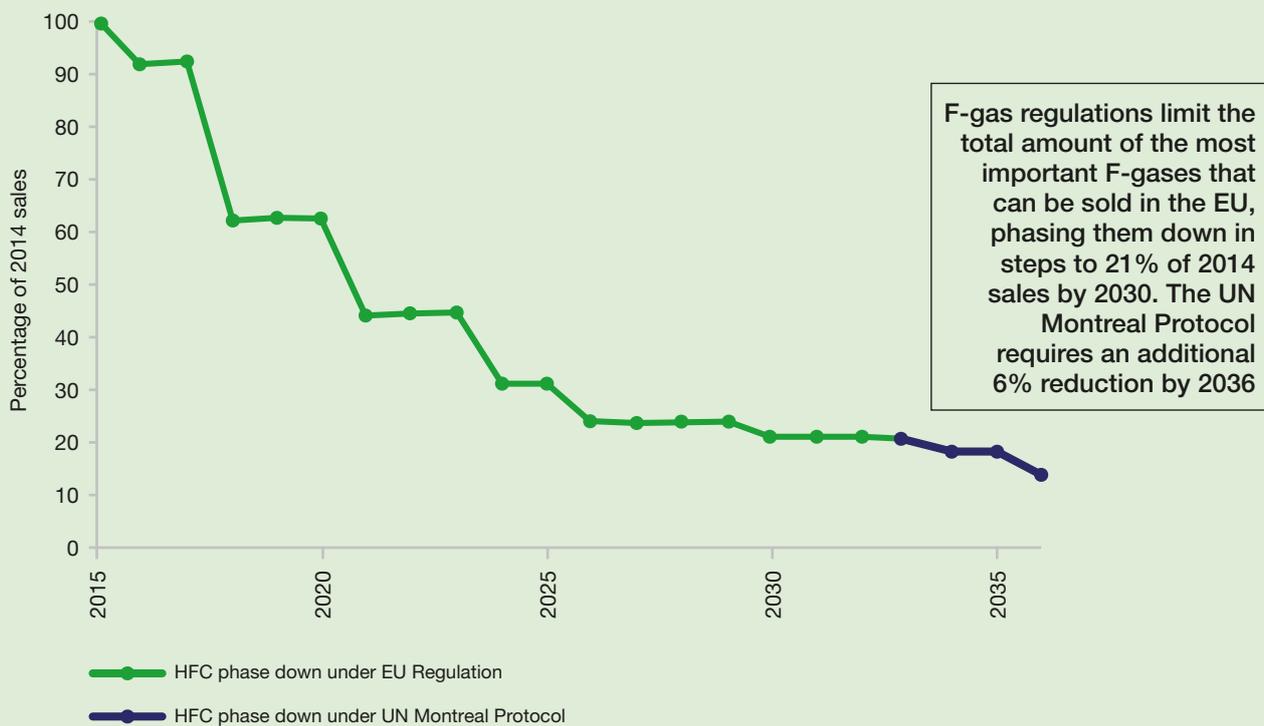
- **Anaerobic Digestion.** We need to ensure the sector continues to support our carbon and air quality goals, and that best practice is followed when digestate is spread to land to minimise ammonia release and air quality and pollutant impacts. This includes development of improved digestion and ammonia and phosphate extraction technologies while working with the sector to focus on reducing methane emissions.
- **Landfill gas capture and management.** There is an opportunity to undertake further research to accelerate methane production in the early life of a landfill site to reduce the length of aftercare required. This could help to reduce emissions from landfill further and in a sustainable way.

### Fluorinated Gases

Fluorinated gases (F-gases) are powerful greenhouse gases with a climate change effect up to 23,000 times greater than carbon dioxide<sup>281</sup>. Often used as refrigerants, the reduction in F-gas emissions has been a major success story as we decarbonise the economy. UK emissions decreased by 20 per cent between 1995 and 2015. Our current policies will cut UK F-gas emissions from 17 MtCO<sub>2</sub>e in 2015 (about 3 per cent of total UK emissions) to 9.3 MtCO<sub>2</sub>e by 2023, 6.6 MtCO<sub>2</sub>e by 2027 and 3.2 MtCO<sub>2</sub>e by 2035, representing an 81 per cent cut from 2015 levels<sup>282</sup>.

The UK led the way in pledging to phase down use of hydrofluorocarbons (HFCs) by 79 per cent by 2030. Following the UK lead, 197 countries agreed under the United Nations Montreal Protocol to a global phase down of HFCs which will see the UK and other developed countries go even further by delivering an 85 per cent phase down by 2036. It is estimated that this deal will reduce emissions equating to 0.5°C of avoided temperature change<sup>283</sup> by 2100, making a major contribution to the Paris Agreement on climate change and the goal of keeping the global temperature increase well below 2 degrees.

Figure 29: F-gas reduction steps, 2015-2036<sup>284</sup>



<sup>281</sup> IPCC (2007) Climate Change 2007: Working Group I: The Physical Science Basis [https://www.ipcc.ch/publications\\_and\\_data/publications\\_ipcc\\_fourth\\_assessment\\_report\\_wg1\\_report\\_the\\_physical\\_science\\_basis.htm](https://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm)

<sup>282</sup> BEIS (2017) Energy and Emissions Projections 2016 <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016>

<sup>283</sup> National Institute for Public Health and the Environment – Netherlands (2016) RIVM research basis for historic climate agreement on HFCs [http://www.rivm.nl/en/Documents\\_and\\_publications/Common\\_and\\_Present/Newsmessages/2016/RIVM\\_research\\_basis\\_for\\_historic\\_climate\\_agreement\\_on\\_HFCs](http://www.rivm.nl/en/Documents_and_publications/Common_and_Present/Newsmessages/2016/RIVM_research_basis_for_historic_climate_agreement_on_HFCs)

<sup>284</sup> European Parliament and Council (2014) Annex V of Regulation (EU) no 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006 <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0517&from=EN>

## Leading in the Public Sector



### Progress

Since 1990, the public sector – including central and local government, health, education and emergency services – has reduced its emissions by 40 per cent<sup>285</sup> as a result of energy efficiency and rationalisation of the central government estate.

Central government and its agencies have led by example through the Greening Government Commitments (GGC), which include a greenhouse gas reduction target. As of 2015/16, we have succeeded in meeting the target by delivering a 27 per cent emissions reduction and £127 million of savings against 2009/10 levels<sup>286</sup>. The original target was a 25 per cent reduction compared to the 2009/10

baseline so new targets were set in January 2017, with the aim of achieving a 32 per cent reduction by 2019/20.

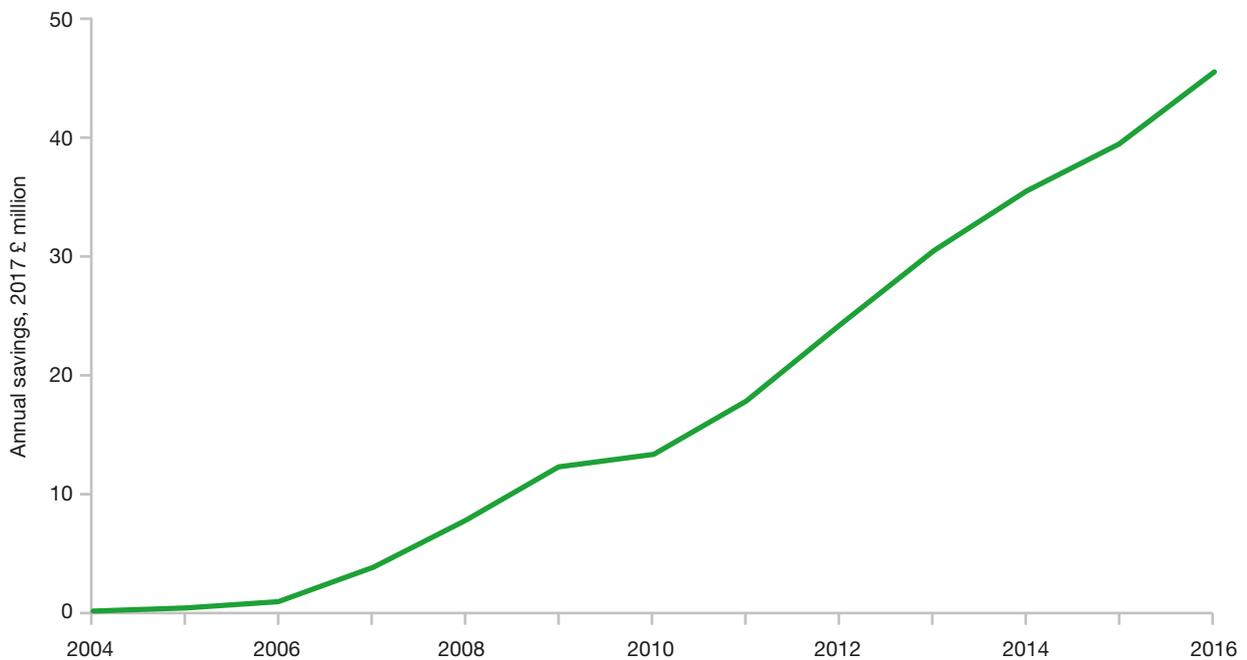
Outside central government, energy efficiency has been supported by an interest-free loan scheme, managed by Salix Finance. To date, the loan scheme has funded over 16,000 projects, improving public sector and higher education buildings for its users and is projected to save the sector around £55 million on energy bills this year<sup>287</sup>. In addition, the Re:Fit programme, managed by Local Partnerships, has helped public sector organisations invest in energy efficiency and energy generation projects by helping them to establish energy service contracts.

<sup>285</sup> Compared to 2015 levels. Sustainable Development Unit (2016) Sustainable Development in Health and Care Report – Health Check 2016 <http://www.sduhealth.org.uk/policy-strategy/reporting/sustainable-development-in-health-and-care-report-2016.aspx>

<sup>286</sup> Defra (2017) Greening Government Commitments 2015-2016 Annual Report <https://www.gov.uk/government/publications/greening-government-commitments-2015-to-2016-annual-report> This includes all end use emissions

<sup>287</sup> Salix Finance: Public Sector Loan Scheme <https://www.salixfinance.co.uk/>

**Figure 30: Annual energy bill savings from public sector Energy Efficiency Loans**



Source: Public Sector Energy Efficiency Loan Scheme BEIS model

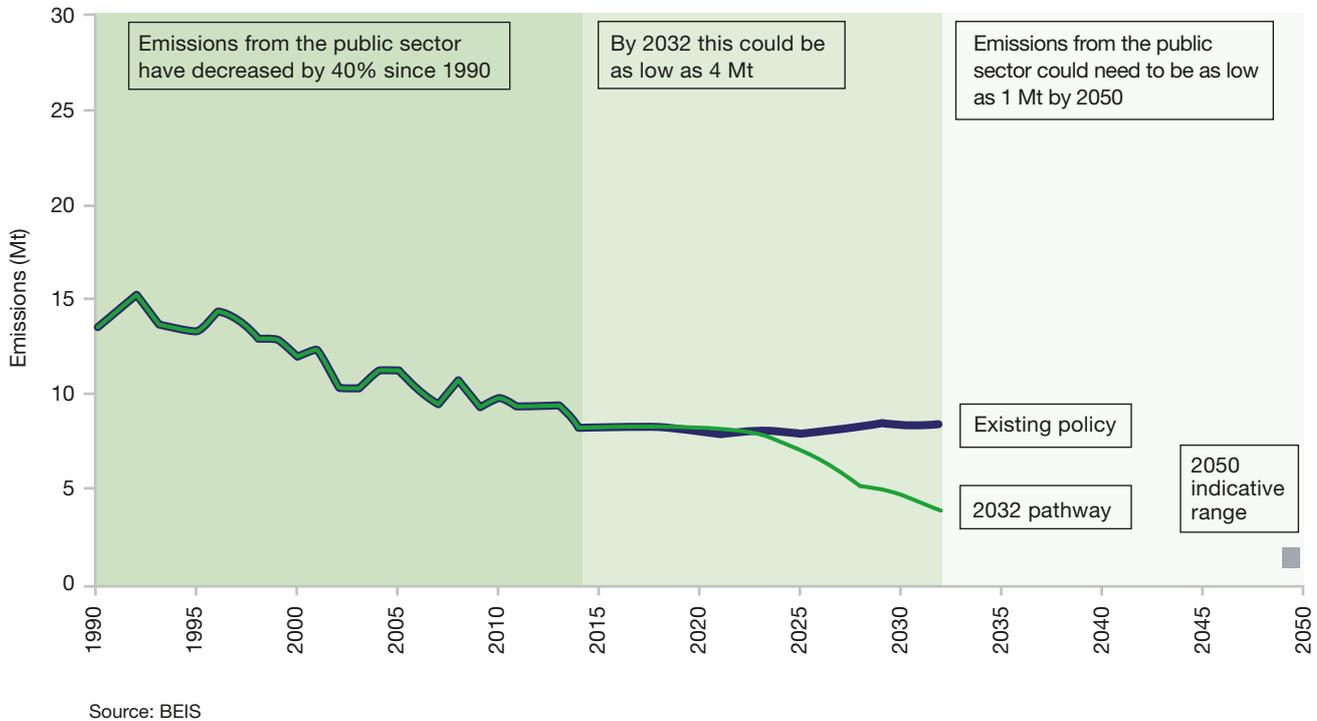
### Ambition

We want the public sector to be a leader in reducing carbon emissions; an approach that will also save organisations significant amounts of money. While central government has shown what is possible, we now want the wider public sector to reap the benefits of this approach. The annual energy bill across all public sector

buildings in England and Wales is estimated to be around £2 billion<sup>288</sup> and this could be reduced significantly, releasing funds for front line services. The public sector also has a key role to play in demonstrating best practice, promoting transparency over emissions reporting and catalysing markets in energy efficiency by implementing measures at scale.

<sup>288</sup> BEIS (2016) Building Energy and Efficiency Survey <https://www.gov.uk/government/publications/building-energy-efficiency-survey-bees>

**Figure 31: Actual and projected emissions in the public sector, taking into account the clean growth pathway, 1990-2050**



To meet the UK's 2050 target, emissions from the buildings and activities of the public sector will need to be near zero. As with homes and commercial property, this means improving energy efficiency and energy management, and decarbonising the heating and cooling of buildings as far as possible.

Our pathway to 2032 sees emissions from the public sector falling by around 50 per cent compared to today. To achieve this, the Government will need to:

- Set longer term emissions reduction targets across the public sector, and encourage transparent reporting on these.

- Address barriers to energy efficiency and low carbon investment, such as supporting organisations to access finance, and make the case for action internally.

### Opportunities

Ambitious action in the public sector will catalyse further innovation in low carbon products and services, generating new business and employment opportunities, and acting as a springboard for the wider low carbon market in the UK and internationally.

## Spotlight: NHS

The NHS is responsible for around a third<sup>289</sup> of public sector carbon emissions and in 2015/16 around £570 million was spent by the NHS Trust on energy<sup>290</sup>. Emissions from energy and travel alone have an annual carbon footprint of 7.4 million tonnes<sup>291</sup> demonstrating the important role of the NHS and the health supply chain in reducing the UK's emissions. Despite the challenges in the sector, over the last ten years the health system has reduced its annual carbon emissions by 3.6 million tonnes and saved almost £2 billion in energy costs<sup>292</sup>. Health organisations have in place mandatory Sustainable Development Management Plans which include recommendations

on reducing carbon emissions, improving energy efficiency, increasing local energy generation and understanding the health and financial impacts of travel<sup>293</sup>. NHS organisations are expected to report annually on carbon reduction with 69 per cent of providers and Clinical Commissioning Groups meeting minimum standards. Health organisations are also strongly encouraged to adopt and report on progress against a carbon reduction target of 34 per cent in line with the Climate Change Act with an NHS baseline of 2007/08<sup>294</sup>. Forty one per cent<sup>295</sup> of trusts already report they are on track to meet the 34 per cent target by 2020/21.

## Dryden School

Dryden School is a secondary special school in Gateshead. They cut their energy bill using a 100 per cent interest free loan of almost £80,000, funded by the Government's Salix scheme. By installing LED lighting, pipework insulation and improving the Building Energy Management System and hydrotherapy pool ventilation system they cut their bill by £17,000 a year – saving over £342 per pupil, and meaning their loan pays back in just over four years.



<sup>289</sup> BEIS (2016) Building Energy Efficiency Survey (BEES) <https://www.gov.uk/government/publications/building-energy-efficiency-survey-bees>

<sup>290</sup> NHS Digital (2017) Hospital Estates and Facilities Statistics <http://hefs.hscic.gov.uk/DataFiles.asp>

<sup>291</sup> Sustainable Development Unit (2016) Carbon Footprint update for NHS in England <http://www.sduhealth.org.uk/policy-strategy/reporting/nhs-carbon-footprint.aspx>

<sup>292</sup> Sustainable Development Unit (2016) Securing Healthy Returns <http://www.sduhealth.org.uk/policy-strategy/engagement-resources/financial-value-of-sustainable-development.aspx>

<sup>293</sup> Sustainable Development Unit (2017) Health Outcomes Travel Tool <http://www.sduhealth.org.uk/delivery/measure/health-outcomes-travel-tool.aspx>

<sup>294</sup> Sustainable Development Unit (2014) Sustainable Development Strategy <http://www.sduhealth.org.uk/policy-strategy/engagement-resources.aspx>

<sup>295</sup> Hospital Estates and Facilities Statistics [http://hefs.hscic.gov.uk/ReportFilterConfirm.asp?FilterOpen=&Year=2015%2F2016+01&Level=T&Section=S&SHA=&Org\\_Type=&Foundation=&Site\\_Type=&PFI=&getReport=Get+Report](http://hefs.hscic.gov.uk/ReportFilterConfirm.asp?FilterOpen=&Year=2015%2F2016+01&Level=T&Section=S&SHA=&Org_Type=&Foundation=&Site_Type=&PFI=&getReport=Get+Report)

## Policies and Proposals

### Setting Targets and Reporting Against Them

1. Outside central government, some parts of the wider public and higher education sectors have already set emission reduction targets to encourage organisations to focus on cutting carbon and energy bills. However there is no common target that covers the whole sector. Therefore, the Government will introduce a voluntary wider public and higher education sector target of a 30 per cent reduction in greenhouse gases by 2020/21, against a 2009/10 baseline, and will publish a Call for Evidence alongside this document to gain views from the sector on the target and a proportionate reporting framework to underpin this, as well as further policies to realise carbon and cost saving potential. We will review progress against this voluntary target by 2020, with a view to moving to a more ambitious target during the 2020s (such as a 50 per cent reduction by 2030). Once a reporting framework is in place, and there is clear evidence of the impact of voluntary action, a mandatory target could also be considered.
2. For central government, the Greening Government Commitments (GGCs) have already produced significant emissions savings across departments and agencies. We are currently working with departments to agree higher targets for 2020 and actions to further reduce greenhouse gas emissions beyond this date. We will publish the new targets in due course.

### Supporting Access To Finance

3. In the 2015 Spending Review, the Government announced £295 million of new funding for public sector energy efficiency across the UK. In England, this increased funding is invested in the existing public sector energy efficiency loan scheme, which is available to the wider public and higher education sectors. The loan scheme administrator currently manages £210 million, and this will rise to some £385 million by 2020. This revolving loan scheme will continue to be recycled to at least 2025. Similar schemes run in Scotland and Wales received £40 million of the 2015 spending review award.
4. An Energy Performance Contract provides finance to organisations so that they can invest in cost-effective energy conservation measures, without incurring any upfront capital costs. The Government will continue to support their expansion in the public sector, as they offer a new route to improve energy efficiency, while producing guaranteed savings. To underpin this approach we are continuing support to the RE: FIT programme in 2017/18, alongside Local Partnerships.

## Local Leadership

Moving to a productive low carbon economy cannot be achieved by central government alone; it is a shared responsibility across the country. Local areas are best placed to drive emission reductions through their unique position of managing policy on land, buildings, water, waste and transport. They can embed low carbon measures in strategic plans across areas such as health and social care, transport, and housing.

The Government recognises the importance of anchoring economic growth in the strengths of local areas. Indeed, each local area will be responsible for coordinating its own local industrial strategy in alignment with the national Industrial Strategy<sup>296</sup>.

Local leaders are already rising to the challenge and putting local carbon targets and strategies in place. Nearly 70 local authorities are signed up to using 100 per cent clean energy by 2050 as part of the UK100 network<sup>297</sup>, reflecting the leadership shown by mayors globally on climate change and clean energy. Partnerships across public, private and community sector organisations can unlock powerful integrated local energy solutions.

The Government is committed to supporting local leadership and has already given additional powers and responsibilities through the Cities and Local Government Devolution Act 2016; many of the Local Devolution deals agreed to date include energy commitments. We work with local areas to support delivery, develop partnerships, and enable access to low carbon procurement frameworks.

In 2017, in England we funded 13 Local Enterprise Partnerships (LEPs) to develop local energy strategies and will support the remaining 25 LEPs to produce their own later this year. We will also launch a new Local Energy programme to support local areas in England to play a greater role in decarbonisation. This will increase local capacity and capability across England and provide on the ground practical support and expertise to unlock local energy opportunities.

The programme will start to support delivery of the Industrial Strategy and Smart Systems Plan, working with local areas to demonstrate that deep decarbonisation can be achieved through local system change in a way that keeps costs down and maximises economic benefit.

Innovation at the local level is also vital. The Energy Innovation Board will ensure that all relevant clean technology innovation funds are accessible to local actors including local authorities, Local Enterprise Partnerships, community sector organisations and others, as appropriate.

Government will continue to work with and support local leaders. We will establish a Local Energy Contact Group, building on the valuable work of the previous Community Energy Contact Group, to continue the crucial dialogue between local stakeholders and Ministers.

### *Local Leadership: Cornwall*

*Cornwall hosts a wealth of renewable energy resources including wind, solar, geothermal and marine energy. Cornwall now contributes more than 768 MW of sustainable energy generation to the UK energy mix<sup>296</sup>, with approximately 25 per cent in local ownership, including 8 MW of Council-owned solar PV and more than 1MW owned by community groups supported by England's first community energy revolving fund with £2.5 million council funds<sup>297</sup>.*



<sup>296</sup> Regen (2016) Renewable Energy: a local progress report for England <https://www.regensw.co.uk/renewable-energy-progress-reports>

<sup>297</sup> Cornwall Council press release (2017) <https://www.cornwall.gov.uk/council-and-democracy/council-news-room/media-releases/news-from-2017/news-from-march-2017/community-energy-remains-at-the-heart-of-cornwall-council-s-energy-agenda/>

# Chapter 5: Next Steps



This Strategy sets out our plan to meet our future carbon budgets. Chapter 4 sets out the potential to reduce emissions across each sector and our policies and proposals to unlock the further savings needed. The timeframes for these actions are set out in full in annexes A and B.

In addition to the Emissions Intensity Ratio, we have also developed a set of metrics which will help us assess and understand progress. These metrics are summarised below and set out in Annex D.

This Strategy is not the end of the process. Our policies and proposals will evolve as we respond to costs coming down, to lessons about what does and does not work, to improved evidence, and to wider trends in the economy, society, technology and innovation. To keep track of this moving picture and our progress towards carbon budgets, we will be monitoring and reporting against each element of this Strategy.

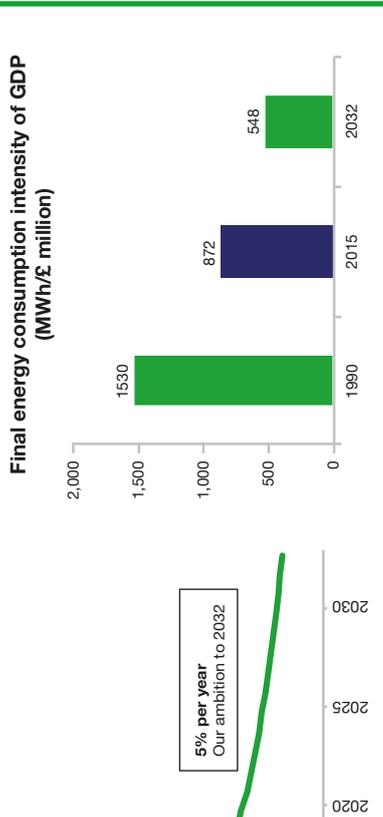
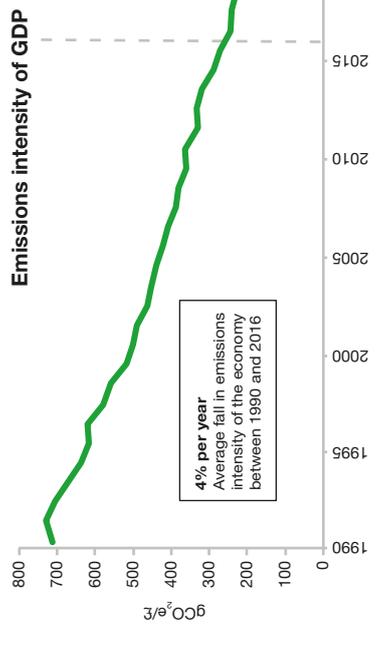
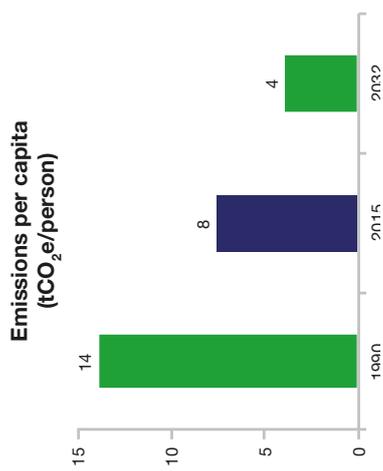
From 2018, we will use the Government's response to the Committee on Climate Change's annual progress report to bring together reporting against this strategy on the emission intensity ratio, metrics and actions. We will publish our performance against the Emissions Intensity Ratio on an annual basis. We will also update key elements of the Strategy in line with our annual statutory responses to the Committee on Climate Change's reports on progress, ahead of setting the sixth carbon budget by 30 June 2021.

We welcome views on this Strategy. Comments and suggestions should be sent to [CleanGrowthStrategy@beis.gov.uk](mailto:CleanGrowthStrategy@beis.gov.uk) by the end of December 2017. Government intends that the individual departmental policies and proposals contained within the plan will be consulted on separately, where such consultation has not already taken place. Views received in response to both this Strategy and the detailed policy proposals which will follow it will be considered as we update key elements of our strategy before setting the sixth carbon budget by 30 June 2021.

The Government will also launch an annual week focusing on climate issues across the UK, to showcase our progress and successes on climate action, share the latest climate science, and highlight and promote economic opportunities arising from clean growth around the country.

# Whole economy

We will report progress against this framework of economy-wide and sector-level metrics annually. Details of each metric are set out in Annex D



## Homes

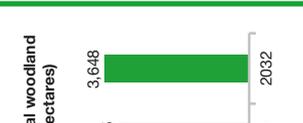
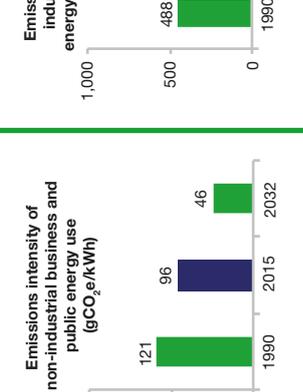
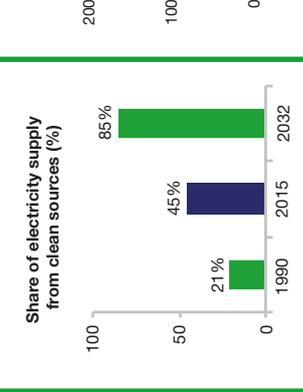
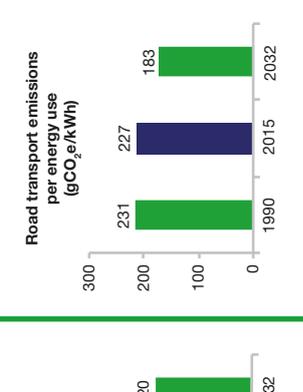
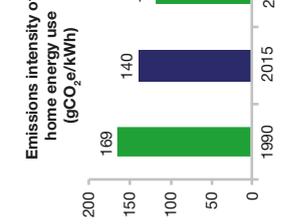
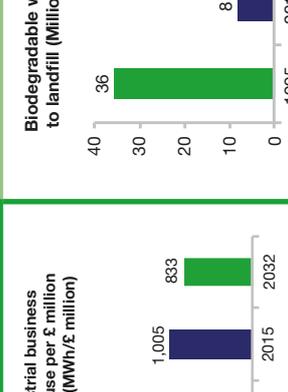
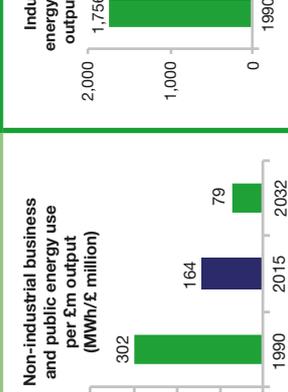
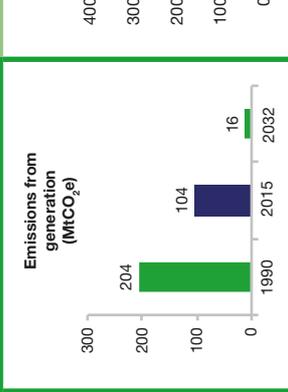
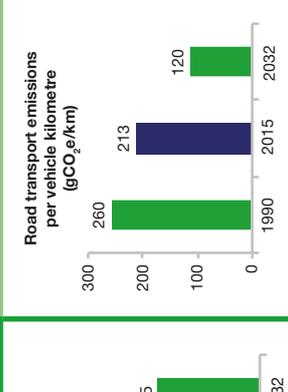
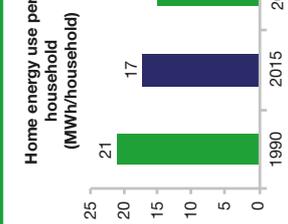


## Power



## Non-industrial business & public sector

## Land & environment





# Annexes

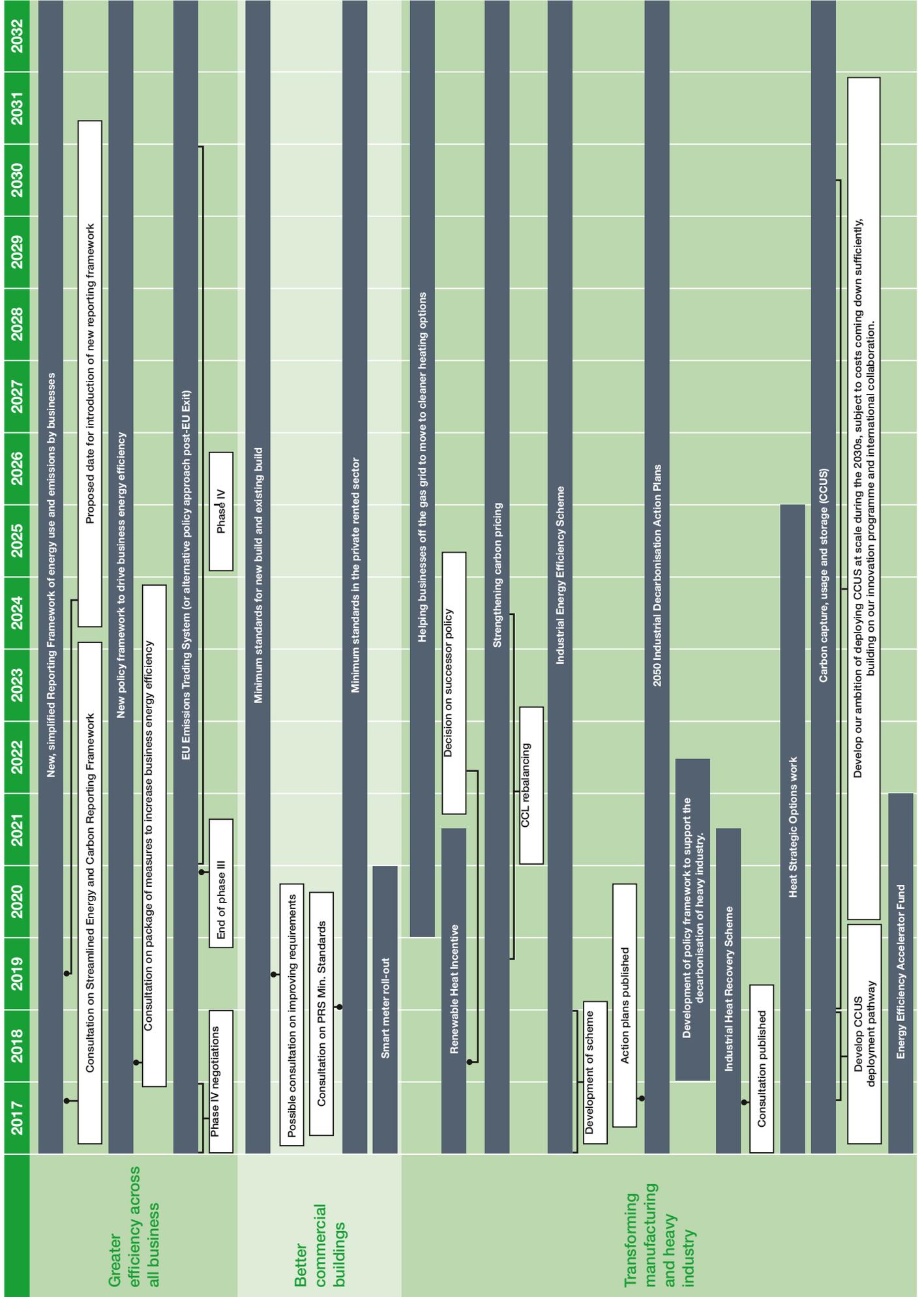


## Annex A:

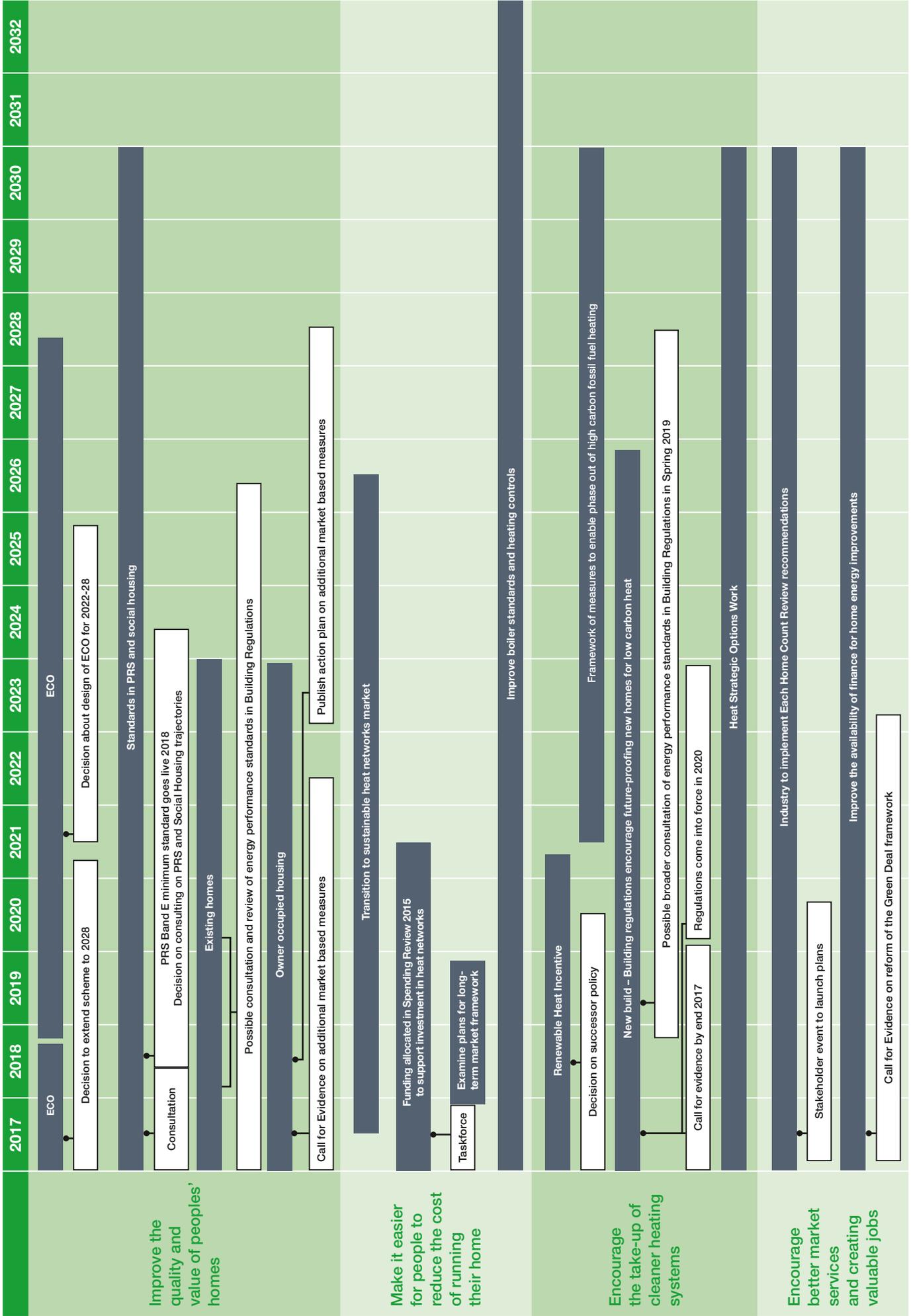
### Decision pathways

These following decision pathways give an overview of how the policies and proposals set out in this Strategy map over time. They include future policy development such as publications, key decisions, reviews and consultations, which aim to unlock further carbon savings. Some Government programmes, such as the Industrial Strategy, cut across several sectors and so are not reflected below.

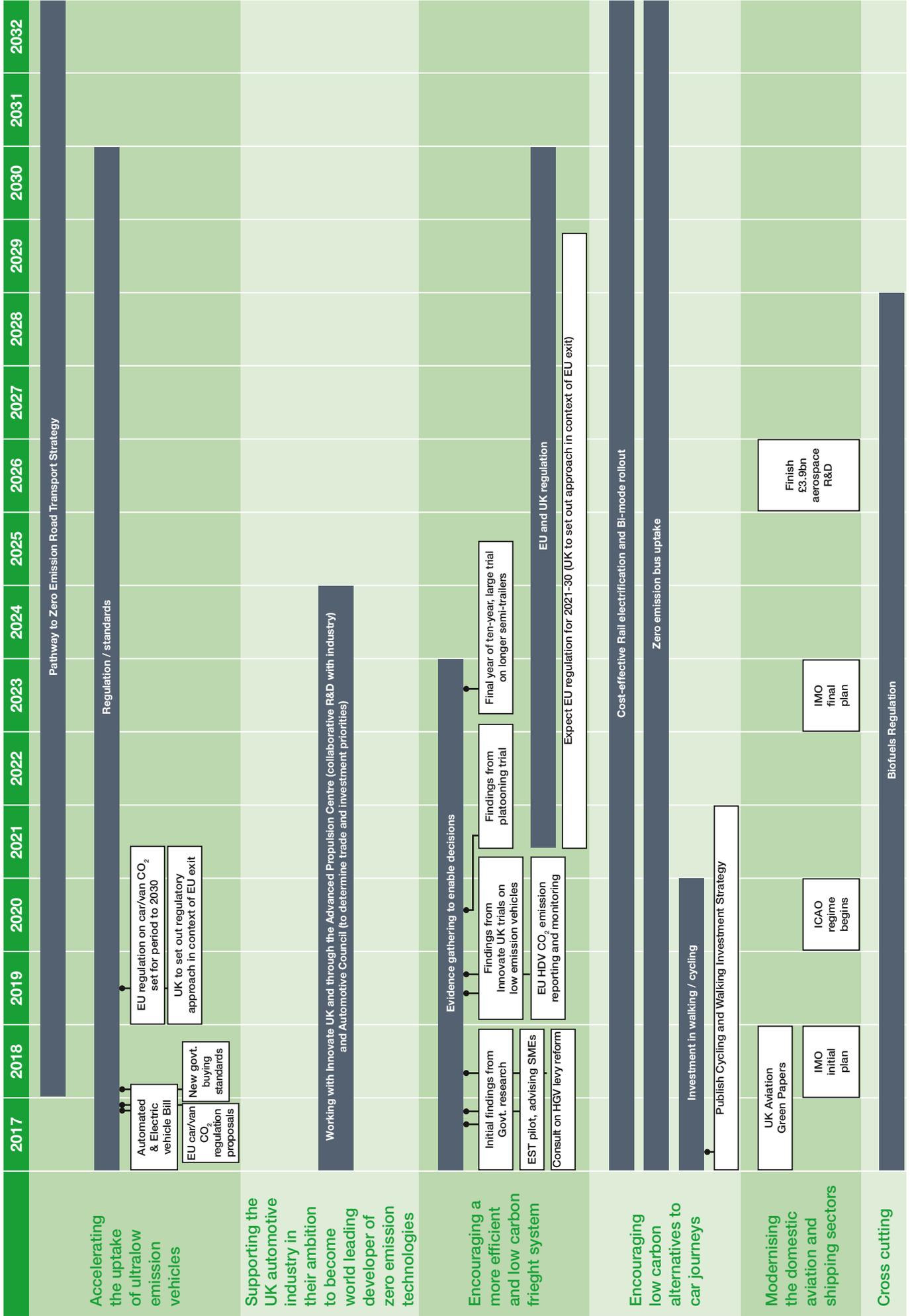
Business and Industry



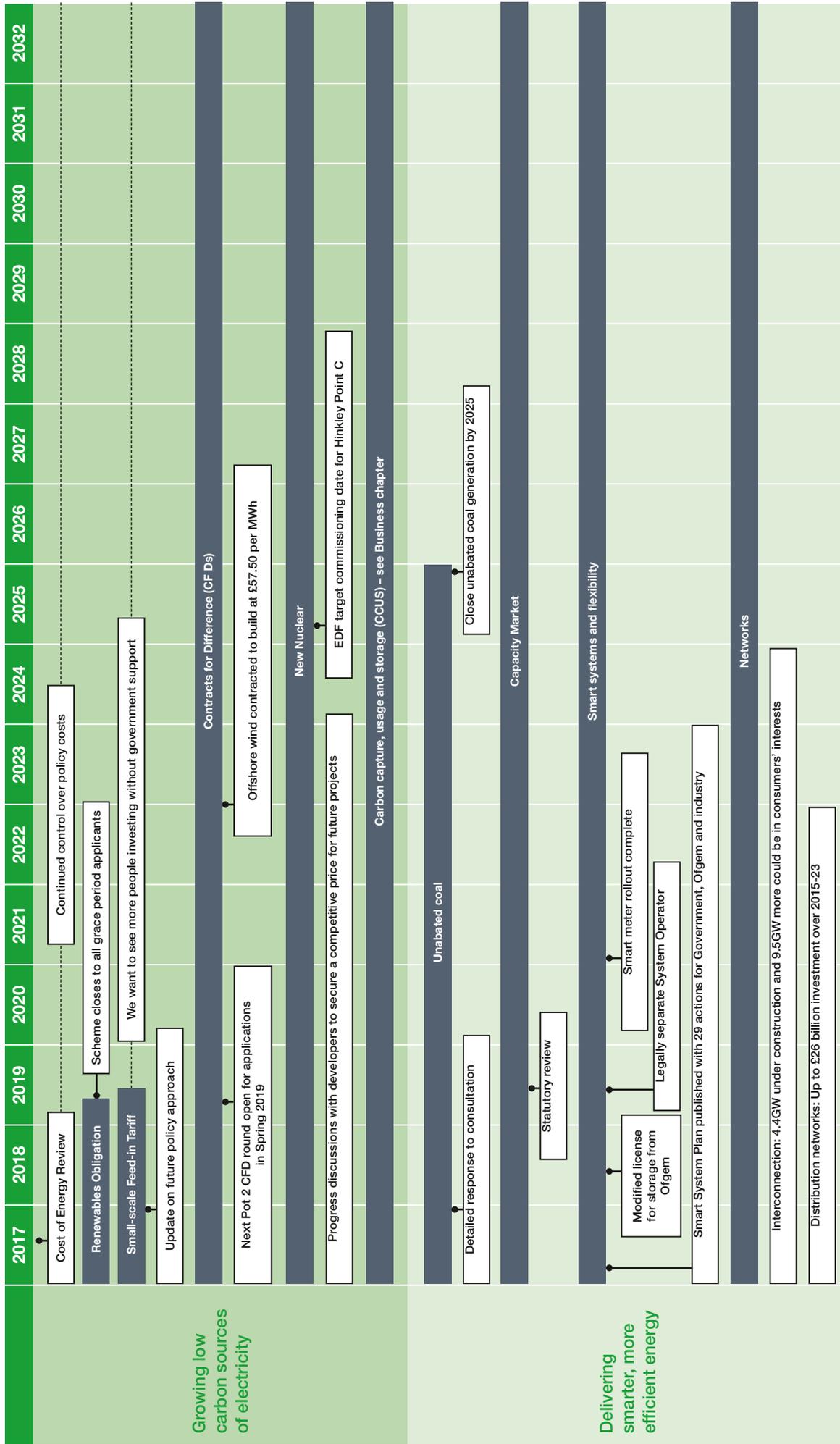
Homes



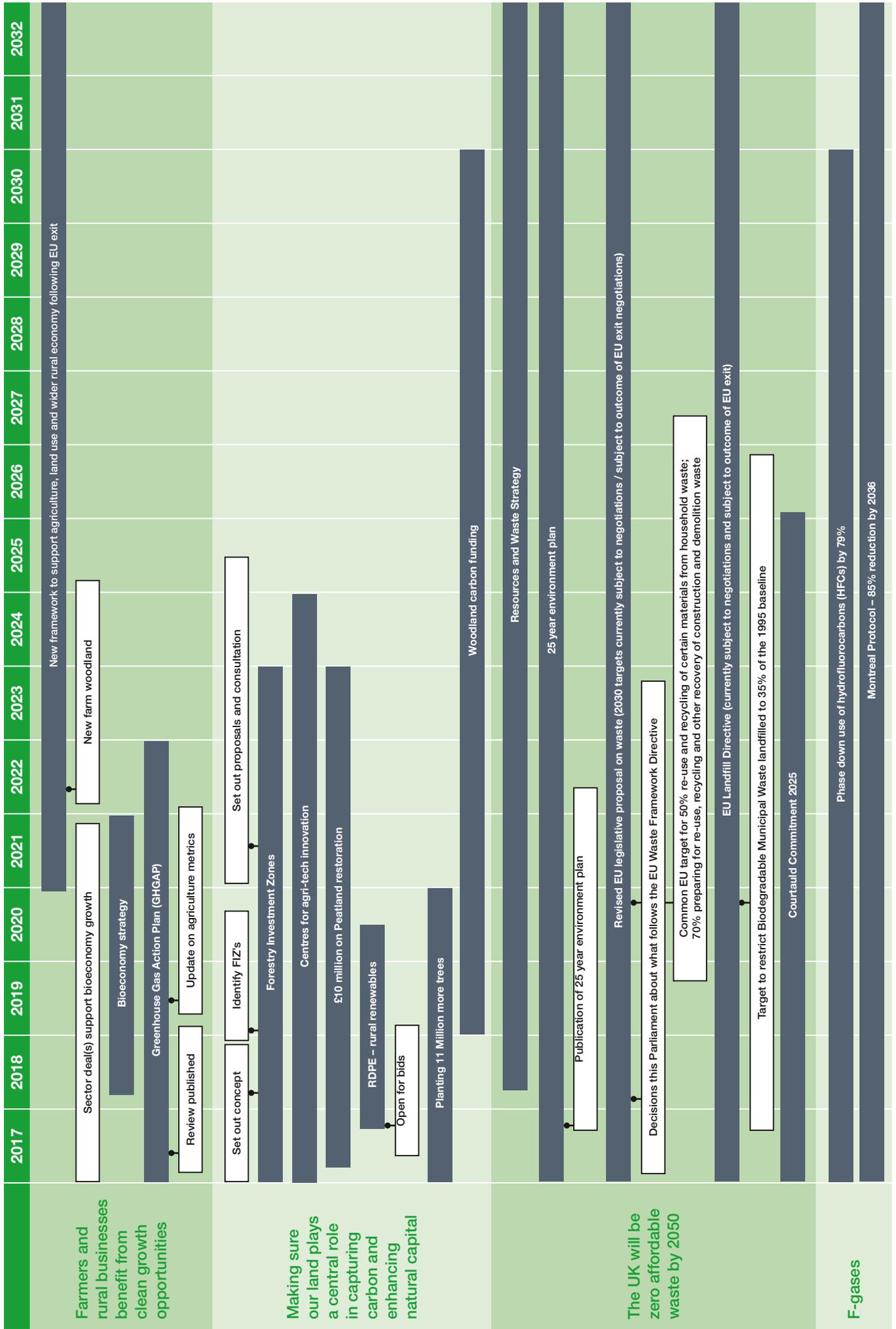
Transport



Power



Natural resources



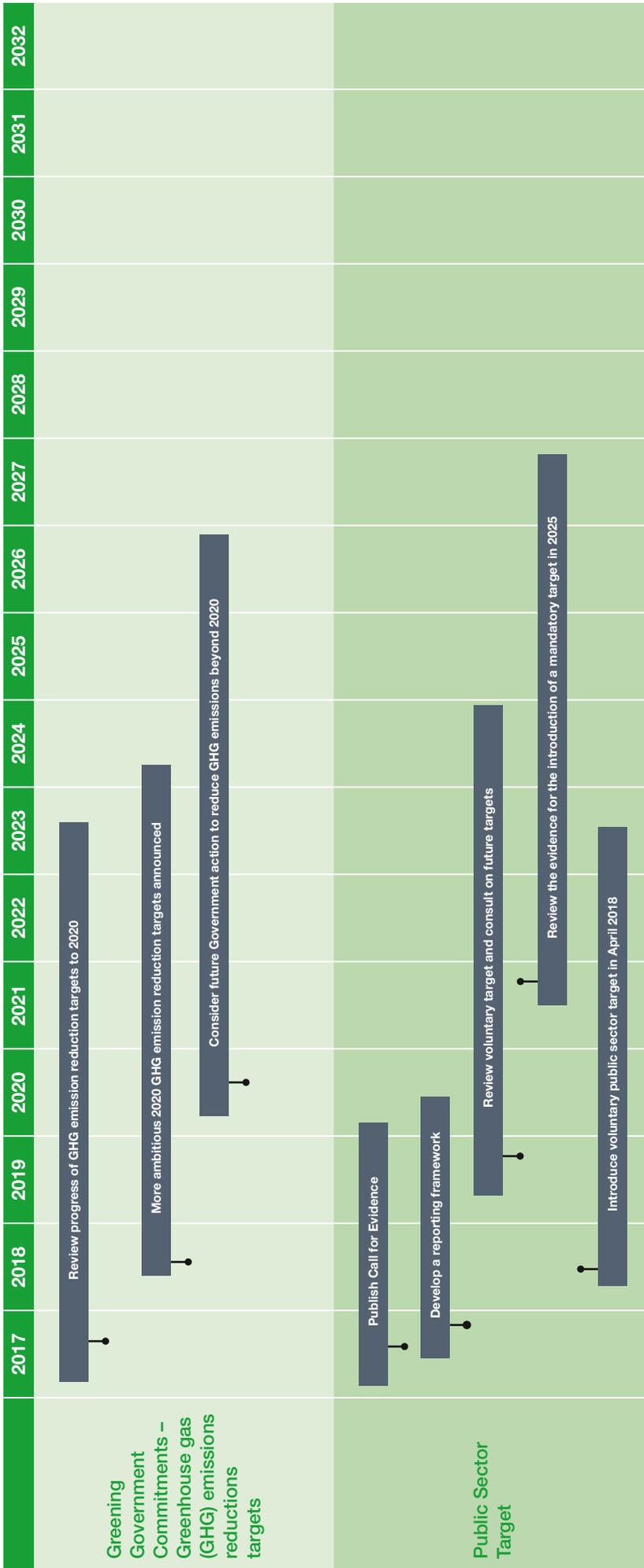
Farmers and rural businesses benefit from clean growth opportunities

Making sure our land plays a central role in capturing carbon and enhancing natural capital

The UK will be zero affordable waste by 2050

F-gases

Public sector



## Annex B:

# Actions and milestones

This annex sets out actions and milestones that the Government is committing to in this plan, and related publications. Actions will be updated and progress reported through

the Government's response to the Committee on Climate Change's annual progress report. Details of the Government's Innovation Investment are set out in Chapter 4.

Lead department	Description	Timing
<b>Improving Business and Industry Efficiency and Supporting Clean Growth</b>		
BEIS	Consult on new and streamlined energy and carbon reporting framework. This will replace some existing schemes, such as the reporting element of the CRC Energy Efficiency Scheme, and align with mandatory annual greenhouse gas reporting by UK quoted companies.	Published alongside this Strategy, with proposed introduction of new framework by 2019
BEIS	Consult on the design of a new £18 million industrial heat recovery programme.	Published alongside this Strategy
BEIS	Publish joint industrial decarbonisation and energy efficiency action plans with seven of the most energy intensive industrial sectors, building on three years of joint industry-Government cooperation.	Published alongside this Strategy
BEIS	New Ministerial-led CCUS Council with industry established.	From 2017
BEIS	CCUS Cost Challenge Taskforce established to deliver a plan to reduce the cost of deploying CCUS.	From 2017
BEIS	Establish an Industrial Energy Efficiency scheme.	From 2017
BEIS/DCLG	Consult on how best to improve the performance of the commercial and private rented sector, through tighter minimum building standards in the Private Rented Sector.	2018
BEIS	Deployment pathway for CCUS produced.	2018
BEIS	Work with industrial clusters to identify the most appropriate way forward to test the potential for development of CCUS industrial decarbonisation clusters.	2018
BEIS	Organise an international CCUS event with international partners.	2018
BEIS	Commit to provide further details on CCUS innovation spend.	2018
BEIS	Develop and consult on a package of measures to support businesses to improve how productively they use energy.	From 2018
BEIS/HMT	Ensure incentives for investment in energy efficiency are regularly reviewed, for instance the list of products that qualify for enhanced capital allowances tax relief.	On-going
BEIS	Undertake an evaluation of the Climate Change Agreements to inform any successor scheme from 2023.	Expected to commence in 2018

Lead department	Description	Timing
DCLG	Following the outcome of the independent review of Building Regulations and fire safety, and subject to its conclusions, the Government intends to consult on improving the energy efficiency of new and existing commercial buildings.	2018
BEIS	Beyond support through the RHI, ambition to phase out high fossil fuel heating in businesses off the gas grid during the 2020s. Businesses and industry will be involved in developing the new policy.	During the 2020s
BEIS	Develop a clear policy framework to support decarbonisation in energy intensive industries.	By 2022

Improving our Homes		
BEIS	Publish a call for evidence on additional measures to encourage energy performance, particularly amongst owner occupiers.	Published alongside this Strategy
BEIS	Publish a call for evidence on how to reform and streamline the Green Deal framework to make the “Pay as You Save” system more accessible to businesses, while ensuring adequate protection for consumers.	Published alongside this Strategy
BEIS	Work with industry to implement the independent industry led <i>Each Home Counts review</i> to improve quality and standards for all retrofit energy efficiency and renewable energy installations.	2017
BEIS/HMT	Work with mortgage lenders to incorporate energy efficiency into their lending decisions, and look at incentives and other levers that could encourage home-owners to invest in energy efficiency improvements.	2017
BEIS	Explore ways in which we could make it easier for innovative approaches or products to be installed under our consumer-facing schemes such as the Energy Company Obligation.	2017
BEIS	For privately rented homes, from April 2018, landlords of the worst performing properties will need to improve those properties to a minimum of EPC E before they can be let; lowering bills for some of the most vulnerable private tenants. We will consult shortly on steps to make these regulations more effective.	2017
BEIS	Consult on ECO's operation through to 2022.	2018
BEIS	Reform the RHI to focus the scheme towards long-term decarbonisation through greater uptake of technologies such as heat pumps and bio methane (biogas to grid).	2017
BEIS	Continue to work with suppliers to ensure that people are provided with tailored advice when a smart meter is installed.	2017
BEIS	Alongside this Strategy, the Government has published <i>Boiler Plus</i> , improving standards for the 1.2 million new boilers installed in England every year and ensuring control devices are included with every installation so people can control comfort in their own homes for less from April 2018.	Spring 2018
BEIS	Replace the existing, telephone-only Energy Saving Advice Service with a digitally led-service working closely with the Each Home Counts implementation, offering tailored advice on improving the energy performance of people's homes.	Spring 2018
BEIS/DCLG	Issue a Call for Evidence seeking views on further triggers points for Energy Performance Certificates (EPCs) to be updated, as well as wider views on how EPCs could be further improved, in light of new sources of data and capabilities	Spring 2018

Lead department	Description	Timing
BEIS/DCLG	The Government will look at a long term trajectory for energy performance standards across the private rented sector, with the aim of as many private rented homes as possible being upgraded to EPC C by 2030 where practical, cost-effective and affordable.	2018
BEIS/DCLG	The Government will also look at introducing similar energy performance standards across the social housing sector, where practical, cost-effective and affordable. This will need to take account of the findings of the independent public inquiry into the fire at Grenfell Tower and the Government's separate work looking at wider social housing policy issues.	2018
BEIS/DCLG	Following recommendations from the review of Building Regulations and fire safety currently underway explore innovative solutions to energy performance improvements not performing as well as predicted, including potential actions on compliance and enforcement of energy performance.	By 2019
BEIS	Continue smart meter roll out.	Roll out complete by end of 2020
BEIS	Funding allocated in the Spending Review 2015 to grow the UK's heat networks market.	By 2021
BEIS	Beyond support through the RHI, ambition to phase out high fossil fuel heating in homes off the gas grid during the 2020s. Consumers and industry will be involved in developing the new policy.	During the 2020s

Accelerating the Shift to Low Carbon Transport		
DfT	Series of consultation papers setting out the Government's strategic approach to aviation, including how to support growth whilst tackling environmental impacts.	2017-2018
DfT	Regulation to improve EV charge point provision and consumer access under the Automated and Electric Vehicle Bill.	2017
DfT	Deployment of £80 million ULEV infrastructure funding announced in Autumn Statement 2016.	2017-2021
DfT	Consider outcome and next steps in light of SME HGV fleet review pilot.	2017
DfT	Pathway to Zero Emission Road Transport Strategy Document.	By early March 2018
DfT/Defra	Updating Government vehicle buying standards.	End 2018
DfT	EU HGV CO <sub>2</sub> emission reporting and monitoring starts.	January 2019
HMT	Decision(s) on future fiscal support/tax incentives for ULEVs.	Ongoing

Lead department	Description	Timing
DfT	Report from Low Emission Freight and Logistics Trial.	2019
DfT	Decision on domestic regulatory regime for car/van CO <sub>2</sub> regulations in context of EU exit.	2019
HMT	Decisions on support for cycling and walking following end of current funding period (to 2019/20).	2020
DfT	Decision on next steps in light of platooning and longer semi-trailer trials.	2020 onwards
DfT	Decision on domestic regulatory regime for freight CO <sub>2</sub> regulations in context of EU exit.	Mid 2020s
DfT	Active participation in the IMO to address GHG emissions from shipping.	Ongoing

Clean, Smart, Flexible Power		
BEIS	Publish a full response to the consultation on ending unabated coal generation in Great Britain.	Shortly
BEIS	Publish independent Cost of Energy Review, undertaken by Professor Dieter Helm CBE.	Autumn 2017
HMT	Set out further details on carbon prices beyond 2020/21.	Autumn 2017
BEIS	Work with industry to develop a nuclear Sector Deal as part of the Industrial Strategy, looking at boosting competitiveness and skills across the sector.	Autumn 2017
BEIS/HMT	Set out new controls to replace the Levy Control Framework beyond 2020/21.	End 2017
BEIS	Provide an update on our approach for small scale low carbon generation beyond 2019.	End 2017
Ofgem	Introduce a modified generation license for storage to improve regulatory clarity.	Summer 2018
BEIS	Continue to work with nuclear developers on their new build proposals, including on financing plans.	2018
Ofgem/National Grid	Create a legally separate system operator.	April 2019
BEIS	Planned Pot 2 Contract for Difference auction.	Spring 2019
BEIS	Continue to work with Ofgem and industry to implement the 29 actions in the Smart Systems and Flexibility Plan.	2020

Lead department	Description	Timing
<b>Enhancing the Benefits and Value of our Natural Resources</b>		
BEIS	Set out approach to bring together biological industries, academia and innovators, linking up farmers and land managers with high tech industries to make the most of existing resources and develop advance feed stocks that are essential for the future low carbon economy.	By end of 2017
BEIS	New Bioeconomy Strategy.	By end of 2017
Defra & BEIS	Set up a stronger and more attractive domestic carbon offset market that will encourage more businesses to support cost-effective emissions reductions such as through planting trees. We will also explore how we could extend this market to include other land activities.	2017 onwards
Defra	Establish forestry investment zones.	2017 onwards
Defra	Set out 25 Year Environment Plan.	2017 onwards
Defra	Government to publish a new Resources and Waste Strategy.	2018
Defra	Publish a Clean Air Strategy.	2018
Defra	£10 million capital grant scheme for peat restoration.	Funds available from April 2018 for 3 years
Defra	Continue working with the Organisation for Economic Co-operation and Development (OECD) on their project to improve the modelling of macroeconomic effects of the transition to a circular economy.	Project concludes end of 2018
Defra	Commit to make available up to £200 million to support rural communities over the next two years and set out agroforestry decisions.	By end of 2019
Defra	Allocated funding to woodland planting to plant 11 million trees.	2020
Defra	EU target of at least 50% of household waste being recycled by 2020.	2020
Defra	Woodland Carbon Fund: £19.2 million to fund larger-scale woodland and forest creation.	By 2021
Defra	Work with industry to encourage the use of low-emissions fertiliser, and review the levels of take up using data from the British Fertiliser Practice Survey.	Over next 5 years
Defra	Targets of a 20% reduction in food and drink waste arising in the UK, a 20% reduction in the greenhouse gas intensity of food and drink consumed in the UK, and a reduction in impact associated with water use in the supply chain through delivery of the Courtauld Commitment 2025.	Concludes in 2025, with an on-going review of progress
Defra	Work towards no food waste entering landfill by 2030.	2030
Defra	UK to phase down use of hydrofluorocarbons (HFCs) by 79% by 2030.	2030
Defra	UK to phase down use of HFCs by 85% by 2036 under the United Nations Montreal Protocol.	2036
Defra	Ambition for the UK to be zero avoidable waste economy by 2050.	2050

Lead department	Description	Timing
<b>Leading in the Public Sector</b>		
BEIS	Continue to fund further improvements in the wider public sector with £295 million of funding allocated to the public sector energy efficiency loan scheme, across the UK, in the 2015 Spending Review.	On going
BEIS	Introduce a voluntary wider public and higher education sector target of 30% reduction in greenhouse gases by 2020/21, against a 2009/10 baseline, and will publish a Call for Evidence. We will review progress against this voluntary target by 2020, with a view to moving to a more ambitious target during the 2020s (e.g. 50% reduction by 2030). Once a reporting framework is in place, and there is clear evidence of the impact of voluntary action, a mandatory target could be considered.	2018
BEIS	Review existing carbon saving policies impacting the public sector to assess whether changes or new policies are needed to realise the carbon and costs savings potential. We will explore this further through a Call for Evidence.	2017
BEIS	Currently assessing how much the current 2020 greenhouse gas emission reduction target under the GGCs could be stretched to be more ambitious yet achievable. We also aim to set an appropriate level of ambition beyond 2020.	2018
BEIS	Continue to support the expansion of Energy Performance Contracts in the public sector which can offer a new route for investment in energy efficiency alongside guaranteed savings.	We are providing continuing support in 2017/18

## Annex C:

### Climate science

UK and international climate action is underpinned by a robust evidence base on the science of climate change. In this annex we summarise (i) the scientific evidence that reinforces the need for ambitious action to reduce

emissions; (ii) the scientific rationale behind the internationally-agreed global temperature goals; (iii) UK climate action; and (iv) future scientific priorities from a UK government perspective.

#### 1: Why we are committed to ambitious action on climate change

We are already seeing the impacts of climate change. The global average temperature of the Earth's surface has risen around 1°C since pre-industrial times<sup>298</sup>. All but one of the top sixteen warmest years on record have occurred since 2000<sup>299</sup>, and each of the last three decades has been successively warmer at the Earth's surface than any preceding decades since 1850<sup>300</sup>. 2015 and 2016 were the warmest years on record by quite some margin<sup>301</sup> -albeit enhanced by the El Niño effect- and the impacts of climate change are already widespread and are affecting many sectors of society<sup>302</sup>. Arctic sea ice extent has declined by about 4 per cent every decade since

records began in 1979 and sea level has risen by about 3 mm a year since the early 1990s<sup>303</sup>. In addition, increased uptake of carbon dioxide by the oceans has caused the pH of ocean surface water to decrease by 0.1 units since the beginning of the industrial era, corresponding to a 26 per cent increase in acidity<sup>304</sup>. Without action to reduce the level of greenhouse gases we emit globally, climate change is set to continue with increasing temperatures on the land and in our oceans. This will result in further increases in sea levels, more frequent and more severe heat waves and a changing rainfall pattern leading to more droughts and floods in some regions; and disruption to some ecosystems<sup>305</sup>. Without significant reductions in emissions, the world is likely to be on course for

<sup>298</sup> Met Office (2016) Indicators of change 2016 <http://www.metoffice.gov.uk/news/in-depth/indicators>

<sup>299</sup> Met Office press release (2016) <http://www.metoffice.gov.uk/news/releases/2017/2016-record-breaking-year-for-global-temperature>

<sup>300</sup> World Meteorological Organization press release (2017) <https://public.wmo.int/en/media/press-release/climate-breaks-multiple-records-2016-global-impacts>

<sup>301</sup> World Meteorological Organization press release (2017) <https://public.wmo.int/en/media/press-release/climate-breaks-multiple-records-2016-global-impacts>

<sup>302</sup> IPCC (2014) Climate Change 2014: Summary for Policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability, Summary for Policymakers. <http://www.ipcc.ch/report/ar5/wg2/>. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

<sup>303</sup> IPCC (2014) Climate Change 2014: Synthesis Report <https://www.ipcc.ch/report/ar5/syr/> Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

<sup>304</sup> IPCC (2014) Climate Change 2014: Synthesis Report <https://www.ipcc.ch/report/ar5/syr/> Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

<sup>305</sup> IPCC (2014) Climate Change 2014: Synthesis Report <https://www.ipcc.ch/report/ar5/syr/> Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

<sup>306</sup> IPCC (2014) Climate Change 2014: Synthesis Report <https://www.ipcc.ch/report/ar5/syr/> Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

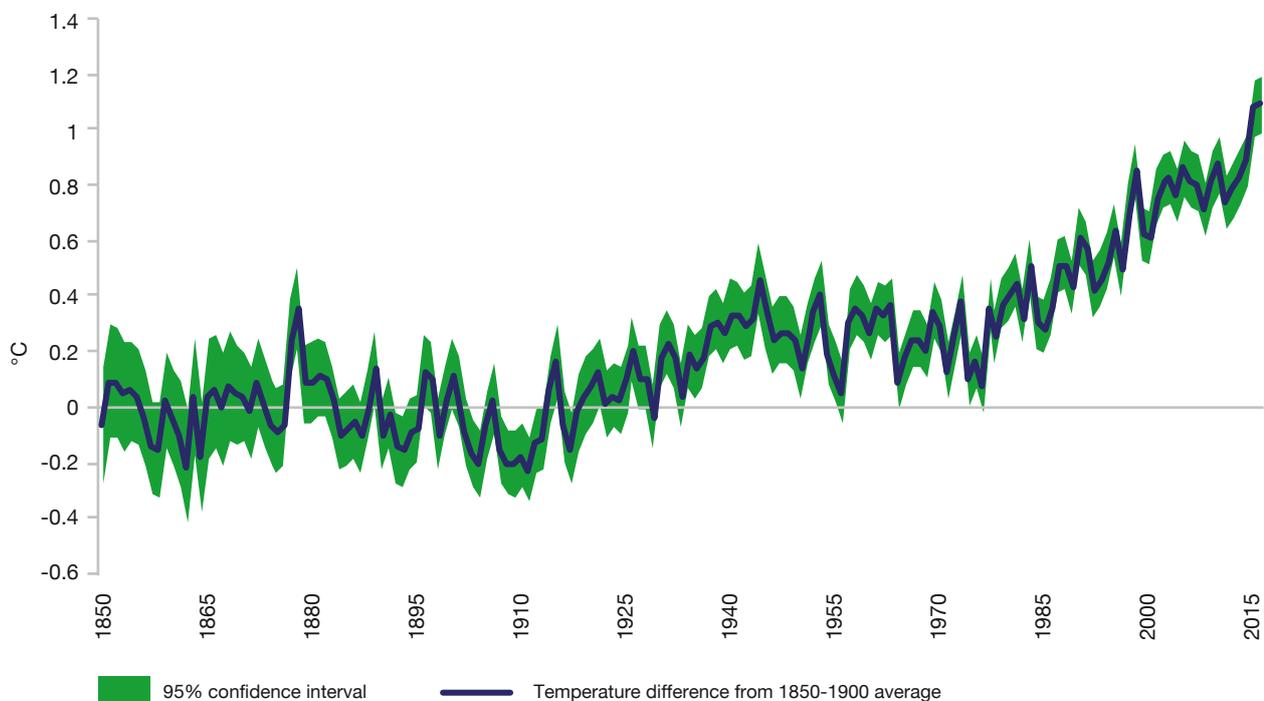
average temperature rise in excess of 2°C above pre-industrial levels, and possibly as much as 5°C for the highest emissions scenarios, by the end of this century<sup>306</sup>. Additionally, continuing acidification of the oceans will pose substantial risks to marine ecosystems.

This growing level of global climate instability poses great risks to natural ecosystems, global food production, supply chains and economic development. It is likely to lead to the displacement of vulnerable people and migration, impact water availability globally, and result in greater human, animal and plant disease. Climate change can indirectly increase the risks of violent conflicts by amplifying drivers of conflicts such as poverty and economic shocks. For this reason the

UN, Pentagon and UK's National Security and Strategic Defence Reviews cite climate change as a stress multiplier.

The UK is likely to feel the impact of climate change both directly and through impacts in other parts of the world which will affect our food and materials prices, trade, investments and security. In its recent UK Climate Change Risk Assessment<sup>307</sup> the Government endorsed the six key climate change risks for the UK identified in an independent review by the Adaptation Sub-Committee<sup>308</sup>: flooding and coastal change; shortages in public water supply; risks to health, wellbeing and productivity from high temperatures; risks to natural capital and our ecosystems; risks to food security and trade; and new pests and diseases.

**Figure 32: Global near-surface annual average temperature relative to a pre-industrial baseline (1850-1900) from 1850 to 2016**



Source: HadCRUT4, Met Office

<sup>307</sup> HM Government (2017) UK Climate Change Risk Assessment 2017 <https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-2017>

<sup>308</sup> CCC (2017) UK Climate Change Risk Assessment 2017 Evidence Report <https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/ccra-chapters/>

## 2: Global temperature goals and our progress towards them

Scientific evidence shows that increasing magnitudes of warming increase the likelihood of severe, pervasive and irreversible impacts on people and ecosystems<sup>309</sup>. These climate change risks increase rapidly above 2°C but some risks are considerable below 2°C. This is why, as part of the Paris Agreement in 2015, 195 countries committed to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change”. The Agreement recognised that in order to achieve this goal, global emissions of greenhouse gases would need to peak as soon as possible, reduce rapidly thereafter and reach a net zero level in the second half of this century.

As part of the Paris Agreement countries also committed to reduce or limit their greenhouse gas emissions. These are contained in their ‘Nationally Determined Contributions’ (NDCs). A number of studies<sup>310</sup> consider how close these commitments bring us to staying below 2°C, and estimate that if they were met we would be on a path to a global temperature rise of 2.7 to 3.7 °C above pre-industrial levels by 2100. It is worth noting that these assessments have different assumptions regarding both the extent to which countries meet their NDCs and, crucially, the actions that will be taken by countries to reduce their emissions after 2030,

which will be a key determinant of whether the world will meet the long-term global temperature goal.

These assessments show that NDCs represent a significant deviation from the 4 to 5°C temperature rise projected if there were no further policies to reduce emissions beyond those in place or planned today. Action would also provide other co-benefits such as limiting the rate of ocean acidification and improving air quality. Nevertheless it is clear that greater action is needed from all countries if we are to limit global temperature increases to well below 2°C.

## 3: UK climate action

The UK's current target is to reduce its greenhouse gas emissions by at least 80 per cent by the year 2050, relative to 1990 levels. This 2050 target was set to be consistent with keeping the global average temperature to around 2°C above pre-industrial levels with a 50 per cent likelihood. In October 2016 the Committee on Climate Change (CCC) said<sup>311</sup> that the Paris Agreement target “is more ambitious than both the ambition underpinning the UK 2050 target and previous international agreements”, but that the UK should not set new UK emissions targets now, as it already has stretching targets and achieving them will be a positive contribution to global climate action. The CCC advised that the UK's fair contribution to the Paris Agreement should include measures to maintain flexibility to go further on UK targets, the development of options to remove greenhouse gases from the air, and that its targets should be kept under review.

<sup>309</sup> IPCC (2014) Climate Change (2014) Impacts, Adaptation, and Vulnerability, Summary for policymakers <http://www.ipcc.ch/report/ar5/wg2/> Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

<sup>310</sup> For example: UNEP (2016) The Emissions Gap Report 2016 <http://www.unep.org/emissionsgap/>

<sup>311</sup> CCC press release (2016) <https://www.theccc.org.uk/2016/10/13/concrete-action-needed-to-meet-uk-climate-commitments-following-paris-agreement-and-brexite-vote/>

There will be an unavoidable level of climate change, regardless of future global emissions, because of the existing accumulation of greenhouse gases in the atmosphere. As a consequence, some level of adaptation will be necessary in the UK. To this end, the UK is already considering climate risks and what actions will be required through its five-yearly policy cycle of a Climate Change Risk Assessment followed by a National Adaptation Programme<sup>312</sup>. The scale of the potential investments, the risks associated with failure, and the long lifetimes and lead-times of the infrastructure, together mean that future investments are likely to be highly sensitive to how climate change evolves over the next two to three decades.

Actions to mitigate climate change can have wider positive impacts on the economy and the environment, beyond the direct benefits of avoided climate change<sup>313</sup>. There is strong evidence that well-designed climate mitigation action can provide substantial co-benefits while minimising any possible adverse side-effects<sup>314</sup>. For example, co-benefits can include substantial air quality improvements from avoided fuel combustion and health and wellbeing benefits of active travel.

#### **4: Future scientific priorities and UK leadership**

In recent years the debate and focus of scientific research has shifted from whether climate change is happening and/or is being caused by

human activity, to the severity of the expected impacts and the level of action required to address climate change through a combination of adaptation and mitigation. Our knowledge has increased significantly but many key research priorities remain. As developed and agreed by the Government Chief Scientific Advisers (CSAs) our current science priorities are:

1. Present weather and climate risks globally and within the UK;
2. Future climate over this century under different emissions scenarios globally and within the UK, including extreme weather events<sup>315</sup>;
3. Climate risks and impacts from future climate variability and change;
4. Emission pathways compatible with different levels of warming including timing and a consideration of technologies to achieve net zero emissions;
5. Impacts and opportunities of mitigation and adaptation; and
6. The case for early action: implications of delaying mitigation actions.

The UK is a global leader in climate science and will play a key role in addressing these research needs.

<sup>312</sup> The second UK Climate Change Risk Assessment was completed in 2017 and this is being used to inform the second National Adaptation Programme due for completion in 2018. The third Climate Change Risk Assessment will be delivered in 2022

<sup>313</sup> Royal Commission on Environmental Pollution (2007) The Urban Environment <http://www.rcep.org.uk/reports/26-urban/26-urban.htm>

<sup>314</sup> IPCC (2014) In: Climate Change 2014: Mitigation of Climate Change, Summary for Policymakers <http://ipcc.ch/report/ar5/wg3/> Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

<sup>315</sup> For example, this includes a better understanding of climate sensitivity and cloud processes, and improving the ability of global climate models to represent regional climate and extremes.

## Annex D:

# Changes that illustrate how our pathway could be delivered<sup>316</sup>

This table illustrates key changes in each sector that could lead to the emissions reductions set out in our

2032 pathway. It is possible that equivalent emissions savings could be achieved in different ways.

**Table 4: Key historic and future changes by sector**

		1990	2015	2032
Overall	Emissions per capita (tCO <sub>2</sub> e/person)	14	8	4
	Emissions Intensity Ratio, EIR (tCO <sub>2</sub> e/£ million of GDP)	717	271	107
	Final energy consumption intensity of GDP (MWh/£ million)	1,530	872	548
Business and public sector	Non-industrial business and public energy use per £ million output (MWh/£ million)	302	164	79
	Emissions intensity of non-industrial business and public energy use (gCO <sub>2</sub> e/kWh)	121	96	46
	Industrial business energy use per £ million output (MWh/£ million)	1,756	1,005	833
	Emissions intensity of industrial business energy use (gCO <sub>2</sub> e/kWh)	488	403	345
Homes	Home energy use per household (MWh/household)	21	17	15
	Emissions intensity of home energy use (gCO <sub>2</sub> e/kWh)	169	140	120
Transport	Road transport energy use per 1,000 vehicle kilometres (kWh/km)	1,127	941	655
	Road transport emissions per vehicle kilometre (gCO <sub>2</sub> e/km)	260	213	120
	Road transport emissions per energy use (gCO <sub>2</sub> e/kWh)	231	227	183
Power	Emissions from generation (MtCO <sub>2</sub> e)	204	104	16
	Share of electricity supply from clean sources (%)	21%	45%	85%
Natural Resources	Total UK conventional woodland area (thousand hectares)	2,778	3,155	3,648
	Emissions intensity per £m agricultural output (tCO <sub>2</sub> e/£ million)	5,354	3,841	2,817
	Biodegradable waste sent to landfill (Million Tonnes)	36 <sup>317</sup>	8	4
	Greenhouse gas emissions from landfill (MtCO <sub>2</sub> e)	60	12	7

<sup>316</sup> Based upon BEIS, Defra, DfT and DCLG analysis. Further information on sources is made available in the technical annex.

<sup>317</sup> Covers the period 1995 as the earliest data available

# Technical Annex

## UK Carbon Budgets Explained

### Framework

Parliament passed the Climate Change Act (the Act) in 2008, establishing the UK's 2050 target and the supporting framework of carbon budgets. Under the Act, the UK is legally required to reduce greenhouse gas emissions by at least 80 per cent by 2050 on 1990 levels<sup>318</sup>. In order to put the UK on a pathway to achieving the 2050 target, the Government is obliged to set legally binding five-year caps on emissions – ‘carbon budgets’ – twelve years in advance and then to publish a report setting out the policies and proposals to meet that budget and those budgets previously set.

### The Committee on Climate Change

The Act also established the Committee on Climate Change (CCC), an independent statutory body, to advise the Government and the Devolved Administrations on setting and meeting carbon budgets. The CCC advises on the level of each budget, the respective contributions that different sectors could make and the extent to which carbon budgets could be met through the use of flexibilities.

## Legislated carbon budgets

Five carbon budgets have been set to date, covering 2008 to 2032<sup>319</sup>. The fourth carbon budget (covering 2023 to 2027) was set in June 2011<sup>320</sup>. The fifth carbon budget (covering 2028 to 2032) was set in July 2016<sup>321</sup>.

### Accounting for emissions

The UK's performance against its 2050 target and carbon budgets is assessed through the UK's net carbon account, measured in tonnes of carbon dioxide equivalent (tCO<sub>2</sub>e)<sup>322</sup>.

The net carbon account<sup>323</sup> comprises greenhouse gas emissions from the UK, emissions which are captured and stored from land use, land-use change and forestry (LULUCF) and net purchases of international carbon units. Carbon units include allowances issued under cap and trade systems, such as the EU Emissions Trading System (EU ETS) and international carbon credits issued under international schemes, such as the Clean Development Mechanism<sup>324</sup>.

<sup>318</sup> The target covers a selection of greenhouse gases in addition to carbon dioxide, namely methane, nitrous oxide, and a range of fluorinated gases (F-gases), specifically hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride. The 1990 baseline consists of emissions in 1990 for all greenhouse gases except for the F-gases, for which the baseline is 1995. The baseline is revised annually in line with updates made to the UK's greenhouse gas inventory (the official record of UK greenhouse gas emissions). BEIS (2017) Final greenhouse gas emissions inventory statistics 1990-2015 <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>319</sup> UK Legislation (2009) The Carbon Budgets 2009 <http://www.legislation.gov.uk/ukxi/2009/1259/article/2/made> Covering first three carbon budgets

<sup>320</sup> UK Legislation (2011) The Carbon Budget Order 2011 <http://www.legislation.gov.uk/ukxi/2011/1603/made>

<sup>321</sup> UK Legislation (2016) The Carbon Budget Order 2016 <http://www.legislation.gov.uk/ukxi/2016/785/made>

<sup>322</sup> Given the size of the UK economy, we typically describe targets in terms of millions of tonnes of carbon dioxide equivalent (MtCO<sub>2</sub>e) – so the fifth carbon budget limits UK emissions to 1,725 MtCO<sub>2</sub>e or 1,725,000,000 tCO<sub>2</sub>e

<sup>323</sup> The Annual Statement of Emissions sets out the net carbon account. BEIS (2017) <https://www.gov.uk/government/collections/annual-statements-of-emissions>

<sup>324</sup> Clean Development Mechanism: <https://cdm.unfccc.int/>

The net carbon account for each budget is calculated according to rules set out in Carbon Accounting Regulations<sup>325</sup>. Under current regulations, the net carbon account reflects the UK's share of the EU ETS for power, heavy industry and domestic aviation. The EU ETS sets a total cap on the amount of greenhouse gases that can be emitted by heavy industry and power plants in the participating countries. For the "non-traded" sectors which fall outside the EU ETS, the net carbon account reflects the UK's reported emissions under the United Nations Framework Convention.

The UK's 2050 target and carbon budgets currently exclude emissions from international aviation and international shipping, but the Act states that in setting carbon budgets, the Government must take these emissions into account<sup>326</sup>. The CCC advises that the UK should plan for international aviation and shipping emissions of around 41 MtCO<sub>2</sub>e in 2050 – this has been incorporated into our scenarios and will be kept under review. Further information is set out in the 2050 pathways section of this technical annex.

### International actions

The 2015 Paris Agreement under the UN established the goal of keeping the global mean temperature rise to well below two degrees, whilst pursuing efforts to limit the rise to under 1.5°C. The UK is already playing its part,

with the CCC confirming that there is presently no need for the UK to change its targets in light of the Paris Agreement (see Annex C on Climate Science).

As well as our obligations under Paris, as a current member of the EU, the UK has EU-level targets to 2020. In October 2014, the European Council agreed an EU level target of at least a 40 per cent reduction in EU domestic emissions from 1990 levels by 2030. This target will be split into an EU-wide target for the traded sector, governed by the EU ETS, and member state-level targets for the non-traded sector, set via the Effort Sharing Regulation (ESR). A separate Land Use, Land Use Change and Forestry Regulation will cover emissions from those activities. The EU ETS, ESR and the LULUCF Regulation for the period 2021-2030 are still under negotiation in Brussels, though we anticipate that the emissions reductions under the UK's domestic Climate Change Act will be more ambitious and challenging than those set by the EU. The EU legislation on greenhouse gas emissions is among the important current arrangements between the UK and EU that will be addressed as part of the UK's EU exit negotiations. However, whatever the form of the UK's partnership with the EU, working closely together to address the global challenge of climate change will remain important.

<sup>325</sup> For each carbon budget the Government proposes accounting rules for Parliament to agree. Carbon accounting rules for the first and second carbon budget can be found here: <https://www.gov.uk/government/publications/2010-to-2015-government-policy-greenhouse-gas-emissions/2010-to-2015-government-policy-greenhouse-gas-emissions#appendix-4-carbon-budgets>

<sup>326</sup> Climate Change Act: Section 30 <http://www.legislation.gov.uk/ukpga/2008/27/section/30>

## The Role of Carbon Markets

Since establishing the first multi-industry carbon trading scheme in the world in 2002 - the voluntary UK ETS - the UK has had an influential role in establishing the EU Emissions Trading System (EU ETS), the first and largest carbon trading scheme. According to the Institute for Public Policy Research, 93.5 per cent of the global market in carbon exchanges is in London, making it the carbon trading capital of the world<sup>327</sup>.

Putting a price on carbon is set to play an increasing role in moving to a global low carbon economy. Carbon markets can help reduce the cost of reducing emissions by enabling the reductions to occur where it is least cost to do so<sup>328</sup>. Already 40 national jurisdictions and over 20 cities, states and regions put a price on carbon amounting to 13 per cent of global greenhouse gas emissions<sup>329</sup>. With China implementing a national emissions scheme this year, this will rise substantially.

The UK supports a number of initiatives to encourage development of carbon markets, such as the Carbon Initiative for Development and the Forest Carbon Partnership Facility Carbon Fund. These deliver development benefits while incentivising high quality, high volume supplies of carbon credits.

Looking beyond 2020, the Paris Agreement provides an opportunity to stimulate international co-operation. The agreement includes a framework for carbon trading, currently under development through international negotiations. It also provides incentives to engage the private sector to get more actively involved in the transition to a low carbon future. The opportunity to develop a trade in good quality carbon units is at the heart of the UK Government's vision for an efficient global carbon market.

## Projections of UK energy and emissions

The Government projects what our energy demand, fuel mix and emissions might look like as a result of our existing policies. These Energy and Emissions Projections (EEP) give us a sense of whether we are on track to meet our carbon budgets. The latest projections were published on 15 March 2017. We are continually working to improve our projections. In 2018 we will share more details of the methodology, enabling further understanding.

Our latest projections show the trend of falling emissions while growing our economy is set

to continue. They estimate that between 2015 and 2020 we will reduce emissions by 17 per cent, while the OBR forecasts the economy is set to grow by nine per cent (in real terms) over this period<sup>330</sup>.

We have met our first carbon budget and current central projections show us exceeding requirements for both the second and third carbon budgets<sup>331</sup>. Emissions are projected to continue to fall through the 2020s, but there is an estimated shortfall against the fourth and fifth carbon budgets, based on estimates of emissions reductions from existing policies.

<sup>327</sup> IPPR (2017) <https://www.ippr.org/public/index.php/news-and-media/press-releases/londons-status-as-carbon-trading-capital-of-the-world-at-risk>

<sup>328</sup> World Bank Group (2016) State and Trends of Carbon Pricing 2016 <https://www.openknowledge.worldbank.org/handle/10986/25160>

<sup>329</sup> World Bank & Ecofys (2017) Carbon Pricing Watch 2017 <http://www.ecofys.com/files/files/world-bank-ecofys-carbon-pricing-watch-2017.pdf>

<sup>330</sup> OBR (2017) Economic and fiscal outlook – March 2017 <http://budgetresponsibility.org.uk/efo/economic-fiscal-outlook-march-2017/>

<sup>331</sup> BEIS (2017) Energy and Emissions Projections 2016 <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016>

**Table 5: Performance against carbon budgets<sup>332</sup>**

		Carbon Budget				
		1 2008-12	2 2013-17	3 2018-22	4 2023-27	5 2028-32
Budget, cumulative emissions, MtCO <sub>2</sub> e		3,018	2,782	2,544	1,950	1,725
Average reduction vs 1990 emissions, %		-25%	-31%	-37%	-51%	-57%
Existing policies	Projected emissions, cumulative emissions, MtCO <sub>2</sub> e	2,982 actual	2,650 E	2,453 E	2,096 E	1,972 E
	Result vs. Budget, %	-1.2%	-4.7%	-3.6%	+7.5%	+14.3%
Existing and new policies and proposals <sup>333</sup>	Projected emissions, cumulative emissions, MtCO <sub>2</sub> e	2,982 actual	2,650 E	2,453 E	2,066 E	1,892 E
	Result vs. Budget, cumulative emissions, MtCO <sub>2</sub> e	-36	-132	-91	+116	+167
	Result vs. Budget, %	-1.2%	-4.7%	-3.6%	+6.0%	+9.7%
	Cumulative surplus (+) or deficit (-), MtCO <sub>2</sub> e		+132	+223	+107	-60

We expect our shortfall against the fifth carbon budget to reduce significantly based on the policies and proposals set out in this Strategy. Initial estimates of these new early stage policies and proposals show an additional potential reduction of up to 30 MtCO<sub>2</sub>e and 80 MtCO<sub>2</sub>e over the fourth and fifth carbon budget periods respectively<sup>334</sup>; these and other policies will be developed building on the proposals outlined in the Strategy.

The Climate Change Act permits the Secretary of State, at certain points in budgetary cycles, to decide to “carry forward” our over achievements from previous budgetary periods or credit carbon units to the net carbon account. These flexibilities may be utilised to meet any shortfalls that crystallised<sup>335</sup>. As is evident from the above table, there is currently sufficient projected surplus available to carry forward to meet the fourth carbon budget and some of the fifth carbon budget; any shortfall that persists following any carry forward may be met through the purchase of international credits, subject to the requirements of the Climate Change Act.

The current projections are subject to significant uncertainty. For example, we cannot predict exactly what type and scale of global technical innovation

will develop over the next decade. Indeed as the past few years have shown we cannot predict our future energy mix since global action can transform the cost and installation of different technologies, driving very different outcomes to those expected.

Other uncertainties include:

**Macroeconomic factors:** such as population, public employment, and gas prices.

**Policy impacts:** How society will respond to incentives such as taxes or regulation.

**Evidence base:** Scientific knowledge evolves over time, as does our knowledge of technology performance.

**Changing behaviours:** Consumer and business behaviour will evolve over time as new priorities change and fashions develop.

This is why we have used “pathways” for each sector rather than specific estimates of emissions reductions from individual policies, to make sure we take an approach that is robust to these uncertainties.

<sup>332</sup> BEIS (2017) Energy and Emissions Projections 2016 <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016>

<sup>333</sup> BEIS initial estimates of a subset of new early stage policies and proposals show an additional potential reduction of up to 30 Mt and 80 Mt over the fourth and fifth carbon budget periods respectively; these and other policies will be developed building on the proposals outlined in the Strategy.

<sup>334</sup> BEIS initial estimates

<sup>335</sup> Chapter 2 sets out more detail on the Climate Change Act requirements Government will need to follow when taking any decisions on use of flexibilities to meet carbon budgets.

### The 2032 pathway

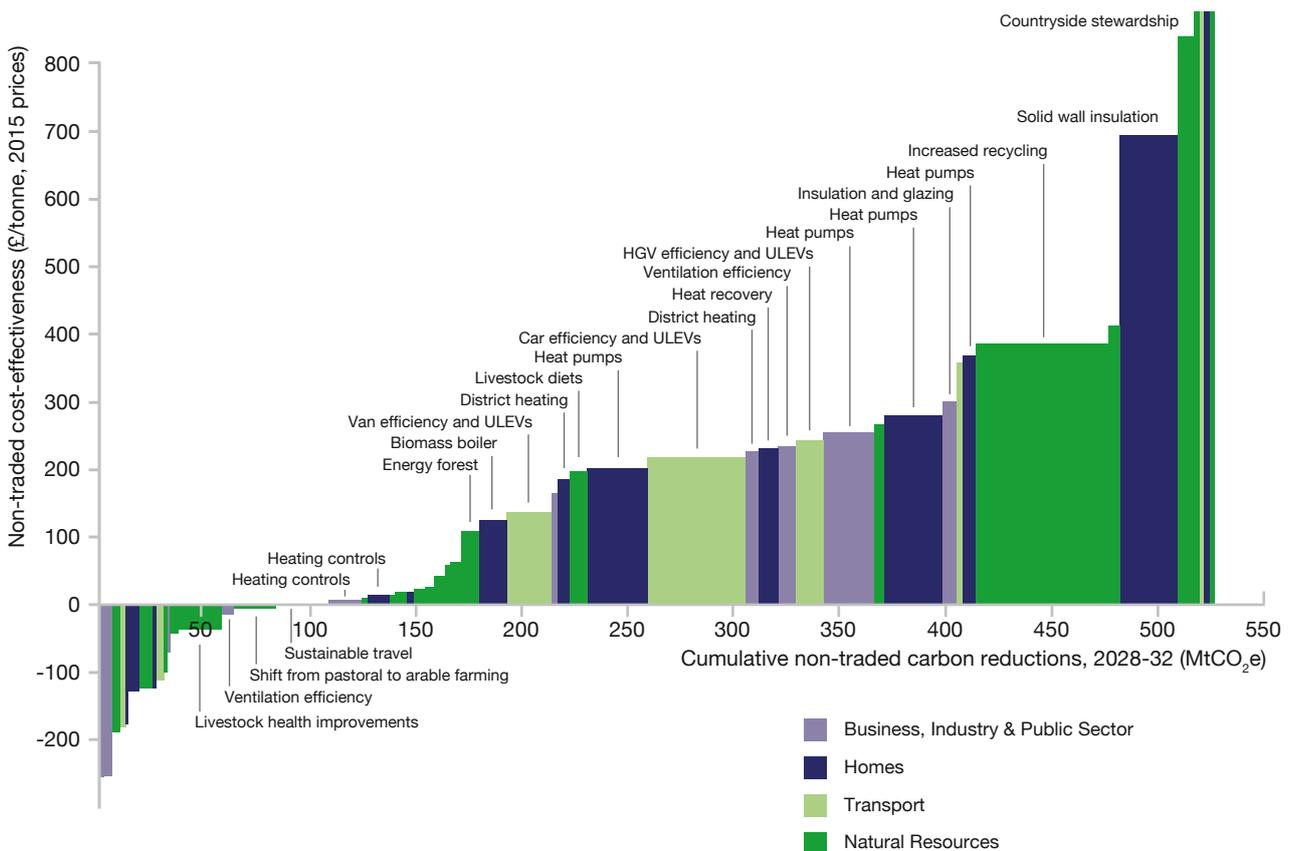
This section provides further details on the impact of the economy-wide pathway presented in Chapter 4 on UK emissions over the period to 2032. Our latest energy and emissions projections provide the starting point for developing the 2032 pathway set out in Chapter 3, and are based on our existing policies.

Emissions reductions beyond our existing policies are then based on the maximum theoretical potential for further abatement identified in the Impact Assessment for the

level of the fifth carbon budget<sup>336</sup>. In doing so, a marginal abatement cost curve (MACC) was estimated, indicating the extent, cost, and type of potential for available emissions reductions opportunities. This is shown in Figure 33.

Table 6 on the following page compares GHG emissions in 2017, 2032 and over the fifth carbon budget period based on a) projected emissions under existing (and past) policies, and b) the 2032 pathway for meeting the fifth carbon budget set out in Chapter 4.

**Figure 33: Non-traded sector MACC showing maximum theoretical potential (central case, 2028-2032)**



Source: DECC

<sup>336</sup> DECC (2016) Impact Assessment for the level of the fifth carbon budget <http://www.legislation.gov.uk/uksi/2016/785/impacts> Section 3.3.4

Table 6: Direct<sup>337</sup> greenhouse gas emissions by sector

MtCO <sub>2</sub> e <sup>338</sup>		Current level	Current policies <sup>339</sup>		2032 pathway	
		2017	2032	Fifth Carbon Budget 2028-2032	2032	Fifth Carbon Budget 2028-2032
Business and Industry	Traded	70	63	317	54	283
	Non-Traded	46	37	192	30	158
	<b>Total</b>	116	100	509	83	441
Homes	Traded	0	0	0	0	1 <sup>340</sup>
	Non-Traded	72	74	366	58	301
	<b>Total</b>	72	74	366	58	302
Transport	Traded	2	2	10	2	10
	Non-Traded	115	103	516	81	435
	<b>Total</b>	117	105	526	83	446
Power <sup>341</sup>	Traded	80	15	79	16	82
	Non-Traded	0	0	0	0	0
	<b>Total</b>	80	15	79	16	82
Natural resources	Traded	0	0	0	0	0
	Non-Traded	66	53	265	41	215
	<b>Total</b>	66	53	265	41	215
Public sector	Traded	0	0	1	0	1
	Non-Traded	8	8	41	4	22
	<b>Total</b>	8	9	42	4	23
Total	Traded	151	79	407	72	377
	Non-traded	308	276	1,380	213	1,132
	<b>Total UK emissions</b>	459	355	1,787	285	1,509
	Assumed UK share of EU ETS allowances <sup>342</sup>			590		590
	<b>UK Net Carbon Account</b> (non-traded emissions plus UK share of EU ETS allowances)			1,972 <sup>343</sup>		1,722

Source: BEIS, DfT, Defra and DCLG analysis

<sup>337</sup> Direct emissions are those produced immediately within the housing sector, and exclude for example emissions from electricity generation.<sup>338</sup> Figures may not sum due to rounding<sup>339</sup> Beyond 2020, the emissions scenario for the power sector provides an illustration only.<sup>340</sup> Increase due to large-scale heat networks<sup>341</sup> Analysis of the power sector 2032 pathway is based on the BEIS (2017) Energy and Emissions Projections Reference scenario, 2016 <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016>. The analysis additionally takes into account changes in electricity demand resulting from actions outlined in the 2032 pathway in energy-consuming sectors (e.g. transport, homes, industry). Furthermore, a number of model updates and improvements have been made regarding the electricity demand profiles of key technologies and how this demand might be shifted, the availability of electricity storage technologies, and assumed system operability requirements.<sup>342</sup> The UK Net Carbon Account is defined by UK Carbon Accounting Regulations. Current regulations require that emissions covered by the EU Emissions Trading System (Traded emissions) are included as being equal to the UK's allocation of permits under the System, rather than actual UK territorial emissions. When setting the fifth carbon budget, this allocation was estimated to be 590 MtCO<sub>2</sub>e during the fifth carbon budget period.<sup>343</sup> Net carbon account as published in the BEIS (2016) Energy and Emissions Projections Reference Scenario prior to the additional analysis made on the power sector (see note above).

**Table 7: Non-traded emissions reductions during 2028-2032: Maximum theoretical potential, and the 2032 pathway<sup>344</sup>**

<i>MtCO<sub>2</sub>e</i>	Maximum theoretical potential for reducing non-traded emissions during 2028-2032	Non-traded sector emissions reductions resulting from the 2032 pathway
Business, Industry and public buildings	82	53
Homes	145	65
Transport	107	80
Natural resources	193	50
<b>Total</b>	<b>527</b>	<b>248</b>

Source: DECC, BEIS

This evidence was combined with judgements about the barriers to delivering emissions reductions, the rate at which low carbon options could be adopted and the timescales of key decisions set out in the Decision Pathways annex. The pathway is based on our current expectations of the availability and performance of low carbon options, but there is considerable uncertainty about how these will develop, and this is only one of several plausible pathways.

The maximum theoretical potential for emissions abatement across the UK economy is compared with the emissions reductions in the 2032 pathway (relative to the central emissions projection) in Table 7.

### Indicative annual range

Section 12 of the Climate Change Act 2008 requires the Government to publish an indicative annual range for the net UK carbon account for each year over which the levels of carbon budgets are set. An indicative annual range is a range within which the Secretary of State expects the amount of the net UK carbon account for the year to fall. Table 8 shows these ranges for the fifth carbon budget, taking account of the emissions savings implied by the 2032 pathway. The range reflects uncertainty in emissions projections under existing policies.

**Table 8: Indicative annual range for the net UK carbon account, 2028-2032 (MtCO<sub>2</sub>e)**

Indicative net UK carbon account	Carbon Budget 5 2028-2032				
	2028	2029	2030	2031	2032
Upper Bound	382	381	372	363	358
Central	357	354	345	336	331
Lower Bound	343	341	331	324	319

Source: BEIS, DfT, Defra and DCLG analysis

<sup>344</sup> DECC (2016) Impact Assessment for the level of the fifth carbon budget <http://www.legislation.gov.uk/uksi/2016/785/impacts> Section 3.3.4

**Table 9: Costs and benefits of the 2032 pathway**

<b>Capital and operating costs</b>	The incremental costs of installing and running low carbon technologies
<b>Finance costs</b>	The real social cost of providing finance for capital investments, which varies between sectors
<b>Energy savings</b>	The value of lower energy use due to improved efficiency of energy consumption, or switching from fossil fuels to low carbon alternatives
<b>Greenhouse Gas emissions impacts</b>	The benefits associated with reduced emissions. Where emissions are covered by the EU ETS, this benefit will be the avoided financial cost of purchasing EU emissions allowances. Reductions in non-traded emissions are valued using the Government's non-traded carbon values
<b>Impacts on air quality</b>	The benefits associated with lower emissions of NO <sub>x</sub> , PM <sub>2.5</sub> and other air pollutants detrimental to the health of individuals
<b>Other cost and benefits</b>	These include the hassle cost to households for installing measures, benefits of shorter journey times due to lower congestion, less noise pollution and warmer homes from energy efficiency improvements

### Positive economic value

Delivering the 2032 pathway described in this Strategy would result in a wide range of costs and benefits as described in Table 9. These costs and benefits can vary significantly. In particular they will depend on a wide range of social and economic factors such as growth in population and gross domestic product; they will depend on how innovation results in new and lower cost low carbon technologies; and importantly the costs and benefits will also depend on the precise actions that are taken as a result of the Strategy.

The extent of these costs and benefits is not fully known at this point in time because they will depend on the final design of the policies and proposals to meet carbon budgets. When setting the fifth carbon budget an indicative set of costs and benefits were estimated and set out in the accompanying impact assessment<sup>345</sup>. Overall, it was estimated that meeting the fifth carbon budget through domestic action alone could be achieved with a net benefit to the UK of up to £5.5 billion over the fifth carbon budget period.

The impact assessment also set out the sensitivity of these estimates to a range of underlying social and economic factors. These factors in particular included uncertainty around technology costs, energy prices, underlying drivers of UK emissions, and non-cost barriers to delivery.

As noted, these estimates only provide an illustration of the potential scale of impacts. The 2032 pathway shows what is considered possible through domestic action, although this is only one of several plausible pathways. As Government delivers its Clean Growth Strategy and finalises policies, these will be accompanied with their own impact assessments where appropriate, which will set out the specific costs and benefits of the proposals.

<sup>345</sup> DECC (2016) Impact Assessment for the level of the fifth carbon budget <http://www.legislation.gov.uk/uksi/2016/785/impacts> Section 4.1

## 2050 pathways

### Developing our illustrative 2050 pathways

To explore the range of opportunities for the UK out to 2050 we have used UK TIMES, a model of the whole UK energy and greenhouse gas system (see further detail below). The model allows us to explore different possible outcomes by considering the availability, performance, feasible build rates, and costs of existing and new technologies, as well as how the future economy might differ from today. This model has been developed by the Government in partnership with University College London (UCL) over a number of years, in consultation with many partners.

There are many ways the 2050 target could be met. To illustrate key potential technologies and uncertainties we investigated three pathways in depth. These three have all been deliberately selected to illustrate a wide range of possible pathways; for example, from 100 per cent battery electric cars to 100 per cent hydrogen fuel cell cars. However, different pathways within this range, and beyond this range, are also possible. All three 2050 pathways are consistent with the sector emissions levels in the 2032 pathway presented in this Strategy. They do not represent the most likely or preferred pathways to meeting the 2050 target, but show that the 2032 pathway would leave open a wide range of options for 2050.

A detailed overview of the three pathways is given below, together with an explanation of the methodology used to develop these pathways.

### Details of the three 2050 pathways

#### Pathway 1: Electricity

This pathway sees UK electricity generation increasing to around 650 TWh in 2050. All cars and vans are electric and four in five buildings use electric heating. Electricity is also the main low carbon energy source to the

industry sector, making up around one-third of fuel demand. Around one in five buildings use a largely low carbon district heat network. In this pathway carbon capture, usage and storage (CCUS) technologies are not available, which means there are no negative emissions. Hydrogen production is very low and industry sector emissions are higher than in the other two pathways.

#### Pathway 2: Hydrogen

This pathway sees a key role for low carbon hydrogen in decarbonising our vehicles and buildings. All cars and vans are fuelled by hydrogen and the majority of buildings use a hydrogen grid. Electricity and district heat still play a role in both residential and commercial/public buildings. Overall hydrogen production is around 700 TWh in 2050, with Steam Methane Reforming and CCUS being the primary generation method. The role for CCUS in this pathway is greater than the other pathways with over 170 MtCO<sub>2</sub>e being captured and stored in 2050. Because hydrogen is the main energy source for heating and transport, electricity demand and therefore generation is lower than the other pathways at around 340 TWh (around the same level as today).

#### Pathway 3: Emissions removal

This pathway illustrates the role that a negative emissions technology (in this case bio-energy with carbon capture and storage) could play in meeting the 2050 target. Here negative emissions in the electricity sector of around 20 MtCO<sub>2</sub>e create “headroom” for other sectors such as transport, buildings and agriculture to decarbonise more slowly. In this pathway total electricity generation is around 570 TWh. Around four of every five cars and vans on our roads are electric and three in every five buildings are heated by low carbon electricity. Around one in every five buildings uses a largely low carbon district heat network.

Table 10: Characteristics of the 2050 pathways in 2050

		Pathway 1: Electricity	Pathway 2: Hydrogen	Pathway 3: Emissions removal
Non-industrial business and public sector	Emissions (MtCO <sub>2</sub> e)	3	1	1
	Share of district heat use in heating (per cent)	17%	24%	18%
	Share of electricity use heating (per cent)	83%	13%	80%
	Share of hydrogen use in heating (per cent)	0%	56%	0%
Industrial business	Emissions (MtCO <sub>2</sub> e)	58	59	48
	Share of electricity use (per cent)	33%	23%	30%
	Share of hydrogen use (per cent)	0%	32%	28%
	Share of bioenergy use (per cent)	20%	15%	9%
	Captured emissions from industrial businesses (MtCO <sub>2</sub> e)	0	165	37
Homes	Emissions (MtCO <sub>2</sub> e)	8	6	19
	Share of district heat use in heating (per cent)	17%	17%	17%
	Share of electricity use in heating (per cent)	76%	14%	60%
	Share of hydrogen use in heating (per cent)	0%	62%	0%
Transport	Emissions (MtCO <sub>2</sub> e)	3	5	15
	Share of car and van km in battery electric vehicles (per cent)	100%	0%	85%
	Share of car and van km in hydrogen fuel cell electric vehicles (per cent)	0%	100%	0%
	Share of HGV km in zero emission vehicles (per cent)	55%	19%	93%
Power	Emissions (MtCO <sub>2</sub> e)	4	3	-22
	Electricity generation (TWh)	647	339	572
	Share of clean electricity generation (per cent)	99%	99%	99%
Natural resources	Emissions (MtCO <sub>2</sub> e)	46	46	60
Aviation and shipping <sup>346</sup>	Emissions (MtCO <sub>2</sub> e)	44	44	44
Total	Emissions (MtCO <sub>2</sub> e)	165	165	165

<sup>346</sup> Includes domestic and international aviation and shipping, in line with advice from the Committee on Climate Change. CCC (2015) Sectoral scenarios for the fifth carbon budget <https://www.theccc.org.uk/publication/sectoral-scenarios-for-the-fifth-carbon-budget-technical-report/>

## Overview of the methodology used to develop 2050 pathways

The 2050 analysis uses UK TIMES, a model of the whole UK energy and greenhouse gas system covering the period 2010 to 2060<sup>347</sup>. The model identifies the least cost technology pathway capable of both producing an assumed set of outputs (e.g. industrial output, space heating, and passenger distances travelled) and an emissions reduction profile. The technology pathway identified by the model will vary according to the input assumptions for technology and resource performance, cost and availability. The model can also be set up to roll out specific technologies in line with a given deployment profile. When the model is used in this way it will take account of the deployment profiles for specific technologies, and identify the least cost mix of remaining options.

The 2050 pathways analysis has two primary objectives.

First, it examines three substantially different “pathways” of economy-wide decarbonisation to understand the range of possible long-term outcomes.

Through previous modelling, research and external engagement, BEIS has identified the three areas of technology and resource uncertainty likely to have a big impact on the 2050 energy system. The pathways were then developed in consultation with internal sector experts to illustrate potential futures based on contrasting roles for these factors:

- The role of electrification;
- The role of hydrogen;
- The role of bioenergy production with CCUS to produce ‘negative emissions’.

Second, it confirms all of the pathways are consistent with meeting the 2050 and fifth carbon budget emissions reduction targets.

The modelled pathways were constructed in UK TIMES by varying input assumptions for:

- Availability of technologies. For example, CCUS is not available in pathway 1 and negative emissions technologies are only available in pathway 3.
- The extent or speed at which technologies can be rolled out e.g. faster growth in hydrogen production is allowed in pathway 2, whilst expansion of electric heating is more restricted.
- Entering fixed deployment profiles for some technologies e.g. 100 per cent of cars and vans are set to be powered by electricity or hydrogen in pathways 1 and 2 respectively.

Other assumptions were kept the same across the pathways. For instance the consumption and output projection assumptions are consistent with current official economic growth and population projections and were the same for each of the modelled 2050 pathways. Technology and resource costs and performance assumptions were also kept the same and sector emissions were aligned to those in the 2032 pathway described in this Strategy.

## Impact of international aviation and shipping on 2050 emissions

International aviation and shipping emissions are not currently included within the UK’s targets under the Climate Change Act. However, carbon budgets have been set in a way that takes these emissions into account – the UK is on a trajectory that could be consistent with a 2050 target that includes emissions from international aviation and shipping.

<sup>347</sup> For this analysis, model version v1.2.3\_d0.6.0\_DNP has been used.

The Government has not reached a final view on the appropriate level of international aviation and shipping emissions in 2050. The CCC in their advice on the fifth carbon budget advised leaving space in the 2050 target of around 41 MtCO<sub>2</sub>e. This has been the modelling assumption used throughout this Strategy<sup>348</sup>.

We have undertaken sensitivity analysis to test the potential impact of higher or lower aviation emissions on how the UK could meet its 2050 target (focusing on aviation emissions as they are greater than shipping emissions).

There are a number of policy measures available, both at the domestic and international levels, to address aviation emissions. It is likely that a combination of approaches and policy measures will be required. Examples of action available to countries include: international level action to tackle aviation emissions (such as through international standards and offsetting schemes) and domestic action to tackle aviation emissions (such as through support for sustainable alternative fuel uptake in aviation or improved operational efficiency).

We have explored the feasibility of taking domestic policy action to offset aviation emissions to 2050 above the CCC planning assumption. We have analysed a scenario from the Airports Commission's (AC) work on aviation capacity. For the case of expansion at Heathrow (a new northwest runway), the AC estimated UK gross aviation emissions in its "carbon traded" scenario to be around 44 MtCO<sub>2</sub>e in 2050<sup>349</sup>.

This scenario for gross UK aviation emissions above the CCC planning assumption provides a useful basis for a sensitivity test. Our analysis shows that it is possible to meet the 2050 target under the Climate Change Act domestically if aviation emissions are 44 MtCO<sub>2</sub>e<sup>350</sup> – this is the case for our three pathways to 2050. Further action could be taken after the fifth carbon budget in order to offset these higher aviation emissions through action elsewhere in the UK. The action taken in the remaining UK sectors depends on the wider pathway to 2050.

### Consideration of wider circumstances

The Climate Change Act requires the Government to take into account a range of factors in developing its plan for meeting carbon budgets. These factors are discussed throughout the Strategy and its annexes. For a number of these factors it is not currently possible to know the full impacts as these will depend on the detailed design of the individual policies that will be developed in the coming years as the Strategy is delivered.

Nevertheless, it is possible to estimate the nature of potential impacts and the considerations that will need to be made as policies are developed. In delivering the Strategy, the Government will undertake analysis to inform policy development. Where appropriate, impact assessments supporting the policy design will be produced.

<sup>348</sup> CCC (2015) Sectoral scenarios for the fifth carbon budget <https://www.theccc.org.uk/publication/sectoral-scenarios-for-the-fifth-carbon-budget-technical-report/>. The CCC's central scenario allows 37.5 MtCO<sub>2</sub>e for aviation emissions in 2050, of which 36.2 MtCO<sub>2</sub>e

<sup>349</sup> The AC used two scenarios – one called "carbon capped", and one called "carbon-traded". In the "carbon-capped" scenario, the AC's analysis showed that policies are available to limit UK aviation emissions to the CCC planning assumption of 37.5 MtCO<sub>2</sub>e in 2050 (domestic and international). In the "carbon traded" scenario, there is a global carbon market allowing reductions to be made where they are most efficient across the global economy resulting in UK aviation emissions of 44 MtCO<sub>2</sub>e (domestic and international).

<sup>350</sup> 47 MtCO<sub>2</sub>e total international aviation and shipping emission assumed in this scenario

## Economic circumstances

Impacts on growth and competitiveness of the UK economy can arise through a number of channels, as a result of actions taken to deliver the Strategy. These arise due to:

- Impacts on the timing and scale of investment spending;
- Impacts on business output resulting from improvements in energy efficiency, and changes in expenditure on capital assets;
- Reorientation of consumption patterns away from emissions-intensive products and towards more energy-efficient products;
- Impacts from changes to energy prices as a result of energy demand changes, and any changes in the costs of policy delivery mechanisms included in energy bills;
- Long-term benefits from innovation, including the development of nascent industries, associated spillover benefits into other sectors, and the increase in exports of knowledge and new technologies;
- Indirect effects on growth through changes in exposure to energy price volatility and supply disruptions;
- Transition costs that could materialise, for example the potential impact of stranded assets and any transitional unemployment; and
- Multiplier effects associated with the above impacts, including any impacts on employment.

The Government has undertaken analysis to assess the likely range of impacts from meeting the range of budgets. This analysis was undertaken in order to inform the setting of the fifth carbon budget and is set out in section 4.1 of the impact assessment.

## Fiscal circumstances

Impacts on taxation, public spending, and public borrowing can arise for a number of reasons:

- The Government currently provides financial support for the take-up of low carbon technologies. Changes to existing policies or new policies may affect this expenditure;
- Impacts on GDP, for the reasons set out above, can affect tax revenues;
- Behaviour change can affect revenues relating to environmental taxes (e.g. landfill tax);
- Decisions may be taken in the future with regards to the wider tax system to take account of the broader fiscal position.

## Social circumstances

Delivering the Strategy may have impacts on fuel poverty in the UK and its nations. The UK Government has a statutory target to raise as many English fuel poor homes as is reasonably practicable to energy efficiency Band C by 2030, with milestones of Band E by 2020 and Band D by 2025. The Devolved Administrations in Scotland and Wales have separate legal fuel poverty targets.

The pathway set out in the Strategy could affect fuel poverty through a number of channels. These include impacts on energy prices, impacts on the energy needs of households through improved building fabric, and changes in the way heat is supplied. We will assess the impact on fuel poverty as part of the implementation of the individual policies outlined in the Strategy.

## Energy policy and energy supplies

Energy security is about ensuring secure, reliable, uninterrupted supplies to consumers, and having a system that can effectively and efficiently respond and adapt to changes and shocks. It is made up of three characteristics: flexibility, adequacy and resilience. The Government is committed to ensuring there are secure supplies for consumers whatever the energy mix.

The energy intensity of the UK economy has fallen significantly since 1990 and this trend is expected to continue. The energy intensity of the UK economy in 1990, as measured through final energy demand, was 1,530 MWh of energy per million pounds of GDP. In comparison, the energy intensity of the UK economy is projected to be around 630 MWh

per million pounds of GDP in 2032, under the EEP 2016 reference emissions scenario based on existing policies. In the 2032 pathway, energy intensity could be as low as 548 MWh per million pounds of GDP by 2032.

Delivering the 2032 pathway would result in changes in fuel consumption across the whole economy, with estimated impacts set out in Table 11. In total, the 2032 pathway would reduce final consumption by around 13 per cent in 2032 relative to projected energy consumption under existing policies, as a result of further improvements in fuel efficiency. The reduction in fossil fuel consumption will help improve energy security but the pathway is also characterised by a shift from end-user fossil fuel consumption towards biomass and electricity.

**Table 11: Change in annual final energy consumption in 2032, relative to the existing policies scenario**

	Potential saving (-) or additional consumption (+) in 2032 (TWh/year)	Percentage impact relative to existing policies
Electricity	+14	+4%
Gas	-124	-23%
Coal	-6	-38%
Oil	-126	-25%
Bioenergy	+28	+29%
<b>Total</b>	<b>-215</b>	<b>-14%</b>

The capacity mechanism will use competition to find the most cost-effective mix of technologies to ensure we have sufficient reliable capacity to meet electricity demand.

The power sector's response to these changes in demand has been modelled using BEIS's Dynamic Dispatch Model (DDM)<sup>351</sup>. All other things being equal increased electricity consumption results in overall increases in the marginal costs of power supply, due to the need to dispatch more expensive generating technologies to meet consumption. The precise impacts depend on a range of factors, including the technology mix, technology costs, and fossil fuel and carbon prices.

While electricity consumption is lower than the reference case projections (existing policies) in the early 2020s, over the fifth carbon budget as a whole 1.5 per cent more electricity is used. This is met through additional supply from clean generation, gas generation and interconnection.

A smarter electricity system reduces the additional capacity and costs from higher electrification of transport and heat through deploying energy storage technologies, and shifting electric vehicle charging and heat pump demand. Smart flexibility and technologies have the effect of reducing electricity consumption at peak times and shifting consumption to times when overall consumption is lower and more low-cost electricity generation capacity is available.

### Sustainability (including the impact on natural capital)

Section 13(3) of the Climate Change Act 2008 states that proposals and policies for meeting carbon budgets must, when taken as a whole, '*be such as to contribute to sustainable development*'. Tackling climate change is essential for maintaining a healthy, resilient natural environment, and the Government is committed to ensuring that the value of nature is appropriately reflected in all relevant policy decisions.

Actions taken to meet our carbon budgets can create both risks and opportunities relating to the quality of our environment. We refer to the stocks of natural assets (e.g., forests, clean air, soils, species, freshwaters, oceans and minerals) that provide flows of natural resource inputs and ecosystem services as natural capital. Government set up the Natural Capital Committee (NCC) in 2012 to advise it on the sustainable use of natural capital, and how the services provided by, and risks to, natural assets can be better accounted for and valued in decision-making. This thinking is informing revisions to the HM Treasury Green Book to ensure a structured and consistent approach to assessing impacts on natural capital in policy appraisal.

To produce an assessment of natural capital impacts for the Strategy, a screening exercise was conducted to identify which policies and proposals might be expected to have natural capital impacts. For these an assessment framework was designed to ensure that potential impacts on natural capital assets and their services were considered in a consistent way. Assessments prompted consideration of the spatial effects of each measure, the timeframe of these effects and a range of environmental assets that could be affected.

<sup>351</sup> DECC (2014) Dynamic Dispatch Model <https://www.gov.uk/government/publications/dynamic-dispatch-model-ddm>

The detail of the assessments showed that impacts can vary depending on the context and policy approach which is important to consider when developing policy.

Important risks and opportunities identified included:

- Increasing forestry cover can have a number of benefits to natural capital including creating new habitats for animals and reducing flood risk. Likewise changes to farming practices can reduce the demands placed on natural resources and aid biodiversity. However, context is very important when changing land use. For example, benefits vary by species of tree planted, or the previous use of land converted to produce less emission intensive crops.
- Transport sector measures such as the deployment of ULEVs may provide significant opportunities to reduce emissions of harmful air pollutants including Particulate Matter (PM) and nitrous oxides. There are also potential benefits in less pollution running off from road and reduced noise levels.
- Burning biomass for heat or power and biofuels for transport can create some harmful emission including Particulate Matter (PM) and Volatile Organic Compounds (VOCs). More broadly, while there are some risks, there are significant opportunities to both reduce greenhouse gas emissions while also reducing harmful air pollutants.

The work also highlighted the need to consider natural capital impacts across groups of policies. These considerations will be taken forward as specific measures are designed and appraised in detail in accordance with Green Book guidance.

### Assumptions and evidence base

The analysis of the 2032 and 2050 pathways are underpinned by a common set of assumptions about future economic and demographic trends, which align with those used for the 2016 Energy and Emissions Projections<sup>352</sup>. The EEP 2016 Reference scenario, representing future emissions under the UK's current suite of climate policies, is also used as the reference for GHG emissions and energy consumption in each sector. The analysis uses assumptions about future energy prices, published as part of supplementary Green Book appraisal guidance.

Wherever possible technical assumptions on costs, performance and availability of technologies have been aligned between the UK TIMES model used for the 2050 pathways analysis and the models used to for the 2032 pathway analysis, although due to differences in modelling approaches there are some minor differences.

<sup>352</sup> BEIS (2017) Updated energy and emissions projections 2016 <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016>

## Evidence base

**Commercial and public buildings:** 2032 pathway analysis was based on the BEIS Non-domestic Building model using evidence from the Digest of UK Energy Statistics, Energy and Emissions Projections, ECUK and the Building Energy Efficiency Survey (BEES) to estimate heating, cooling and ventilation demand to 2032. Technology evidence was taken from BEES; RHI statistics and an interim heat pump performance report; an AECOM report on heat network costs and performance; and cost data from Heat Networks Delivery Unit (HNDU) sponsored projects. The Products Policy model was used for ventilation scenarios. For the 2050 pathways additional assumptions were taken from Carbon Trust; Valuations Office Agency and Poyry.

**Industry:** The 2032 pathway was developed using BEIS Industry Pathways Models, split into eight industry sectors. A capital cost uplift of 10 per cent has been applied in the 2032 analysis to reflect potential hidden costs of delivering measures. For iron and steel, paper, cement and a part of chemicals actual production steps are modelled, using evidence from the Usable Energy Database<sup>353</sup>. The remaining sectors (other chemicals, non-metallic minerals, non-ferrous metals, food and drink and 'other' industry) are split into the different energy service demand categories (e.g. high temperature heat, low temperature heat) and generic technologies that produce these types of energy are modelled. Assumptions for these sectors are mainly based on UK MARKAL. Evidence from the Government's 2050 Industrial Decarbonisation and Energy Efficiency Roadmaps, published in 2015, was incorporated into the modelling; in particular, the timing and extent of technologies deployed in the 2032 pathway analysis.

**Transport:** The 2032 pathway was developed using the Department of Transport's National Transport Model (NTM)<sup>354</sup> for road measures and the Rail Emissions Model for rail measures. The NTM forecasts emissions and traffic accounting for impacts on vehicle fuel efficiency and fuel mix. The ECCo model was used to develop uptake scenarios for Ultra Low Emissions Vehicles. Impacts of sustainable travel measures were based on evidence from the evaluation of the Sustainable Travel Towns<sup>355</sup>. The NTM covers Great Britain, so an uplift has been applied to account for transport emissions from Northern Ireland. This is the standard approach taken by DfT. For 2050 pathways analysis, nine vehicle groups are represented (e.g. car, bus, lorry), each with different types of vehicle choice (e.g. electric or hydrogen). Car and LGV assumptions were based on Element Energy's ECCo Cost and Performance Database; HGV assumptions from a Ricardo report to the CCC (A review of the efficiency and cost assumptions for road transport vehicles to 2050); and maximum growth and delivery rate assumptions from DfT/ University College London (UCL).

<sup>353</sup> UKERC Energy Data Centre, Industrial Energy use: <http://tinyurl.com/k8nohc7>

<sup>354</sup> DfT (2012) Transport appraisal and modelling tools <https://www.gov.uk/government/collections/transport-appraisal-and-modelling-tools>

<sup>355</sup> Sloman et al. (2010) The effects of smarter choice programmes in the sustainable travel towns: research report <https://www.gov.uk/government/publications/the-effects-of-smarter-choice-programmes-in-the-sustainable-travel-towns-full-report>

**Domestic buildings:** The 2032 pathway for existing buildings covers energy efficiency, heating technologies, heat networks, and behaviour change. The pathway was developed through the BEIS Domestic Buildings Scenario Model. Cost and performance assumptions for energy efficiency and heat measures is based on published analysis for the Renewable Heat Incentive (RHI) and Energy Company Obligation. For new homes, build rate assumptions were taken from the 2015 Housing Standards Review Impact Assessment, and impacts of low carbon heat measures was based on analysis conducted by an AECOM-led consortium. Additional assumptions for the 2050 pathways analysis are taken from UCL, Office of National Statistics (ONS) and Energy Consumption in the UK (ECUK).

**Power:** The power sector's response to the changes in demand under the 2032 pathway has been modelled using BEIS's Dynamic Dispatch Model<sup>356</sup>. The DDM is a comprehensive fully-integrated power market model covering the market in Great Britain over the medium to long-term. The model enables analysis of electricity dispatch from GB power generators and investment decisions in generating capacity from 2010 through to 2050. It considers electricity demand and supply on a half-hourly basis for sample days. Investment decisions are based on projected revenue and cash flows taking into account policy impacts and changes in the generation mix. The full lifecycle of power generated plant is modelled, from planning through to decommissioning. The modelling accounts for risk and uncertainty involved in investment decisions. UK TIMES 2050 modelling uses the same technology assumptions as the DDM where possible, and also includes additional evidence from UCL, National Grid, EPRI and Carbon Trust.

**Agriculture and land use:** Agriculture: Evidence has been scaled from England to cover all of the UK Greenhouse Gas Emissions Inventory for England, Scotland, Wales and Northern Ireland (1990-2015). The scaling factor is based on a five-year average of the national contributions to overall agricultural emissions from the national inventory report (the 2014 common reporting format tables). From that data the average English contribution to agricultural GHGs is 63 per cent and estimates are scaled up on this basis.

**Forestry:** Emissions reductions are projected using an off-line version of the CARBINE carbon accounting model with policy specific mixes of woodland types. Biomass supply from relevant harvest fractions are included in the scenario analysis, but carbon storage and emissions reductions associated with the use of harvested wood products are not. This evidence has been scaled from England to cover all of the UK, based on both the share of current and historical activity<sup>357</sup> and afforestation scenarios developed with DA forestry leads through the LULUCF GHG inventory and projections project funded by the BEIS Science team.

**Soils:** The 2032 pathway analysis for England uses analysis of the potential GHG savings from different types of peatland restoration. Emission reductions are estimated using preliminary findings from an forthcoming BEIS-funded research project combined with cost data from the peatland code, agri-environment payments and reports for the CCC Adaptation sub-Committee. In order to cover the UK as a whole the England-only data has been scaled based on estimates of total UK peatland area. Agriculture and land use is represented in the 2050 pathway analysis by applying a fixed emissions profile with a series of mitigation options available. This profile combines components from land use, crops and livestock.

<sup>356</sup> DECC (2014) Dynamic Dispatch Model <https://www.gov.uk/government/publications/dynamic-dispatch-model-ddm>

<sup>357</sup> Forestry Commission (2017) Forestry Statistics <https://www.forestry.gov.uk/forestry/infd-7aqqdc>

**Waste:** The emission saving from waste in the 2032 pathway has been informed by a variety of sources. Food waste prevention savings are based on WRAP analysis associated with the Courtauld Commitment 2025. Landfill diversion was based on Defra's Routemap. Projections of waste arising are a key input to the model. Landfill gas capture and oxidation assumptions were developed in an expert elicitation exercise with the Environment Agency. Cover the UK as a whole, the England only data has been scaled based on the Greenhouse Gas Emissions Inventory for England, Scotland, Wales and Northern Ireland (1990-2015).

**Economic growth and demographic changes:** The 2032 pathway analysis used the same growth assumptions as the 2016 Energy and Emissions projections. In the UK TIMES model used for 2050 pathway analysis, there are 60-plus growth drivers which are exogenous to the model and based on a variety of assumptions including: BEIS Energy Demand Model outputs, GDP growth assumption, ONS population growth, Department for Communities and Local Government (DCLG) household projections and Department for Transport (DfT) transport driver estimates.

**Fossil fuel prices:** Fossil fuel prices assumptions are based on the BEIS Fossil Fuel Price Assumptions 2016<sup>358</sup>.

**Carbon Values:** The Government's current approach to carbon valuation was adopted in 2009 based on a "target-consistent" methodology. This is set out here <https://www.gov.uk/government/collections/carbon-valuation--2>.

**Aviation and Shipping (A&S):** The CCC planning assumption is used to set the aviation and shipping "headroom" level in 2050. Domestic aviation and shipping is modelled as part of carbon budgets leading up to 2050.

**Bioresource:** Bioresource availability is based on the Bioenergy Feedstock Availability Model<sup>359</sup>. The assumed land area available for energy crops has been limited by excluding a wide range of sensitive sites on both landscape and biodiversity grounds. Domestic and imported bioresource costs are from a range of sources including CCC, E4tech, Carbon Trust and Nix Farm Management.

**Air quality:** Air quality emissions factors are provided by the National Atmospheric Emissions Inventory and Aether. Air quality damage costs are consistent with COMEAP guidance on air pollution.

**Hydrogen:** Hydrogen assumptions were developed by University College London<sup>360</sup>. The costs are based on the assumption that a new network would need to be built to allow heating to be supplied by hydrogen.

**EU ETS:** Assumptions for the UK's share of EU ETS allowances are aligned with the levels assumed at the time of setting the respective budgets. These are 1,078 MtCO<sub>2</sub>e (second carbon budget); 985 MtCO<sub>2</sub>e (third); 690 MtCO<sub>2</sub>e (fourth); and 590 MtCO<sub>2</sub>e (fifth).

<sup>358</sup> BEIS (2016) Fossil Fuel Price Assumptions 2016 <https://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2016>

<sup>359</sup> BEIS (2017) The UK and global bioenergy resource model

<sup>360</sup> Dodds PE, Mcdowall, W. (2012) A review of hydrogen production technologies for energy system models <http://discovery.ucl.ac.uk/1402719/>

## Source information for metrics see Annex D: Changes that illustrate how our pathway could be delivered

**Overarching:** Emissions estimates for these metrics are taken from the BEIS (2017) GHG emissions statistics<sup>361</sup> and 2032 pathway analysis. Population data (historical and projected) are sourced from the Office for National statistics (2017)<sup>362</sup>. Energy data are taken from the BEIS (2016) Digest of UK Energy Statistics (DUKES)<sup>363</sup> and 2032 pathway analysis. Gross Domestic Product (GDP) estimates to 2015 are taken from the Office for National Statistics<sup>364</sup>. Emissions and energy use projections are based upon BEIS (2017) Energy and Emissions Projections 2016<sup>365</sup>. GDP projections are taken from the Office for Budget Responsibility (OBR) Economic and Fiscal Outlook November 2016.

**Business and public sector:** Emissions estimates for these metrics are taken from the BEIS (2017) GHG emissions statistics and 2032 pathway analysis. Energy data are taken from the BEIS (2016) Digest of UK Energy Statistics and 2032 pathway analysis. Output gross value added (GVA) estimates for services and industry are sourced from the Office for National Statistics on a constant price basis<sup>366</sup>. There are no official projections of output GVA; estimated trends have been made consistent with assumptions used in BEIS (2017) Energy and Emissions Projections.

**Homes:** Emissions estimates for these metrics are taken from the BEIS (2017) GHG emissions statistics and 2032 pathway analysis. Energy data are taken from the BEIS (2016) Digest of UK Energy Statistics and 2032 pathway analysis. UK Household historical estimates have been taken from BEIS (2017) Energy Consumption in the UK<sup>367</sup> with projections sourced from BEIS (2017) Energy and Emissions Projections 2016, both of which are consistent with DCLG household modelling.

**Transport:** The road transport metrics cover cars, vans and freight only. Emissions estimates for these metrics are taken from the BEIS (2017) GHG emissions statistics and 2032 pathway analysis. Energy data for road transport are taken from BEIS (2016) Energy Consumption in the UK, consistent with DUKES. Projected energy estimates are taken from the 2032 pathway analysis. Road transport demand estimates (in vehicle kilometres) are taken from DfT (2017) Road Traffic statistics<sup>368</sup> (Table TRA0201) and 2032 pathway analysis.

<sup>361</sup> BEIS (2017) Final GHG Emissions Inventory Statistics, <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

<sup>362</sup> ONS (2017) population and migration statistics, <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration>

<sup>363</sup> BEIS (2016) Digest of UK Energy Statistics, <https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes>

<sup>364</sup> Office for National Statistics (2017), Gross Domestic Product: chained volume measures: <https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/abmi/pn2>

<sup>365</sup> BEIS (2016) Energy and Emissions Projections, <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016>

<sup>366</sup> ONS (2016) Annual and quarterly low level aggregates of UK output gross value added (GVA), <https://www.ons.gov.uk/economy/grossdomesticproductgdp/datasets/ukgdpolowlevelaggregates/current>

<sup>367</sup> BEIS (2017) Energy Consumption in the UK, <https://www.gov.uk/government/statistics/energy-consumption-in-the-uk>

<sup>368</sup> DfT (2017) Road Traffic Statistics, [www.gov.uk/government/organisations/department-for-transport/series/road-traffic-statistics](http://www.gov.uk/government/organisations/department-for-transport/series/road-traffic-statistics)

**Power:** Emissions estimates for these metrics are taken from the BEIS (2017) GHG emissions statistics and 2032 pathway analysis. Low carbon generation data are taken from BEIS (2016) Digest of UK Energy statistics, chapter 5, with projections sourced from 2032 pathway analysis.

**Natural Resources:** Emissions estimates for these metrics are taken from the BEIS (2017) GHG emissions statistics and 2032 pathway analysis. Estimates of biodegradable waste to landfill are taken from the Defra (2017) Digest of Waste and Resource statistics<sup>369</sup> and 2032 pathway analysis. Estimates of total conventional woodland cover are sourced from the Forestry Commission's (2017) Forestry statistics<sup>370</sup> and 2032 pathway analysis. Output gross value added (GVA) estimates for agriculture are sourced from the Office for National Statistics on a constant price basis. There are no official projections of output GVA; Defra analysts have estimated future GVA based on historic trends.

<sup>369</sup> Defra (2017) digest of waste and resource statistics, <https://www.gov.uk/government/collections/digest-of-waste-and-resource-statistics>

<sup>370</sup> Forestry Commission (2016) Forestry Statistics, <https://www.forestry.gov.uk/forestry/infd-7aqdgc>

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HM Government

# The Ten Point Plan for a Green Industrial Revolution

Building back better, supporting green jobs, and accelerating  
our path to net zero

November 2020







HM Government

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## 2 The Ten Point Plan for a Green Industrial Revolution

# Foreword from the Prime Minister



This year has taken a very different path from any we expected, but I have not lost sight of our ambitious plans to unite and level up our country.

Just as science will enable humanity to rout Coronavirus, so we will use the UK's extraordinary powers of invention to repair the economic damage and build back better. Now is the time to plan for a green recovery – with high-skilled high-paid jobs that offer the extra satisfaction of helping to make our nation cleaner, greener and more beautiful.

Imagine how our Green Industrial Revolution could transform life across our United Kingdom. You cook your breakfast using hydrogen power before getting in your electric car, having charged it overnight from batteries made in the Midlands. Around you the air is cleaner, and the trucks and trains, ships and planes are running on hydrogen or a synthetic fuel. British towns and regions — Teesside, Port Talbot, Merseyside and Mansfield — have become synonymous with green technology and the jobs they bring. This is where Britain's ability to make hydrogen and capture carbon pioneered the decarbonisation of transport, industry and power.

This Ten Point Plan to get there will mobilise £12 billion of government investment, and potentially three times as much from the private sector, to create and support up to 250,000 green jobs. There will be electric vehicle technicians in the Midlands, construction and installation workers in the North East and Wales, specialists in advanced fuels in the North West, agroforestry practitioners in Scotland, and grid system installers everywhere. And we will help people train for these new green jobs through our Lifetime Skills Guarantee.

We will turn the UK into the world's number one centre for green technology and finance, laying the foundations for decades of economic growth by delivering net zero emissions in a way that creates jobs and allows us to carry on living our lives. And we will harness Mother Nature's ability to absorb carbon by planting 30,000 hectares of trees a year by 2025, and restore the abundance of nature by rewilding 30,000 football pitches worth of countryside.

The UK was the first major economy to embrace a legal obligation to achieve net zero carbon emissions by 2050. I will establish Task Force Net Zero to take forward this national priority, and through next year's COP26 Summit, we will urge countries and companies around the world to join us in delivering net zero globally.

We long ago proved that green and growth can go hand-in-hand. So let us meet the most enduring threat to our planet with one of the most innovative and ambitious programmes of job-creation we have known

**The Rt Hon Boris Johnson MP**

Prime Minister

# Foreword from the Secretary of State for Business, Energy & Industrial Strategy



As the world looks to recover from the impact of coronavirus on our lives, livelihoods and economies, we have the chance to build back better: to invest in making the UK a global leader in green technologies.

If we apply the same zeal and ingenuity to stopping climate change as we have to tackling coronavirus, we can do so while transforming our economy, delivering jobs and growth across the country.

Our Ten Point Plan sets the firm foundations to do just that. The plan brings together ambitious policies and significant new public investment, while seeking to mobilise private investment. This has the potential to deliver up to an estimated £42 billion of private investment by 2030 across energy, buildings, transport, innovation and the natural environment. In doing so, we will position the UK to take advantage of export opportunities presented by low carbon technologies and services into new, global emerging markets – providing jobs and reinvigorating our industrial heartlands.

The Ten Point Plan demonstrates the UK's significant and continuing commitment to tackling greenhouse gas emissions. We have led the G7 countries in cutting emissions since 1990. As President-Designate for the United Nations Framework Convention on Climate Change Conference of the Parties 26 (COP26), I am committed to ensuring we also use our leadership role so that all countries, businesses, cities and investors adopt a greener, more resilient, sustainable path for the future.

This will build on a Conservative track record of addressing the climate challenge. From helping to secure the Paris Agreement, to legislating for net zero, and setting out the greenest manifesto in the UK's history, this plan delivers on our commitments to present a vision for the UK that is greener, more prosperous and at the forefront of global industry. We will continue to build on this plan.

Over the next year we will bring forward ambitious proposals across the economy to cut emissions and secure long-term growth for the whole country, starting with the Energy White Paper before the end of the year. I look forward to working with businesses, organisations representing the interests of UK citizens, the Devolved Administrations and Governments across the world to make this a reality.

**The Rt Hon Alok Sharma MP**

Secretary of State for Business, Energy and Industrial Strategy, President COP 26

# Introduction

Two centuries ago the UK led the world's first Industrial Revolution. Powered by innovation and private investment, this transformation gave birth to many of our great cities and effectively created the modern world. Today we will mobilise the same forces to level up our country and enable our proud industrial heartlands to forge the future once again. By investing in clean technologies – wind, carbon capture, hydrogen and many others – Britain will lead the world into a new Green Industrial Revolution.

As the world begins to recover from the devastating impact of the coronavirus on lives and livelihoods, a broader transformation is taking shape. We will create hundreds of thousands of new jobs by investing in pioneering British industries while simultaneously protecting future generations from climate change and the remorseless destruction of habitats.

Britain is already leading the way. Over the last 30 years, we have shown that economic success and environmental responsibility go hand in hand. We expanded our GDP by 75 per cent while cutting emissions by 43 per cent. Our low-carbon industries already support over 460,000 jobs,<sup>1</sup> from electric vehicle manufacturing in the Midlands and the North East to our thriving offshore wind industry centred on the Humber and the Tees. In 2019, we became the first major economy to adopt a legally binding obligation to reach net zero greenhouse gas emissions by 2050.

This year, our Ten Point Plan will lay the foundations for a Green Industrial Revolution. We will start by supporting 90,000 jobs across the UK within this Parliament, and up to 250,000 by 2030. Engineers, fitters, construction workers and many others will be engaged in harnessing British science and technology to create and use clean energy and forge great new industries that export to new markets around the world. Our Lifetime Skills Guarantee will equip people with the training they need to take advantage of these opportunities.

The government has announced over £5 billion to support a green recovery. This plan mobilises £12 billion – and potentially more than three times as much from the private sector – to place green jobs at the heart of our economic revival.

As the world goes green, we will seek to put the UK at the forefront of global markets for clean technology. One measure of the opportunity is that 83 per cent of the \$13.3 trillion of global investment in electricity systems by 2050 could be in zero-carbon technologies.<sup>2</sup>

We will generate new clean power with offshore wind farms, nuclear plants and by investing up to half a billion pounds in new hydrogen technologies. We will use this energy to carry on living our lives, running our cars, buses, trucks and trains, ships and planes, and heating our homes while keeping bills low. And to the extent that we still emit carbon,

<sup>1</sup> <https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/lowcarbonandrenewableenergyeconomy/creesurveyqmi>

<sup>2</sup> <https://about.bnef.com/new-energy-outlook/>

we will pioneer a new British industry dedicated to its capture and return to under the North Sea. Together these measures will reinvigorate our industrial heartlands, creating jobs and growth, and pioneering world-leading SuperPlaces that unite clean industry with transport and power. All of these ambitions will be propelled by doubling down on Britain's world-leading expertise in green finance and innovation.

Finally, we will harness nature's ability to absorb carbon by establishing new National Parks and Areas of Outstanding Natural Beauty, and making them even greater havens of biodiversity, with the aim of protecting 30% of England's countryside by 2030. We will use the freedoms we regain by leaving the EU to support Britain's farmers so that, alongside producing high-quality food, we ensure healthy soils which will also retain and – over time – capture carbon. We will restore our peatlands and woodlands, create the Nature Recovery Network and wilder landscapes, generating new jobs in nature and land management. And we will better adapt and protect our communities from the already visible effects of climate change by investing in flood defences and using nature-based solutions to increase flood resilience.

The cumulative effect of this plan will be to reduce UK emissions by 180 million tonnes of carbon dioxide equivalent (Mt CO<sub>2</sub> e) between 2023 and 2032, equal to taking all of today's cars off the road for around two years. But this is only the start. Over the next year we will work with industry to devise further sectoral plans and meet our carbon budgets and target of net zero by 2050. To drive our progress towards this national priority, the Prime Minister will establish a new Task Force Net Zero, putting a systems approach at the heart of our thinking.

But action by the UK alone will not be sufficient to avoid catastrophic climate change. Our Ten Point Plan strengthens our ability to bring other countries with us and positions Britain as a leader in the green technologies we all need to employ. Through our Presidency of the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties 26 (COP26) in Glasgow, the UK will urge ambitious action from countries, businesses, cities, and investors alike. Together we will deliver the promises of the 2015 Paris Agreement and drive progress towards global net zero. And next month, alongside the UN and France, the UK will host a Climate Ambition Summit five years after COP21 in Paris to rally the world behind the goal of a greener, more resilient and sustainable future.

# The Ten Point Plan for a Green Industrial Revolution



**Point 1**  
Advancing Offshore Wind



**Point 2**  
Driving the Growth of Low Carbon Hydrogen



**Point 3**  
Delivering New and Advanced Nuclear Power



**Point 4**  
Accelerating the Shift to Zero Emission Vehicles



**Point 5**  
Green Public Transport, Cycling and Walking



**Point 6**  
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**Point 7**  
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**Point 8**  
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**Point 9**  
Protecting Our Natural Environment



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Green Finance and Innovation

## Point 1: Advancing Offshore Wind



Offshore wind is a critical source of renewable energy for our growing economy, with the UK already leading the world. By 2030 we plan to quadruple our offshore wind capacity so as to generate more power than all our homes use today, backing new innovations to make the most of this proven technology and investing to bring new jobs and growth to our ports and coastal regions.

The UK already generates more electricity from offshore wind than any other country, harnessing the wind power our seas are well placed to produce. Government support to unleash the potential of this industry has seen the cost of offshore wind fall by two thirds in the last five years. To offer further commitment to the industry and help further reduce costs, next year, we will aim to deliver up to double the amount of renewables we procure through our next Contract for Difference auction. And by **2030, we aim to produce 40GW of offshore wind**, including **1GW of innovative floating offshore wind** in the windiest parts of our seas. The UK is home to the world's first two floating offshore windfarms and by 2030 we intend to have scaled this twelvefold. Our target could encourage £20 billion of private investment into the UK and could double jobs in the sector over the next decade, ranging from construction workers to top-end engineers.

With a single turn of their blades, the latest wind turbines generate enough electricity to power a house for more than 24 hours. We will put ourselves at the forefront of manufacturing as we see wind turbines grow in size. To support this enlarging industry, we will invest **£160 million into modern ports and manufacturing infrastructure**, providing high quality employment in coastal regions. We will also enable the **delivery of 60% UK content in offshore wind projects**, as set out by the industry, through more stringent requirements for supply chains in the Contract for Difference auctions. This will help attract inward investment into manufacturing in the UK and increase our global competitiveness and expertise.

To integrate clean technologies like offshore wind, we must transform our energy system, building more network infrastructure and utilising smart technologies like energy storage. **Our Offshore Transmission Network Review** will set out our strategy to connect offshore wind in a clean and cost-effective way, and we will outline our plans for smart systems and introducing competition in onshore networks in the forthcoming Energy White Paper.

Advancing offshore wind could deliver...		
Support for up to <b>60,000 jobs</b> in 2030	Around <b>£20bn</b> of private investment by 2030	Savings of <b>21MtCO<sub>2</sub>e</b> between 2023 and 2032, or <b>5%</b> of 2018 UK emissions

### Policy impacts

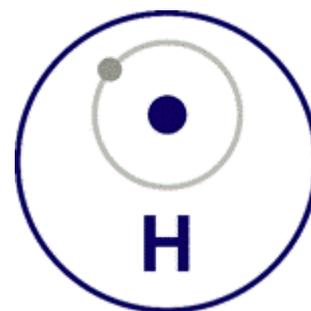
- Our commitment to a 40GW offshore wind target could help bring forth around £20bn of private investment in renewable energy.
- Co-ordinated offshore wind connection could deliver up to £6bn in consumer savings by 2050, significantly reducing environmental and social impacts on coastal communities.
- An estimated 60% of spending on UK offshore wind will be invested back into the economy by 2030.

### Target Milestones

<b>2020</b>	Competitive process launched to support modern, integrated portside infrastructure
<b>2021</b>	Consult on the introduction of more stringent supply chain plan requirements, and support up to twice the capacity of renewable generation in the next CfD round, with onshore wind and solar projects eligible to bid for CfD contracts
<b>2021</b>	The Offshore Transmission Network Review will publish an update by the end of the year, with a view to providing clarity for an enduring approach in 2021



## Point 2: Driving the Growth of Low Carbon Hydrogen



Hydrogen is the lightest, simplest and most abundant chemical element in the universe. It could provide a clean source of fuel and heat for our homes, transport and industry. The UK already has world-leading electrolyser companies, and unparalleled carbon capture and storage sites that we can maximise. Working with industry the UK is aiming for 5GW of low carbon hydrogen production capacity by 2030. Hubs where renewable energy, CCUS and hydrogen congregate will put our industrial ‘SuperPlaces’ at the forefront of technological development. We are also pioneering hydrogen heating trials, starting with a Hydrogen Neighbourhood and scaling up to a potential Hydrogen Town before the end of this decade.

Working **alongside partners in industry, our aim is for the UK to develop 5GW of low carbon hydrogen production capacity by 2030** that could see the UK benefit from around 8,000 jobs across our industrial heartlands and beyond. This will be supported by a range of measures, including a **£240 million Net Zero Hydrogen Fund**, and setting out next year, our hydrogen business models and a revenue mechanism for them to bring through private sector investment.

The UK is already a world leader in investigating the use of hydrogen for heating, replacing fossil fuels like natural gas with hydrogen and hydrogen blends. We are keen to accelerate this work and support industry. For example, Ofgem will publish details later this month on the proposed **network demonstration** in the Levenmouth area of Fife, intended to provide hydrogen to 300 homes over a four-year period. Simultaneously, we are scaling-up the electric heat pump market, ensuring we can exploit a range of low carbon heating options available for UK consumers.

Producing low carbon hydrogen at scale will be made possible by carbon capture and storage infrastructure, and we plan to grow both of these new British industries side by side so our industrial ‘**SuperPlaces**’ are envied around the world. We will also build on our success in offshore wind and other renewables, to bring forward the zero-carbon hydrogen of the future. Together this will develop resilient supply chains, support jobs and position UK companies at the forefront of an exciting growing global market, as well help things like industrial processes, industrial heat, power, shipping and trucking to make the shift to net zero.

### Driving the growth of low carbon hydrogen could deliver...

<p>Support for up to <b>8,000 jobs</b> by 2030, potentially unlocking up to <b>100,000 jobs</b> by 2050 in a high hydrogen net zero scenario</p>	<p>Over <b>£4bn</b> of private investment in the period up to 2030</p>	<p>Savings of <b>41MtCO<sub>2</sub>e</b> between 2023 and 2032, or <b>9%</b> of 2018 UK emissions</p>
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### Policy impacts

- Aiming for 5GW Hydrogen production capacity by 2030 in partnership with industry.
- Lower carbon heating and cooking with no change in experience for domestic consumers through hydrogen blends and reducing the emissions of the gas used by up to 7%.

### Target Milestones

<b>2021</b>	Publish our Hydrogen Strategy and begin consultation on Government's preferred business models for hydrogen
<b>2022</b>	Finalise hydrogen business models
<b>2023</b>	Work with industry to complete testing necessary to allow up to 20% blending of hydrogen into the gas distribution grid for all homes on the gas grid
<b>2023</b>	By 2023 we will support industry to begin hydrogen heating trials in a local neighbourhood
<b>2025</b>	We hope to see 1 GW of Hydrogen production capacity
<b>2025</b>	Will support industry to begin a large village hydrogen heating trial, and set out plans for a possible pilot hydrogen town before the end of the decade

### Case study: ITM POWER

ITM Power is a manufacturer of PEM (proton exchange membrane) electrolyzers, a technology which enables the generation of hydrogen from water and are active in projects in the UK and throughout Europe. The company is based in Sheffield. Coupled with a renewable energy supply, this production method is capable of producing zero carbon hydrogen. The Gigastack project explores the potential to scale up electrolyser size and integrate those units with offshore wind facilities. BEIS is currently supporting a consortium led by ITM Power along with Orsted, Phillips 66, and Element Energy through its Low Carbon Hydrogen Supply Programme.

## Point 3: Delivering New and Advanced Nuclear Power



Our electricity system will grow and could double in size by 2050 as demand for low-carbon electricity in sectors like heat and transport rises. Nuclear power provides a reliable source of low-carbon electricity. We are pursuing large-scale nuclear, whilst also looking to the future of nuclear power in the UK through further investment in Small Modular Reactors and Advanced Modular Reactors.

The UK was home to the world’s first full-scale civil nuclear power station more than sixty years ago, and this industry now employs around 60,000 people in the UK. We see the ongoing potential of this technology. Whether a large-scale power plant, or next generation technologies such as Small and Advanced Modular Reactors, new nuclear will both produce low carbon power and create jobs and growth across the UK. We are pursuing **large-scale new nuclear projects**, subject to value-for-money. To support this, we will provide development funding.

Alongside this, we are also looking to invest further in the next generation of nuclear technology. Subject to value-for-money and future spending rounds, we are announcing **up to £385 million in an Advanced Nuclear Fund**. This will enable investment of up to **£215 million into Small Modular Reactors** to develop a domestic smaller-scale power plant technology design that could potentially be built in factories and then assembled on site. It will unlock up to £300 million private sector match-funding.

We are also committing **up to £170 million for a research and development programme on Advanced Modular Reactors**. These reactors could operate at over 800°C and the high-grade heat could unlock efficient production of hydrogen and synthetic fuels, complementing our investments in carbon capture, utilisation and storage (CCUS), hydrogen and offshore wind. Our aim is to build a demonstrator by the early 2030s at the latest to prove the potential of this technology and put the UK at the cutting edge against international competitors.

To help bring these technologies to market, we will invest an additional **£40 million in developing the regulatory frameworks and supporting UK supply chains**.

New and advanced nuclear power could deliver...		
A large-scale nuclear power plant will support a peak of around <b>10,000 jobs</b> during construction	Government support could unlock significant private investment, up to <b>£300m</b> for development of small modular reactors alone	Each GW of nuclear power generation is enough to power <b>2 million homes</b> with clean electricity

## Policy impacts

- Key role for nuclear in delivering deep decarbonisation of our electricity system, alongside renewables and other technologies.
- High-skilled jobs created and sustained across the UK.
- Likely role for AMRs in decarbonising industry, heat and transport.

## Target Milestones

<b>2020</b>	Publication of the Energy White Paper
<b>2021</b>	Proposed launch of Phase 2 of UK SMR design development
<b>Mid 2020s</b>	Hinkley Point C comes online
<b>Early 2030s</b>	First SMRs and AMR demonstrator deployed in the UK

## Case study: Hinkley Point C

The main construction for Hinkley Point C in Somerset started in 2016. It is one of the largest and most complex construction projects in the UK and is expected to take approximately ten years. The project will create around 25,000 employment opportunities during construction and 900 jobs throughout 60 years that it will be operational.

The developer originally predicted that during construction, the South West economy would receive a boost of £1.5 billion, while during operation, a contribution of £40 million a year will be made. In May 2020, the developer reported that £1.67 billion had already been spent with companies in the South West.



## Point 4: Accelerating the Shift to Zero Emission Vehicles



Zero emission vehicles can be our most visible incarnation of our ability to simultaneously create jobs, strengthen British industry, cut emissions, and continue travelling. From 2030 we will end the sale of new petrol and diesel cars and vans, 10 years earlier than planned. However, we will allow the sale of hybrid cars and vans that can drive a significant distance with no carbon coming out of the tailpipe until 2035. The accompanying support package of £2.8 billion demonstrates our continued faith in British car manufacturing as the backbone of UK industry in the West Midlands, Wales and the North, bringing jobs and investment back into the UK whilst simultaneously reducing greenhouse gas emissions and improving the air we breathe.

The UK is a leading a manufacturer of Electric Vehicles. The Nissan Leaf, produced in the UK, was the third highest selling EV in Europe in 2019. There are over 100 models of EVs on the market, and by 2025 nearly as many models as with conventional petrol and diesel vehicles are expected. With cars and vans making up nearly a fifth of emissions, **we are taking decisive action to end the sale of new petrol and diesel cars and vans by 2030, with all vehicles being required to have a significant zero emissions capability (e.g. plug-in and full hybrids) from 2030 and be 100% zero emissions from 2035.** We will work with industry to make the transition to ensure it remains one of Britain's success stories. Alongside this new phase-out date, we will **publish a Green Paper next year on the UK's post-EU emissions regulations.** As we move forward with this transition, we will need to ensure that the tax system encourages the uptake of EVs and that revenue from motoring taxes keeps pace with this change, to ensure we can continue to fund the first-class public services and infrastructure that people and families across the UK expect.

We must take advantage of the once in a generation opportunity to build a world-leading EV supply chain here in the UK and improve air quality in our towns and cities. We have committed up to **£1 billion to support the electrification of UK vehicles and their supply chains, including developing "Gigafactories" in the UK** to produce the batteries needed at scale. A single factory could employ around 2,000 people in highly skilled jobs. We are **announcing the first £500 million of investment this Parliament** to drive the electrification of the UK automotive sector, protect existing jobs including in the West Midlands, Wales and the North and support thousands of high-quality jobs across the UK.

We will invest **£1.3 billion to accelerate the roll out of charging infrastructure**, targeting support on rapid charge points on motorways and major roads to dash any anxiety around long journeys, and installing more on-street charge points near homes and workplaces to make charging as easy as refuelling a petrol or diesel car. And whilst the costs of EVs are already falling, we will provide **£582 million to extend the Plug-in Car, Van, Taxi and Motorcycle grants to 2022–23** to reduce their sticker price for the consumer.

We will also **consult on a date for phasing out the sale of new diesel heavy goods vehicles** (HGVs). We will invest **£20 million next year in freight trials** to pioneer hydrogen and other zero emission lorries, to support industry to develop cost-effective, zero-emission HGVs in the UK.

### Accelerating the shift to zero emission vehicles could deliver...

Support for around <b>40,000</b> <b>new jobs</b> in 2030	Around <b>£3bn</b> of private investment by 2026	Savings of around <b>5MtCO<sub>2</sub>e</b> to 2032 and <b>300MtCO<sub>2</sub>e</b> to 2050
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### Policy impacts

- Realising carbon savings of around 300 Mt CO<sub>2</sub> e to 2050.
- Thousands more ultra-low and zero-emission cars and vans on UK roads, supported by additional funding for plug in vehicle grants.
- Thousands more charge points in homes, workplaces, in residential streets and along motorways and major A roads.

### Target Milestones

<b>2021</b>	We will publish a Delivery Plan setting out key milestones to deliver the new phase out dates
<b>2021</b>	We will publish a Green Paper on the UK's post EU emissions regulations and the car and van phase out dates, as well as launch a consultation on the phase out of new diesel HGVs
<b>2030</b>	We expect the network of charge points on England's motorways and major A road to be extensive with more than 2,500 high powered charge points that can charge your car so it can drive over 100 miles, all in the time it takes to have a cup of coffee
<b>2030</b>	End of sales of new petrol and diesel cars and vans
<b>2035</b>	All new cars and vans will be zero-emission from the tailpipe leading to cleaner, greener vehicles on UK roads. England's motorways and major A roads will have around 6,000 high powered charge points

## Point 5: Green Public Transport, Cycling and Walking



As well as decarbonising private vehicles, we must increase the share of journeys taken by public transport, cycling and walking. We will therefore accelerate the transition to more active and sustainable transport by investing in rail and bus services, and in measures to help pedestrians and cyclists. We will fund thousands of zero-emission buses and give our towns and cities cycle lanes worthy of Holland. This will improve the air we breathe and increase both mental and physical health, as well as reduce emissions.

We will invest tens of **billions of pounds in enhancements and renewals of the rail network, £4.2 billion in city public transport and £5 billion on buses**, cycling and walking, as announced by the Prime Minister in February. We will **electrify more railway lines**; end the complicated franchising model and create a simpler, more effective system; and create integrated bus and train networks in more places, with smart ticketing, more frequent services, and bus lanes to speed journeys. We will **invest £120 million next year to begin the introduction of at least 4,000 more British built zero emission buses**. Early next year, we will publish the first-ever **National Bus Strategy**, funded through the £5 billion of new money for buses and cycling announced by the Prime Minister, including more frequent and cheaper "superbus" networks and integrated ticketing between operators and modes. We will fund at least two **all-electric bus towns, beginning this financial year, as well as developing the first fully zero-emission city centre**.

We will expand rail routes around our big regional cities, including Manchester and Birmingham. As set out in the manifesto, our long-term aim is to improve public transport in city regions to make it as good as London's, which would save thousands of tonnes of carbon. In smaller places, we will improve buses, introduce more rural on-demand services, and restore many of the rail links removed in the Beeching era to give people the choice not to drive. We will progress the **Midlands Rail Hub** scheme in Birmingham and improvements in Manchester and Leeds, alongside Northern Powerhouse Rail to improve east-west links across the Pennines.

We will build first hundreds, then thousands, of miles of **segregated cycle lane and create more low-traffic neighbourhoods** to stop rat-running and allow people to walk and cycle. We will expand school streets, which have caused dramatic falls in traffic and pollution around schools. We have already started this transformation with £250 million spending this year as part of the PM's announcement that we will spend £2 billion over this Parliament. A new body, **Active Travel England**, will hold the budget, inspect schemes, and assess local authorities for their performance on active travel. We will also launch a national programme of support to increase uptake of electric bikes.

Decarbonising our public transport could deliver...		
Up to <b>3,000</b> jobs by 2025	Government investment of <b>£5bn</b> in buses, cycling and walking this parliament	Savings of around <b>2MtCO<sub>2</sub>e</b> from green buses, cycling and walking between 2023 and 2032

### Policy impacts

- We will bring 4,000 zero emission buses onto our roads, representing 12% of the local operator bus fleet in England.
- We will further electrify regional and other rail routes.
- We will launch the first-ever National Bus Strategy, as part of the PM’s £5 billion funding, integrated ticketing between operators and modes and more bus lanes, making services faster, more attractive and cheaper to operate.
- We will spend £500 million reopening lines and stations closed under the Beeching cuts.
- Over 1,000 miles of safe and direct cycling and walking networks delivered by 2025 with network plans developed and being built out in every town and city in England.

### Target Milestones

<b>Early 2021</b>	National Bus Strategy and first electric bus town
<b>2021</b>	First of 4,000 new zero-emission buses delivered
<b>2023–2024</b>	First rail lines reopened
<b>2025</b>	Cycle training available to every school child and adult who wants it
<b>By 2025</b>	We will double cycling rates from 2013 levels to 1.6 billion stages per year



## Point 6: Jet Zero and Green Ships



We will position the UK at the forefront of aviation and maritime technology to push forward low carbon travel and build on UK strengths. By taking immediate steps to drive the uptake of sustainable aviation fuels, investments in R&D to develop zero-emission aircraft and developing the infrastructure of the future at our airports and seaports – we will make the UK the home of green ships and planes. Internationally, we will continue to lead efforts to find solutions to global aviation and maritime emissions, including using our COP Presidency to develop a sector-led goal.

A century ago, a Mancunian and a Glaswegian completed the first non-stop transatlantic flight and created civil aviation. Fast-forward to September 2020 when the first commercial aircraft powered by a hydrogen fuel cell took off in Cranfield. British innovation will unlock the world of sustainable fuels, turning these fossil fuel intensive journeys into lower carbon routes of transportation that allow the opportunity of global travel whilst also safeguarding our planet. To achieve this, we have established the **Jet Zero Council** as a sector-wide partnership to accelerate the development and adoption of new technologies to help develop our strategy to reach net zero aviation, which we will set out next year. We are investing **£15 million into FlyZero** – a 12-month study, delivered through the Aerospace Technology Institute (ATI), into the strategic, technical and commercial issues in designing and developing zero-emission aircraft that could enter service in 2030.

Moving to sustainable fuels is one of the key steps to success that we can unlock. We will run a £15 million competition to support the production of **Sustainable Aviation Fuels (SAF)** in the UK, building on the success of the Future, Fuels for Freight and Flight Competition. We will establish a SAF clearing house, the first of its kind in Europe, to enable the UK to certify new fuels, driving innovation in this space. Alongside this, we intend to **consult on a Sustainable Aviation Fuel mandate** to blend greener fuels into kerosene, which will create a market-led demand for these alternative fuels. To support the emergence of a market in zero emission aircraft we will invest in R&D into the infrastructure upgrades required at UK airports to move to battery and hydrogen aircrafts.

The UK has a strong history in shipbuilding, with the maritime sector employing 185,000 people. To complement our work on aviation, we will invest **£20 million into the Clean Maritime Demonstration Programme** to develop clean maritime technology. We are already running hydrogen ferry trials in Orkney and due to launch a hydrogen refuelling port in Teesside, as we seek to revitalise our ports and coastal communities.

Taking action on net zero aviation and green ships could deliver...		
<p>Up to <b>5,200 jobs</b> supported by a domestic SAF industry</p>	<p>Future proofing the aerospace industry which is worth <b>£12bn</b> to the economy</p>	<p>Savings of up to <b>1MtCO<sub>2</sub>e</b> by 2032 from clean maritime and nearly <b>15MtCO<sub>2</sub>e</b> by 2050 from SAF</p>

### Policy impacts

- These measures will enable the production of sustainable aviation fuels in the UK, supporting industry and driving fuel uptake.
- Our action will cement our position as a global leader in aerospace, (worth £12 billion to the UK economy), and position the UK at the forefront of the zero-emission aircraft revolution.

### Target Milestones

- |             |  |
|-------------|--|
| <b>2021</b> | We will consult on the Aviation Decarbonisation Strategy   |
| <b>2025</b> | We will consult on a SAF mandate and run a £15 million competition for fuel plants in 2021, with a mandate possibly starting in 2025 |



## Point 7: Greener Buildings



We will put our homes, workplaces, schools and hospitals at the heart of our green economic recovery, supporting 50,000 jobs and building new supply chains and factories in the UK. Making our buildings more energy efficient and moving away from fossil fuel boilers will help make people's homes warm and comfortable, whilst keeping bills low. We will go with the grain of behaviour, and set a clear path that sees the gradual move away from fossil fuel boilers over the next fifteen years as individuals replace their appliances and are offered a lower carbon, more efficient alternative.

Action on buildings can rapidly support jobs and level-up across the country. In addition to supporting around 50,000 jobs by 2030, today's announcements provide an opportunity to develop the growing UK heat pump manufacturing base and expand supply chains for building efficiency. Funding and regulatory measures, delivered in partnership with industry, will stimulate near-term investment whilst supporting the most vulnerable.

To future-proof new buildings and avoid the need for costly retrofit, we will seek to **implement the Future Home Standard in the shortest possible timeline, and consult shortly on increased standards for non-domestic buildings** so that new buildings have high levels of energy efficiency and low carbon heating. As is the common theme across this plan, we want to stimulate investment and manufacturing in the UK. **We will aim for 600,000 heat pump installations per year by 2028**, creating a market led incentive framework to drive growth, and will bring forward regulations to support this especially in off gas grid properties. This ambition still leaves open the choice as to whether we ultimately pursue hydrogen heating, an electrified heating system, or a mixture of both, whilst we continue to pilot the options.

We are providing **£1 billion** to extend the schemes announced by the Chancellor earlier in the year to further kickstart this market. We will extend the **Green Homes Grant** for another year to improve the energy efficiency of homes and replace fossil fuel heating. We will reduce emissions in schools, hospitals and public buildings by further funding for **Public Sector Decarbonisation Scheme**. We will transform the lives of more homeowners who live off the gas grid, particularly in rural areas, with upgrades to their heating systems through the **Homes Upgrade Grant**. And we will commit to further funding for the **Social Housing Decarbonisation Fund** to continue upgrading the least efficient social housing.

Private renters too will benefit, as we **strengthen energy efficiency requirements for private sector landlords**. To support those least able-to-pay, we will **extend the Energy Company Obligation to 2026**, so suppliers can help improve the draughtiest and coldest homes.

To go with the grain of consumer habits, we will improve energy efficiency standards of household products so they use less energy and materials, helping households and

businesses reduce their bills with minimal effort, including by launching an **improved Energy Technology List website**. And we will kickstart the green home finance market by **consulting on introducing mandatory disclosure requirements for lenders on the energy performance of homes** on which they lend and setting voluntary improvement targets.

Developing greener buildings could deliver...		
Support for around <b>50,000 jobs</b> in 2030	Around <b>£11bn</b> Of private investment in the 2020s	Savings of <b>71MtCO<sub>2</sub>e</b> between 2023 and 2032, or <b>16%</b> of 2018 UK emissions

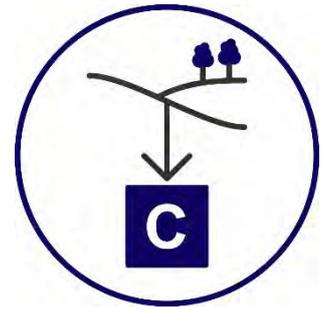
### Policy impacts

- We are setting an ambition of 600,000 heat pumps installations per year by 2028.
- Homes built to the Future Homes Standard will be ‘zero carbon ready’ and have 75–80% lower carbon dioxide emissions than those built to current standards.
- Our green home finance initiatives could help to improve the energy efficiency of around 2.8 million homes, improving around 1.5 million to EPC C standard by 2030.

### Target Milestones

<b>2021</b>	Set out our Heat and Buildings Strategy
<b>2021</b>	Launch a world class energy related products policy framework. We will push for products to use less energy, resources, and materials, saving carbon and helping households and businesses to reduce their energy bills with minimum effort
<b>By 2032</b>	Ensure that the public sector has reduced its direct emissions by 50% compared to a 2017 baseline

## Point 8: Investing in Carbon Capture, Usage and Storage



Carbon Capture, Usage & Storage (CCUS) will be an exciting new industry to capture the carbon we continue to emit and revitalise the birthplaces of the first Industrial Revolution. Our ambition is to capture 10Mt of carbon dioxide a year by 2030, the equivalent of four million cars' worth of annual emissions. We will invest up to £1 billion to support the establishment of CCUS in four industrial clusters, creating 'SuperPlaces' in areas such as the North East, the Humber, North West, Scotland and Wales. We will bring forward details in 2021 of a revenue mechanism to bring through private sector investment into industrial carbon capture and hydrogen projects via our new business models to support these projects.

CCUS technology captures carbon dioxide from power generation, low carbon hydrogen production and industrial processes, storing it deep underground where it cannot enter the atmosphere. This technology will be globally necessary, but no one country has yet captured the market. The UK has an unrivalled asset – our North Sea, that can be used to store captured carbon under the seabed. Developing CCUS infrastructure will contribute to the economic transformation of the UK's industrial regions, enhancing the long-term competitiveness of UK industry in a global net zero economy. It will help decarbonise our most challenging sectors, provide low carbon power and a pathway to negative emissions.

**We will establish CCUS in two industrial clusters by mid 2020s, and aim for four of these sites by 2030, capturing up to 10 Mt of carbon dioxide per year.** Developed alongside hydrogen, we can create these transformative “**SuperPlaces**” in areas such as the heart of the North East, the Humber, North West and in Scotland and Wales. **Our £1 billion CCUS Infrastructure Fund** will provide industry with the certainty required to deploy CCUS at pace and at scale. These clusters will be the starting point for a new carbon capture industry, which could support up to 50,000 jobs in the UK by 2030, including a sizeable export potential. Alongside this, we will bring forward details in 2021 of a revenue mechanism to bring through private sector investment in industrial carbon capture and hydrogen projects, to provide the certainty investors require.

## Investing in carbon capture usage and storage could potentially deliver...

<p>Support for around <b>50,000 jobs</b> by 2030<sup>3</sup></p>	<p>Up to <b>£1.bn</b> of public investment by 2025</p>	<p>Savings of around <b>40MtCO<sub>2</sub>e</b> between 2023 and 2032, or <b>9%</b> of 2018 UK emissions</p>
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### Policy impacts

- Ambition to capture and store 10Mt of CO<sub>2</sub> per year by 2030 – the equivalent of all the industrial emissions in the Humber or taking around 4 million cars off the road.
- We will facilitate the deployment of CCUS in four clusters by 2030.

### Target Milestones

<b>2021</b>	Execute a process for CCUS deployment, working in collaboration with industry and set out further details of a revenue mechanism for industrial carbon capture and hydrogen projects
<b>2022</b>	New CCUS business models finalised
<b>2030</b>	Two clusters operational by the mid 2020s, subject to relevant value for money and affordability considerations and a further two clusters operational by 2030

### Case study: Tata CCUS

Tata Chemicals Europe (TCE) are constructing, with the support of a £4.2 million grant from BEIS, the UK's first industrial-scale Carbon Capture & Utilisation (CCU) demonstration plant at their site in Northwich, for the manufacture of high purity sodium bicarbonate. The plant will be commissioned in 2021 and is capable of capturing up to 40,000 tons per year of carbon dioxide and will reduce carbon emissions at the plant by 11 per cent. TCE exports 60% of its sodium bicarbonate production in the UK to over 60 countries across the globe. The CCU project will be a springboard for TCE to unlock further expansion into its export markets.

<sup>3</sup> BEIS internal analysis using Energy Innovation Needs Assessment calculators.

## Point 9: Protecting Our Natural Environment



The natural environment is one of the most important and effective solutions we have for capturing and sequestering carbon long-term. We will safeguard our cherished landscapes, restore habitats for wildlife in order to combat biodiversity loss and adapt to climate change, all whilst creating green jobs.

We will protect our natural environment through the creation of **new National Parks and Areas of Outstanding Natural Beauty (AONB)**. We will start the process for designating more of England's beautiful and iconic landscapes as National Parks and AONBs, safeguarding these areas for future generations and bringing more people within closer reach of nature. These new National Landscapes will play a key role in meeting the Government's commitment to protect and improve 30% of UK land by 2030.

We will immediately create more green jobs with a **£40 million second round of the Green Recovery Challenge Fund**. This fund will help create and retain thousands of jobs to work on nature conservation and restoration projects across England helping to improve biodiversity and tackle climate change.

We are acting now to protect our precious landscapes and create nature restoration jobs. We will also accelerate the vital work needed to restore our natural ecosystems with the establishment of 10 long-term Landscape Recovery projects over the next four years. These Landscape Recovery projects will pilot land use change to restore wilder landscapes in England helping to sequester carbon and establish a Nature Recovery Network. And as we leave the EU, our new **Environmental Land Management** scheme will be a key vehicle in our efforts to combat climate change whilst also delivering other environmental benefits, by incentivising land management actions such as tree planting and peatland restoration. We will **launch Environmental Land Management pilots next year** as we move away from the Common Agricultural Policy, alongside Productivity Grants for farmers to invest in modern technology to make their businesses more efficient and more profitable, while reducing their emissions.

Investment in flood defences will protect our homes, businesses, and communities from the risk of flooding, whilst also safeguarding our natural environment and helping us adapt to our changing climate. We will **invest £5.2 billion in a six-year programme for flood and coastal defences** including new innovative approaches to work with the power of nature to not only reduce flood risk, but deliver benefits for the environment, nature and communities.

### Protecting our natural environment could deliver...

<p>Up to <b>20,000 jobs</b> from improving flood defences by 2027</p>	<p>Up to <b>£5.2bn</b> of investment for flood defences</p>	<p><b>Climate and biodiversity benefits</b> from protecting our national landscapes</p>
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### Policy impacts

- Increasing the Green Recovery Challenge Fund to £80 million will mean that over 100 nature projects are delivered on the ground over the next 2 years.
- New National Parks, AONB designations and Landscape Recovery projects will protect up to an additional 1.5% of natural land in England, contributing to our target of protecting 30% of UK land by 2030.
- Establishing 10 Landscape Recovery projects could create the equivalent of well over 30,000 football pitches of wildlife rich habitat.
- Investment in flood defences will support 2,000 flood schemes across every region of England and will better protect over 336,000 properties from risk of flooding.

### Target Milestones

<b>2020–2021</b>	From the end of 2020 we will award the first £40 million in a range of nature projects across England through the Green Recovery Challenge Fund, with a second-round worth up to a further £40 million in 2021
<b>2021</b>	In 2021 we aim to start the process for designating new National Parks and AONBs
<b>2021</b>	Starting in 2021, we will invest £5.2 billion in a six-year capital investment programme for flood and coastal defences
<b>2022–2024</b>	Between 2022 and 2024 we aim to initiate 10 long-term Landscape Recovery projects

## Point 10: Green Finance and Innovation



Unleashing innovation and developing new sources of finance are fundamental for further developing the green technologies for net zero. We have committed to raising total R&D investment to 2.4% of GDP by 2027 and in July 2020 published the UK Research and Development Roadmap. The next phase of green innovation will help bring down the cost of the net zero transition, nurture the development of better products and new business models, and influence consumer behaviour.

Our vision is for the UK to be a global leader in the technologies needed to decarbonise our economies and transition to net zero. Through our world class innovators, entrepreneurs and finance institutions we will focus progress on the key technologies of the future. Alongside specific green policies, this will also be backed by the record increase in public investment in research and development and the new agency designed to fund our scientists to pursue high risk, high reward work that might create a step change in the world's path to net zero.

To accelerate the commercialisation of innovative low-carbon technologies, systems and processes in the power, buildings, and industrial sectors, we will launch the **£1 billion Net Zero Innovation Portfolio**. The portfolio will focus on ten priority areas that correspond with this Ten Point Plan, including: floating offshore wind; nuclear advanced modular reactors; energy storage and flexibility; bioenergy; hydrogen; homes; direct air capture and advanced CCUS; industrial fuel switching; and disruptive technologies such as artificial intelligence for energy. We have already launched the first phase of a **£100 million investment in brand-new Greenhouse Gas Removals including Direct Air Capture** in November 2020, which captures carbon dioxide emissions directly from the air. We will **provide £100 million for Energy Storage and Flexibility innovation challenges** – essential technology as we move towards an increasingly renewables-heavy system to allow us to store energy over hours, days and even months.

We are doubling down on our ambition to be the first country in the world to **commercialise fusion energy technology**, enabling low carbon and continuous power generation. We are already providing £222 million for the visionary STEP programme (Spherical Tokamak for Energy Production), which aims to build the world's first commercially viable fusion power plant in the UK by 2040, and £184 million for new fusion facilities, infrastructure and apprenticeships to lay the foundations of a global hub for fusion innovation in the UK.

Across land and sea, we will invest in transport innovation to trial and deploy new technologies, building on the world leading expertise of UK businesses and by investing **£3 million in the Tees Valley Hydrogen Transport Hub**. On roads, the Government will invest **£20 million across trials of zero emission heavy goods vehicles**, testing technologies at scale. We will also continue to support climate ambition internationally and



grow global markets for clean technologies through our International Climate Finance programmes. Since June 2020, we have already committed £170 million to support green recovery across Latin America, Africa and Asia.

Delivering clean investment at the scale and pace required will mean taking bold steps. That is why we will **issue the UK's first Sovereign Green Bond in 2021** subject to market conditions – and intend to follow up with a series of further issuances to meet growing investor demand for these instruments. These bonds will help finance sustainable projects, finance much-needed infrastructure investment and create green jobs across the country.

We will harness the international reputation of the UK's world leading financial sector to encourage private investment into supporting innovation and manage climate financial risk. In line with the recommendations of the Taskforce on Climate-related Financial Disclosures (TCFD), we intend to introduce **mandatory reporting of climate-related financial information across the economy by 2025, with a significant portion of mandatory requirements in place by 2023**. We will position the UK, and the City of London, as a leader in the global voluntary carbon markets, including in response to the recommendations of the independent Taskforce on Scaling Voluntary Carbon Markets. Furthermore, we will implement a **green taxonomy** that defines which economic activities tackle climate change and environmental degradation to help better guide investors. Combined, these measures will provide investors with clarity and a clear framework to deliver the low carbon finance needed for a net -zero economy by 2050. We recognise that these signals are powerful long-term markers for investments, alongside other tools – such as a clear carbon price as we leave the EU Emissions Trading System. HMT's Net Zero

Review will consider the choices across our tax, spend, regulatory and other levers to maximise growth opportunities and ensure an equitable balance of contributions across society.

To ensure we have the skilled workforce to deliver net zero, we have launched **the Green Jobs Taskforce**, working in partnership with business, skills providers and unions, to help us develop plans for new long-term good quality, green jobs by 2030 and advise what support is needed for people in transitioning industries. The taskforce will conclude its work in spring 2021, with the actions feeding into our Net Zero Strategy to be published later in the year.

Enhancing green finance and innovation could deliver...		
<p>The potential for <b>hundreds of thousands</b> of jobs by 2030</p>	<p><b>£1bn</b> of government funding in net zero innovation with <b>£1bn</b> of matched funding and potentially <b>£2.5bn</b> of follow on funding from the private sector</p>	<p>Enables <b>carbon savings</b> across low carbon sectors</p>

### Policy impacts

- By 2030, unlock the potential for 300,000 jobs in exports and domestic industry through new commercial opportunities across low carbon sectors.
- Enables savings across low carbon sectors.

### Target Milestones

<b>2020</b>	Publish priorities within the Net Zero Innovation Portfolio
<b>2021</b>	Remaining priority innovation challenges within the Net Zero Innovation Portfolio launched
<b>2022</b>	Start vessel trials in Orkney, work towards a hydrogen port in Tees Valley, and launch feasibility studies for several clean maritime clusters across the UK
<b>2022</b>	Announce the site for UK fusion power plant demonstrator

### **Case study: The Green Finance Institute – building partnerships to accelerate green finance**

The Green Finance Institute, launched in July 2019 is led by Chair, Sir Roger Gifford, senior banker at SEB and former Lord Mayor of the City of London, and CEO, Dr Rhian-Mari Thomas OBE, former Barclays executive.

Seed funded by the UK Government and the City of London Corporation, the Institute champions the UK's green finance brand internationally and brings together global experts and practitioners to co-design sector-specific solutions that channel capital towards a clean, resilient and environmentally sustainable economy.

The Institute's early successes have included establishing a Coalition for the Energy Efficiency of Buildings and subsequent Zero Carbon Heating Taskforce of over 200 expert members, launching a Green Finance Education Charter, developing the case for the UK's first Green Sovereign Bond from investors with more than \$10 trillion assets under management and co-hosting the Green Horizons Summit, which featured global leaders from the public and private sector and attracted over 300,000 viewers across 90 countries.



## Look Ahead: The Race to Zero

The Ten Point Plan ensures that our recovery from coronavirus will be green, generate jobs and bolster the economy, whilst continuing to drive down emissions both now and in the future. There is however more to be done to achieve net zero by 2050, and the Ten Point Plan represents one more step on the path to ending the UK's contribution to global emissions once and for all. In the coming year, we will set out further plans for reducing emissions across all the UK's major economic sectors as outlined below, including our overall Net Zero Strategy, which will clearly set out our pathway to achieving net zero emissions by 2050. These efforts need to be undertaken in parallel with adaptation action, building resilience to the effects of climate change we are already experiencing.

Climate change is a global issue, and the UK must use our own net zero ambition to encourage other nations to adopt similar targets. In November 2021, the UK will host the United Nations Framework Convention on Climate Change, Conference of the Parties (COP26), bringing together world leaders, climate experts, business leaders and citizens to agree ambitious action to tackle climate change. This December, the UK, along with the UN and France, will host a virtual leader-level Climate Ambition Summit to demonstrate the urgency of action and provide an important moment for international leaders to show they are committed to a greener, more resilient, sustainable path for the future.

In 2015 at COP21, the UK played a leading role in securing the agreement of 195 parties to sign up to the historic Paris Climate Agreement, setting a goal of limiting global temperature increases to well below 2°C (vs pre-industrial levels) and to pursue efforts towards a 1.5°C goal. Whilst progress has been made through the Paris Agreement, current commitments will not achieve the temperature goals that were set, instead implying a devastating rise of around 3°C of warming by 2100. Increased action at COP26 is therefore vital, and we will use our COP26 Presidency role to work through five priority areas – Adaptation and Resilience, Zero Emission Vehicles, Energy Transition, Nature, and Finance. We are also considering the UK's revised Nationally Determined Contribution (NDC), itself an embodiment of our efforts to reduce national emissions, and we will set this out by the Climate Ambition Summit. Our roadmap below of forthcoming announcements will demonstrate the UK's commitment and action in delivering on our net zero target, encouraging similar levels of ambition from businesses, organizations and nations around the world.

# Look Ahead

<p><b>Energy White Paper</b> </p> <p>The White Paper will set out how the transformation of our energy system can drive economic growth and jobs, all whilst reducing emissions, consistent with our 2050 net zero target, and keeping bills affordable. It signals the transition away from unabated fossil fuels to clean energy solution; setting out actions that build on our success in power generation, look forward to challenges in heat and industry, and provide support to our vital oil and gas sector as it adapts to a net zero world. As we undergo this change, our energy system will evolve, becoming more integrated, more dynamic and more decentralised. Our strategy enables us to exploit smart, digital-enabled technologies to drive competition and harness innovation for the benefit of consumers.</p>	<p><b>Transport Decarbonisation Plan</b> </p> <p>The Transport Decarbonisation Plan will set out how we will move further and faster to decarbonise the entire UK transport system. The bold and ambitious plan will take a holistic and cross-modal approach to put us on a pathway to net zero by 2050. Alongside delivering the technical measures required, the Transport Decarbonisation Plan will seek to maximise the benefits of decarbonisation through place-based solutions and developing the UK as a green transport leader.</p>	<p><b>Heat &amp; Buildings Strategy</b> </p> <p>The Heat &amp; Buildings Strategy will set out the immediate actions we will take for reducing emissions from buildings. These actions include the deployment of energy efficiency measures and low carbon heating as part of an ambitious programme of work required to enable key strategic decisions on how we achieve the mass transition to low-carbon heat and set us on a path to decarbonising all homes and buildings.</p>
<p><b>National Infrastructure Strategy</b> </p> <p>The government will publish the National Infrastructure Strategy, setting out how infrastructure can support the economic recovery and deliver our long term growth ambitions. The NIS will focus on decarbonising our infrastructure networks and levelling up the economy, as well as supporting private finance and accelerating infrastructure delivery through project Speed.</p>	<p><b>Industrial Decarbonisation Strategy</b> </p> <p>This strategy will set out the Government's vision for a prosperous, low carbon UK industrial sector in 2050. Working closely with the Devolved Administration partners, we will set out how the low carbon transition can support industrial competitiveness and the green recovery across the UK, including identifying opportunities for new markets and sectors to develop.</p>	<p><b>Hydrogen Strategy</b> </p> <p>The strategy will outline government's ambitions for a UK hydrogen economy, and set out the near-term actions that need to be taken to ensure low carbon hydrogen can play a vital role in decarbonising industry, heat and heavy transport, whilst also providing system value through grid balancing and integration of increasing levels of intermittent renewable electricity.</p>
<p><b>England Tree Strategy</b> </p> <p>The Tree Strategy will set out our long-term vision for trees, woodlands and forestry in England, and the role we expect them to play in tackling climate change and biodiversity loss. It will set out actions we will take over the coming years to move towards this vision and meet our manifesto commitment to increase planting to 30,000 hectares per year, building on the announcement of the £640m Nature for Climate Fund to support tree planting and peatland restoration.</p>	<p><b>Net Zero Strategy</b> </p> <p>This strategy will set out the Government's pathway for transitioning to a net zero economy, making the most of new growth and employment opportunities across the UK. Building on the sectoral plans we will bring forward in 2020/21, we will develop a comprehensive net zero strategy building on the 10 Point Plan. The strategy will also consider what is needed to enable change at scale over the next 30 years – the skills we need in the economy, the shifts to our energy systems, finance flows and behaviours at individual, local and national level required to fully decarbonise our economy, recognising the complex interactions between energy systems, land and individuals in a net zero world.</p>	<p><b>HMT Net Zero Review</b> </p> <p>The Net Zero Review will consider how the transition to net zero will be funded and where the costs will fall, helping ensure an equitable balance of contributions between households, businesses and taxpayers.</p>
<p><b>England Tree Strategy</b> </p> <p>The Tree Strategy will set out our long-term vision for trees, woodlands and forestry in England, and the role we expect them to play in tackling climate change and biodiversity loss. It will set out actions we will take over the coming years to move towards this vision and meet our manifesto commitment to increase planting to 30,000 hectares per year, building on the announcement of the £640m Nature for Climate Fund to support tree planting and peatland restoration.</p>	<p><b>Net Zero Strategy</b> </p> <p>This strategy will set out the Government's pathway for transitioning to a net zero economy, making the most of new growth and employment opportunities across the UK. Building on the sectoral plans we will bring forward in 2020/21, we will develop a comprehensive net zero strategy building on the 10 Point Plan. The strategy will also consider what is needed to enable change at scale over the next 30 years – the skills we need in the economy, the shifts to our energy systems, finance flows and behaviours at individual, local and national level required to fully decarbonise our economy, recognising the complex interactions between energy systems, land and individuals in a net zero world.</p>	<p><b>Nature Strategy</b> </p> <p>Our new strategy for nature will set our ambition to conserve and enhance England's biodiversity, delivering on our global targets under the Convention on Biological Diversity and the goals set out under our 25YEP. The Nature Strategy will be clearly linked to other strategies, including those for Trees, Peat and Pollinators. We plan to publish in 2021 but are already implementing key commitments such as the Nature Recovery Network.</p>

## Notes on figures

Any figures or values displayed without reference to a direct or external source have been calculated in accordance with standard HMG analysis procedure. Aggregate figures rely on simplifying assumptions without presuming macroeconomic market conditions and are subject to further consideration in upcoming sectoral strategies. For further guidance on methodology, see below.

**Emissions savings:** The figures estimate the amount of greenhouse gas emissions (in million tonnes of carbon dioxide equivalent or MtCO<sub>2</sub>e) saved in total over the period 2023–2032. This corresponds to the period of the UK's 4th and 5th Carbon Budgets and savings are relative to HMG's 2019 Energy and Emissions Projections (<https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019>). Central estimates are presented based on HMG modelling and analysis.

**Jobs impacts:** The figures estimate the impact on jobs in the relevant low carbon sector and its supply chain in 2030. In most cases estimates are based on the number of full-time equivalent jobs and sustained HMG support required to deliver the deployment levels of low carbon technologies set out in the plan. Also accounted for are wider technology market opportunities. Central estimates are presented based on HMG analysis, drawing on sources such as the Energy Innovation Needs Assessment (<https://www.gov.uk/government/publications/energy-innovation-needs-assessments>).

**Investment:** The figures estimate the amount of public (directly HMG funded) and private sector expenditure on capital (i.e., physical assets such as property, technology, buildings, infrastructure, and equipment) over the period to 2030 unless specified otherwise.





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HM Treasury

# National Infrastructure Plan 2014



December 2014



HM Treasury

# National Infrastructure Plan 2014

December 2014



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# OVERALL

## Progress since 2010

55

major roads and local transport projects completed

King's Cross completed, along with improvements to over 400 other stations

Construction started on transformational projects like Mersey Gateway and the Northern Hub rail upgrade

More than 500 flood and coastal erosion defence improvement schemes completed



Roads Investment Strategy to treble spending on strategic roads investing a further £15 billion in over 100 schemes

£38bn

of spend on our railways in Network Rail Control Period 5

Hinkley Point C, High Speed 2 and Thames Tideway Tunnel due to start construction

Start of construction expected on more than 1,400 flood schemes, with £2.3 billion capital investment

## Plan to 2020-21

# OVER 2500 PROJECTS COMPLETED SINCE 2010

- Opening of new Heathrow Terminal 2 and Birmingham runway extension

Over  
1.5m

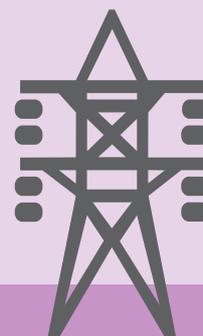
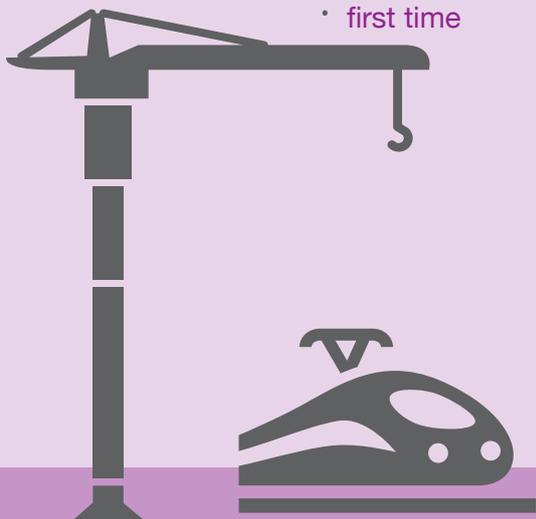
- homes and businesses with access to superfast broadband for the first time

£22bn

- of private-sector investment in water and waste water assets

Nearly  
20GW

- of new electricity generation capacity created – enough to power around 23 million homes



£46bn

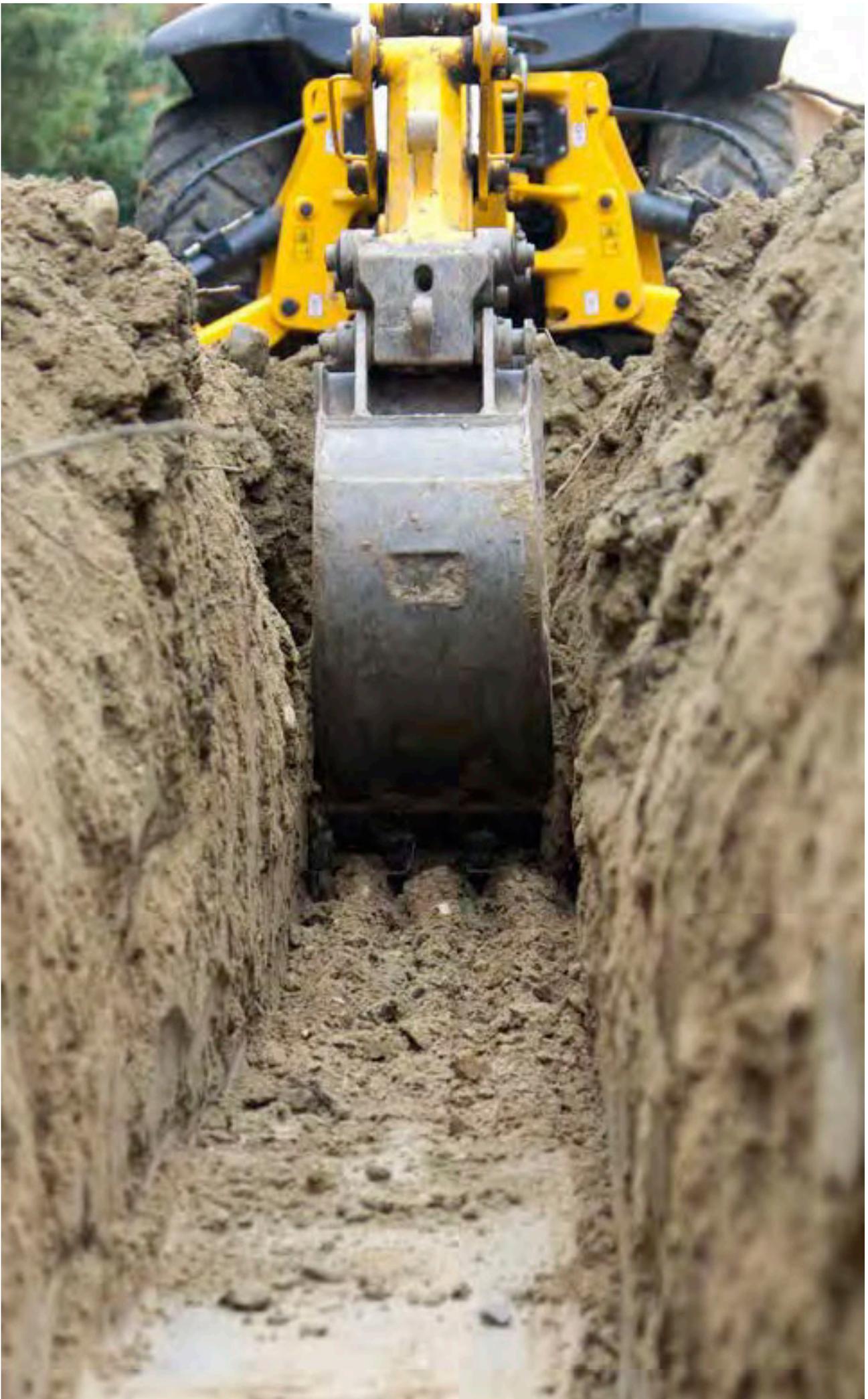
- of investment in gas and electricity networks in the pipeline

- Results of first Capacity Market auction and Contracts for Difference allocations due in 2015

- Francis Crick Institute due to be fully operational in 2016

- Final Airports Commission report to be published in summer 2015

**OVERALL INFRASTRUCTURE PIPELINE £466BN**  
**In construction £277bn**  
**Future investment £189bn**



# Executive summary

Improving the UK's productivity is a vital element of the government's Long-Term Economic Plan. High-quality infrastructure boosts productivity and competitiveness, allowing businesses to grow and enabling them to reach suppliers, deepen labour and product markets, collaborate and innovate and attract inward investment.

The choices that we make about infrastructure enable us to shape the type of economy and society that we want for the future. Infrastructure has the capacity to unlock economic potential in individual regions and ensure that growth and opportunities are distributed across the country, while also creating networks which bind together the different parts of the UK. Investment in infrastructure also helps the government to deliver new housing and business development where it is most needed.

The National Infrastructure Plan 2014 (NIP 14) sets out an ambitious infrastructure vision for the next parliament and beyond, reinforcing the government's commitment to investing in infrastructure and improving its quality and performance. It is underpinned by a pipeline of over £460 billion of planned public and private investment.<sup>1</sup>

The government is prioritising the public funding of infrastructure, putting in place the right policy framework to give investors the confidence to commit to long-term projects, and ensuring the supply chain has the certainty and tools it needs to deliver effectively. It recognises the importance of getting the fundamentals right – delivering our key projects and programmes on time and on budget – while also addressing longer-term challenges: integration, resilience, skills, and sustainability.

## Progress since 2010

Public and private infrastructure investment has increased in recent years. A top down analysis of average annual infrastructure investment between 2011 and 2014 has been refreshed for NIP 14. **HM Treasury estimates now indicate that average annual infrastructure investment is 15% higher in this parliament than it was in the previous parliament.**<sup>2</sup>

Of course, levels of investment are only meaningful if they translate to successful delivery. **Since 2010, over 2,500 different infrastructure projects or schemes have been completed.**

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<sup>1</sup> This includes oil and gas investment for the first time.

<sup>2</sup> £47 billion in 2010-11 to 2013-14, compared with £41 billion in 2005-06 to 2009-10 (in 2013-14 prices). HM Treasury estimates, based on published sources. These figures are not comparable to pipeline data presented in this document, which is a forward-looking bottom-up assessment of planned infrastructure investment. Please refer to 'Methodology and Sources for National Infrastructure Plan 2014' for further information on how these estimates are calculated.

Some of these such as the King's Cross redevelopment are long-term projects which have been undertaken over a number of years – just as some of the projects to which the government is now committing will yield benefits in decades to come. Others are smaller in-year schemes which can have an immediate impact at a local level, for example, Highways Agency pinchpoint schemes which have been planned, constructed and completed within this parliament. All are crucial to meeting the UK's infrastructure needs.

A comprehensive update on delivery since 2010 is published as an annex to this document. Key highlights include:

- 55 major roads and local transport projects completed
- start of construction on transformational transport projects such as Mersey Gateway Bridge and Northern Hub
- completion of King's Cross, along with improvements to 400 other stations
- significant progress on Crossrail, the biggest construction project in Europe, which is on time and on budget, with almost 90% of tunnelling complete and flagship stations in construction
- completion of more than 500 flood and coastal erosion defence improvement schemes, improving the standard of protection to over 160,000 homes
- nearly 20GW of new electricity generation capacity created – enough to power around 23 million homes
- over 1.5 million homes and businesses with access to superfast broadband for the first time
- completion of Heathrow Terminal 2 and a runway extension at Birmingham Airport
- increase in container ports capacity of more than 3 million TEU,<sup>3</sup> including completion of the London Gateway port and logistics park

The government has also made significant progress in laying the foundations for long-term investment in key projects and programmes:

- the High Speed Rail Preparation Act received Royal Assent, a vital step forward in the delivery of HS2
- the Energy Act has provided the legislative basis for Electricity Market Reform, with the first 8 investment contracts for renewable projects awarded in Spring 2014, unlocking up to £12 billion of investment
- key commercial terms for Hinkley Point C have been agreed, and the project has now secured state aid approval from the European Commission
- the Airports Commission published its interim report in 2013 and is now consulting on shortlisted options
- Thames Tideway Tunnel received development consent and the tender process for construction of the tunnel is underway
- following a consultation on the location options for the lower Thames Crossing, one option has been dropped and work to develop the remaining two options continues to progress well

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<sup>3</sup> Twenty-foot Equivalent Unit – a measure of container handling capacity

The government has also taken cross-cutting action to support long-term infrastructure investment and drive delivery:

- publishing the **first ever National Infrastructure Plan** bringing together for the first time its vision and approach for the key economic infrastructure sectors, supported by a robust and detailed infrastructure pipeline
- establishing the **UK Guarantees Scheme**, which has now approved support for projects worth around £4 billion
- **streamlining the planning regime** to ensure that decisions get made as quickly as possible
- **strengthening government delivery capability** and creating a Major Infrastructure Tracking unit within Infrastructure UK to monitor progress and address obstacles to delivery

## Infrastructure to 2020 and beyond

NIP 2014 builds on this progress by providing a clear forward-looking delivery plan for each of the economic infrastructure sectors.

The tough choices the government has made on day-to-day spending have enabled it to prioritise public investment in vital infrastructure. **This has enabled it to establish long-term funding certainty for the key areas where infrastructure is publicly funded – roads, rail, flood defences and science. All of the publicly funded elements of the infrastructure pipeline now represent a firm and specific government commitment.** This is vital in allowing us to take a strategic approach to investment and delivery and unlocking crucial efficiencies. It also gives the supply chain the confidence in the level of forthcoming infrastructure activity that is fundamental to investment decisions.

NIP 2014 builds on these commitments by setting out clear and fully funded delivery plans for the next parliament (including details of specific projects and programmes). Highlights include:

- **£15 billion of investment in the Strategic Road Network** as part of a new Road Investment Strategy which will include undertaking over 100 major schemes to 2020-21, including transformational projects for the A303 and A1 north of Newcastle
- **a £2.3 billion programme of flood investment investing in over 1,400 schemes to protect at least 300,000 homes;** underpinned by a detailed pipeline of individual schemes including at Oxford, Lowestoft, Yalding, River Thames and the Humber
- **a £38 billion Network Rail delivery programme,** including electrification of key lines, as well as commitments to transformational projects such as Crossrail, phase 1 of which is due to complete in 2018, and HS2, phase 1 of which is due to start construction in 2017
- continued support for digital infrastructure which will ensure that 95% of premises have access to superfast broadband by 2017
- an ambitious programme of investment in science infrastructure, including ground-breaking projects such as a new polar research ship and Met Office supercomputer

The majority of the infrastructure pipeline is expected to be privately funded and financed, and the NIP also includes plans for energy, water, waste, aviation and ports where most or all of the investment comes from the private sector. The government will continue to make sure that the conditions are right for such investment to come forward by upholding a competitive tax system and world-class regulatory regime. **NIP 14 sets out some key policy milestones to 2020-21 in these sectors, including:**

- **implementation of the final stages of Electricity Market Reform** to support long-term investment in electricity generation, with the first Capacity Market auction taking place in December 2014 and the first Contracts for Difference being allocated under the enduring regime in early 2015
- **publication of the Airports Commission's final report on airport capacity** in the South East in summer 2015

**This year's National Infrastructure Plan also includes detailed analysis of how the private-sector element of the pipeline will be funded and financed.** Since 2010, the government has implemented a number of initiatives to incentivise private investment, in particular the £40 billion UK Guarantees Scheme. Our world-class system of independent regulation continues to attract investment into sectors such as water, electricity and gas networks and telecommunications. Around a further £80 billion of project-specific finance (primarily in non-regulated sectors) is likely to be required between now and 2020. NIP 14 provides more detail than ever before on where these opportunities are expected to lie, providing transparency and clarity for investors, and setting out the action the government is taking to ensure that such investment comes forward.

To ensure value for money for taxpayers and consumers, the government's infrastructure plan must continue to be underpinned by a relentless focus on successful infrastructure delivery and performance. **NIP 14 sets out the action the government is taking to ensure effective delivery of its key projects, identify and address drivers of high costs and to address future delivery challenges,** focusing on issues such as skills, asset management, further improvements to streamline the planning system, and the integration and resilience of our key networks. The government has also refreshed its Top 40 priority investments to reflect changes in project status and ensure that they continue to reflect the government's priorities in each infrastructure sector. This is essential if it is to remain an effective tool for monitoring and supporting progress in infrastructure delivery. Annexes providing a detailed update on delivery since 2010, the top 40, and more detailed performance indicators for individual sectors are provided online.<sup>4</sup>

In addition to setting out detailed plans to the end of the decade, **NIP 14 sets the direction and ambition for the government's longer-term approach to infrastructure in each of the sectors that it covers.** While these plans are less detailed, the government is taking action now to ensure that it is well placed to meet the infrastructure challenges facing the UK in the 2020s and beyond.

<sup>4</sup> [www.gov.uk/government/collections/national-infrastructure-plan](http://www.gov.uk/government/collections/national-infrastructure-plan)

## Infrastructure pipeline

The NIP is underpinned by the infrastructure pipeline, which is a forward-looking, bottom-up assessment of planned public and private infrastructure investment in the UK.<sup>5</sup> The pipeline enhances visibility and certainty for investors and the supply chain and allows government to work more effectively to ensure that the UK's infrastructure needs are met.

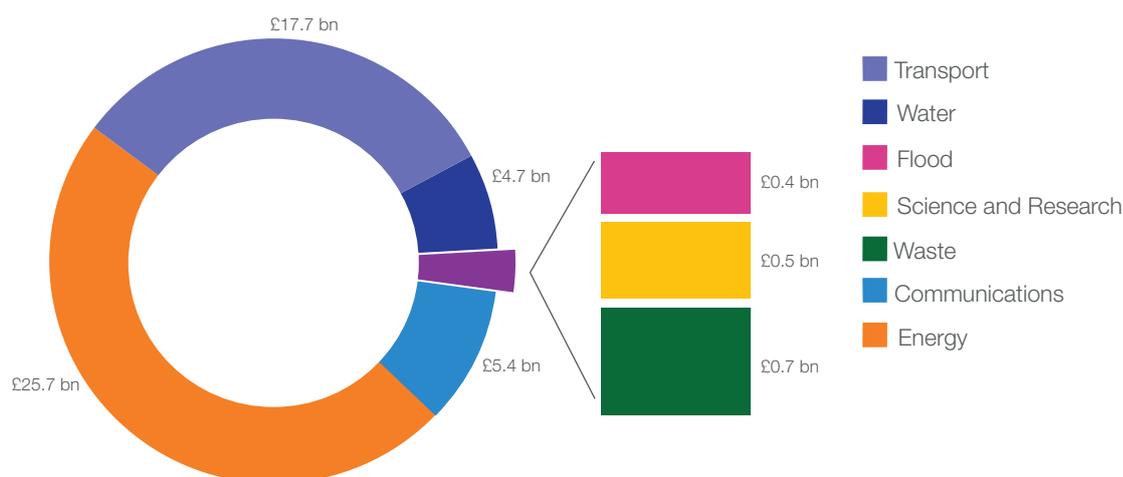
The refreshed infrastructure pipeline sets out over £460 billion of planned public and private investment to the end of the decade and beyond across the key infrastructure sectors. This includes upstream oil and gas investment for the first time – without oil and gas, the pipeline is £413 billion (this compares with £383 billion in NIP 2013<sup>6</sup>).

**Table ES.1: 2014 Infrastructure pipeline, by sector, 2014-15 onwards**

Sector	No of Projects	No of Programmes	Pipeline Value (£ bn)
Communications	1	5	11.0
Energy	77	70	274.9
<i>(of which Oil&amp;Gas)</i>	<i>0</i>	<i>1</i>	<i>53.0</i>
Flood	5	21	3.7
Science and Research	18	4	1.4
Transport	141	129	142.3
Waste	20	0	2.0
Water	1	59	30.9
<b>Total</b>	<b>263</b>	<b>288</b>	<b>£466</b>
<i>(excluding Oil&amp;Gas)</i>	<i>263</i>	<i>287</i>	<i>£413</i>

£55 billion of investment (including £12 billion oil and gas) is planned for 2015-16 alone and over £320 billion (including £53 billion oil and gas) up to 2020-21.

**Chart ES.1: 2014 infrastructure pipeline, by sector, spend in 2015-16**



Source: HM Treasury, Major Infrastructure Tracking Unit

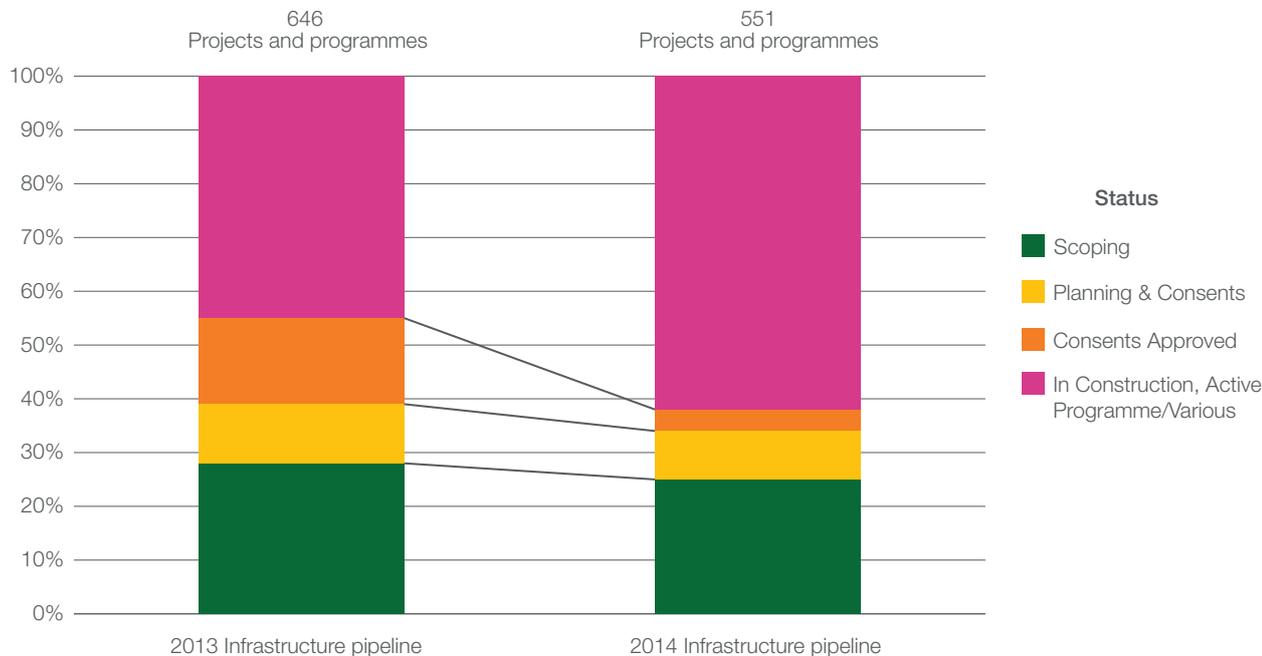
Note: Spend on energy in 2015-16 includes oil and gas of £12 billion

<sup>5</sup> The infrastructure pipeline includes projects and programmes with a capital value of c.£50 million and over.

<sup>6</sup> All pipeline figures are in 2013-14 prices. The pipeline published at NIP 2013 was £377 billion in 2012-13 prices

As is to be expected for a pipeline stretching well into the next decade, projects and programmes are at different stages of development. However, with government support, projects in the pipeline are making the crucial transition from scoping and planning into delivery and towards completion. Over 60% of the projects and programmes in the pipeline (excluding oil and gas) are now in construction or part of an active programme (compared with 45% in 2013).

**Chart ES.2: Projects and programmes in infrastructure pipeline, by status**



Source: HM Treasury, Major Infrastructure Tracking Unit

Note: Some smaller projects that were individually listed in the 2013 pipeline have been grouped into larger programmes this year. This does not affect overall investment assumptions. Projects and programmes that have been completed since NIP 13 have also been removed from the pipeline

Further details on the pipeline can be found at:

[www.gov.uk/government/collections/national-infrastructure-plan#national-infrastructure-pipeline](http://www.gov.uk/government/collections/national-infrastructure-plan#national-infrastructure-pipeline)

## Table ES.2: Announcements in NIP 2014

**Roads Investment Strategy** – the government is committing £15 billion between 2015-16 and 2020-21 to continue the transformation of the Strategic Road Network, including major projects for the A303, A1, A47 and A27

**Flood defences** – the government has published its 6-year programme of investment in flood defences, allocating the £2.3 billion capital funding provided at the 2013 Spending Round

**Interconnectors** – the government will ensure that interconnectors can participate in the 2015 capacity auction; it will estimate the eligible capacity of each interconnector on a case-by-case basis

**Swansea Tidal Lagoon** – the government will start closer discussions with Tidal Lagoon Power Ltd to establish whether a potential tidal lagoon project at Swansea Bay is affordable and value for money for consumers (without prejudice to the planning decision on the project)

**Moorside** – HM Treasury has reached a cooperation agreement with Toshiba, GDF Suez and NuGen with the aim of issuing a statement of intent to provide a guarantee to assist the financing of a new nuclear power plant at Moorside, subject to due diligence and ministerial approval

**Broadband connection vouchers** – the government will provide up to £40m to extend the SME connection voucher scheme to March 2016 and to more cities; vouchers will be available on a first come, first served basis

**700MHz spectrum change of use** – further details of the clearance process for high-value spectrum will be set out in 2015 ahead of a further auction of mobile broadband spectrum, subject to the development of delivery options by DCMS and Ofcom

**Barking Riverside** – the government will agree a principal heads of terms agreement for a loan of £55 million to support the extension of the London Overground to Barking Riverside, to unlock the delivery of 11,000 homes

**Brent Cross** – the government supports the London Borough of Barnet and GLA plans for the regeneration of Brent Cross which could deliver 7,500 homes, subject to a full business case

**Ebbsfleet** – the government is making the first £100m available to fund infrastructure and land remediation at Ebbsfleet, taking forward its commitment to build the first new garden city for almost 100 years, which will deliver up to 15,000 new homes

**Access to Ebbsfleet** – the government will undertake a review of transport provision for the Ebbsfleet area, including Crossrail, High Speed 1, Southern and Southeastern rail services

**Queen Elizabeth Olympic Park redevelopment (Olympicopolis)** – the government will invest £141m to support the London Legacy Development Corporation and Mayor of London's plans to build a new higher education and cultural quarter at the Queen Elizabeth Olympic Park

**Northstowe** – the government will take forward development at Northstowe, to support accelerated delivery of up to 10,000 homes, and evaluate the feasibility and economic impact of using this model at a wider scale to support and accelerate housing supply

**Crossrail 2** – the government will provide £2 million between 2014-15 and 2015-16 to support the development of a comprehensive business case produced jointly by the Department for Transport and Transport for London, to complete ahead of the next Spending Review; this will be combined with a full options appraisal of all potential major transport projects in London, including an extension of the Bakerloo Line to improve connectivity in South East London, and the devolution of South Eastern rail services to London

**Ultra-low emission vehicle research and development** – the government is announcing up to £50 million between 2017-18 and 2019-20, to support innovation in manufacturing of ultra-low emission vehicles in the UK, based on a government contribution of £25 million for which it will seek match-funding from industry.

**Ultra-low emission vehicles in London** – the government will provide an additional £10 million between 2017-18 and 2019-20 to increase ultra-low emission vehicles in London, in support of the ambition to introduce an Ultra-Low Emission Zone by 2025

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**Support for ultra-low emission vehicles** – the Roads Investment Strategy sets aside £15 million between 2015-16 and 2020-21 for a national network of chargepoints for ultra-low emission vehicles on the Strategic Road Network; the government is also announcing further detail of three funds totalling £85 million to support ultra-low emission taxis, buses and cities

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**Local highways maintenance grant** – the government has already announced that local highways maintenance funding will be increased, totalling £5.8 billion over the next six years, and can now announce how the formula grant will be broken down by region

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**Clean Vehicle Technology fund** – the government will provide up to £4 million to extend the Clean Vehicle Technology fund in 2014-15 which funds road vehicle modification by local authorities in order to reduce air pollution

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**Chesterton Rail Station** – as announced by the Prime Minister and Deputy Prime Minister the government will provide £44 million between 2014-15 and 2016-17 to build a new rail station at Chesterton, linked to Cambridge Science Park

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**Cycle City Ambition grants** – as announced by the Deputy Prime Minister on 27 November, the government will provide £114 million between 2015-16 and 2017-18 to enable the continuation of the Cycle City Ambition scheme in the eight cities it already covers; this will provide capital funding for better cycle infrastructure such as segregated lanes and improved junctions

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**Access for all** – the government will increase the funding for the Access for All scheme by £60 million between 2015-16 and 2018-19, improving platform access at around 20 stations

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**Norwich in Ninety** – the government supports the key recommendations of the Great Eastern Main Line Task Force, including upgraded infrastructure and the latest Rolling Stock. Bidders for the next Anglia Franchise, which will start in October 2016, will be incentivised to submit plans for achieving these recommendations for services to Norwich in 90 minutes and associated benefits along the Great Eastern Mainline

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**East West Rail** – the government will consider the outputs of the Network Rail study into the East West Rail central section (Bedford to Cambridge) as part of the planning for Control Period 6 (2019-2024)

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**Dawlish rail services** – the government will support Network Rail in its work to improve the resilience of the railway at Dawlish; additionally, it will ask Network Rail to examine wider issues surrounding connectivity to and within the South West peninsula; specifically, Network Rail will consider alternatives to the current mainline route to the South West via Dawlish, including an alternative route via the north side of Dartmoor through Okehampton; this work will feed into Network Rail's Initial Industry Plan for Control Period 6 (2019-2024)

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**Bath City Centre Congestion Relief** – the government welcomes the strategy put forward by Bath and North East Somerset Council and the West of England LEP to improve transport capacity East of Bath and reduce city centre congestion; the government will consider a business case, which will be developed by Bath and North East Somerset Council that assesses the viability of proposals including a park and ride, as well as a park and rail service, located to the East of Bath

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**Compulsory Purchase Reforms** – proposals will be published for consultation at Budget 2015 to make processes clearer, faster and fairer, with the aim of bringing forward more brownfield land for development

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**National Transport Policy** – the government plans to lay the National Networks National Policy Statement before Parliament this month for consideration and a formal vote

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**Planning: establishing the principle of development** – the government will take forward measures to ensure that the principle of development need only be established once

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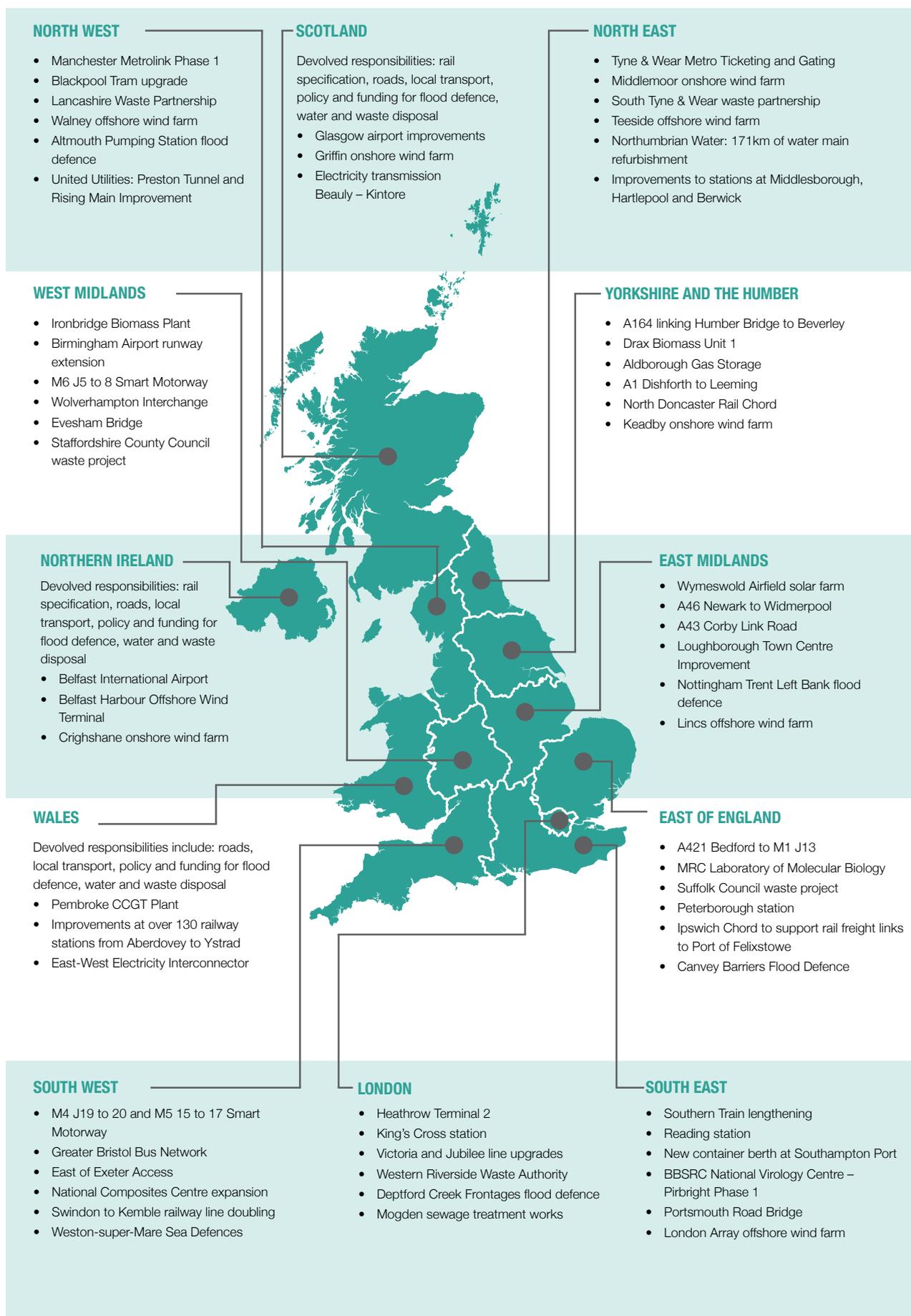
**Planning: section 106 negotiations** – the government will take steps to speed up section 106 negotiations, to reduce delays to the planning process

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**Planning: speed of decisions** – the government will keep the speed of major decisions under review, with minimum performance thresholds increasing to 50% of major decisions made on time as performance improves

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# PROJECTS COMPLETED SINCE 2010



# ECONOMIC IMPACT OF INFRASTRUCTURE INVESTMENT



Infrastructure investment could support 5,000 construction jobs for every £1 billion spent, as well as many more indirectly in design, engineering and planning



For every £1 the government is investing in broadband, the UK economy will benefit by £20



£266 million of transport pinch point funding means local transport improvements of over £511 million, with the potential to support over 200,000 jobs and around 150,000 new homes



62% of suppliers winning work for Crossrail are outside London; 58% are SMEs



Increase in overall economic activity of £2.84 for every £1 spent on infrastructure construction

## Sources:

Construction jobs/£: ONS data, DfT calculations

Broadband: SQW – UK Broadband Impact Study – Nov 2013

Pinch points: Press release – Road and rail projects to boost local and regional transport – Dec 2013

Crossrail: Crossrail calculations (<http://crossrail.co.uk/news/articles/new-figures-show-impact-of-crossrail-on-jobs-and-growth-around-the-uk>)

Overall economic activity (£2.84): CECA – Securing our economy: The case for infrastructure – May 2013

# Chapter 1:

# The government's strategy for UK infrastructure

## The government's infrastructure strategy

- 1.1 There is a strong economic case for infrastructure investment. A majority of economic studies report that infrastructure has a significant positive effect on output, productivity, and growth rates, and is a key driver of jobs throughout the economy. As such, it is a key element of the government's long-term economic plan.
- 1.2 Prior to 2010, many areas of UK infrastructure had suffered from historic under-investment. By prioritising vital capital investment in infrastructure, the government has been able to provide long-term funding certainty for the key areas where infrastructure is publicly funded – roads, rail, flood defences and science. This means that all of the publicly funded elements of the infrastructure pipeline now represent a firm and specific government commitment.
- 1.3 The UK's mixed model of infrastructure investment enables the government to prioritise public investment in the areas where it provides greatest value for money. In other areas, it harnesses the efficiencies created by a competitive market and commercial incentives. The action the government has taken to stabilise the public finances has been vital to ensuring the private sector has the confidence to invest.
- 1.4 The UK's competitive tax system and world-class regulatory regime, which provides the basis for significant investment in areas such as water, telecoms, and electricity and gas networks, are crucial to providing the right conditions for investment in private-sector infrastructure. So too is the targeted intervention the government has made in individual sectors (e.g. electricity and broadband) and the dedicated support it provides for private-sector finance for individual projects.
- 1.5 The final element of the government's infrastructure strategy has been a relentless focus on successful delivery – this means projects delivered faster, better and more cost-effectively. A key priority has been ensuring that the conditions for successful delivery are right across both the public and private sectors: streamlining the planning regime; developing a robust and transparent pipeline of projects and programmes; ensuring the right skills and capacity are in place; reducing infrastructure costs; adopting a more intelligent approach to procurement; and developing best practice to inform how infrastructure projects are managed and run.

- 1.6 The government is leading by example by strengthening its own approach to delivery. For example, through its Top 40 priority investments it has introduced a clear and consistent approach to project prioritisation. There has also been a step-change in the government's own delivery capability, overseen by Lord Deighton, the Commercial Secretary to the Treasury; and the introduction of mechanisms that allow the government to identify and address risks early and effectively. This includes a dedicated programme management function within Infrastructure UK and an infrastructure-focused Cabinet committee chaired by the Chief Secretary to the Treasury.

## The role of the National Infrastructure Plan

- 1.7 The government published the first National Infrastructure Plan (NIP) in 2010, bringing together for the first time its vision and approach for the key economic infrastructure sectors – transport, energy, flood defences, water, waste, communications and science. Since then, the government has continued to develop and refine its approach in response to feedback from investors and the supply chain to ensure the NIP is a maturing, integrated plan for UK infrastructure. The NIP is underpinned by the infrastructure pipeline, which sets out details of planned public and private investment to 2020 and beyond.
- 1.8 The NIP ensures that the government's approach in individual sectors is transparent and coordinated, providing a single point of reference for potential investors and the supply chain in setting out how the infrastructure needs of the economy are expected to be met.
- 1.9 This enables the government to maximise value for taxpayers and consumers by taking a holistic view of issues that cut across a number of different areas of infrastructure – such as the availability and cost of finance, infrastructure skills, planning and permitting, and network resilience. The NIP also allows for a more integrated approach to infrastructure planning, and supports initiatives to develop and share best practice on issues such as reducing construction costs and improving asset management and sustainability.
- 1.10 The NIP also means that the government can address infrastructure delivery in a focused and joined-up way. It sets out the government's priority projects and programmes, and acts as a tool for driving and monitoring progress across sectors – including addressing any obstacles which emerge.
- 1.11 The NIP is produced by Infrastructure UK (IUK), a unit within HM Treasury which is dedicated to infrastructure planning, financing and delivery.

## National Infrastructure Plan 2014

- 1.12 In NIP 14, the government seeks to consolidate and build on the progress already made in this parliament, and to provide the clarity and visibility that industry and investors need on its direction and commitments for infrastructure in future.
- 1.13 Having previously set out long-term capital commitments for key publicly-funded sectors, the government is now in a position to set out a clear delivery plan for each of the key infrastructure sectors for the next five years. This includes providing details of specific publicly-funded capital projects and programmes being taken forward as a result of the commitments made at Spending Round 2013.
- 1.14 NIP 14 also sets out a detailed, cross-cutting approach to infrastructure finance and delivery. In addition, the document starts to address some of the longer-term challenges that UK infrastructure will have to address in the 2020s and beyond.

1.15 The structure of the document is as follows:

- Chapter 1 (this chapter) outlines the government's overall strategy for UK infrastructure
- Chapter 2 sets out the government's plan to support and promote infrastructure development at a local and regional level across the UK, as well as in Scotland, Wales and Northern Ireland
- Chapters 3-13 set out the detailed sector plans; these include the government's objectives, an evidence-based needs analysis, a clear strategy for each sector, a detailed plan for the next five years, and a broader sense of direction over the longer term; they also identify the government's priority projects and programmes for each sector
- Chapter 14 highlights the government's approach to infrastructure funding and finance, including its most detailed assessment yet of the potential finance opportunities in infrastructure; for the first time, this also includes a robust analysis of the potential market for infrastructure finance
- Chapter 15 summarises the action the government is taking to improve infrastructure planning, delivery and performance, including the work it is doing with industry to build on the achievements of the Infrastructure Cost Review
- Chapter 16 sets out the government's approach to its 'Top 40' priority investments
- there are also three online-only annexes to the document, which provide more details on infrastructure delivery since 2010, a delivery update on the 'Top 40', and performance indicators for key sectors

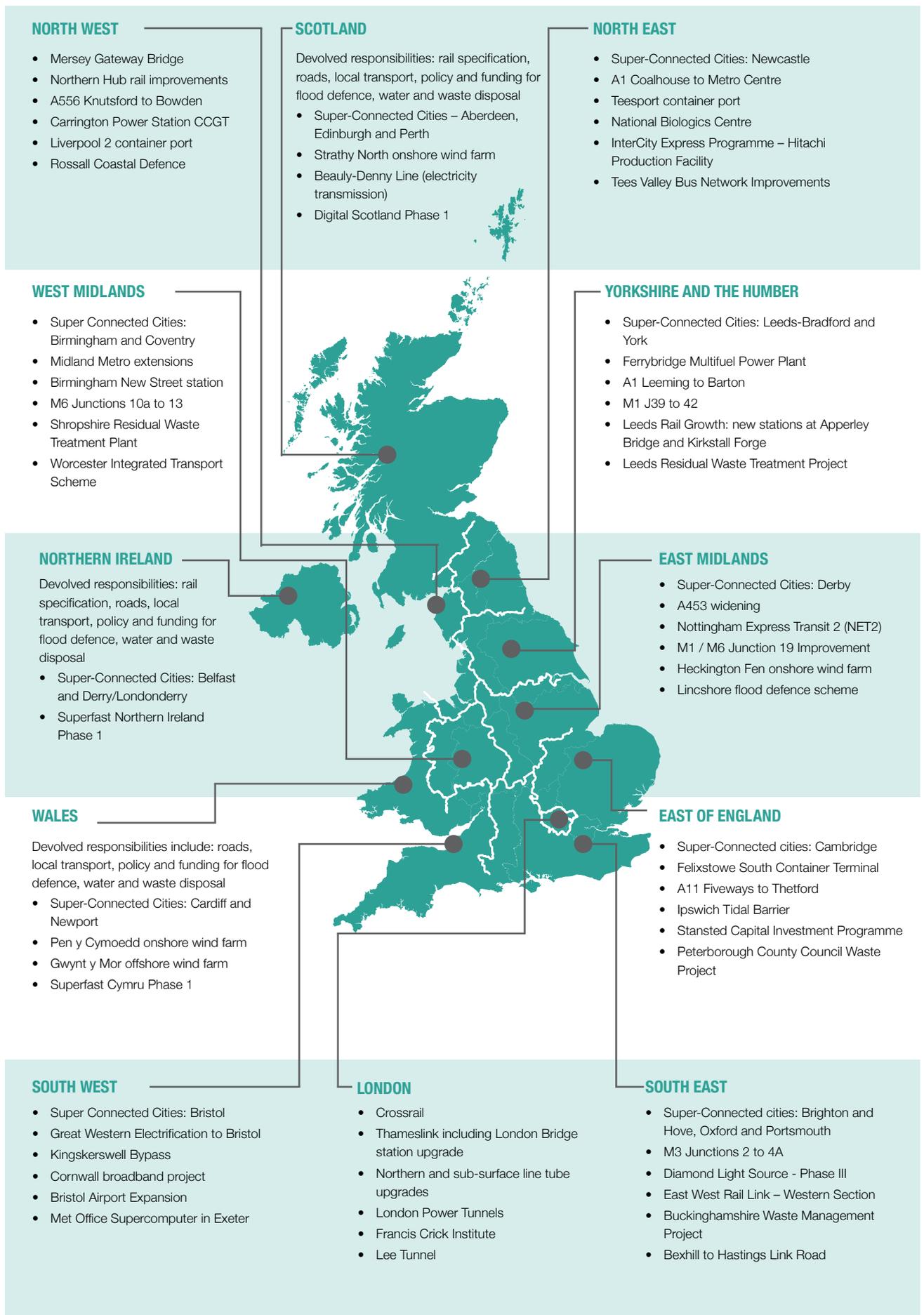
## Meeting the longer-term challenges

- 1.16 NIP 14 is published alongside a refreshed infrastructure pipeline which provides details of over £460 billion of planned investment across both the public and private sectors (this includes upstream oil and gas investment for the first time). Many of the infrastructure assets and networks delivered as a result of these plans are expected to be used for decades to come.
- 1.17 Of course, the government's role is to plan not just for the infrastructure we need now, but also for what we will need in the future – and to provide industry with the visibility and stability that it needs to do the same.
- 1.18 Predicting those long-term requirements is far from straightforward, and it is important that future governments retain the flexibility to adapt their approach as new opportunities or pressures emerge. However, there are some long-term challenges that we can be relatively confident our infrastructure will need to be able to meet.
- 1.19 One such challenge is changes to the social landscape. The UK population is growing, and growth is projected to continue throughout this century in most forecasts. The ONS central projections and research by the Infrastructure Transitions Research Consortium (ITRC) show that the UK population will grow by around 25 million people (to 90 million) by the end of the century, with a greater number than ever before over the age of 65. Population increase puts upward pressure on demand for infrastructure services like energy, water and transport.<sup>1</sup>

<sup>1</sup> ITRC, 'National infrastructure assessment: Analysis of options for infrastructure provision in GB', ITRC, January 2014

- 1.20 Climate change will also shape the future of UK infrastructure, testing the sustainability and resilience of our networks and assets and strengthening the imperative to make our transport and energy systems greener.
- 1.21 We know too that technological advances will change both our infrastructure needs and the way in which those needs are met – through the development of new types of infrastructure, or the opportunity to deliver or use existing mechanisms in new ways. For example, the increasing requirement for digital connectivity and innovative approaches such as driverless cars are already influencing the choices we make in developing our communication and transport systems. Likewise, we are adapting the way in which we deliver our projects and programmes through breakthroughs in off-site manufacturing. While the nature of innovation makes it inherently difficult to predict, our infrastructure systems will need to be nimble enough to adapt to, and take advantage of, future advances.
- 1.22 The government is taking steps to ensure that the UK is as well placed as possible to meet those challenges when they emerge. Setting out clear and comprehensive plans for the next five years in each of its key infrastructure sectors is key to that, as is the action it is taking to drive forward transformative long-term projects such as HS2, Crossrail and Hinkley Point C.
- 1.23 In addition to setting out clear plans to the end of the decade, NIP 14 gives an initial sense of direction and ambition for the government's longer-term approach to infrastructure in each of the sectors that it covers. By their very nature, these plans are less detailed. However, the government is taking action now to ensure that it has the right organisational and institutional structures in place to develop and take them forward. That means a National Infrastructure Plan that allows it to develop a coherent and credible approach to infrastructure investment and delivery; mechanisms to ensure long-term funding and finance in both the public and private sectors; governance structures that allow every region in the UK to maximise its economic potential, and a conducive delivery environment.
- 1.24 With that framework in place, and with a strong dialogue with industry and the supply chain, the government is confident that UK infrastructure is well placed to meet the challenges that it will face in the next few decades and beyond.

# PROJECTS IN CONSTRUCTION AS OF 2014-15





# Chapter 2:

## Infrastructure across the UK

- 2.1 As set out in the previous chapter, ensuring we have the right infrastructure in the right places is vital to allow our society and economy to function effectively. It is also a crucial tool in driving growth and regeneration across the UK and creating strong and prosperous communities in which people want to live and work.
- 2.2 The government is committed to giving local areas the tools they need to ensure they have the infrastructure that is right for them. That means not taking a one-size-fits-all approach, but giving local authorities, cities and regions the autonomy to determine what is delivered locally, and ensuring they have the ability to influence the regional and national infrastructure that will shape their areas.

### **The infrastructure pipeline in the regions**

- 2.3 The infrastructure pipeline, published alongside the National Infrastructure Plan 2014, gives an indication of the breadth of infrastructure investment being undertaken across the UK. While 38% of the investment in the pipeline is presented on a regional basis, this does not include cross-regional and UK-wide projects or programmes which will have a transformative effect in individual areas – such as the roll-out of superfast broadband (£1.7 billion), the £20 billion of works maintaining the country's gas and electricity networks which straddle more than one region, and major multi-regional projects such as HS2.

### Box 2.A: Case study: the infrastructure pipeline in the South West

- Improvements to the strategic and local road networks including the A303, the Kingskerswell Bypass (A380) and 30 pinchpoint schemes
- Electrification of the Great Western Mainline and improvements to Bristol Temple Meads station
- Expansion of Bristol Airport
- The Cornwall Broadband project, worth £132 million, which is deploying 130,000km of fibre optic cable throughout the area
- Government funding of over £54 million to enable the delivery of superfast broadband across Devon and Somerset
- Western Power's plans to spend over £1.5 billion on electricity distribution networks across spending control periods
- Investment in water and sewerage networks of over £2 billion, and in waste of £228 million
- Approximately £136 million Grant in Aid (GIA) from the 6-year floods and coastal erosion management programme is supporting at least 240 projects in this region<sup>1</sup>
- A 3.3GW Nuclear Power Plant at Hinkley Point C worth £16 billion

Source: HM Treasury Major Infrastructure Tracking unit

2.4 The maps on pages 15, 21 and 31 further highlight the diverse range of projects that the government has completed and set out plans to take forward across the UK.

## Empowering local areas

- 2.5 The government has established Local Enterprise Partnerships (LEPs) between local government and business in functional economic areas, giving them the opportunity to decide what the priorities should be for investment in roads, buildings and facilities in the area. The 39 LEPs have made Strategic Economic Plans, which bring together priorities across local areas and sectors. These documents clearly present the direction the local economy is taking, and highlight important local infrastructure development and delivery opportunities. As such, they act as the starting point for a dialogue on the priorities for spending.
- 2.6 At a regional level, the government encourages LEPs, local authorities and cities to come together and work with central government to shape the infrastructure that they need in their own areas.

### Box 2.B: Northern Powerhouse

The government has been clear on the need to rebalance the economy in order to restore economic growth in this country. An important aspect of such rebalancing is to ensure that all areas of the country are able to realise their full economic potential and prosperous cities in the north can complement prosperous cities in the South. The Chancellor has set out plans to create a Northern Powerhouse, through provision of modern transport connections, support for science and universities and more power and control to civic government to maximise the potential of the North of England and reduce the decades-old gap between London and other cities. The government has also listened to the ideas that have come forward through the Deputy Prime Minister's Northern Futures project.

<sup>1</sup> The level of GIA may vary across the programme regions as detailed project planning proceeds

- 2.7 The government has also introduced a range of wider mechanisms for devolving governance and funding to enable local areas to take responsibility for driving economic growth in their own areas.

### Box 2.C: London

London has established itself as an incredibly successful thriving global capital, with a population of over 8 million. It is a standout example of how an empowered and ambitious city can help drive the country's economy forward.

London has an elected mayor who sets an overall vision for London and has a duty to create plans and policies for the capital covering a range of issues including transport, planning and regeneration.

Transport for London (TfL) is the public body with standalone responsibility for the majority of transport services in London. It receives over £12 billion of funding from the government over the current Mayor of London's 4 year term. This has enabled it to pursue major programmes of investments such as upgrades to the Northern and Victoria tube lines and expansion of the London Overground network, the rollout of electric and hybrid bus fleets, and the improvement of cycle infrastructure including Cycle Superhighways and segregated cycle lanes. This is in addition to a significant rolling programme of maintenance and renewal. It also undertakes one-off major infrastructure projects such as Crossrail, which is a joint venture with the Department for Transport.

Infrastructure investment in London has ripple effects across the whole country. 43% of businesses that won Crossrail work for example are based outside London and the southeast, with 62% based outside the capital itself.<sup>2</sup>

### City Deals

- 2.8 City Deals are agreements between government and a city that give the city control over decisions that affect their area and how public money should be spent in order to help businesses grow and create economic growth. A total of 28 City Deals have been concluded over this Parliament; 27 in England and one in Scotland (Glasgow and Clyde Valley).
- 2.9 A key element of several City Deals has been the establishment or strengthening of economically prioritised infrastructure spending programmes – notably in Greater Manchester, Glasgow and Clyde Valley, and Greater Cambridge which will see a combined investment from central and local government along with private sector partners of over £3.5 billion.

“[The Greater Cambridge City Deal] is a very significant step towards providing the City with the economic means to shape our future and that of those who live and work in this unique place. It is a great example of what can be achieved when local authorities and others collaborate as they did here”

Jane Paterson-Todd, Chief Executive for Cambridge Ahead

<sup>2</sup> <http://www.crossrail.co.uk/news/articles/55bn-of-crossrail-contracts-creating-jobs-and-business-opportunities-around-the-uk>

## Growth Deals

- 2.10 Building on the success of City Deals, the government has introduced Growth Deals which provide LEPs with money from the Local Growth Fund (LGF) for projects that benefit the local area and economy. Growth Deals have provided the opportunity to bring together LEP, local authority and private sector resources behind the key priorities of the local economy as set out in the strategic economic plans.
- 2.11 The LGF was created in response to Lord Heseltine's report *No Stone Unturned*<sup>3</sup> and combines £12 billion of spending allocations across transport, housing and skills over the six year period to 2020-21. Allocations are made on the basis of a competitive process. The first round of deals were agreed in July 2014, in which £6 billion was allocated across 39 LEPs.<sup>4</sup> Details of some of the projects that received funding through these deals are set out in Chapter 5.
- 2.12 These Growth Deals are crucial in supporting local infrastructure. Firstly LEPs can now plan a significant amount of capital spending over the medium term to 2020-21; this increased certainty is vital for effective infrastructure planning and delivery. They also give LEPs greater autonomy. Of the 332 transport schemes partially or fully funded through the LGF, approximately 90% will be free from any further central government approval. Under the previous approvals system, only around half of the schemes would have enjoyed this freedom. The government has retained an appropriate degree of control for those projects it assesses to be the most complex, contain the greatest degree of risk, or which have significant strategic linkages to other major schemes. The government is also facilitating the sharing of good practice between local authorities, in order to embed consistently high standards of delivery right across the country.

## Supporting the funding and financing of local infrastructure

- 2.13 In addition to giving local areas control over infrastructure investment through the mechanisms outlined above, the government has put in place some specific sources of funding to help unlock local investment in infrastructure and other growth projects:
- The Growing Places Fund (GPF) provides up-front capital to help local authorities and developers take infrastructure projects forward where relatively small amounts of funding can help to unlock further development. The GPF is supporting 323 projects across the country.
  - The Regional Growth Fund (RGF) is a £3.2 billion fund helping companies throughout England to create jobs between now and the mid-2020s. Over £168 million has been used for local transport and utilities development, helping local areas realise their economic potential by making essential improvements to road, rail and port infrastructure and over £78 million for energy schemes, including low carbon technology. A further round of successful bidders is to be announced in spring 2015.
  - The Community Infrastructure Levy (CIL) is a levy that local authorities in England and Wales can choose to charge on new developments in their area. The money is being used to support development by funding infrastructure that the council, local community and neighbourhoods want.

<sup>3</sup> 'No stone unturned: in pursuit of growth', The Rt Hon the Lord Heseltine of Thenford CH, October 2012

<sup>4</sup> Interactive map of Local Enterprise Partnerships [http://www.tripline.net/trip/Local\\_Growth\\_Deals\\_2014-60344703535410079317EC660AA1B3AF](http://www.tripline.net/trip/Local_Growth_Deals_2014-60344703535410079317EC660AA1B3AF)

**Box 2.D: Case study: Growing Places Fund**

Greater Lincolnshire LEP used £2.9 million of Growing Places Fund funding to provide for the upfront infrastructure costs necessary to allow the Mablethorpe development to proceed. This will include the delivery of 180 homes (of which 120 are affordable), a new supermarket, a sports field and improved access to the local junior school. Overall the scheme will create 530 jobs, and bring in a further £6.5 million private sector investment.

**Using infrastructure to support and stimulate regeneration****Box 2.E: Regeneration announcements**

- **Barking Riverside** – the government will agree a principal heads of terms agreement for a loan of £55 million to support the extension of the London Overground to Barking Riverside, to unlock the delivery of 11,000 homes
- **Brent Cross** – the government supports the London Borough of Barnet and GLA plans for the regeneration of Brent Cross which could deliver 7,500 homes, subject to a full business case
- **Ebbsfleet** – the government is making the first £100 million available to fund infrastructure and land remediation at Ebbsfleet, taking forward its commitment to build the first new garden city for almost 100 years, which will deliver up to 15,000 new homes
- the government will undertake a review of **transport provision for the Ebbsfleet** area, including Crossrail, High Speed 1, Southern and Southeastern rail services
- **Queen Elizabeth Olympic Park redevelopment (Olympicopolis)** – the government will invest £141 million to support the London Legacy Development Corporation and Mayor of London's plans to build a new higher education and cultural quarter at the Queen Elizabeth Olympic Park
- **Northstowe** – the government will take forward development at Northstowe, to support accelerated delivery of up to 10,000 homes, and evaluate the feasibility and economic impact of using this model at a wider scale to support and accelerate housing supply

- 2.14 The government also recognises that key national infrastructure schemes can be instrumental in unlocking regeneration or housing projects in local areas. For example, an improved A14 will support further growth in the region as the east coast Haven ports at Ipswich, Harwich and Felixstowe expand, as well as major developments such as Northstowe, the Alconbury Enterprise Zone, and expansion on the northern and eastern fringes of Cambridge.
- 2.15 The High Speed 2 (HS2) Growth Taskforce, which reported in March 2014, made a number of recommendations to maximise the potential of HS2. This includes helping the UK's cities and businesses grow, to generate more jobs, to breathe new life into areas in need of regeneration and to create opportunities for businesses to compete for HS2 contracts. Responding to the recommendations in this report, Phase 1 places are due to finalise their HS2 local growth strategies in spring 2015 and will set up local delivery bodies by summer 2015. The government will also continue to consider proposals for a central HS2 regeneration and development company.

2.16 The government has made significant progress on its commitment to specific housing and regeneration projects, including:

- agreeing principal heads of terms for a loan of £55 million to support the extension of the London Overground to Barking Riverside to unlock the delivery of 11,000 homes
- supporting the London Borough of Barnet and GLA plans for the regeneration of Brent Cross which could deliver 7,500 homes, subject to a full business case
- taking forward the commitment to build the first new garden city for almost 100 years at Ebbsfleet, which will deliver up to 15,000 new homes; the A2 Bean and Ebbsfleet Junction improvements will be delivered as part of the Highways Agency programme; the Chairman Designate of the proposed Urban Development Corporation is now in place and the government has reached agreement with the key landowners on the site on a collaborative approach to the delivery of development; the government will make the first £100 million available to fund infrastructure and land remediation to kick start development, subject to due diligence
- the government will undertake a review of transport provision for the Ebbsfleet area, including Crossrail, High Speed 1, Southern and Southeastern rail services
- the government will invest £141 million in order to support the London Legacy Development Corporation and Mayor of London's Olympicopolis project to redevelop the Queen Elizabeth Olympic Park; this will support the construction of a new higher education and cultural quarter carried out in partnership with University College London, the Victoria and Albert Museum, University of the Arts London and Sadler's Wells, driving innovation and growth and ensuring that this opportunity builds on the success of London 2012
- the government will take forward development of Northstowe; the government will trial a new delivery model on the site, with the Homes and Communities Agency taking the lead on delivering the site, including through master-planning and commissioning; this will support the construction of up to 10,000 new homes on the site, up to twice as fast as conventional development routes; the government will report by Budget on the delivery vehicle, governance and investment in the site; the government will undertake an evaluation of the Northstowe development, and of the feasibility and economic impacts of pursuing this model at a wider scale

## Infrastructure investment in Northern Ireland, Scotland and Wales

2.17 In Northern Ireland, Scotland and Wales, the split between the responsibility of the UK government and each of the devolved administrations for infrastructure policy and funding varies according to the distinct devolution settlement in place for each administration. For example:

- responsibility for investment in roads infrastructure is fully devolved to the Northern Ireland Executive, Scottish Government and Welsh Government
- rail specification is devolved in Northern Ireland and Scotland, but not devolved in Wales
- decisions on public sector support for infrastructure in or around airports and ports is generally devolved, whilst regulation of aviation and air transport is dealt with at the UK government level

- similarly, energy policy is devolved in Northern Ireland (aside from some UK government responsibilities in relation to nuclear energy), whereas in Scotland and Wales responsibility for investment in infrastructure has largely remained a reserved matter for the UK government; regulation is conducted by Ofgem in Wales and Scotland but by the Utilities Regulator in Northern Ireland, reflecting the more extensive level of devolution in place there
- both environmental infrastructure and regulation are the responsibility of the three devolved administrations, including policy and funding responsibility for flood defences, water infrastructure, and sewage and waste disposal
- infrastructure relating to broadcasting and telecommunications remains largely a non-devolved matter, although the devolved administrations may support businesses involved in those sectors as part of their general role in promoting economic development

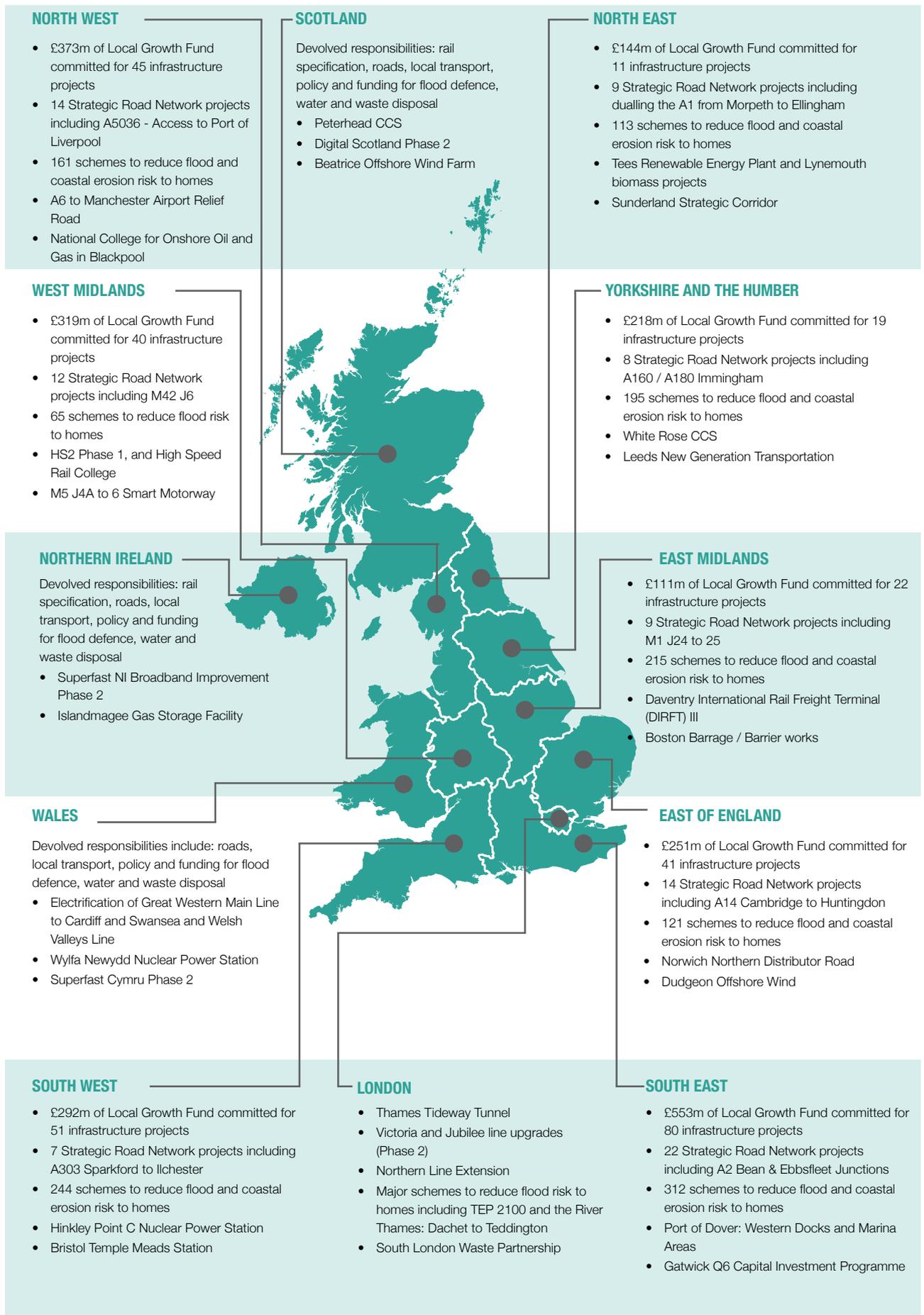
### **Box 2.F: UK government investment in Northern Ireland, Scotland and Wales**

The government remains committed to supporting investment in Northern Ireland, Scotland and Wales in areas where policy responsibility is non-devolved. For example:

- funding of £122 million has been granted to Scotland (including Highlands and Islands), £69 million to Wales and £12 million to Northern Ireland for funding in superfast broadband; Cardiff and Newport in Wales, and Aberdeen, Edinburgh and Perth in Scotland and Belfast and Derry/Londonderry in Northern Ireland are also super-connected cities
- as part of its commitment to the development of marine energy, the government has provided £10 million of grant funding to the MeyGen project in the Pentland Firth Inner Sound in Scotland and the SeaGeneration Wales Limited project in Anglesey
- the UK government is investing £50 million in an offshore renewable energy catapult in Glasgow, designed to accelerate the design, deployment and commercialisation of renewable energy technology innovation
- the government has announced UK Guarantees for the Grangemouth petrochemical plant and the Countesswells development in Aberdeen, which will finance a new development of 3,000 homes; it has also signed a cooperation agreement with Hitachi and Horizon with the aim of being able to agree an in-principle guarantee by the end of 2016 to support the financing of a new nuclear power plant at Wylfa, subject to final due diligence and ministerial approval
- the UK government agreed a funding package with the Welsh government to electrify the Valley Lines; the UK government will also cover the full costs of electrifying the Great Western Main Line to Swansea and devolve the Wales and Borders rail franchise, so that the Welsh government will decide the new franchise in 2018; in order to make this deal happen, the UK government will take over sponsorship and fund the delivery of the Cardiff-Bridgend section of the Main Line electrification scheme to Swansea – worth £105 million, and contribute £125 million towards the costs of the wider Valley Lines electrification scheme; the Welsh government will take over sponsorship and delivery of the Valley Lines project
- the government also provides support for private-sector energy investment in Scotland, and the Beatrice offshore wind farm was one of 8 UK projects to receive an early Investment Contract as part of the Final Investment Decision Enabling for Renewables allocation in spring 2014

- 2.18 Except for those areas which are non-devolved responsibilities, Northern Ireland, Scotland and Wales are responsible for prioritising and delivering infrastructure investment, supported by the funding they receive from the government through their 'block grant' allocations.
- 2.19 The UK government has also allowed local authorities in Scotland and Wales to access the cheaper Project Works Loan Board 'project rate' in relation to borrowing in support of key infrastructure projects. A total of £400 million of borrowing has been made available through to the end of 2015-16. The Scottish and Welsh Governments have now established arrangements for accessing the project rate with local authorities in their own jurisdictions.
- 2.20 The Scottish government published an Infrastructure Investment Plan in 2011 setting out a pipeline of public investment in both economic and social infrastructure through to 2030. A report on progress against the Plan is published annually. The investment pipeline was updated further in August 2014, and now provides information on 30 major programmes and over 100 individual projects. The Scottish 'Infrastructure Investment Plan' and related documents are available at: [www.scotland.gov.uk/Topics/Government/Finance/18232/IIP/](http://www.scotland.gov.uk/Topics/Government/Finance/18232/IIP/)
- 2.21 The Northern Ireland Executive published its latest 'Investment Strategy for Northern Ireland 2011-21' (ISNI) in October 2012. The ISNI sets out the Executive's renewed priorities for capital investment in social, economic and environmental infrastructure projects – with schemes valued at over £13 billion in total to be delivered in the period up to 2021. The 'Investment Strategy for Northern Ireland' is available at: [www.sibni.org/investment\\_strategy\\_for\\_northern\\_ireland\\_2011\\_-\\_2021.pdf](http://www.sibni.org/investment_strategy_for_northern_ireland_2011_-_2021.pdf)
- 2.22 The Welsh Government set out its approach to identifying, prioritising and delivering the social and economic infrastructure needs of Wales in the 'Wales Infrastructure Investment Plan' (published in 2012). Together with the infrastructure investment pipeline, which provides details of priority infrastructure investments in Wales – incorporating over 320 investments worth over £34 billion across both public and private sectors, including in the non-devolved areas of rail and energy – these documents provide a clear picture of how the Welsh Government is delivering its strategic investment priorities, as well as providing an overview of sectoral investment plans. The Wales Infrastructure Investment Plan is available at: <http://wales.gov.uk/funding/wiipindex/?lang=en>

# FORTHCOMING PROJECTS TO 2020-21



# ROADS

## Progress since 2010

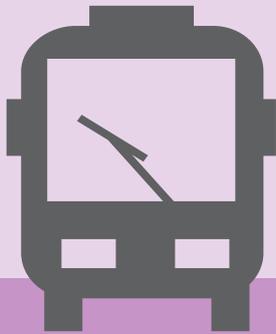
14

major roads projects completed and 14 more in construction



Over  
200

smaller improvements delivered around the country

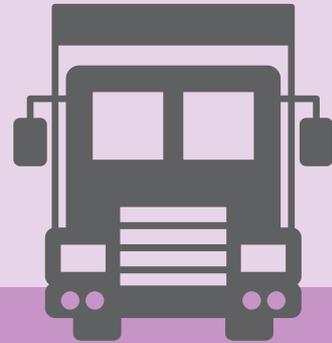


New Smart Motorway lanes opened including on the M1, M6 and M25



£400m

invested in development of Ultra Low Emission Vehicles



Creation of a new national Strategic Highways Company

Over  
£15bn

to undertake over 100 strategic road schemes

Investing in new 'expressways' to link under-served areas including A303 and A1 north of Newcastle

Resurfacing up to 80% of the Strategic Road Network

Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR ROADS £15.9BN**

**In construction £2.5bn**

**Future investment £13.4bn**

# Chapter 3:

## Roads

### Box 3.A: Announcements on roads

- **Roads Investment Strategy** – the government is committing £15 billion between 2015-16 and 2020-21 to continue the transformation of the Strategic Road Network; this will be the biggest programme of road investment since the 1970s, with investment tripling from current levels by the end of the decade and over 100 schemes to take place over the next Parliament; major projects are taking place in every region, with at least £1.8 billion invested in every area; the schemes being taken forward include substantial projects to upgrade the A303 in the South West, A1 in Gateshead and north of Newcastle, A47 in the East of England, and the A27 along the south coast
- **Support for ultra-low emission vehicles (ULEVs)** – the government is announcing up to £50 million between 2017-18 and 2019-20 to support innovation in manufacturing of ultra-low emission vehicles in the UK, based on a government contribution of £25 million for which it will seek match-funding from industry. The Roads Investment Strategy sets aside a further £15 million between 2015-16 and 2020-21 for a national network of chargepoints for ULEVs on the Strategic Road Network. The government is also providing £10 million support for ULEV measures in London, as well as further detail of three funds totalling £85 million to support ultra-low emission taxis, buses and cities

### Objectives

- 3.1 The government's aim is to create a national road network fit for the 21st century, which improves economic productivity and supports jobs and growth across the country. It seeks to increase capacity, tackle congestion, support development, strengthen connectivity, improve reliability and resilience, and ensure a road network of the best possible quality.

### Needs

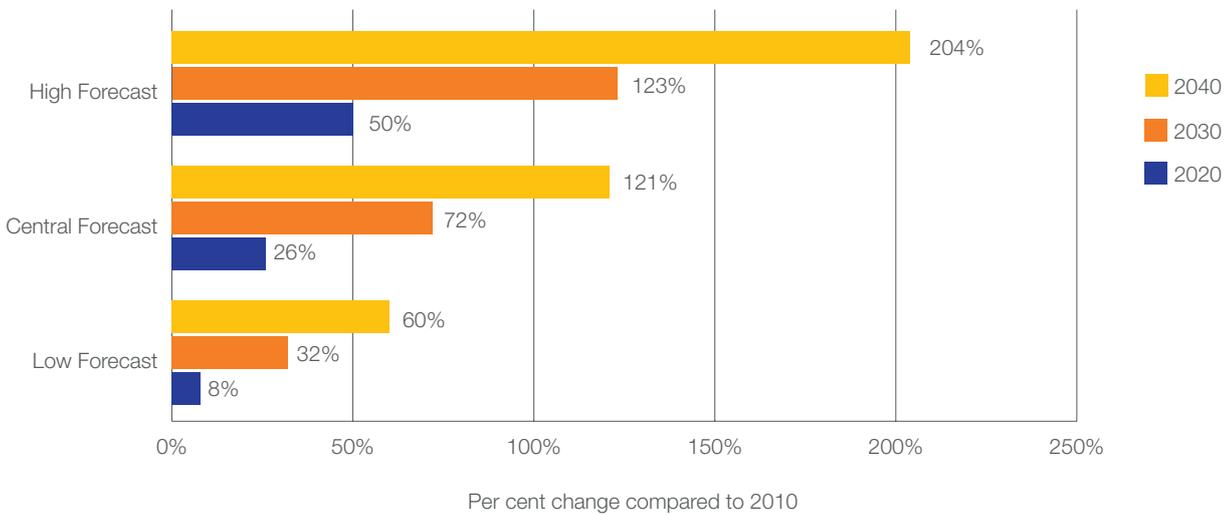
- 3.2 The road network is vital to the economic sustainability of the UK. Well-connected road infrastructure enables people to travel for work and leisure and businesses to move goods. Over 65% of freight movements and 90% of passenger miles are made by road.<sup>1</sup> The long-term trend is of growing road traffic with vehicle miles travelled per year increasing from 28.9 billion in 1949 to 303.7 billion vehicle miles in 2013.<sup>2</sup>

<sup>1</sup> National Policy Statement for National Networks, Department for Transport, (forthcoming)

<sup>2</sup> Annual Road Traffic Estimates – Great Britain 2013, Department for Transport, June 2014

- 3.3 With GDP and population expected to rise, demand for travel on the UK’s Strategic Road Network will increase further. DfT analysis estimates that by 2040 traffic in England will be between 27% and 57% higher than 2013 levels based on a range of forecasts of economic growth, motoring costs and the trend in individual travel behaviour.<sup>3</sup> This growth, unaccompanied by the required level of investment or appropriate policies to encourage mode shift, is likely to have a significant impact on levels of congestion.
- 3.4 The Strategic Road Network (SRN) is a crucial element of our road infrastructure; in 2013, while it only accounted for 2.4% of the total road network in England, it carried 32.9% of all motor vehicle traffic and 65.6% of all HGV traffic.<sup>4</sup> Chart 3A identifies a range of scenarios for congestion levels on the Strategic Road Network in England between 2010 and 2040.<sup>5</sup>

**Chart 3.A: Forecast of congestion on the strategic road network in England<sup>6</sup>**



Source: Road Traffic Forecasts, Department for Transport, (forthcoming)

- 3.5 Greater congestion will lead to greater delays and uncertainty about journeys for commuters and businesses, potentially incurring significant economic costs. DfT estimates indicate that congestion on the SRN already costs over £2 billion per year in value of time and could rise to nearly £10 billion per year by 2040 unless action is taken.<sup>7</sup>

## Strategy

- 3.6 The vast majority of UK roads investment is publicly funded. The government directly funds the maintenance and development of the SRN through the Highways Agency. Local roads remain the responsibility of local authorities, with funding support from the government, and are covered in the Local Transport section.

<sup>3</sup> Road Traffic Forecasts, Department for Transport, (forthcoming)

<sup>4</sup> Annual Road Traffic Estimates: Great Britain 2013, Department for Transport, June 2014

<sup>5</sup> Investment assumptions do not take account of announcements made in Investing in *Britain’s Future* in June 2013

<sup>6</sup> Data based on forecast scenario 1 and high/low demand variants from Road Traffic Forecasts – (forthcoming)

<sup>7</sup> National Policy Statement for National Networks, Department for Transport, (forthcoming)

- 3.7 The government is taking action across the SRN to address growing demand and the resulting pressures on the network. This includes:
- the biggest programme of roads investment since the 1970s, focusing on developing and maintaining the existing network to a high standard
  - the creation of a new publicly-owned Strategic Highways Company, freed from government red-tape, and supported by long-term funding certainty and a clear Road Investment Strategy
  - making the best use of road capacity – including through ‘Smart Motorways’, making extra lanes available at key times on more of the busiest routes by opening up the hard shoulder, and using innovative technology to keep traffic moving
  - taking advantage of technological change to improve the experiences and choices of travellers and developing new techniques for the performance and operation of vehicles and the management of transport systems

## Delivery plan

- 3.8 The government is taking steps to revolutionise the way that it plans and delivers roads investment, including:
- publishing the first-ever Road Investment Strategy (RIS1) spanning 2015-16 to 2019-20, to set out the national priorities and plans for our Strategic Road Network
  - replacing the Highways Agency with a new strategic highways company, and transforming it into a world-class infrastructure company
  - creating a new highways monitor, charged with ensuring that taxpayers’ money is well spent and the highways authority is delivering efficiencies during RIS 1 and for the future.



3.9 These changes will be underpinned in legislation, through the Infrastructure Bill currently before Parliament.

### Key actions to 2020-21

3.10 RIS1 provides details of the government's commitment to treble spending on strategic road enhancements, investing a further £15.2 billion in over 100 major schemes by 2021. This will include:

- to improve the condition of our strategic roads: £6 billion to resurface up to 80% of the Strategic Road Network by the end of the decade
- to improve connectivity and support the growth of regional economies, a package of transformational developments:
  - £2 billion of improvements to the A303/A30/A358 corridor, transforming connectivity to the South West with a new expressway, including a tunnel of at least 1.8 miles at Stonehenge
  - £640 million to further improve the A1 to the west and north of Newcastle, with a particular focus on tackling congestion by further widening sections of the Western-Bypass and dualling north to Ellingham
  - £350 million to upgrade the A47 in the East of England, including continuous dual carriageway around Norwich
  - £350 million to upgrade the A27 on the south coast, including a dual carriageway bypass for Arundel
  - £170 million to improve connections on trans-Pennine roads including improvements to the A61 and A628
  - £1.5 billion of investment in the A14 Cambridge to Huntingdon which improves freight access to Felixstowe, one of the country's major shipping ports, tackling the congestion in the East of England and unlocking a major housing development at Northstowe
- to extend the capacity of the existing network and address the very worst congestion that is holding back the economy:
  - tripling the level of investment in enhancements to the Strategic Road Network – rising from recent levels of £1 billion per year to £3 billion per year by the end of the decade – allowing for sustained investment in improvements to the strategic road network in every region of the country
  - 1,300 lane miles of extra capacity, including a 'smart spine' of Smart Motorways linking London, Birmingham and the North West, providing additional capacity to some of the busiest routes on the network
  - £9 billion to invest in over 100 major projects on the Strategic Road Network by the end of the decade
  - upgrading the country's most important A roads to 'Expressways' – with many similar standards and similar safety levels to our motorways, expected to deliver mile a minute speeds for most journeys; Expressways would generally be dual-lane, with grade separated junctions and technology used to control and inform traffic

- 3.11 RIS1 will also establish 5 designated funds worth £900 million to address a range of specific issues over and above the traditional focus of road investment and ensure the new Strategic Highways Company is at the cutting edge of innovation in road construction and network management. The funds are:
- Environment
  - Cycling, Safety and Integration
  - Innovation
  - Air Quality
  - Growth & Housing
- 3.12 In order to support its ambitious investment programme, in November 2014 the Highways Agency appointed 26 companies to the largest ever Collaborative Delivery Framework worth £5 billion over the next 5 years.
- 3.13 The government will also provide over £500 million of additional capital investment by the end of the decade to support the further uptake of ultra-low emission vehicles (ULEVs). This includes a £32 million fund for charging infrastructure, on top of which the Road Investment Strategy includes £15 million for a network of chargepoints which will ensure access to a chargepoint every 20 miles on 95% of the Strategic Road Network. This infrastructure investment will ensure that ULEV drivers can easily find a rapid charge point to help undertake any journey they choose. A further £11m of joint government and industry funding will help establish an initial network of up to 15 hydrogen refuelling stations by the end of 2015.

### **Priority investments (Top 40)**

- 3.14 To support delivery of its objectives for the roads sector, the government has included the following within its Top 40 priority infrastructure investments:
- Accelerated Road Schemes
  - Strategic Roads New Capacity
  - Smart Motorways
  - A14
  - Lower Thames Crossing
  - A303 / A30 / A358 Corridor
  - A1 (North East)
- 3.15 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

### **Longer term**

- 3.16 The government's vision is nothing short of a transformation of the nation's road network over the next quarter of a century, with the aim of putting the nation's Strategic Road Network back in the top ten globally.

3.17 As part of RIS1, the government has also asked the new Strategic Highways Company to explore the feasibility of further transformational investments including:

- consideration of further improvements for trans-pennine connectivity from Manchester to Sheffield, raising the level of future ambition and determining if there is an historic opportunity to link two of our great northern cities; this work will be taken forward with Transport for the North as part of the development of the wider Northern transport strategy
- an Oxford to Cambridge Expressway – a new east-west connection linking Cambridge, Bedford, Milton Keynes, and Oxford, connecting a number of high-growth areas, and creating a much better direct east-west connection between some of our most important scientific and technical centres of excellence
- M25 South West quadrant improvements – exploring options for tackling the extremely serious levels of congestion on the busiest road in Britain, making best use of all transport modes

3.18 Transforming our road network is the work of a generation and more detailed future plans will be laid out in subsequent Road Investment Strategies. Alongside the results on future feasibility study work this may well include further improvements to our major trunk roads, such as the A1 between London and Scotland.

**Further information**

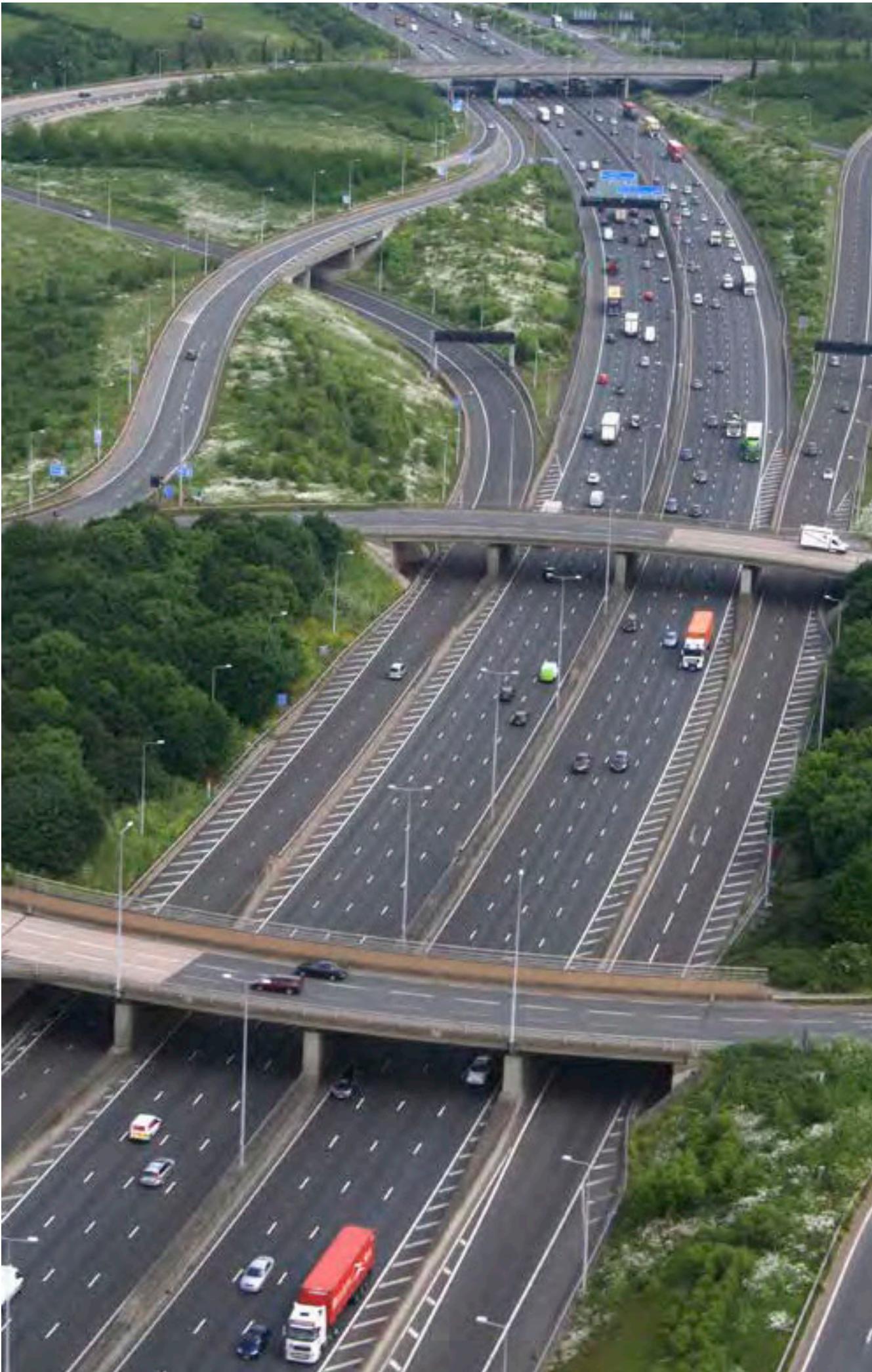
3.19 The infrastructure pipeline sets out details of major planned projects and programmes within the roads sector, including current status, projected construction start/completion dates and cost profiles (where available).

3.20 The full Road Investment Strategy 1 can be found on the gov.uk website.

**Key policy and delivery milestones**

	2015-16	<p><b>Top 40 key project starts due:</b> A160/A180 Immingham (all accelerated roads now in construction)</p> <p><b>Top 40 key project completions due:</b> M1 J28 to 31 and J39 to 42, M6 J10 to 13, A453 Widening</p> <p>Consultation on detailed route options for the Lower Thames Crossing</p>
	2016-17	<p><b>Top 40 key project starts due:</b> A14 (Cambridge to Huntingdon)</p> <p><b>Top 40 key project completions due:</b> M3 J2 to 4A, A556 Knutsford to Bowden, Manchester Smart Motorways, M1/M6 J19, A160/A180 Immingham, A1 Coal House to Metro Centre</p>
	2017-18	<p><b>Top 40 key project completions due:</b> A5-M1 Link Road, A1 Leeming to Barton</p>
	2018-19	
	2019-20	<p><b>Top 40 key project starts due:</b> A303 (Sparkford to Ilchester)</p> <p><b>Top 40 key project completions due:</b> A14 (Cambridge to Huntingdon)</p> <p>Over 100 Strategic Road Network schemes due to be completed or in construction as part of RIS1</p> <p>RIS2 due to be published</p>
	2020-21	<p>Start of RIS2 period</p>

Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes. Final decisions on private-sector led projects will be taken by the project developer.



# RAIL

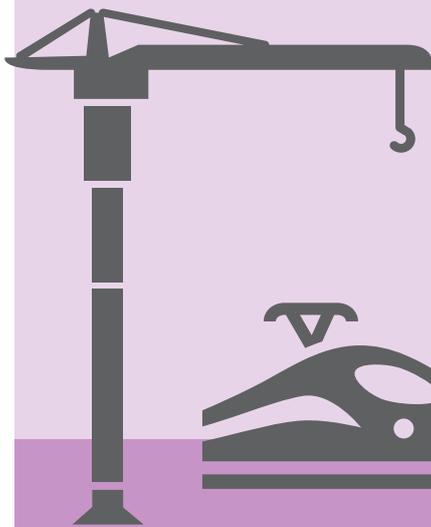
## Progress since 2010

- Major upgrade of King's Cross Station, unlocking 2,000 new homes

- Improvements to over 400 other stations around the country

- Crossrail tunnelling nearly 90% complete and flagship stations in construction

- Construction started on the transformational Northern Hub rail upgrade



£38bn

- Network Rail delivery plan, including electrification of key lines

- Crossrail due to be fully operational by 2019

- HS2 phase 1 due to start construction in 2017

- Plans to reduce industry costs by up to £3.5 billion by 2019

Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR RAIL £86.9BN**

**In construction £34.8bn**

**Future investment £52.1bn**

# Chapter 4:

# Rail

## Box 4.A: Announcements in the rail sector

- **Crossrail 2** – see Chapter 5 (Local Transport)
- **Norwich in Ninety** – the government supports the key recommendations of the Great Eastern Main Line Task Force, including upgraded infrastructure and the latest Rolling Stock. Bidders for the next Anglia Franchise, which will start in October 2016, will be incentivised to submit plans for achieving these recommendations for services to Norwich in 90 minutes and associated benefits along the Great Eastern Mainline
- **East West Rail** – the government will consider the outputs of the Network Rail study into the East West Rail central section (Bedford to Cambridge) as part of the planning for Control Period 6 (2019-2024)
- **Dawlish rail services** – the government will support Network Rail in its work to improve the resilience of the railway at Dawlish. Additionally, it will ask Network Rail to examine wider issues surrounding connectivity to and within the South West peninsula. Specifically, Network Rail will consider alternatives to the current mainline route to the South West via Dawlish, including an alternative route via the north side of Dartmoor through Okehampton. This work will feed into Network Rail's Initial Industry Plan for Control Period 6 (2019-2024)
- **Access for all** – the government will increase the funding for the Access for All scheme by £60 million between 2015-16 and 2018-19, improving platform access at around 20 stations
- **Chesterton Rail Station** – as announced by the Prime Minister and Deputy Prime Minister the government will provide £44 million between 2014-15 and 2016-17 to build a new rail station at Chesterton, linked to Cambridge Science Park

## Objectives

- 4.1 The government's objectives for the rail network are to:
- increase rail capacity, particularly into major cities
  - reduce journey times
  - strengthen connectivity
  - improve reliability, safety and the passenger experience

- 4.2 The government's rail strategy supports overall decarbonisation of the transport system by providing a greener alternative to roads and aviation.

## Needs

- 4.3 Rail is vital to the UK's economic prosperity. If rail services are inefficient and do not meet people's needs for routing or frequency, business and jobs suffer. Since privatisation in the mid-1990s, there has been sustained growth in rail passenger demand. Over 4.3 million journeys are now made by rail every day. Over the last 10 years, passenger journeys in Great Britain have increased by 57%. Demand for long distance rail travel has also increased with 129 million long distance journeys made in 2013/14.<sup>1</sup>
- 4.4 Demand for rail freight has also grown, with freight volumes increasing by over 60% since 1995.<sup>2</sup> In the year to March 2014 alone, the volume of freight moved by rail has grown by 5.8%.<sup>3</sup> Economic impact analysis suggests that the transport of over 100 million tonnes of goods annually by the rail freight industry, worth around £30 billion, directly contributes £870 million to the economy.<sup>4</sup> Rail freight produces 76% less carbon dioxide than road freight per tonne, with each freight train estimated to remove between 43 and 77 HGVs from the roads.<sup>5</sup>
- 4.5 Rising commuter satisfaction and improved service provision, as well as population growth and capacity constraints on other transport modes, mean both passenger and freight demand are predicted to increase further. An upper estimate of forecast growth in passenger rail journeys (passenger-miles) can be seen in Chart 4.A below.



<sup>1</sup> Passenger Journey by Sector, National Rail Trends Portal, ORR

<sup>2</sup> Value and Importance of Rail Freight, Network Rail, April 2013

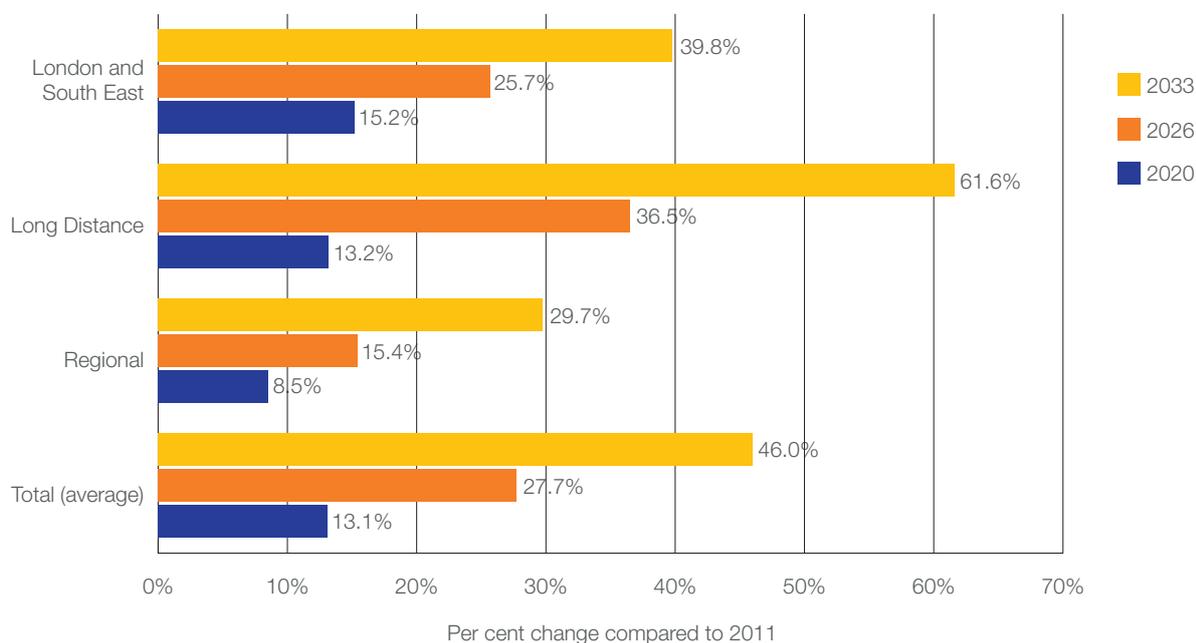
<sup>3</sup> Freight Rail Usage, ORR, May 2014

<sup>4</sup> Value and Importance of Rail Freight, Network Rail, April 2013

<sup>5</sup> *ibid*

4.6 Total freight traffic, in terms of tonne kilometres moved, is forecast to increase at an average of 2.9% per annum through to 2043.<sup>6</sup>

**Chart 4.A: Forecast of passenger miles on the rail network in Great Britain<sup>7</sup>**



Source: National Policy Statement for National Networks, Department for Transport, (forthcoming)

## Strategy

4.7 The government provides strategic direction and funding to the railways and procures franchises, key projects and in exceptional cases some targeted rolling stock. The majority of rail infrastructure investment is publicly funded (supplemented by access revenue from train and freight operating companies). It also takes targeted action on rail fares to ease the burden on consumers while ensuring that the railway remains financially sustainable.

4.8 The government's approach to the rail sector involves:

- investing in improving capacity and connectivity on the rail network and enhancing passenger experience by:
  - building new lines and making improvements to existing lines, including a rolling programme of electrification and the introduction of better signalling, to provide faster, more frequent journeys
  - enhancing and redeveloping stations
  - enabling a franchise-led programme of progressive investment in rolling stock
  - supporting growth in rail freight by strengthening the Strategic Rail Freight Network
- investing in High Speed 2, the biggest transport project for a generation, which will result in new capacity, better connectivity and quicker journeys; HS2 will link 8 of Britain's 10 largest cities, serving one in five of the UK population; it will allow more passengers to use trains and more freight operators to use rail rather than road; it will also be an engine for economic growth, generating jobs and helping to rebalance the economy between north and south

<sup>6</sup> The Freight Market Study, Network Rail, October 2013

<sup>7</sup> Estimates for demand growth by 2030, based on current GDP trend forecasts and fares policy

- investing in other major projects such as Crossrail, which will change the way that people travel around London, improving journey times across the capital, easing congestion and offering better connections; Crossrail will, for the first time, deliver a direct connection between all of London's main employment centres – linking Heathrow with Paddington, the West End, the City and Canary Wharf

## Delivery plan

- 4.9 Network Rail is the company responsible for owning, operating and managing Britain's railway network, operating under a licence enforced by the Office for Rail Regulation. In December 2013, the Office for National Statistics (ONS) announced that, following implementation of the European System of Accounts 2010 (ESA10), Network Rail Limited with all of its subsidiaries would be reclassified as a central government body. That decision took effect on 1 September 2014 and Network Rail is now a public-sector arms-length body of the Department for Transport.
- 4.10 HS2 Ltd is the company responsible for developing and promoting the UK's new high speed rail network and is wholly owned by the government.
- 4.11 Responsibility for the delivery of Crossrail belongs to Crossrail Ltd, a fully-owned subsidiary of Transport for London, which is sponsored by the Department for Transport.

## Key actions to 2020

- 4.12 The government is undertaking the largest modernisation programme for over a century.
- 4.13 Over the next 5 years it is committed to:
- overseeing £38 billion of expenditure by Network Rail in Control Period 5 (2014 – 2019) including the following enhancement projects:
    - the start of a major electrification programme including key routes such as the Great Western Line, Trans-Pennine and Midland Main Line
    - redevelopment of key stations in Birmingham, Bristol and Manchester
    - capacity improvements at key routes such as the South West and through the Northern Hub
    - beginning implementation of the European Rail Traffic Management System to improve line capacity
    - further development of the Strategic Rail Freight Network
  - ensuring Crossrail is completed on time and on budget; for further detail on Crossrail 2, see Chapter 5
  - completion of the Thameslink upgrade programme, including the redevelopment of London Bridge station and a new direct interchange with Crossrail at Farringdon
  - provision of 3,400 new rail vehicles; this includes around 2,500 for 3 major projects – new trains for the Intercity Express Programme, Thameslink and Crossrail – which are being procured by the public sector
- 4.14 The HS2 Hybrid Bill is currently going through Parliament, and has now passed Second Reading, with Royal Assent expected by the end of 2016. Phase 1 is due to start construction in 2017. This will coincide with the opening of the new National College for High Speed Rail, which will provide up to 2,000 apprentices and will be crucial in supporting the leading edge supply chain provision needed for HS2. The government will also confirm next steps on how to take forward Phase 2 in 2015.

- 4.15 A detailed timetable for all rail franchise competitions over the next 8 years has now been published by the government, and will be refreshed annually, to provide long-term certainty to the market and support major investments in the network. This can be accessed at the following address: <https://www.gov.uk/government/publications/rail-franchise-schedule>
- 4.16 In its 2012 Command Paper “Reforming our Railways, Putting the Customer First”, the Government challenged the Rail Industry to deliver savings of up to £3.5 billion by 2019 to bring it alongside its very best overseas comparators. In its Final Determination for the next Control Period (covering the years 2014 to 2019) the Office of Rail Regulation has set Network Rail the detailed efficiency targets that will achieve this. In parallel, through its franchising programme, the Department for Transport is incentivising Train Operators to deliver operational efficiencies and help drive down industry’s costs.

### Priority investments (Top 40)

- 4.17 To support delivery of its objectives for the rail sector, the government has included the following within its Top 40 priority infrastructure investments:
- Intercity Express Programme
  - European Rail Traffic Management System
  - High Speed 2
  - Strategic Freight
  - Crossrail
  - Thameslink
  - Rail Investment Strategy route programmes
  - Major Stations
- 4.18 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

### Longer term

- 4.19 Network Rail Control Period 6 will run from 2019 to 2024. It is likely that the initial industry plan will be released in Autumn 2016, with a view to a final determination by the ORR in 2018, though final timings will be confirmed in due course.
- 4.20 Phase 1 of High Speed 2 is due to open in 2026, with Phase 2 currently scheduled to complete in 2033.
- 4.21 To improve connectivity in the Midlands and the North, Sir David Higgins, Chairman of HS2 Ltd has recommended that decision making on HS2 be integrated with Network Rail’s decision making for improvements to the existing network during control period 6. The Secretary of State for Transport has commissioned HS2 Ltd and Network Rail to make recommendations before the government’s response to the Phase Two consultation. The government is also working on ways to accelerate delivery of the Phase 2 section to Crewe, pending a decision on the route in 2015.

- 4.22 The government will support the railway industry study, due to report in February 2015, which is considering the case for including electrification of the following eight routes in Network Rail's Control Period 6: Leeds – Harrogate – York, Selby – Hull, Sheffield – Leeds, Sheffield – Doncaster, East Coast Main Line – Middlesbrough, Sheffield – Manchester (including the Hope Valley Line), Warrington – Chester, Crewe – Chester.
- 4.23 The government has also given its backing to develop proposals for a new High Speed 3 rail connection for cities in the north, which could significantly reduce journey times across the region. In response to recommendations from Sir David Higgins, the government has announced the creation of a new body called Transport for the North made up of the main northern city regions. This body will work together with other authorities and stakeholders and allow the north to speak with one voice on the big decisions to benefit the region as a whole.
- 4.24 The government, working with Transport for the North, will now produce a comprehensive transport strategy for the region. This will include options, costs and a delivery timetable for a HS3 east-west rail connection. An interim report will be produced in March 2015.

### Further information

- 4.25 The infrastructure pipeline sets out details of major planned projects and programmes within the rail sector, including current status, projected construction start/completion dates and cost profiles (where available).
- 4.26 The full Network Rail Control Period 5 Delivery Plan is available at: [www.networkrail.co.uk/publications/delivery-plans/control-period-5/cp5-delivery-plan/](http://www.networkrail.co.uk/publications/delivery-plans/control-period-5/cp5-delivery-plan/)
- 4.27 Further details on delivery of HS2 and Crossrail can be found on the relevant project websites.

### Key policy and delivery milestones

2015	Manchester Victoria and Birmingham New Street station works due to be completed
	New Intercity Express Programme (IEP) plant due to be fully operational
	HS2 Phase One construction contracts due to be put out to tender and phase 1 locations due to finalise growth strategies
	Northern Electrification Taskforce Report due to be published
2016	Initial Industry Plan for Control Period 6 due to be published
	Royal Assent due to be granted for HS2 Hybrid Bill
2017	Control Period 6 High Level Output Specification due to be published
	HS2 Phase 1 construction due to start
	Crossrail tunnel and station fit-outs due to be completed and first rolling stock in use
2018	London Bridge works (Thameslink programme) due to be completed
	First InterCity Express Programme trains due to be in service on East Coast Main Line
	Office of Rail Regulation final determination on Control Period 6 due to be published
	First Crossrail services due through Central London tunnelled sections
2019	Network Rail Control Period 6 Delivery Plan due to be published and start of works
	Full Crossrail services due to be operating from Heathrow & Reading to Abbey Wood & Shenfield.

Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes. Final decisions on private-sector led projects will be taken by the project developer.



# LOCAL TRANSPORT

## Progress since 2010

Over

£1bn

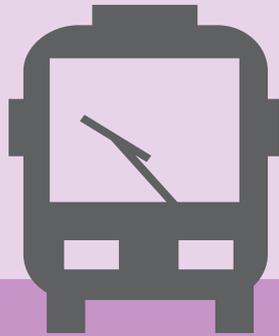
allocated to local sustainable transport projects

41

major local transport projects completed and 28 more under construction

Mersey Gateway Bridge started construction in spring 2014

Completion of the London orbital rail route, Victoria line upgrade and new trains on Circle and Hammersmith and City tube lines



Over

330

transport improvements to be supported through £3.1 billion of Local Growth Funding

41

major transport schemes to be delivered including in Nottingham, Bristol and Leeds

Mersey Gateway Bridge due to open to traffic in autumn 2017

Northern Line Extension due to start construction in 2015

## Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR LOCAL TRANSPORT £32.3BN**

**In construction £19.8bn**

**Future investment £12.5bn**

# Chapter 5:

## Local transport

### Box 5.A: Local transport announcements

- **Crossrail 2** – the government will provide £2 million between 2014-15 and 2015-16 to support the development of a comprehensive business case produced jointly by the Department for Transport and Transport for London, to complete ahead of the next Spending Review this will be combined with a full options appraisal of all potential major transport projects in London, including an extension of the Bakerloo Line to improve connectivity in South East London, and the devolution of South Eastern rail services to London
- **Cycle City Ambition grants** – as announced by the Deputy Prime Minister on 27 November, the government will provide £114 million between 2015-16 and 2017-18 to enable the continuation of the Cycle City Ambition scheme in the eight cities it already covers; this will provide capital funding for better cycle infrastructure such as segregated lanes and improved junctions
- **Clean Vehicle Technology Fund** – the government will provide up to £4 million to extend the Clean Vehicle Technology fund in 2014-15 which funds road vehicle modification by Local Authorities in order to reduce air pollution
- **Local highways maintenance grant** – the government has already announced that local highways maintenance funding will be increased, totalling £5.8 billion over the next six years, and can now announce how the formula grant will be broken down by region
- **Bath City Centre Congestion Relief** – the government welcomes the strategy put forward by Bath and North East Somerset Council and the West of England LEP to improve transport capacity East of Bath and reduce city centre congestion; the government will consider a business case, which will be developed by Bath and North East Somerset Council that assesses the viability of proposals including a park and ride, as well as a park and rail service, located to the East of Bath

### Objective

- 5.1 The government is committed to ensuring that local transport systems are tailored to the needs of local communities, allowing them to travel freely and easily and supporting jobs and growth.

## Strategy

- 5.2 Local roads, which are not part of the Strategic Road Network, are a crucial element of the overall transport system and carry the majority of non-freight road traffic. Local authorities have responsibility for managing, maintaining and making improvements to local roads in a way that best meets local needs. The government provides supporting funding for many larger enhancement and maintenance schemes.
- 5.3 In addition to this the government will be providing local authorities (in England) with £5.8 billion over the next six years for maintenance of local highways. At around £400 billion the local road network is one of the UK's most valuable infrastructure assets, and this investment will ensure that is kept in good order, preventing potholes and making journeys safer.
- 5.4 The government is now able to announce that of this funding £4.7 billion will be allocated according to a needs-based formula, with £580 million to incentivise good asset management and efficiencies, and £575 million reserved to a challenge fund for large one-off maintenance and renewal projects. Funding from the needs-based formula, before including incentive and challenge funding, will indicatively be allocated regionally as follows:
- North East – £270 million
  - North West – £630 million
  - Yorkshire and the Humber – £490 million
  - East Midlands – £540 million
  - West Midlands – £510 million
  - East of England – £640 million
  - South East – £780 million
  - South West – £850 million
- 5.5 55% of car journeys are under five miles, and many of these local trips could be made by public transport, cycling or walking. The government works with local authorities to encourage people to use these options as an alternative to cars to ease congestion whilst cutting carbon, and also provides supporting funding for larger improvements (bus stations, tram schemes). Some funding is also provided for ongoing services, including buses.

## Delivery plan

- 5.6 As set out in Chapter 2, a significant proportion of future local transport funding (including the capital element of the Local Sustainable Transport Fund) has now been incorporated into the Local Growth Fund (LGF).
- 5.7 LGF spending has been devolved to 39 Local Enterprise Partnerships (LEPs) between local authorities and businesses. The LEPs are responsible for determining local priorities, with responsibility for delivery of projects remaining primarily with local authorities.

## Key actions to 2020

- 5.8 The government has already agreed the first £6 billion of local projects through a wave of Growth Deals with LEPs. This includes the complete allocation of £2 billion from the

LGF for 2015-2016. LGF projects are expected to be matched by local investments worth around twice the contribution from the government. 332 transport improvements will be supported including:

- £44 million for the Metrolink transport system in Manchester, which will include 12 new trams, as part of a £448 million transport package in Greater Manchester including revamped stations and improved bus services
- £23 million for a new road crossing of the M4 linking Swindon to nearby Wichelstowe, creating thousands of jobs and opening up a new site for thousands of homes
- funding for Birmingham to help the city make the most of HS2 – including improving connection to the Birmingham Curzon Street station
- more than £600 million for local sustainable transport schemes

- 5.9 In addition, there are over 100 local authority major (over £5 million) transport projects where funding has been incorporated into the LGF, which are expected to be complete by 2020.
- 5.10 The government will provide support to LEPs and local authorities to improve their delivery capability through the Transport Delivery Excellence programme.
- 5.11 The government has recently consulted on a draft Cycling Delivery Plan. The plan includes a number of specific actions for the next 10 years focusing on infrastructure developments such as cycle-proofing our roads and promoting cycling and walking as alternative sustainable travel choices. The government will respond to the consultation in the new year.



## London

- 5.12 Transport for London (TfL) is the public body with standalone responsibility for the majority of the capital's transport services.
- 5.13 It has a number of major infrastructure upgrades planned, including:
- completion of major projects to rebuild Tottenham Court Road, Victoria and Bond Street stations, increasing capacity and adding step-free access
  - further projects to modernise some of the underground's busiest stations are planned for Bank, Holborn and Camden Town
  - increasing the number of trains on the Jubilee and Victoria lines up to 36 trains per hour (a train every 100 seconds) in the peak hours over the next six years
  - £4 billion investment to improve London's roads, including 17 major roads schemes and 33 junction improvements
- 5.14 The government welcomes the Crossrail 2 Funding and Financing report, completed by PWC, which was published on 27 November 2014. The proposal to build a second Crossrail line could support regeneration and help London's transport network to support long term growth by addressing crowding and offering more direct, fast, frequent services that are not available at present. The Funding and Financing report shows that a significant local contribution to the costs of Crossrail 2 is possible, although genuinely private sources of funding are limited. As with all government spending, the government would need to consider affordability and a business case for Crossrail 2 before making a decision to proceed. In response to the report, the government will provide £2 million between 2014-15 and 2015-16 to support the development of a comprehensive business case produced jointly by the Department for Transport and Transport for London, to complete ahead of the next Spending Review. This will be combined with a full options appraisal of potential major transport projects in London, including an extension of the Bakerloo line and the devolution of South Eastern rail services to London.
- 5.15 Construction of the Northern Line Extension to Battersea is due to start construction in 2015. The extension will improve transport links and public spaces in the area and is essential to support the transformation of Vauxhall, Nine Elms and Battersea, a designated regeneration area on the South Bank. The project could support up to 25,000 jobs and creation of 16,000 new homes.
- 5.16 TfL has consulted recently on options for a new river crossing in East London, with options including crossings at Woolwich, Gallions Reach and Belvedere. An interesting proposal made by Sustrans, and worth looking at in more detail, would be a new pedestrian and cycle bridge from Rotherhithe to Canary Wharf – which could be called the Brunel Bridge in tribute to one of the great figures in the history of UK infrastructure

## Priority investments (Top 40)

- 5.17 To support delivery of its objectives for the local transport sector, the government has included the following within its Top 40 priority infrastructure investments:
- Local Transport Major Schemes
  - Mersey Gateway Bridge
  - Transport for London Major Schemes
  - Northern Line Extension

5.18 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

### Longer term

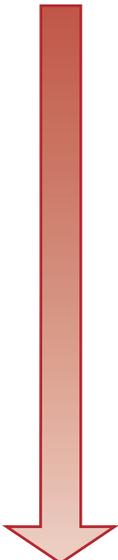
5.19 The government has confirmed availability of a Local Growth Fund of at least £12 billion until 2020-21. It remains committed to the localism agenda and will continue to consider ways in which it can give local areas more control to influence the local growth and infrastructure funding that affects them.

### Further Information

5.20 The infrastructure pipeline sets out details of major planned projects and programmes within the local transport sector, including current status, projected construction start / completion dates and cost profiles (where available).

5.21 Further details of projects funded through Growth Deals can be found here: <http://maps.dft.gov.uk/local-growth-deals/>

### Key policy and delivery milestones

	2015	<p><b>Top 40 key project starts due:</b> Norwich Northern Distributor Road, Sunderland Strategic Corridor (New Wear Crossing). Northern Line Extension also due to start</p> <p><b>Top 40 key project completions due:</b> Nottingham NET2, Midland Metro, Kingskerswell Bypass</p> <p>Start of Local Growth Fund projects</p>
	2016	<p><b>Top 40 key project completions due:</b> Heysham to M6 Link Road</p>
	2017	<p><b>Top 40 key project starts due:</b> Leeds New Generation Transport</p> <p><b>Top 40 key project completions due:</b> Norwich Northern Distributor Road and Sunderland Strategic Corridor (New Wear Crossing). Mersey Gateway Bridge open to traffic</p>
	2018	
	2019	
	2020	<p><b>Top 40 key project completions due:</b> Leeds New Generation Transport. Northern Line Extension also due to complete</p>

Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes. Final decisions on private-sector led projects will be taken by the project developer.

# AVIATION

## Progress since 2010

- Opening of new Heathrow Terminal 2
- 
- 
- 

- First planes took off from extended runway at Birmingham Airport
- 
- 
- 

Completion of

£164m

- programme to replace the NATS en-route radar network
- 
- 



- Final Airports Commission report due in summer 2015
- 
- 
- 

£6.1bn

- of private-sector aviation investment in the pipeline
- 
- 

- Better road links to support airports including the M42 in Birmingham and A6 in Manchester
- 
- 

Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR AVIATION £6.1BN**

**In construction £5.7bn**

**Future investment £0.4bn**

# Chapter 6:

# Aviation

## Objectives

6.1 The government seeks to ensure that the UK:

- has sufficient airport capacity to meet current and forecast need
- remains one of the best connected countries in the world via its air links
- maintains its aviation hub capability

## Needs

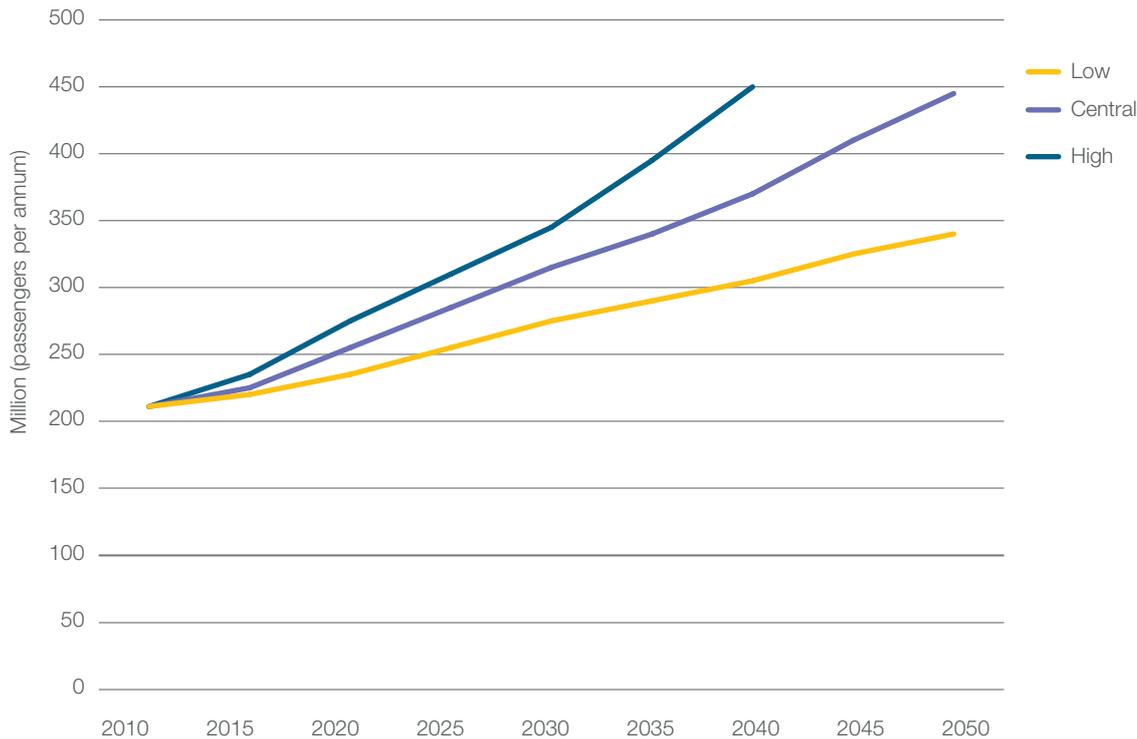
6.2 Air transport has a key role in supporting long-term economic growth, with the aviation sector contributing around £18 billion per annum of economic output to the economy and employing 220,000 people directly.<sup>1</sup> During 2013, UK airports handled 228 million passengers providing access to over 360 destinations worldwide.<sup>2,3</sup>



<sup>1</sup> Aviation Policy Framework, Department for Transport, March 2013

<sup>2</sup> Civil Aviation Authority statistics, March 2014

<sup>3</sup> Aviation Policy Framework, Department for Transport, March 2013

**Chart 6.A: Forecast of terminal passengers at UK airports, 'max use' capacity scenario**

Source: DfT, UK Aviation Forecast, Jan 2013

- 6.3 Demand for air travel is forecast to increase within the range of 1% to 3% a year up to 2050.<sup>4</sup> Low, central and high forecasts for passenger numbers at UK airports, taking into account the impact of capacity constraints, are shown in Chart 6.A.
- 6.4 With rising demand for air travel, the UK's airports face a capacity and connectivity challenge. Heathrow Airport – one of the busiest airports in the world – has operated at almost 98% capacity in 6 of the last 10 years and other major South East airports are forecast to reach full capacity between 2025 and 2030 under certain scenarios.<sup>5</sup>

## Strategy

- 6.5 Aviation in the UK is largely privately owned and managed, and the government believes that a competitive aviation market is the most effective way to meet the interests of air passengers and other users. The government's role is primarily to uphold a strong international and domestic regulatory framework which ensures a level playing field and the maintenance of high standards of safety and security. Within this framework the Civil Aviation Authority is responsible for regulating airports which pass a market power test under the Civil Aviation Act 2012 (currently Heathrow and Gatwick).
- 6.6 In order to ensure that the UK is well placed to maintain its aviation hub capability, the government has appointed an independent Airports Commission to examine the scale and timing of airport capacity needs in the South East and to identify how they should be met. The Commission has been asked to assess the options for meeting the UK's international connectivity needs, and recommend the optimum approach to meet those needs.
- 6.7 The government also recognises the importance of maximising the capacity and connectivity of existing airport infrastructure. This includes:

<sup>4</sup> UK Aviation Forecasts, Department for Transport, January 2013

<sup>5</sup> Airports Commission: Interim Report, Airports Commission, December 2013

- encouraging ongoing programmes of private investment at airports across the UK
  - optimising existing capacity through the adoption of innovative operational approaches and new technology
  - taking action to improve the quality of surface transport links to existing airports
- 6.8 The government is also taking action to maintain regional air access to London where there is the probability that an existing service would be lost, and to allow start-up aid for new routes from UK regional airports handling fewer than 5 million passengers per annum, in order to underpin the role of aviation in promoting local growth and connectivity.
- 6.9 Across all these measures, the government's policy is to manage the environmental impact of aviation including limiting and, where possible, reducing the number of people in the UK significantly affected by aircraft noise.

## Delivery plan

- 6.10 There is significant private-sector investment planned to improve capacity at airports across the UK between now and 2020. The government will also be taking action to support better use of existing airport capacity and, through the Airports Commission, to ensure future needs are met.

### Key actions to 2020

- 6.11 The Airports Commission has now published its interim report and is currently consulting on its assessment of proposals for additional runway capacity at Gatwick and Heathrow airports. The Commission will publish its final report in summer 2015. The Commission's analysis will be used to inform government decisions in summer 2015 on future airport capacity in the South East which will include how powers for any new runway could be delivered.
- 6.12 The government will continue to take action to make better use of existing airport capacity, including through a package of surface access measures for international gateways:
- the new Roads Investment Strategy includes plans for a comprehensive upgrade of the M42 Junction 6 near Birmingham airport, allowing better movement of traffic on and off the A45, supporting access to the airport and preparing capacity for the new HS2 station
  - Western Rail Access to Heathrow, to provide a direct service from Reading, will commence enabling works in 2017, subject to feasibility
  - Network Rail is producing a feasibility study into options on Southern Rail Access to Heathrow, to report its findings in 2015
  - Network Rail is consulting on extending the scope of the East Anglian Mainline study to include access to Stansted and will report findings in 2015
  - Network Rail is looking at capacity on the Brighton Mainline as part of the Route Study for Sussex on which it is currently consulting
- 6.13 In total, there is £6.1 billion of planned investment in UK airports and air traffic control in the pipeline between now and the end of the decade. Both Heathrow and Gatwick, regulated by the Civil Aviation Authority, have significant investment plans as part of the sixth quinquennium regulatory period which started on 1 April 2014 for both airports, and will run until 31 December 2018 for Heathrow and until 31 March 2021 for Gatwick.

A number of other privately-owned airports are also expected to bring forth investments to improve capacity on a commercial basis.

**Priority investments (Top 40)**

6.14 To support delivery of its objectives for the aviation sector, the government has included the following within its Top 40 priority infrastructure investments:

- Airport Infrastructure Improvements
- Airport Connectivity (see also ports)

6.15 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

**Longer term**

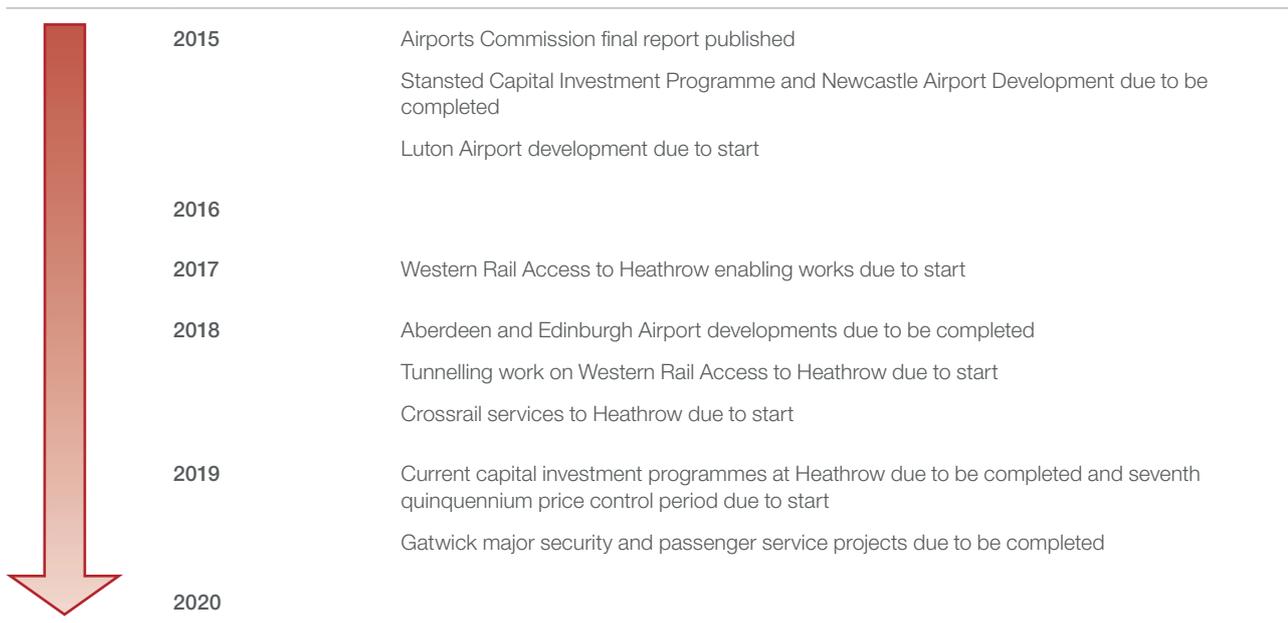
6.16 The Airports Commission has focused primarily on recommendations to meet capacity constraints that are forecast to emerge by 2030. However, the Airports Commission has also indicated that there is likely to be a demand case for a second additional runway in operation by 2050 or, in some scenarios, earlier. It is currently carrying out further analysis on this issue in the second phase of its work programme, including looking at the implications for any future capacity. This will enable it to make recommendations to government in its final report as to when, how and by whom the case for a second new runway should be considered.

**Further information**

6.17 The infrastructure pipeline contains details of major planned projects and programmes within the aviation sector, including current status, projected construction start/completion dates and cost profiles (where available).

6.18 Further details on the work of the Airports Commission can be found at: [www.gov.uk/government/organisations/airports-commission](http://www.gov.uk/government/organisations/airports-commission)

**Key policy and delivery milestones**



Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes. Final decisions on private-sector led projects will be taken by the project developer.



# PORTS

## Progress since 2010

More than  
**3m**  
TEU of new  
container port  
capacity opened

London Gateway  
open for business –  
the UK's largest new  
port for many  
decades

Major projects  
delivered at  
Belfast,  
Southampton and  
Felixstowe



Over  
**£1bn**  
of private-sector  
investment in  
major ports  
projects in the  
pipeline

Further developments  
at Dover, Liverpool,  
Hull and other ports

Better road links to  
major ports including  
the A5036 to  
Liverpool, A14 to  
Felixstowe and  
A160/A180 to  
Immingham

Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR PORTS £1.2BN**

**In construction £1bn**

**Future investment £0.2bn**

# Chapter 7:

## Ports

### Objectives

- 7.1 The government seeks to ensure sustainable port development that will cater for long-term forecast growth in volumes of imports and exports by sea.

### Needs

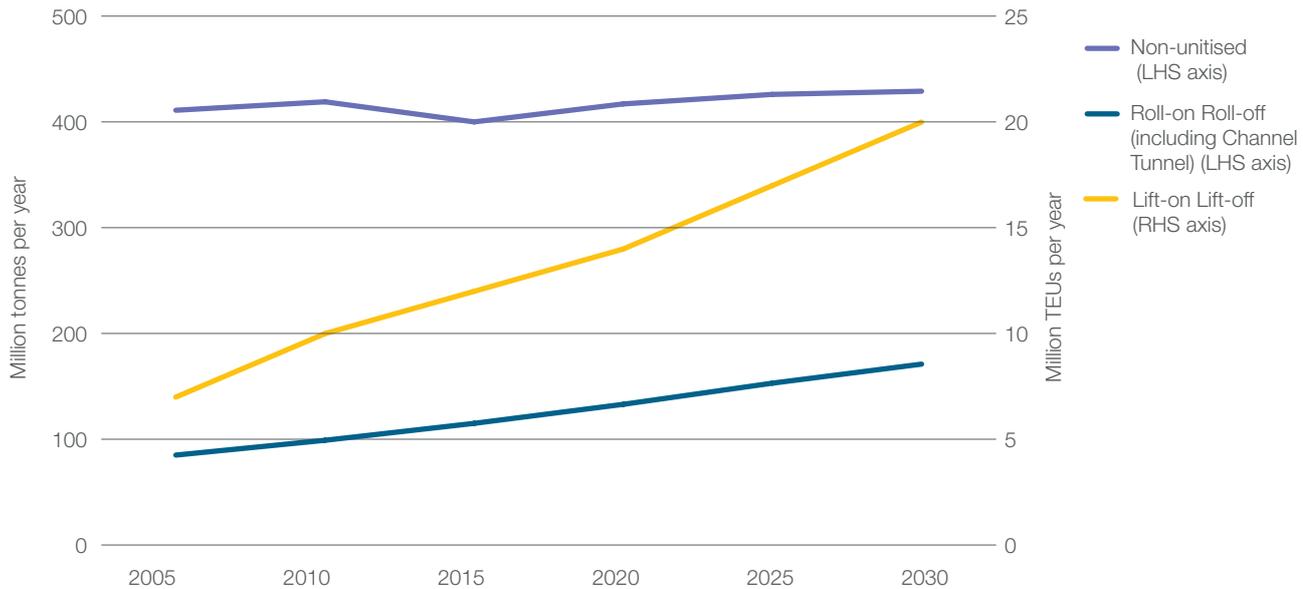
- 7.2 As an island economy, shipping provides the most effective way to move the vast majority of freight and bulk commodities in and out of the UK. The provision of sufficient port capacity will remain an essential element in ensuring sustainable growth in the UK economy.
- 7.3 There are approximately 120 commercial ports in the UK<sup>1</sup> and the UK handles the largest amount of freight in Europe in terms of tonnage. Ports in England and Wales handle around 95% of all goods in and out of the UK by volume. Freight traffic through UK ports has increased by three-quarters in the last 40 years.<sup>2</sup> Estimates suggest that the ports sector contributed approximately £7.9 billion to UK GDP in 2011.<sup>3</sup>
- 7.4 Future need for port infrastructure depends on overall demand for port capacity. In 2007 the Department for Transport published demand forecasts up to 2030. The results are shown in Chart 7.A.

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<sup>1</sup> UK Major Ports Group

<sup>2</sup> National Policy Statement for Ports, Department for Transport, February 2012

<sup>3</sup> The economic impact of the UK Maritime Services Sector: Ports, Oxford Economics, February 2013

**Chart 7.A: Forecast of port traffic in Great Britain**

Source: MDS Transmodal Ltd., Update of UK Port Demand Forecasts to 2030 & Economic Value of Transshipment Study, July 2007  
TEUs stands for Twenty-foot Equivalent Unit – a standard measure for container handling capacity

- 7.5 The department has commissioned fresh forecasts which will reflect changes in port freight demand following the global financial crisis and a further update is expected in spring 2015.
- 7.6 Ports also have an important part to play in the import and export of energy supplies, including coal, oil, liquefied natural and petroleum gas, and biomass. In particular, ports will have a crucial role in supporting the installation, operation and maintenance of offshore wind facilities.

## Strategy

- 7.7 The ports sector consists of a mixture of company, trust and municipal ports, which operate independently of government, on commercial principles. The government believes that the best way to achieve its objectives is to facilitate a competitive and efficient port industry, allowing judgements about when and where new developments are proposed to be made on the basis of commercial factors. However, the government has established a strategic partnership with the ports industry to provide a cohesive platform for future development. This includes taking action to improve surface access to and from ports where appropriate.

## Delivery plan

7.8 The private sector operates 15 of the largest 20 ports by tonnage and around two-thirds of the UK ports' traffic. Development of capacity will therefore be driven largely by private investment.

### Key action to 2020

- 7.9 The pipeline includes £1.2 billion of planned investment in major ports projects, from renewals to expansions between now and the end of the decade. For example:
- the Port of Felixstowe is on target to deliver a container handling capacity of 6 million TEUs a year by 2020 (and could deliver an additional 2 million TEUs<sup>4</sup> in the Harwich Haven by 2030)
  - Green Port Hull is planned to be operational in early 2016. The start of production at the blade factory is scheduled to be in the middle of 2016 with full production levels reached from mid-2017 onwards
  - Dover Port redevelopment of the Western docks
  - a programme of capital investment by Associated British Ports across its portfolio
- 7.10 The government will continue to support the development of international gateways by improving connectivity through measures on surface access. These include the A503 development to improve access to the Port of Liverpool, the A63 (Castle-street) at Hull, the A14 serving Felixstowe, and various rail gauge clearance and path improvements.
- 7.11 Infrastructure UK is working with Atlantic Gateway to facilitate the delivery of critical infrastructure projects in the North West.

### Priority investments (Top 40)

- 7.12 To support delivery of its objectives for the ports sector, the government has included the following within its Top 40 priority infrastructure investments:
- Container Port Capacity
  - Ports Connectivity (see also airports)
- 7.13 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

### Longer term

- 7.14 If completed as planned, the private-sector container terminal projects already granted development consent since 2005 would together provide sufficient aggregate container capacity to meet forecast demand at national level for at least the next 20 years.
- 7.15 The government has also left open the possibility for other developers to bring forward proposals for additional developments that satisfy demand that these consented developments are not meeting, as well as a continuing requirement for further new container capacity to meet expected longer term growth.

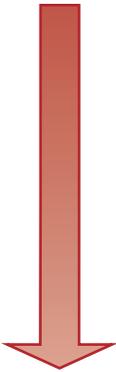
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<sup>4</sup> Twenty-foot Equivalent Unit

## Further information

7.16 The infrastructure pipeline contains details of major planned projects and programmes within the ports sector, including current status, projected construction start/completion dates and cost profiles (where available).

## Key policy and delivery milestones

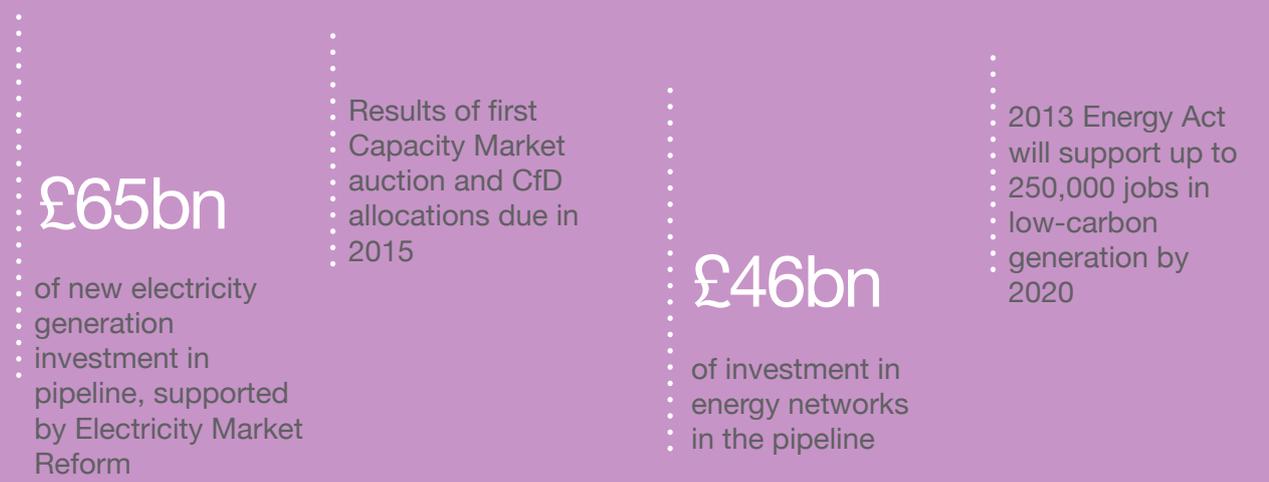
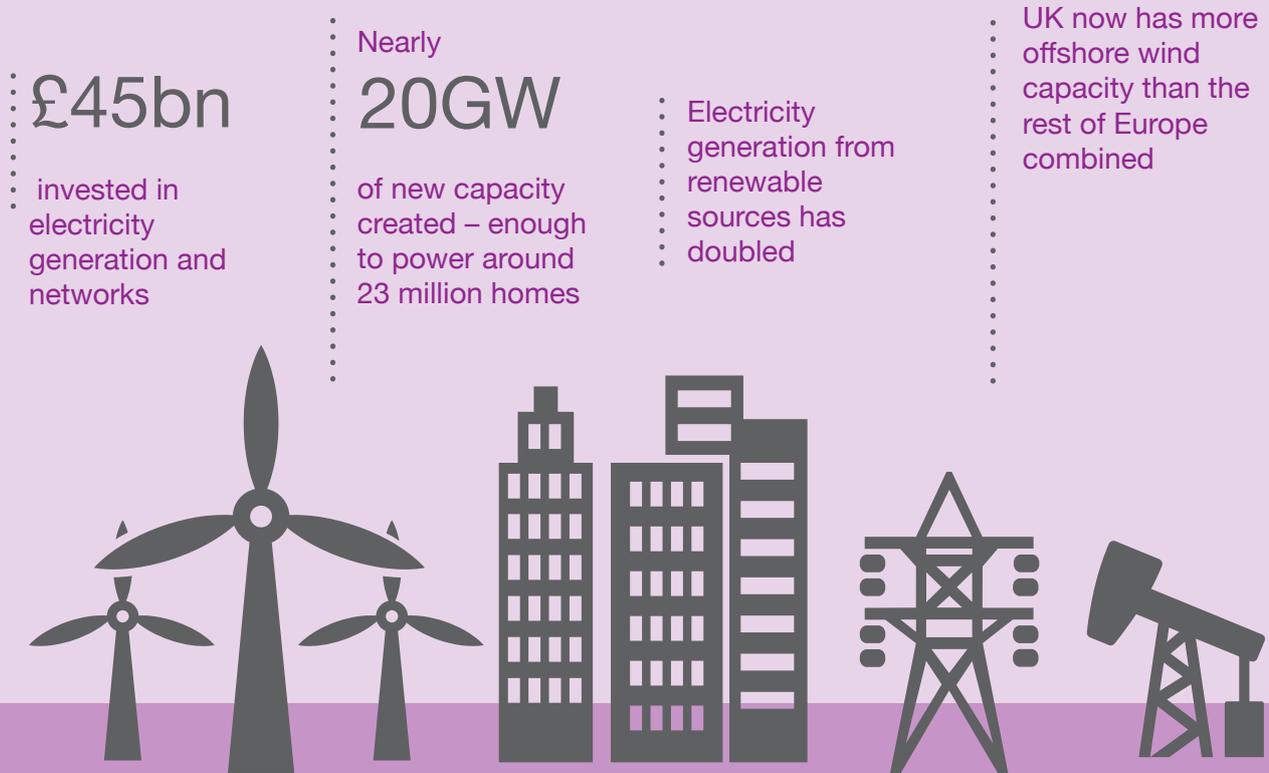
	2015	New DfT forecasts on freight demand for ports due to be published Liverpool 2 development due to be completed Port of Dover Western Docks development due to start construction Felixstowe South development due to be completed
	2016	
	2017	Teesport development due to be completed Green Port Hull wind turbine manufacturing site due to be completed
	2018	
	2019	
	2020	Port of Dover Western Docks development due to be completed

Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes. Final decisions on private-sector led projects will be taken by the project developer.



# ENERGY

## Progress since 2010



Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR ENERGY £274.9BN**

**In construction £194.7bn**

**Future investment £80.2bn**

# Chapter 8:

## Energy

### Box 8.A: Announcements in energy

- **Interconnectors** – the government will ensure that interconnectors can participate in the 2015 capacity auction, estimating the eligible capacity of each interconnector on a case-by-case basis
- **Swansea Tidal Lagoon** – the government remains committed to achieving its low carbon energy goals through the deployment of a range of technologies; it believes there may be significant tidal lagoon potential in the UK which is why DECC has started to explore the potential for a future lagoon programme; the government will start closer discussions with Tidal Lagoon Power Ltd to establish whether a potential tidal lagoon project at Swansea Bay is affordable and value for money for consumers (without prejudice to the planning decision on the project); if the project were to progress it could become the first tidal lagoon project in the world
- **Moorside** – HM Treasury has reached a cooperation agreement with Toshiba, GDF Suez and NuGen with the aim of issuing a statement of intent to provide a guarantee to assist the financing of a new nuclear power plant at Moorside, subject to due diligence and ministerial approval

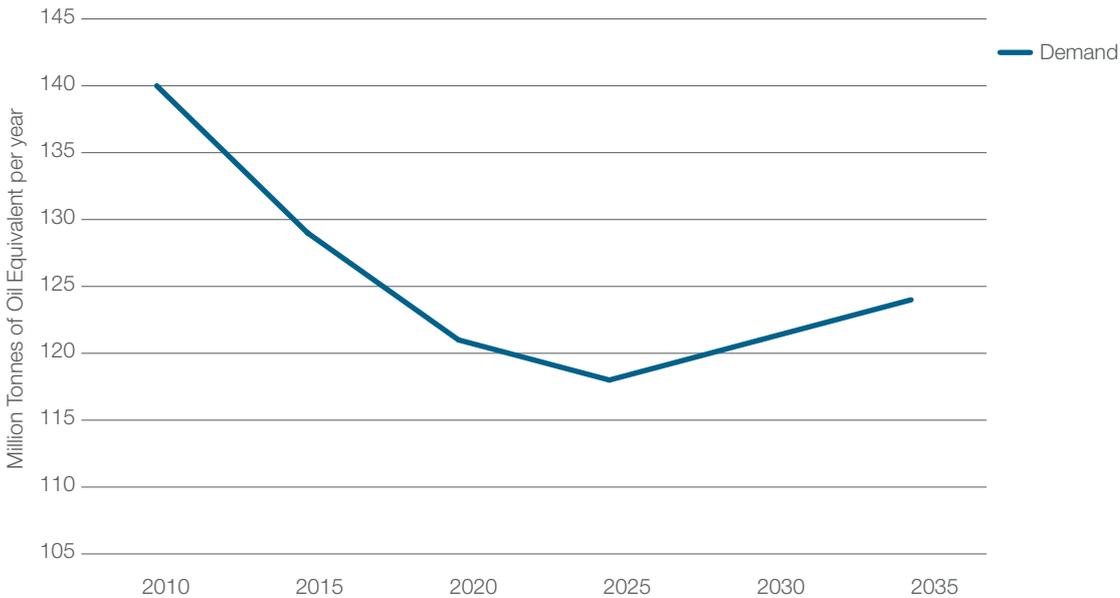
### Objectives

- 8.1 The government seeks to support the level and type of energy infrastructure investment and behavioural change required to:
- ensure power, heat and transport are affordable for households and businesses
  - provide energy security to facilitate day-to-day activities and support economic growth
  - reduce carbon emissions in order to mitigate climate change and meet its legally-binding targets

## Needs

8.2 Energy underpins the operation of a successful economy and allows other infrastructure networks to function, generating further economic growth. Overall energy demand, while difficult to predict, is expected to continue its general downward trend up until 2025. After this, demand is forecast to rise as the impact of existing policies declines. This is because, in the absence of policy intervention, trend improvements in energy efficiency and the impact of fossil fuel prices are insufficient to offset the impact of economic and population growth.<sup>1</sup> Projected final energy demand is shown in Chart 8.A.

**Chart 8.A: Energy demand by final users, UK**



Source: Updated energy and emissions projections 2014, DECC, September 2014  
Excludes international aviation

- 8.3 Large-scale investment in gas and low-carbon electricity generation is vital in order to replace ageing energy infrastructure, maintain secure energy supplies and meet legally-binding environmental targets. Around £100 billion of investment is estimated to be required in electricity generation and networks by 2020.<sup>2</sup>
- 8.4 National Grid and Ofgem project that current electricity generation capacity will reduce until the middle of the current decade.<sup>3</sup> In total, a fifth of our existing power stations are scheduled to close by 2020 because they are old, inefficient or polluting.
- 8.5 As legacy coal, gas and nuclear power stations come off line, they will increasingly be replaced with a combination of renewable energy, new nuclear power and fossil fuel power stations fitted with Carbon Capture and Storage (CCS) technology. New gas plant is also needed as a vital backup for less flexible renewable generation and to ensure that the system can meet peak electricity demand. Demand for gas to supply heat to homes and businesses will also remain significant for some time to come.

<sup>1</sup> Updated energy and emissions projections 2014, DECC, September 2014

<sup>2</sup> Implementing Electricity Market Reform, DECC, June 2014

<sup>3</sup> Electricity Capacity Assessment, Ofgem, June 2014

8.6 There is also significant opportunity for greater energy efficiency in the UK. Analysis suggests that there may be potential for up to 32 terawatt hours of electricity savings in 2030 (or around 9 % of estimated total demand).<sup>4</sup>

## Strategy

- 8.7 There are three key elements to UK energy infrastructure: oil and gas production; electricity generation; and transmission and distribution through gas and electricity networks. In addition, the government is committed to investment in improved energy efficiency to reduce demand. In all these areas, investment is primarily planned and delivered by the private sector.
- 8.8 In the case of gas and electricity transmission and distribution, independent economic regulation ensures value for money for consumers. Ofgem sets the levels of return which the monopoly network companies can make through a price control process. For electricity transmission, the government and Ofgem have introduced a competitive tender process for the delivery of offshore connections, and Ofgem has recently consulted on proposals to extend a similar approach to certain onshore assets. By upholding a robust system of economic regulation, the government provides companies with the confidence they need to invest in maintaining and developing the country's networks.
- 8.9 In other areas, the government believes that the best way to ensure value for consumers and taxpayers is through the operation of a liberalised energy market. However, within this framework, the government recognises the value of targeted intervention where necessary to achieve the scale and pace of change required to meet overall energy objectives. The government has therefore taken targeted action in the following areas:
- introducing a Levy Control Framework, which sets the aggregate amount that can be levied from consumers by energy suppliers to implement government policy, supporting investment and ensuring bill payers are protected; the government is also committed to being transparent about the costs of levies on bills and publishes an annual report showing their impact on household and business energy bills
  - legislating for Electricity Market Reform, which is designed to minimise costs while also delivering investment, key elements of which include:
    - the Capacity Market, which provides steady payments to providers (both demand and supply side) in return for the delivery of capacity when needed
    - Contracts for Difference (CfDs), which are long-term, legally-binding agreements to stabilise prices for low-carbon plant, providing the policy certainty required to underpin investment and making renewable energy cheaper for consumers by delivering that investment at a lower cost of capital
  - taking steps to support the maximum economic production of remaining reserves in the UK Continental Shelf (UKCS) and exploit new opportunities for shale gas production
  - actively pursuing a significant increase in electricity interconnection capacity to ensure the UK has access to the imports it needs

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<sup>4</sup> Implementing Electricity Market Reform, DECC, June 2014

- 8.10 The government is also taking measures to ensure energy markets are competitive, including through an annual assessment of the state of competition in energy markets. Following the first of these, the energy market has been referred to the Competition and Markets Authority (CMA) for investigation.
- 8.11 The government is committed to minimising the UK's energy needs through the introduction of measures to improve energy efficiency and reduce demand. As set out in the government's Energy Efficiency Strategy, this includes:
- expanding choice and support for households through the introduction of the Green Deal and Energy Company Obligation (ECO)
  - requiring suppliers to roll out smart electricity and gas meters to all households and small non domestic sites by the end of 2020 to put consumers in control of their energy consumption
  - ensuring that both UK businesses and the public sector have access to the support and information they need to install cost-effective energy efficiency measures
  - mobilising investment in the green economy through the Green Investment Bank, which has energy efficiency as one of its key priorities

## Delivery plan

- 8.12 The government's plan for energy infrastructure will be delivered through private-sector investment, supported by government in line with the policy framework set out above.

### Key action to 2020

#### Electricity generation

- 8.13 Annual levy caps for the total projected costs of schemes within the Levy Control Framework (LCF) have been set to 2020-21.

**Table 8.1: Levy Control Framework annual limits (£ million, 2011-12 prices)**

2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
4,300	4,900	5,600	6,450	7,000	7,600

Source: HM Treasury

- 8.14 The infrastructure pipeline includes a total of £65 billion of mixed energy generation investment by the private sector between now and 2020-21. The overall investment assumptions around low-carbon technologies in the pipeline take into account the LCF limits set out above.
- 8.15 Investment Contracts (an early form of Contract for Difference) have been awarded under the Final Investment Decision Enabling for Renewables process, which is expected to unlock up to £12 billion of investment backed and over 4.5GW of renewables generation capacity.
- 8.16 The contract allocation process under the enduring CfD regime is currently underway, and successful applicants will be notified that they have been awarded contracts early in 2015. The budget for the first CfD allocation round is now £300 million, to be allocated via a competitive auction process to drive value for consumers. The government has held back a significant part of the budget for future allocations within the Levy Control Framework cap.

- 8.17 The government has confirmed that it will seek to procure 48.6GW in the capacity market auction in December 2014. All capacity has to be available from October 2018 for one year, with further auctions held for future delivery years on a rolling basis.
- 8.18 In the nuclear sector, the government and EDF are working together to finalise the Hinkley Point C plant, including the full CfD terms and financing arrangements for the project, which includes support from a UK Guarantee. Progress on Wylfa Newydd continues as the advanced boiling water reactor which Hitachi and Horizon have proposed for this site moves through the Generic Design Assessment, with completion of the process expected in 2017. HM Treasury has also reached a cooperation agreement with Toshiba, GDF Suez and NuGen with the aim of issuing a statement of intent to provide a guarantee to assist the financing of a new nuclear power plant at Moorside, subject to due diligence and ministerial approval.
- 8.19 The government is actively pursuing a significant increase in electricity interconnection to support security of supply, and a robust pipeline of projects is in place which could more than double our capacity by the 2020s.
- 8.20 In recognition of their contribution to security of supply and affordability, the government will ensure that interconnectors can participate in the 2015 capacity auction. This will enable the widest possible range of resources to compete to deliver the capacity we need to ensure the security of our electricity supply in future. It should strengthen the case for the development of further interconnectors linking Great Britain with other electricity markets and could contribute to around £5 billion of private sector investment to 2020,



with savings to consumers of up to £9 billion over the longer term.<sup>5</sup> Interconnectors will participate on the basis of a calculation of de-rated capacity which reflects the individual circumstances of each interconnector, based on an assessment of likely future direction of electricity flows between interconnected markets, and technical reliability, at times of system stress. The government will provide a full response to the policy consultation in January 2015 which will set out the details of the methodology to be used for de-rating.

- 8.21 Ofgem has introduced a new ‘cap and floor’ regulatory regime to bring forward interconnector investment and 5 projects are already being assessed. This is in addition to the NEMO interconnector to Belgium which piloted the regime, and the ElecLink interconnector to France which received regulatory approval to proceed as a merchant project this summer. Subject to progress with the regulatory settlement between Ofgem and the developers (Statnett and National Grid), a final investment decision on the NSN electricity interconnector project, is also expected in early 2015. The project, which would link the UK and Norway, would be the longest sub-sea electricity interconnector in the world.

### Oil and gas

- 8.22 The pipeline includes £53 billion of planned investment within the oil & gas sector between now and 2018-19.
- 8.23 The government is committed to ensuring that the UK Continental Shelf attracts the right investment and has the right infrastructure in place to maximise economic recovery as the basin matures. The UKCS has recently seen record investment of £14.4 billion in 2013, £7 billion of which was directly incentivised by the government’s field allowances. Building on Sir Ian Wood’s ‘UKCS Maximising Recovery Review’, the government has been considering interactions between the tax system and strong asset stewardship as part of the review of the oil and gas fiscal regime to ensure we maximise the benefits of our existing infrastructure. The initial conclusions of the review will be published at Autumn Statement.

### Electricity and gas transmission and distribution

- 8.24 RIIO (Revenue = Incentives + Innovation + Outputs) is Ofgem’s new performance-based model for setting network company price controls, lasting for eight years. Ofgem completed the first price control reviews to use the RIIO framework in early 2013: RIIO-T1 for gas and electricity transmission and RIIO-GD1 for gas distribution. The final determination for the RIIO-ED1 price control for electricity distribution was published in November 2014. This will set expenditure to 2022-23.
- 8.25 The pipeline includes £8 billion of planned capital investment in gas transmission and distribution and £38 billion in electricity transmission and distribution to 2020-21 including offshore transmission and interconnectors. This is consistent with the final determinations for RIIO-ET1, RIIO-GD1, RIIO-GT1 and the draft determination for RIIO-ED1 and adjusted for current DECC modelling on network requirements.

### Energy efficiency

- 8.26 Energy suppliers will be responsible for replacing over 53 million gas and electricity meters with Smart Meters by 2020. This will involve visits to 30 million homes and small businesses.

<sup>5</sup> According to analysis carried out on behalf of the Department of Energy and Climate Change: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/266307/DECC\\_Impacts\\_of\\_further\\_electricity\\_interconnection\\_for\\_GB\\_Redpoint\\_Report\\_Final.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266307/DECC_Impacts_of_further_electricity_interconnection_for_GB_Redpoint_Report_Final.pdf)

8.27 The government is also testing whether projects that deliver lasting electricity savings at peak times, for example by replacing old bulbs with LEDs or improving motors and pumps, could in future compete in Capacity Market auctions. The first Electricity Demand Reduction Pilot auction is for up to £10 million and is being held in January 2015. Subject to the outcome a further auction may follow. The total budget for the EDR Pilot is at least £20 million.

### Priority investments (Top 40)

8.28 To support delivery of its objectives for the energy sector, the government has included the following within its Top 40 priority infrastructure investments:

- electricity generation – nuclear (including Hinkley Point C)
- electricity generation – gas
- electricity generation – wind
- electricity generation – other renewables (biomass, solar, marine)
- electricity interconnection
- Carbon Capture and Storage
- energy transmission and distribution
- oil and gas production (including shale gas)
- Smart Meters

8.29 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

### Longer term

8.30 £80 billion of the energy generation investment in the pipeline is planned for beyond 2020-21. While there remains ongoing demand to build new power generating capacity up to 2030 and beyond to meet our energy needs, the exact technology mix will depend on a number of factors including demand, affordability and progress towards our decarbonisation targets.

8.31 Within that context, the government has secured an ambitious but flexible deal on European Union emissions targets which will cut greenhouse gas emissions by at least 40% within the EU by 2030. This will allow the UK to decide how to decarbonise at least cost to consumers, while also improving energy security by reducing EU reliance on imported energy.

8.32 In the long term, the government's strategy for the electricity market envisages a transition to a market where low carbon technologies can compete fairly on price, with a decreasing role for the Government over time. The government is taking steps now to support the development of less mature low-carbon technologies, which are expected to play a bigger role post 2020. For example:

- to help develop and commercialise wave and tidal technologies, the UK has put in place the most comprehensive marine energy support programme in the world, including protecting revenue support for 100MW of wave and tidal stream projects

- the government will also start closer discussions with Tidal Lagoon Power Ltd to establish whether a potential tidal lagoon project at Swansea Bay is affordable and value for money for consumers (without prejudice to the planning decision on the project); if the project were to progress it could become the first tidal lagoon project in the world
- supporting the development of Carbon Capture and Storage (CCS) through the ongoing £1 billion commercialisation competition and a £125 million 4-year co-ordinated research, development and innovation programme; the government is also now seeking views on phase 2 of CCS

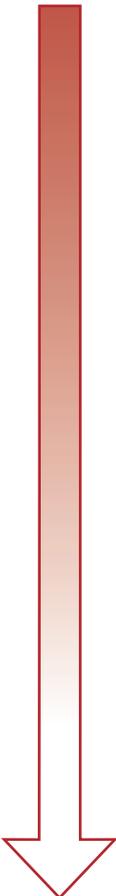
8.33 The government also anticipates significant deployment of new nuclear power through the 2020s with Nuclear New Build (NNB) Generation Company, Horizon and NuGen setting out plans to develop around 16GW of new capacity.

### Further information

8.34 The infrastructure pipeline sets out details of major planned projects and programmes within the energy sector, including current status, projected construction start/completion dates and cost profiles (where available).

8.35 Further details on the delivery plan for Electricity Market Reform can be found at <https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform>

### Key policy and delivery milestones

	2015	Results of first enduring CfD regime allocation round and Capacity Market Auction due Beaulieu-Denny Line (electricity transmission) due to be completed Nemo, NSN and ElecLink interconnector project final investment decisions due Smart Meter installation phase and 8-year RIIO-ED1 electricity distribution price control due to start
	2016	Hinkley Point C due to start construction Dudgeon (offshore wind) and Burbo Bank Extension (offshore wind) due to start construction Carrington (CCGT) and Ferrybridge (Biomass) projects due to be completed Westernmost Rough and Humber Gateway OFTOs due to be in operation
	2017	Further (T-I) Capacity Market Auction for 2018-19 capacity Western Coast Link (electricity transmission) due to be completed Pen Y Comoedd (onshore wind) and Drax (Biomass conversion) due to be completed
	2018	Capacity from first Capacity Market auction to be available for at least one year from October Beatrice (offshore wind) and Walney projects (offshore wind) due to start construction Dudgeon (offshore wind) and Burbo Bank Extension (offshore wind) due to be completed Horizon Wylfa (nuclear) final investment decision due NuGen Moorside (nuclear) final investment decision due
	2019	Hornsea (offshore wind) due to start construction Tees Renewable Energy Plant (Biomass) due to be completed NEMO interconnector (subject to final investment decision) due to be completed
	2020	Smart Meter rollout to over 30 million premises due to be completed

Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes. Final decisions on private-sector led projects will be taken by the project developer.



# FLOODS

## Progress since 2010

More than

500

flood and coastal erosion defence improvement projects completed

Major flood schemes completed in Essex, Lincolnshire, Weston-super-Mare, and Nottingham

Nearly

160,000

homes protected to date...

...and on track to deliver target of 165,000 by the end of the Parliament



£2.3bn

capital investment committed helping to avoid more than £30 billion in economic damages

Improved protection for at least 300,000 homes

Investment in more than

1,400

schemes

10%

efficiency savings planned across the investment period

Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR FLOODS £3.7BN**

**In construction £1.9bn**

**Future investment £1.8bn**

# Chapter 9:

## Floods and coastal erosion

### Box 9.A: Announcements on flooding and coastal erosion

- The government has published its 6-year programme of investment in flood defences, allocating the £2.3 billion capital funding provided at the 2013 Spending Round

### Objectives

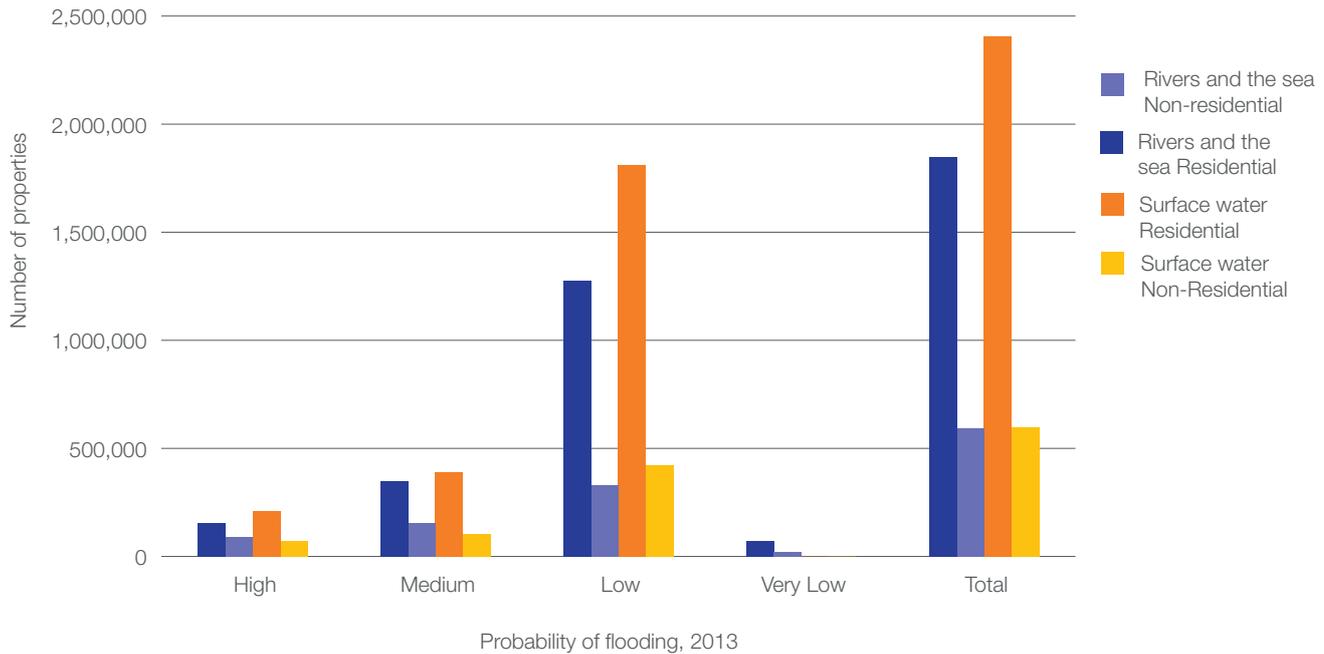
- 9.1 The government's priority is to reduce the risks of flooding and coastal erosion and the consequences for people, the economy, environment and society.

### Needs

- 9.2 The flooding in recent years demonstrates the impact flooding and coastal erosion can have on households, businesses and communities. The Environment Agency's Long-Term Investment Scenarios (LTIS) report,<sup>1</sup> published today, is an economic assessment of future flood and coastal erosion risk management looking ahead over a 50-year horizon. The number of properties at risk of flood from both surface water and from the rivers and sea is shown in Chart 9.A.



<sup>1</sup> Long Term Investment Scenarios, Environment Agency, December 2014

**Chart 9.A: Properties at risk from flooding, by type of property and source of risk**

Source: Environment Agency, Long-Term Investment Scenarios, Dec 2014

## Strategy

9.3 The government's flood and coastal erosion risk management strategy comprises:

- promoting a nationally consistent approach to assessing and managing flood and coastal erosion risk
- achieving greatest value for the taxpayer in managing investment in new and improved defences
- taking a risk-based management approach that targets resources to those areas where they have the greatest effect; the government offers access to public funding for all worthwhile schemes and prioritises its investment to achieve the greatest reduction in risk possible
- facilitating and securing alternative sources of funding where possible to maximise overall reduction in risk and encourage greater local choice with local beneficiaries having a greater stake

9.4 The government is the largest funder of risk management of flooding and coastal erosion from main rivers and the sea. In making decisions about where to prioritise resources, the government takes into account the overall economic damages avoided and the number of households benefiting.

## Delivery plan

9.5 For the first time, this government has set out a specific long-term funding settlement for flood and coastal erosion risk management. This government will invest £2.3 billion in total across the six year period, representing a real terms increase of 9% compared with the spending review 2010 period. This ensures a major long-term commitment, and is consistent with the recommendations put forward by the Environment Agency in the Long-term Investment Scenarios.

### Key action to 2020

9.6 The 6-year capital investment plan will:

- deliver improved protection to at least 300,000 homes and help avoid more than £30 billion in economic damages, including a £1.5 billion reduction in potential losses for the farming sector
- provide for investment in more than 1,400 schemes
- benefit homes and businesses right across England, including replacing seawalls at Fleetwood; building a barrage at Boston; refreshing tidal defences at the Thames Estuary; and undertaking schemes at Oxford, Lowestoft, Yalding and the Humber
- attract approximately £600 million of additional local contributions through partnership funding
- reduce overall flood risk by 5% compared to current levels by 2021

9.7 Also set out are the Environment Agency's commitments to improving how the programme will be managed and delivered, to ensure the benefits of long-term funding certainty are maximised. This includes:

- developing a clear high level statement of outputs and KPIs that aligns and incentivises delivery and performance at all levels, learning from similar approaches in the private and regulated sectors
- delivering further efficiencies from longer-term funding certainty by building on the process of grouping projects into larger 'packages' and programmes of work and exploring the opportunities for a more flexible 'whole-life' approach
- the adoption of new collaborative approaches to delivery building on the recent successful procurement of the TEP1 alliancing initiative (phase 1 of TEP 2100)
- continued investment in improved asset management and programme management datasets and tools
- a strengthened programme management function with the capacity and capability to monitor and intervene early on any obstacles that pose a risk to successful delivery of the programme
- targeted Environment Agency support for local area and local authority led schemes delivery capability

9.8 The plan commits the Agency to developing an integrated approach to deliver these enhancements by spring 2015. This will help deliver the commitment to increase capital efficiency by at least 10% across the investment period compared to a 2014-15 baseline, and is also expected to allow targeting of further efficiency within the maintenance programme.

## Priority investments (Top 40)

- 9.9 To support delivery of its objectives for the floods and coastal erosion sector, the government has included the Flood and Coastal Erosion Risk Management Programme within its Top 40 priority infrastructure investments.
- 9.10 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

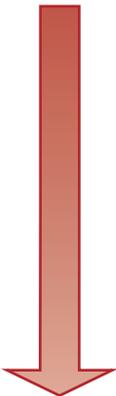
## Longer term

- 9.11 Government's current investment plans to 2020-21, supplemented by forecast local contributions and 10% efficiencies, are consistent with the profiles for investment demand currently modelled in the LTIS. It is projected that those investment profiles would deliver a 12% reduction in expected flood damages compared to current levels over the next 50 years.
- 9.12 A number of factors will influence future investment needs, including changes in climate change, development in areas of risk and the costs of protection. The government's approach to flood risk management therefore allows for an adaptive investment strategy to tackle these challenges in the longer term.

## Further information

- 9.13 The infrastructure pipeline sets out details of major planned projects and programmes within the floods and coastal erosion sector, including current status, projected construction start/completion dates and cost profiles (where available).
- 9.14 Further details on the floods vision and Long Term Investment Scenarios are available on the gov.uk website.

## Key policy and delivery milestones

	2015-16	Start of 6-year flood capital investment plan Thames Estuary 2100 Programme Phase 1 due to start construction
	2016-17	Rossall Coastal Defence scheme due to be completed Lincshore scheme due to be completed
	2017-18	Boston Barrage / Barrier Works due to start construction
	2018-19	Oxford Western conveyance scheme due to start construction
	2019-20	River Thames Scheme: Datchet to Teddington due to start construction Boston Barrage / Barrier Works due to be completed

Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes and necessary partnership funding. Final decisions on private-sector led projects will be taken by the project developer.



# COMMUNICATIONS

Progress since 2010

80%

of the UK now has superfast broadband coverage with over 1.5 million homes and businesses having access for the first time



Over

25,000km

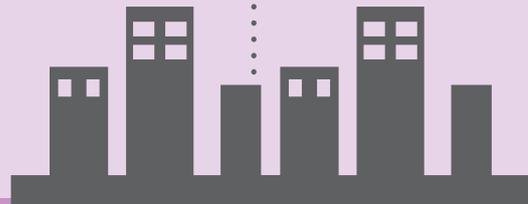
of fibre-optic cabling rolled out – 25 times the distance from Land's End to John O'Groats

22

Super-Connected Cities created across the UK

4G

services rolled out to over 300 towns and cities



95%

of the UK will have access to superfast broadband by 2017 and 8 pilot schemes will explore how to reach the final 5%

70%

of rail passengers to benefit from high-speed broadband on trains by 2019

4G

to reach 98% of premises by 2017

Digital Communications Infrastructure Strategy response to be published in 2015

Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR COMMUNICATIONS £11.0BN**

**In construction and future investment £11.0bn**

# Chapter 10:

# Communications

## Box 10.A: Announcements in the communications sector

- **Broadband connection vouchers** – the government will provide up to £40 million to extend the SME connection voucher scheme to March 2016 and to more cities; vouchers will be available on a first come, first served basis
- **700MHz spectrum change of use** – further details of the clearance process for high-value spectrum will be set out in 2015 ahead of a further auction of mobile broadband spectrum, subject to the development of delivery options by DCMS and Ofcom

## Objectives

10.1 The government is committed to ensuring that the UK has the right digital communications infrastructure to drive economic growth and innovation, enhance our national competitiveness and build a digital society.

## Needs

10.2 Digital infrastructure influences people's ability to access information and services, and to connect with the wider world. The economic impact of the internet is expected to keep growing and is predicted to reach £221 billion by 2016, an 11% rise each year. By this time it will account for 12.4% of the UK's GDP, a significant increase from 8.3% in 2010 and almost double the developed market average including Germany, Japan, the US and France.<sup>1</sup>

10.3 As the number of internet users and global connected devices increase, estimates suggest that the availability and take-up of faster broadband speeds will add about £17 billion to the UK's Gross Value Added by 2024, as a result of enhanced productivity, more uptake in the labour force and flexibility in working practices such as the ability to telework.<sup>2</sup> Faster broadband could also reduce commuting costs and lead to total household savings of £270 million per annum by 2024.<sup>3</sup>

10.4 Forecasting future needs in the communications space is challenging, but there is a level of consensus that the future will see continued rapid technological change. More

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<sup>1</sup> The Internet Economy in the G20, Boston Consulting Group, March 2012

<sup>2</sup> UK Broadband Impact Study: Impact Report, SQW, November 2013

<sup>3</sup> *ibid*

bandwidth will be needed as the traffic over fixed and wireless networks continues to rise, fuelled by the increased take up of smartphones, together with a rise in the availability and use of applications. The scale, availability and capacity of WiFi networks will become increasingly critical. The number of consumers will also remain on the rise (particularly in the older age group) and there will be more focus on reliability, in addition to speed.

- 10.5 Given these factors, and the enduring importance of a world-class digital infrastructure in supporting international competitiveness, the UK will need to continue to prioritise to ensure its communications compare favourably with those of other leading nations.

## Strategy

- 10.6 The UK telecoms market is one of the most open and competitive in the world. Effective deregulation has set industry free to create new services and set international standards. The government will always look to the market to deliver communications infrastructure but will also take action where necessary to support innovation and growth, ensure fairness, and protect consumers and other citizens.
- 10.7 To make sure everyone in the UK has access to fast, reliable broadband, the government has set out a vision for a superfast broadband network in the UK of over 24 Megabits per second (Mbps), to reach 95% of the population by 2017. Significant public funding has been committed to enable the rollout to areas where investment would otherwise not be commercially viable.
- 10.8 Some areas of the UK do not get good quality mobile coverage, or do not get any coverage at all. Good mobile coverage helps businesses to grow and people to stay in touch, which can be very important for people who are vulnerable or isolated. The government is therefore investing to improve the quality and coverage of mobile phone voice and data services.
- 10.9 Alongside this direct investment, the government continues to ensure that the policy and regulatory environment is conducive to delivering significant private sector investment in both fixed and wireless technologies, responding to demand and competitive pressures. That includes facilitating the use of spectrum.



## Delivery plan

10.10 The Department for Culture, Media and Sport leads on digital communications infrastructure policy, with a dedicated unit, Broadband Delivery UK (BDUK), which has responsibility for managing the government's broadband delivery.

### Key actions to 2020

- 10.11 90% of the UK will have access to superfast broadband by early 2016, supported by public investment of over £1.2 billion through the government's superfast broadband programme. An additional £500 million has been allocated with the aim of providing coverage to 95% of UK premises by the end of 2017.
- 10.12 Alongside government funded programmes, the private sector is also investing in excess of £5 billion in commercial programmes to upgrade the UK's digital communications infrastructure: BT's superfast broadband roll-out to two thirds of the UK is almost complete and mobile network operators are rolling out 4G technology at pace, following government's auction of 4G spectrum in 2013.
- 10.13 Over 5000 SMEs across 22 cities have benefitted from the government's connection voucher scheme, with new broadband connections on average six times faster than before. In order for more businesses to benefit, the government is allocating up to £40 million to extend the scheme to March 2016 and to more cities. Vouchers will be available in the new cities from April 2015, and will be available on a first come, first served basis.
- 10.14 The government is also planning to roll out a high speed (50 Mbps) broadband network on the busiest 30% of Britain's railways. Noticeable improvements will start during 2015, with 70% of passengers benefitting from the new technology by 2019. The programme will tackle a series of 'not-spots' – areas along rail corridors with intermittent or poor mobile phone signal coverage – delivering a consistent and reliable service on key routes.
- 10.15 Government's Mobile Infrastructure Programme is a unique model for extending mobile coverage to areas where it will have significant social benefits, and is delivering where the commercial sector alone will not. To ensure benefits of the programme are maximised, it has been extended to 2016.

### Priority investments (Top 40)

- 10.16 To support delivery of its objectives for the digital communications sector, the government has included the following programmes within its Top 40 priority infrastructure investments:
- Superfast broadband
  - Super-Connected Cities
  - Mobile Infrastructure Project
  - Commercial 4G rollout
- 10.17 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

### Longer term

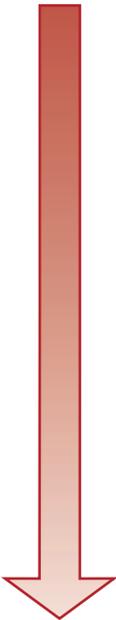
10.18 To achieve the government's ambition to have the right digital communications infrastructure to drive economic growth and innovation we need infrastructure that will allow people to access services when they want, where they want.

- 10.19 The government's current investment plans for digital communications infrastructure are expected to have achieved their objectives by the end of the decade. The government therefore recognises the need for a strategy that goes beyond 2020.
- 10.20 To meet this goal, the government published its consultation on a Digital Communications Infrastructure Strategy in August 2014, which considers different scenarios for future demand and looks at what should follow delivery of superfast broadband and address the rapid convergence of the broadband and telecommunications markets. The government will publish its response to the consultation and its long-term strategy in 2015.
- 10.21 The UK Spectrum Strategy sets out a framework up to 2025 and beyond. In this time, the value of spectrum is expected to double to reach £100 billion. Government's Strategy aims to support this growth and offer business the access it needs to innovate and grow, and everyone in the UK the services they need to live their lives to the full.
- 10.22 As part of this, the government supports Ofcom's work on the change of use of 700MHz spectrum, which it estimates will bring in quantified benefits of between £900 million and £1.3 billion in network cost savings as well as significant unquantified benefits such as improved coverage, capacity and speed in rural areas. Allocating the 700MHz band for mobile broadband will support the growth in demand for mobile services by providing greater capacity in the 4G networks as well as potentially preparing for 5G services. Subject to the development of delivery options by DCMS and Ofcom, further details of the clearance process for this high-value spectrum will be set out in 2015.

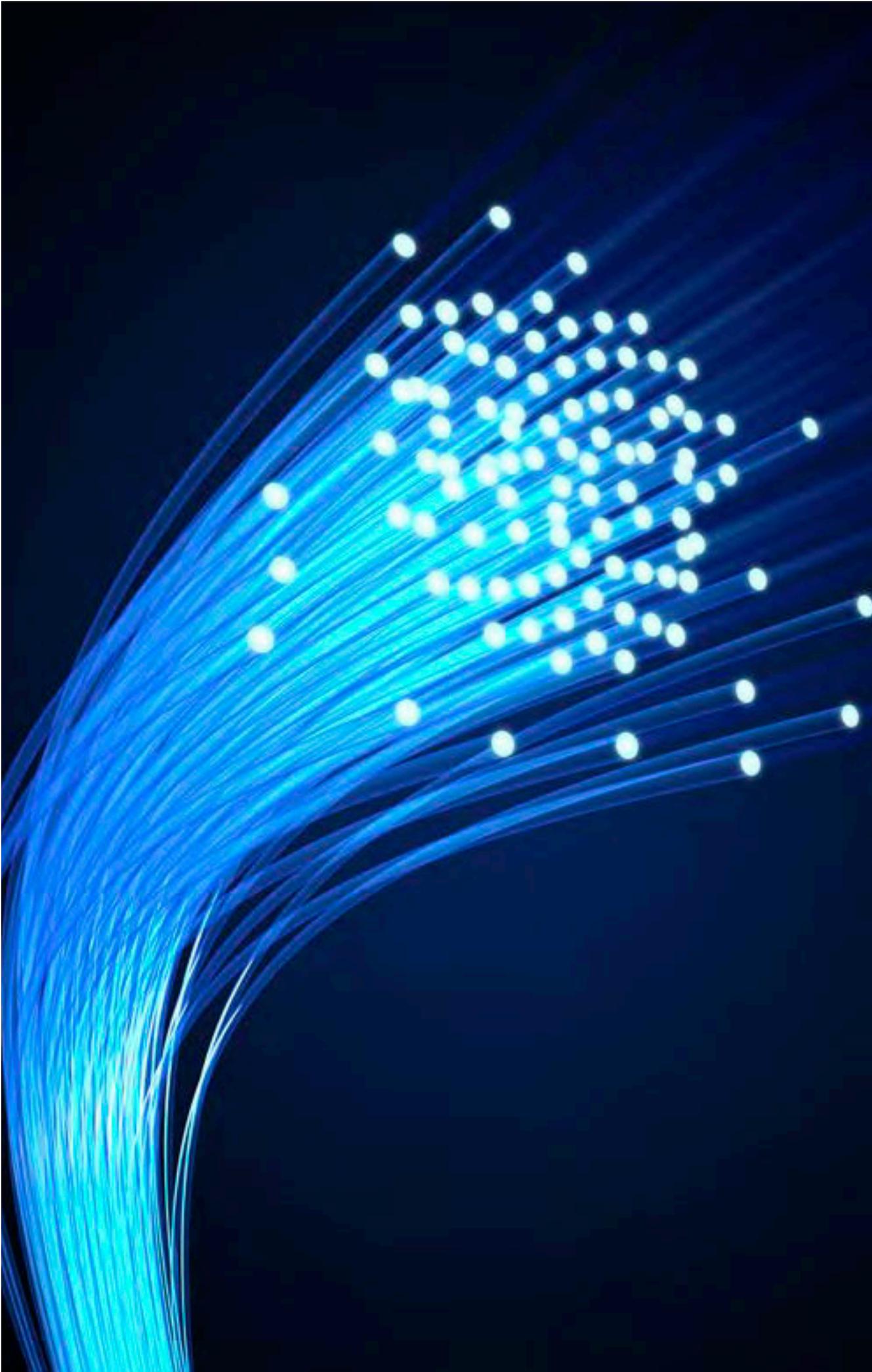
### Further information

- 10.23 The infrastructure pipeline sets out details of major planned projects and programmes within the digital communications sector, including current status, projected construction start/completion dates and cost profiles (where available).
- 10.24 Further information on the roll-out of superfast broadband can be found at:  
[www.google.com/maps/d/viewer?mid=zwLLqmDnfnjA.khRmsBv2kR70&msa=0&ll=53.709714,-2.768555&spn=7.417298,14.0625&dg=feature](http://www.google.com/maps/d/viewer?mid=zwLLqmDnfnjA.khRmsBv2kR70&msa=0&ll=53.709714,-2.768555&spn=7.417298,14.0625&dg=feature)

### Key policy and delivery milestones

	2015	Digital Communications Infrastructure Strategy due to be published 1,000 public buildings, over 100 trains and 1,300 buses due to have been fitted with free Wi-Fi and 10,000 businesses connected to superfast broadband as part of the Super-Connected Cities programme Further details of the clearance process for high-value spectrum due to be set out, subject to development of delivery options by DCMS and Ofcom
	2016	Superfast Broadband Phase 1 due to be completed – 90% UK coverage Mobile Infrastructure Project due to be completed Connection voucher scheme now extended to 2016
	2017	Commercial 4G services due to be fully rolled out Superfast Broadband Phase 2 due to be completed – 95% UK coverage
	2018	
	2019	70% of rail passengers due to benefit from high-speed broadband on trains
	2020	Deadline for the release of 500 MHz of public sector spectrum below 5 GHz

Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes. Final decisions on private-sector led projects will be taken by the project developer.



# WATER

## Progress since 2010

£22bn

of private-sector investment in water and waste water assets

Improvements at almost 500 sewage works since 2010, reducing phosphate and ammonia pollution

Environmental quality of 3,290 km of rivers protected or improved ...

... and cleaner beaches with a record 99.5% of England's bathing waters passing EU standards



£30.9bn

of water and waste water asset investment in the pipeline

2014 Water Act to give all business, charity and public sector customers in England the freedom to switch supplier from 2017

Thames Tideway Tunnel expected to start construction in 2016

Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR WATER £30.9BN**

**In construction £4.1bn**

**Future investment £26.8bn**

# Chapter 11:

# Water

## Objectives

11.1 The government's objectives for the water sector are to secure a fair deal for customers while enabling water companies to continue to attract low-cost investment needed to provide the high quality, resilient water services customers want.

## Needs

11.2 The country's existing water and wastewater infrastructure is of varied age and condition, and some of it is well over a century old. There are three main factors influencing future water needs: changing demand, demographic changes and the impact of climate change:

- household demand has been increasing since the 1950s, and although water companies forecast that average personal consumption will drop from 146 litres per day in 2010-11 to 132 in 2030-31, population growth will offset this fall;<sup>1</sup> Industrial water use has been declining as the economy moves away from heavy industry; however, a drive to reduce carbon emissions, e.g. through carbon capture and storage at power stations, could increase water usage
- with population growth likely to be concentrated in the most water-stressed parts of the country, combined with a trend towards smaller households, total household consumption is forecast to increase by 3%, while total water demand (for all purposes) may rise by 5% by 2020. Some extreme scenarios suggest water demand could rise by as much as 49% by 2050<sup>2</sup>
- a Met Office study suggests a worst case scenario of 10 times as many significant droughts by 2100;<sup>3</sup> while water companies are better prepared for such events, sustained investment is likely to be required for a changing climate; demand is likely to increase too, with more water used in hotter weather and potential for greater irrigation<sup>4</sup>

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<sup>1</sup> Aggregate of final company water resource management plans (2015-2040). Figures are for England only.

<sup>2</sup> Water for life, DEFRA, 2011

<sup>3</sup> An extreme value analysis of UK drought and projections of change in the future, Met Office, 2010

<sup>4</sup> Water for life, DEFRA, 2011

- 11.3 Waste water treatment infrastructure is also essential for a clean environment and public health. Every day in England and Wales the sewerage system collects approximately 10 billion litres of waste water from households and industry.<sup>5</sup> Demand for new and improved waste water infrastructure is expected to increase as a result of statutory requirements to protect the environment and water quality, population growth, urbanisation and adaptation to climate change.
- 11.4 New infrastructure is not the only solution to the above issues. However, a sustained and significant programme of maintenance, renovation and replacement in water infrastructure will also be necessary in order to reduce leakages and ensure a high level of service for customers both now and in the future.

## Strategy

- 11.5 The government sets the strategic policy framework for a privatised water industry to ensure sufficient supplies of secure and sustainable water – including a requirement to plan to balance supply and demand over the long term. In doing so, it seeks to set the conditions for a water sector that is as innovative, efficient and customer-focused as possible.
- 11.6 An independent economic regulator (Ofwat), sets the framework within which individual companies make their commercial decisions, ensuring that consumers receive high standards of service at a fair price. In doing so, it must take into account the government's stated policy priorities including considering the impact on investment, innovation, resilience, sustainable development and the need to prepare for longer-term challenges.
- 11.7 Water companies are regulated by the Drinking Water Inspectorate to ensure water supplies in England and Wales are safe and drinking water quality is acceptable to consumers. The Environment Agency regulates environmental impacts, abstractions and discharges.
- 11.8 The government also takes targeted action where appropriate to ensure that water companies support vulnerable customers, and when necessary, to facilitate investment in projects of exceptional size and complexity such as Thames Tideway Tunnel.

## Delivery plan

- 11.9 Privately-owned water and sewerage companies are responsible for running, maintaining and, where necessary, upgrading the UK's water infrastructure.

### Key action to 2020

- 11.10 The Thames Tideway Tunnel is a key element of the programme to modernise London's aging sewerage network and the project received development consent in September 2014. Following the government's decision to specify the project under the Water Industry Act it will be designed, financed and operated by a separately regulated Independent Infrastructure Provider. Thames Water is currently procuring through competition both the Infrastructure Provider and the main contractors for the construction. Contract negotiations should be completed in mid-2015 with construction due to start in 2016.

<sup>5</sup> National Policy Statement for Waste Water, DEFRA, March 2012

- 11.11 The water industry operates on five-yearly cycles called asset management periods. Ofwat has now published draft determinations setting the price, investment and service package that water companies should provide for the next asset management period (AMP6), which will begin on 1 April 2015. Ofwat's final determinations will be published on 12 December 2014.
- 11.12 Based on its draft determination proposals for AMP6, Ofwat projects that by 2020:
- there will be £43 billion of total investment on delivering, maintaining and improving services; the pipeline captures a projection of the capital element of this<sup>6</sup>
  - average bills will fall by about 5% in real terms
  - more than 340 million litres of water a day will be saved by tackling leakage and promoting water efficiency
  - there will be on average a 40% reduction in the time lost due to supply interruptions
- 11.13 Major projects and programmes due for delivery in AMP6 will be confirmed in companies business plans once the final determination has been published.
- 11.14 The Water Act will, for the first time, mean all businesses, charities and public sector customers in England will have the freedom to switch supplier from 2017.

### Priority investments (Top 40)

- 11.15 To support delivery of its objectives for the water sector, the government has included the following within its Top 40 Priority Infrastructure Investments:
- Water Supply and Sewerage Networks
  - Thames Tideway Tunnel
- 11.16 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

### Longer term

- 11.17 Following AMP6, Asset Management Period 7 will run from 2020 to 2025. The price review process for AMP7 is expected to involve a similar total expenditure (TOTEX) and output-based approach to that taken in PR14.
- 11.18 Companies produce Water Resources Management Plans which set out how they will balance the demand and supply of water over the long-term, taking account of factors such as population growth, economic growth and climate change. Companies consider options from managing demand as well as options for developing new sources of supply, for example reservoirs. The plans are subject to public consultation and the Environment Agency provides technical advice to the Secretary of State, who decides whether each company should publish its proposals as a final plan.
- 11.19 Most water companies have now published the final version of their latest plans (covering 2015 to 2040). The companies will begin consulting on their next plans in 2018.

<sup>6</sup> For the AMP6 period (2015-20), Ofwat is moving to a total expenditure approach in which capital investment and operating expenditure are assessed together. Of the £43 billion of totex in AMP6, an estimated £22 billion represents expenditure which would have been traditionally reported as capex.

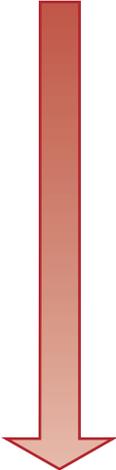
### Further information

11.20 The infrastructure pipeline sets out details of major planned projects and programmes within the water sector, including current status, projected construction start/completion dates and cost profiles (where available).

11.21 Further details on the price review process for AMP6 is available on Ofwat’s website.

### Key policy and delivery milestones

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	<b>2015</b>	Start of Asset Management Period 6 (AMP6) with £43 billion of anticipated investment to deliver, maintain and improve water services  Thames Tideway Tunnel contract awarded to Infrastructure Provider  Lee Tunnel due to be completed
	<b>2016</b>	Thames Tideway Tunnel due to start construction
	<b>2017</b>	All businesses, charities and public sector customers will have the freedom to switch supplier under the 2014 Water Act
	<b>2018</b>	
	<b>2019</b>	Ofwat final determinations on AMP7 due to be published
	<b>2020</b>	End of AMP6 and start of AMP7

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Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes. Final decisions on private-sector led projects will be taken by the project developer.



# WASTE

Progress since 2010

£3.2bn

in funding allocated to support 27 new local authority waste projects

19

projects completed including in Cumbria, Staffordshire and Exeter

4.6m

tonnes of extra processing capacity per year



20

waste projects worth more than £2 billion in the pipeline

England on track to meet EU targets for reducing waste sent to landfill

Negotiation on EU review of resource and waste management expected to be concluded by 2018

Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR WASTE £2.0BN**

**In construction £1bn**

**Future investment £1bn**

# Chapter 12:

## Waste

### Objectives

- 12.1 The government's ambition is to move towards a 'circular economy' where material resources are valued and kept in circulation. This means that we make the best use of materials and resource, prevent and deal with waste, and recycle properly. This is essential for our future growth, increased resilience and environmental and human health.

### Needs

- 12.2 Waste and resource management is critical to the UK. England produced approximately 42 million tonnes of Municipal Solid Waste (including 19.1 million tonnes of Commercial and Industrial waste similar in nature to household waste in 2012), 16.2 million tonnes of which went to landfill.<sup>1</sup> As well as being damaging to the environment this is a loss of a valuable resource.
- 12.3 The UK also needs sufficient waste infrastructure capacity to be in place to meet the requirements of the EU Landfill Directive targets for biodegradable municipal waste (BMW). The current target requires that the amount of BMW sent to landfill in England by 2020 decreases to 35% of 1995 levels (to 10.2 million tonnes).<sup>2</sup> England met its contribution to the UK BMW target for 2010 and the latest data, for 2012, shows BMW to landfill already within the requirements of the 2013 and 2020 targets. Based on the latest assumptions, levels of BMW to landfill in England are expected to be around 3.5 million tonnes in 2020.<sup>3 4</sup>

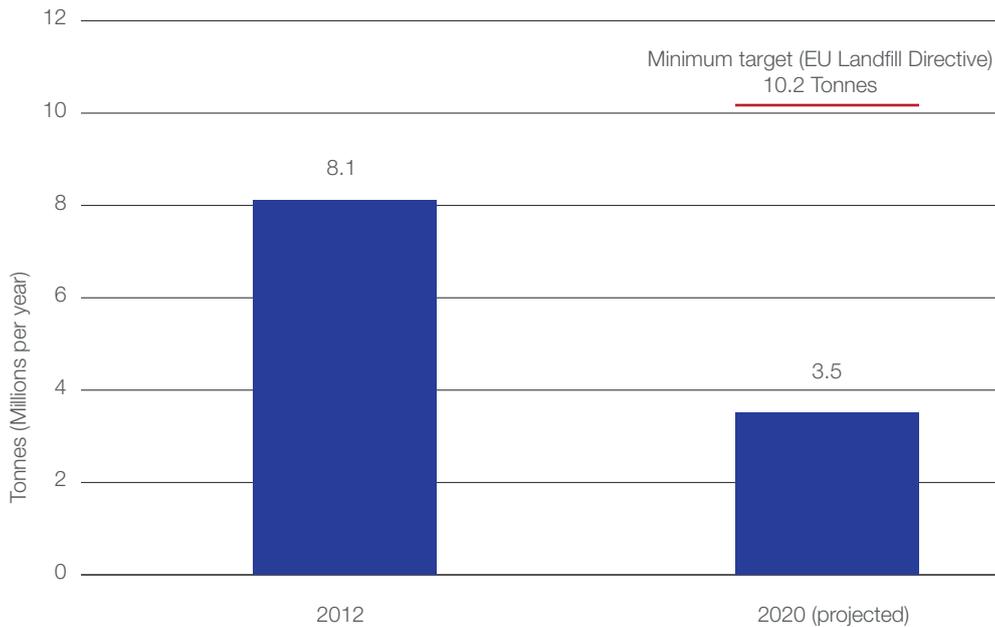
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<sup>1</sup> Estimate includes household waste and similar waste from commercial and industrial sources. Source: Wastedataflow and Forecasting 2020 Waste Arisings and Treatment Capacity, Defra, October 2014

<sup>2</sup> Defra – UK statistics on waste – 2010 to 2012, Defra, September 2014

<sup>3</sup> *ibid*

<sup>4</sup> Forecasting 2020 Waste Arisings and Treatment Capacity, Defra, October 2014

**Chart 12.A: Forecast of biodegradable municipal waste sent to landfill in England**

Source: UK statistics on waste, 2010 to 2012, Defra, Sep 2014;  
Forecasting 2020 waste arisings and treatment capacity, Defra, Oct 2014

## Strategy

- 12.4 The government seeks to ensure the best use of materials and resources, and that waste in England is dealt with as efficiently as possible, in a way that meets EU targets. It also believes that the efficient use of resources should primarily be driven by the market, operating within a policy and regulatory structure that provides the right economic incentives. This includes using the tax system to influence behavioural change where appropriate (e.g. through the landfill tax).
- 12.5 Private sector suppliers build and run waste plants that treat waste and divert biodegradable municipal waste from landfill. To ensure that it will meet its EU obligations, the government provides financial support to help local authorities part-fund residual waste infrastructure contracts with private sector suppliers. The government also provides technical and commercial expertise to PFI/PPP waste projects, including helping local authorities identify and secure substantial efficiency savings.

## Delivery plan

- 12.6 The government routinely monitors progress against its requirements under the EU Landfill Directive and, as set out above, England is currently on track to meet the existing 2020 targets. All grant funding has now been allocated to waste infrastructure and the government is not currently planning to fund any new projects through Waste Infrastructure Credits.

### Key action to 2020-21

- 12.7 There are some 20 existing waste PFI and PPP projects representing almost £2 billion of investment between now and 2020-21 in the infrastructure pipeline, 11 of which are already in construction.
- 12.8 In July 2014, the European Commission published proposals as part of a review of resource and waste management policy and legislation, including key targets in EU waste legislation. The government is committed to the negotiation and implementation of proportionate EU agreements, and has made clear that it would not support new targets at an EU-level unless there is a clear economic and environmental case to do so.
- 12.9 There will now be a period of negotiation on the European Commission proposals which is expected to conclude between 2016 and 2018.
- 12.10 It is only once these negotiations have substantively concluded that the government expects to have sufficient clarity to decide what further action, including on infrastructure, will be necessary to meet any revision of the targets.

### Longer term

- 12.11 In the longer term, the government wants to see businesses leading the way in resource use and management, increasingly realising the economic and commercial opportunities that arise from resource efficiency and tackling environmental challenge.
- 12.12 The government will continue to have a role to play. It will continue to work with local authorities, industry and other stakeholders to promote good practice and ensure businesses have the tools and the freedom to realise the benefits of moving towards a more circular economy

### Further information

- 12.13 The infrastructure pipeline sets out details of major planned projects and programmes within the waste sector, including current status, projected construction start/completion dates and cost profiles (where available).
- 12.14 Details of individual PFI and PPP projects are available on local authority websites.

### Key policy and delivery milestones

2015	3 waste projects in London, Surrey and Gloucestershire due to start construction
	4 waste projects due to be completed including in Shropshire, Barnsley and Wakefield
2016	8 waste projects due to be completed including in Merseyside, Buckinghamshire and Cornwall
2017	3 waste projects in North Yorkshire, North Lincolnshire and Derby due to be completed
2018	EU negotiations on new waste targets due to have concluded
	South London waste project due to be completed
2019	
2020	Deadline for meeting existing EU Landfill Directive targets

Project-specific dates are based on the infrastructure pipeline and are indicative of current plans. Some projects may be subject to finalisation of statutory processes. Final decisions on private-sector led projects will be taken by the project developer.

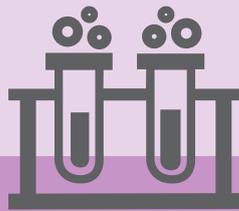
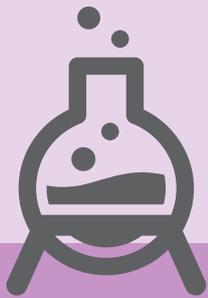
# SCIENCE AND RESEARCH INFRASTRUCTURE

Progress since 2010

.....  
Laboratory of  
Molecular Biology  
one of more than  
20 new research  
facilities opened  
.....

..... 7  
.....  
new Catapults  
established to  
support  
commercialisation  
of research  
.....

..... 27  
.....  
projects supported  
through £400  
million Research  
Partnership  
Investment Fund  
.....



.....  
Publication of the  
Science and  
Innovation  
Strategy  
.....

..... 2  
.....  
new Catapults  
planned in Energy  
Systems and  
Precision Medicine  
.....

.....  
New  
£225m  
.....  
Polar Research  
Ship as part of  
£5.9 billion science  
capital spending  
.....

.....  
Francis Crick  
Institute to be fully  
operational in 2016  
.....

Plan to 2020-21

**INFRASTRUCTURE PIPELINE FOR SCIENCE £1.4BN**

**In construction £1bn**

**Future investment £0.4bn**

# Chapter 13:

## Science and research

### Objectives

- 13.1 The government aims to make the UK the best place in the world to do science and research.

### Needs

- 13.2 Science is a crucial driver of productivity growth. The UK's ability to develop and commercialise new ideas, products and services will be critical to its economic success.
- 13.3 Yet the science and innovation landscape is changing. The scale of science is increasing, meaning long-term strategic investment by government and business is required. Sophisticated infrastructure and kit means that national, or in some cases international, facilities are often the only realistic solution. The global pace of research is increasing, meaning the UK needs to work harder to remain at the cutting edge. Science – and the way it is conducted - is also becoming more open, working across organisational, disciplinary and geographic boundaries and requiring greater collaboration between business, research and academic institutions, and government.
- 13.4 All this poses new challenges for the way we approach science infrastructure. Sustained and efficient future investment in scientific and research infrastructure is essential to ensure that UK research is able to remain internationally competitive.

### Strategy

- 13.5 Recognising its importance, the government has taken tough decisions this parliament to increase spending on science at a time of falling budgets. This has delivered major programmes spanning both blue skies and applied science, and across the eight great technologies.
- 13.6 In addition to directly funding capital projects, the government continues to enhance funding at institutional and project level through Research Councils UK (RCUK) and the Higher Education Funding Council for England (HEFCE) to ensure a joined-up network of science infrastructure.
- 13.7 It also uses funding mechanisms and incentives to encourage greater collaboration between the research community, business and government. For example, the Research Partnership Investment Fund (RPIF) which gives awards to large-scale projects and can attract at least double public investment from private or charitable sources. Likewise,

Catapults are a network of widely-supported technology and innovation centres which aim to boost the UK's innovation capability in areas that have a large global market potential, bringing together public and private sector actors through a risk sharing model. Many of the Catapults support research into areas with direct implications for economic infrastructure sectors, including in future cities, offshore renewable energy, transport systems and digital communications.

## Delivery plan

### Key actions to 2020-21

- 13.8 The government has increased capital funding for science and research in real terms to £1.1 billion in 2015-16, and provided a long-term commitment which sees it growing in line with inflation each year to 2020-21.
- 13.9 The government recently consulted on proposals for long-term capital investment to 2020-21. In doing so, it set criteria for the prioritisation of publicly funded capital projects: affordability (including revenue costs), excellence, impact, skills development, and efficiency and leverage of other funding sources. Projects are also required to support the government's wider priorities: the 'eight great technologies', the industrial strategy and developing collaboration across disciplines and boundaries.
- 13.10 At Autumn Statement 2014, the government will announce which large projects have been selected in the first round of funding as part of this consultation. Shortly afterwards, it will publish its Science and Innovation Strategy, and full response to the capital consultation. These will build on the feedback received and set out how the long-term funding settlement for the sector will be used to support key priorities and projects.
- 13.11 The government will also continue to focus on delivery of its existing infrastructure commitments, including major science projects such as Diamond Phase III, the Pirbright Institute Development Phase 2 and the Francis Crick Institute.

### Longer-term

- 13.12 The government's forthcoming Science and Innovation Strategy will set out the government's long-term objectives for the sector.

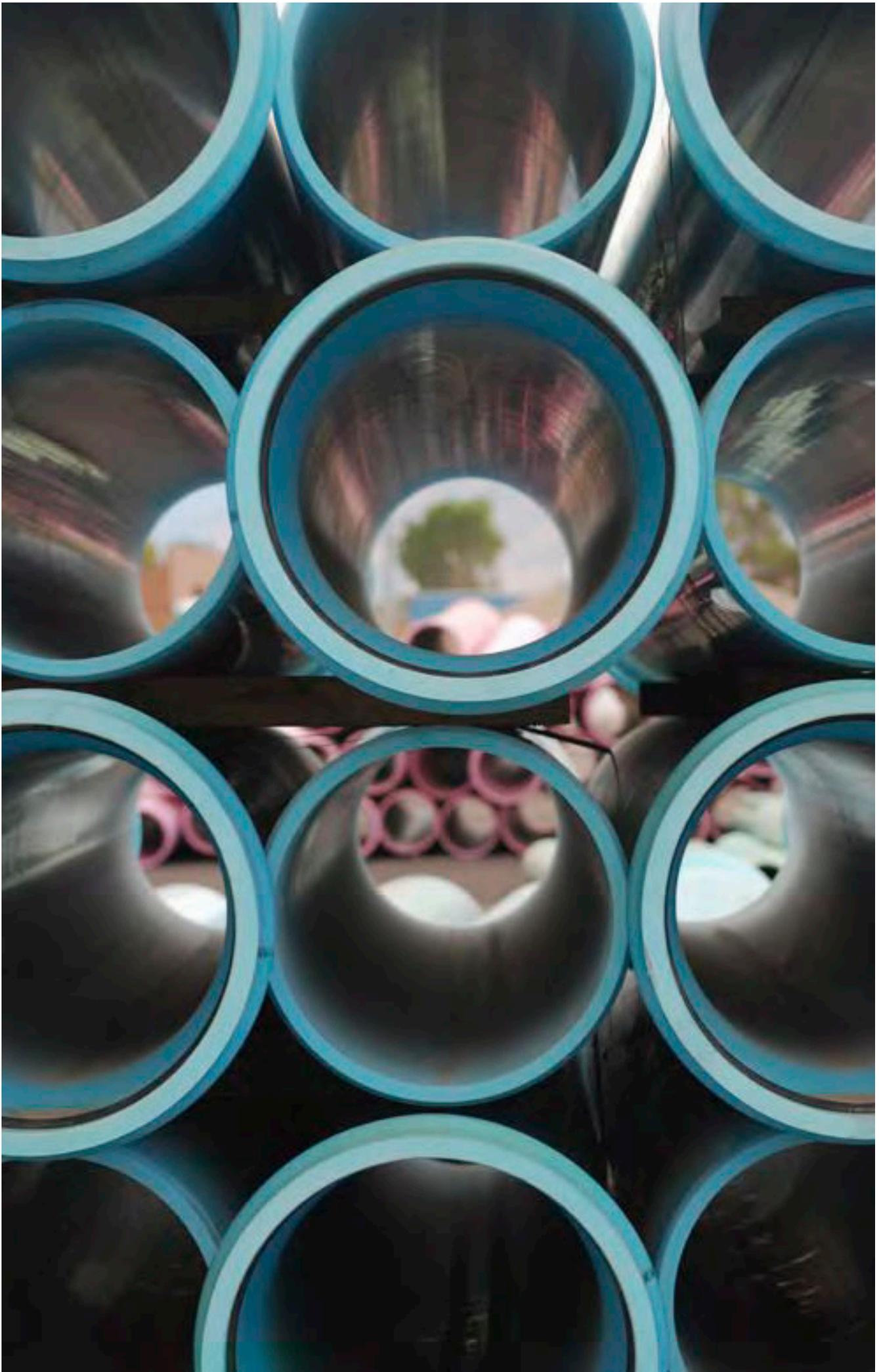
### Priority projects

- 13.13 To support delivery of its objectives for the science and research sector, the government has included the following within its Top 40 priority infrastructure investments:
- Science Major Projects – focusing on the largest projects by capital value
  - Science and Innovation Catapults – focusing on physical infrastructure elements
- 13.14 For full details on the Top 40 selection criteria and how the government tracks and supports progress, please see Chapter 16, which also sets out the key projects and programmes within individual investments.

### Further information

- 13.15 The infrastructure pipeline contains details of major planned projects and programmes within science and research infrastructure, including current status, projected construction start/completion dates and cost profiles (where available).





# Chapter 14:

## Financing UK infrastructure

- 14.1 Securing the right funding and financing is critical to delivering UK infrastructure effectively and efficiently. Overall, analysis of investment trends show that investment in UK infrastructure has been increasing, from an average annual investment of £41 billion between 2005-6 and 2009-10 to an average annual investment of £47 billion between 2010-11 and 2013-14.<sup>1</sup>
- 14.2 The infrastructure pipeline sets out details of around £327 billion of planned investment across the public and private sectors to 2020-21. This chapter sets out the details of how this investment will be delivered, and the opportunities for private investment in the 2014 infrastructure pipeline.

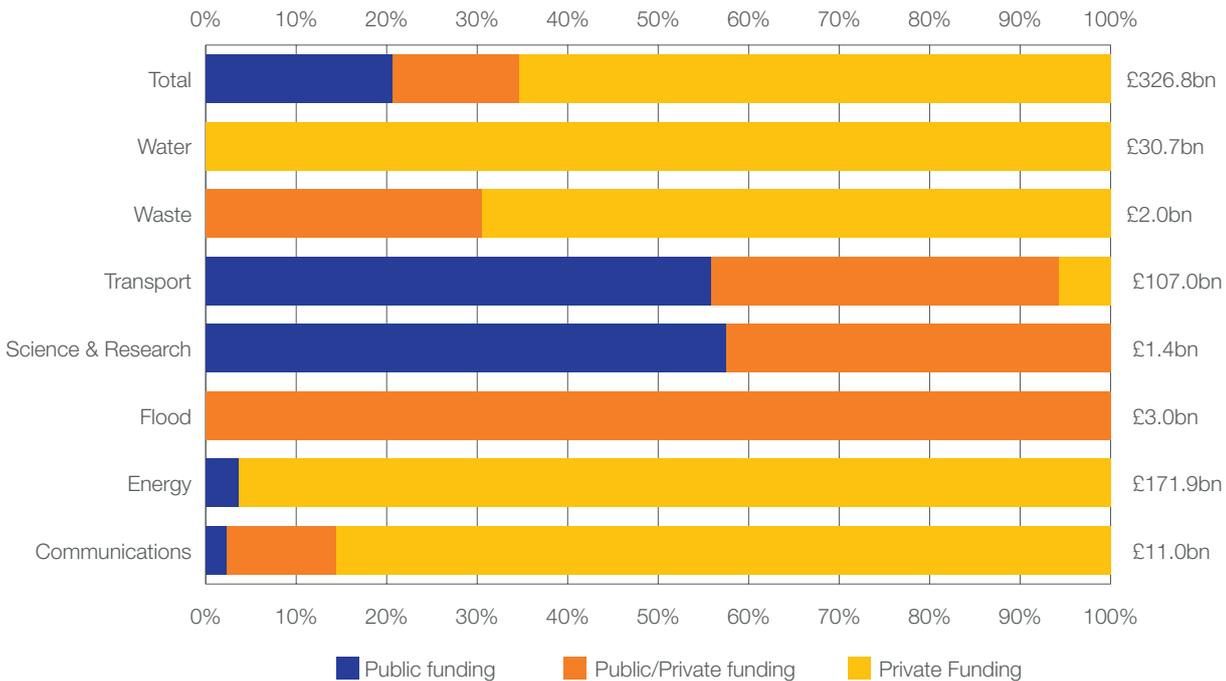
### Funding infrastructure

- 14.3 Underpinning investment in UK infrastructure is the funding source which will ultimately pay for the asset. Funding is paid for in three main ways: from consumers through bills and user charging, through public spending raised from general taxation, or a combination of the two.
- 14.4 Chart 14.A below shows the proportion of public and private funding for infrastructure investment in the 2014 infrastructure pipeline.

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<sup>1</sup> 2013-14 prices. HM Treasury estimates, based on published sources. These figures are not comparable to pipeline data presented in this document, which is a forward-looking bottom-up assessment of planned infrastructure investment. Please refer to 'Methodology and Sources for National Infrastructure Plan 2014' for further information on how these estimates are calculated

**Chart 14.A: Funding mix of 2014 infrastructure pipeline, 2014-15 to 2020-21, by sector**



Source: HM Treasury, Major Infrastructure Tracking Unit

- 14.5 The UK has been at the forefront of developing a model of infrastructure investment whereby responsibility for funding, financing and delivery is split between the public and private sectors. This means that 20.6% (£67.5 billion) of the planned investment in the infrastructure pipeline is entirely public investment, with a further 13.8% (£45 billion) representing a mix of public and private sources, and 65.6% (£214.4 billion) will be purely private investment.
- 14.6 The approach to delivering investment depends on the sector concerned, the nature of the asset, for example whether there are a defined set of users who will benefit and could reasonably be charged for usage, and takes into account the relative efficiency and fairness of different approaches to funding. The government’s objective is to ensure an open market for investment in UK infrastructure to maximise competition for investment and ultimately drive down the costs of delivering infrastructure. The model also seeks to allocate risk appropriately between the public and private sectors to ensure value for money is delivered for the taxpayer.
- 14.7 For example, the partnership funding policy for the floods programme prioritises investment on a transparent and objective basis. It increases certainty, local ownership and choice, and incentivises communities to reduce costs and maximise benefits. Alongside the £2.3 billion of government capital expenditure, the government expects to attract contributions from other sources, including the private sector, of around £600 million for the schemes within the 6 year programme.

## Financing infrastructure

- 14.8 While the funding model determines the revenue stream that will ultimately pay for an asset, financing is the method of securing upfront capital investment which will get a project started and support associated jobs and economic growth. Predictability in the revenue stream enables finance to be made available to developers of an asset, so that the project can get underway.

## Public financing

- 14.9 Where projects are publicly funded, this means that they are financed (in their entirety or in part) directly out of the agreed capital budgets of the relevant government department, local authority or arms-length delivery body.
- 14.10 Of the current UK infrastructure pipeline to 2020-21, £67.5 billion will come from public investment with a further £45 billion from a mix of public and private sources. All publicly funded elements of the infrastructure pipeline now represent a firm and specific government commitment. Details of new government funding commitments are set out in the previous sector chapters of this document.

## Investment in the regulated sectors

- 14.11 A significant proportion of private investment in the infrastructure pipeline is in regulated sectors. The UK has pioneered a system of independent regulation for the following sectors of the economy: electricity and gas transmission and distribution; water; telecommunications; airports; and rail. While the specific approach varies between sectors, regulation is structured in a way that protects consumers, rewards efficiency and innovation, and gives investors the confidence to privately finance the infrastructure the UK economy needs.
- 14.12 Regulated companies will continue to require investment in order to both maintain existing infrastructure and construct large new assets, such as the Thames Tideway Tunnel. The infrastructure pipeline to 2020-21 includes £113.5 billion of investment in the regulated sectors.
- 14.13 The essential nature of network infrastructure means that demand for services is strong and expected to grow over time. Price controls and licence conditions are set by independent economic regulators and provide investors with a high degree of predictability about the extent of future profitability in the sector, which is free from political interference. This system of independent regulation has proved particularly attractive to traditionally long-term investors, such as pension funds.
- 14.14 Equity investment in the regulated sectors is made either directly in large publicly-listed regulated companies, or through share-holdings in the groups or investment funds that own regulated companies as part of their portfolio.
- 14.15 The capital-intensive nature of regulated industries, as well as the make-up of regulatory settlements, creates considerable opportunities for debt investment. Regulated companies commonly issue debt as fixed term interest-bearing bonds, or bonds linked to RPI as inflation is included in the regulatory settlement. Other forms of debt investment are also generally available including short-term debt such as commercial paper, and other financial instruments designed to match the company's future interest payments to the levels allowed in the price control settlement.
- 14.16 Moody's Investors Service (a credit rating agency) regards the regulatory regime for electricity and gas networks and water companies in Great Britain as amongst the most stable and predictable in the world, assigning the highest score (Aaa) for the relevant factor under its methodologies for the two sectors.

14.17 Developments in regulatory settlements continue to make regulated infrastructure networks an even more attractive place to invest. For example:

- in regulated energy networks, the length of regulatory settlements has extended from five to eight years; in addition, there is a mechanism to update this settlement annually with movements in the cost of debt and to set allowances for major projects agreed during the price control period; this removes the need to 'log-up' capital investments until the next price review period
- Ofwat and Ofgem have introduced new mechanisms to award 'enhanced status' (water) or 'fast-track' status (energy) to companies whose business plans are high-quality, ambitious, fully engaged with their customers and well justified; network companies that achieve this status are then subject to only a 'light-touch' regulatory review; this new mechanism reduces the 'regulatory burden' and reduces uncertainty for the companies demonstrating outstanding business plans and frees them to focus on delivering their business plans

14.18 The government is fully committed to the system of independent regulation for delivering the required infrastructure investment in the regulated sectors, while protecting consumers' interests. The stability of the UK economic regulation systems means that companies operating regulated networks in the UK are consistently regarded as stable and relatively low-risk. There should therefore be continued competition to invest in the regulated sectors, reducing the cost of capital, which is a positive outcome for consumers.

### **Private investment**

14.19 As well as corporate investment in the regulated sectors, there is a further £130 billion of private investment in the non-regulated sectors of the infrastructure pipeline to 2020-21. For several sectors, in particular waste, ports, and oil and gas, financing is likely to be almost entirely provided by project developers on balance sheet – where investment is financed from the companies' own resources.

14.20 For other sectors, primarily in energy generation, balance sheet financing is also important. However, many developers in these sectors – particularly the large utilities – have had limited headroom for investment on balance sheet for some time. The opportunity for project financing is therefore likely to grow and involves raising long-term financing in the form of debt and equity to be repaid from the cash flows generated by the project once operational.

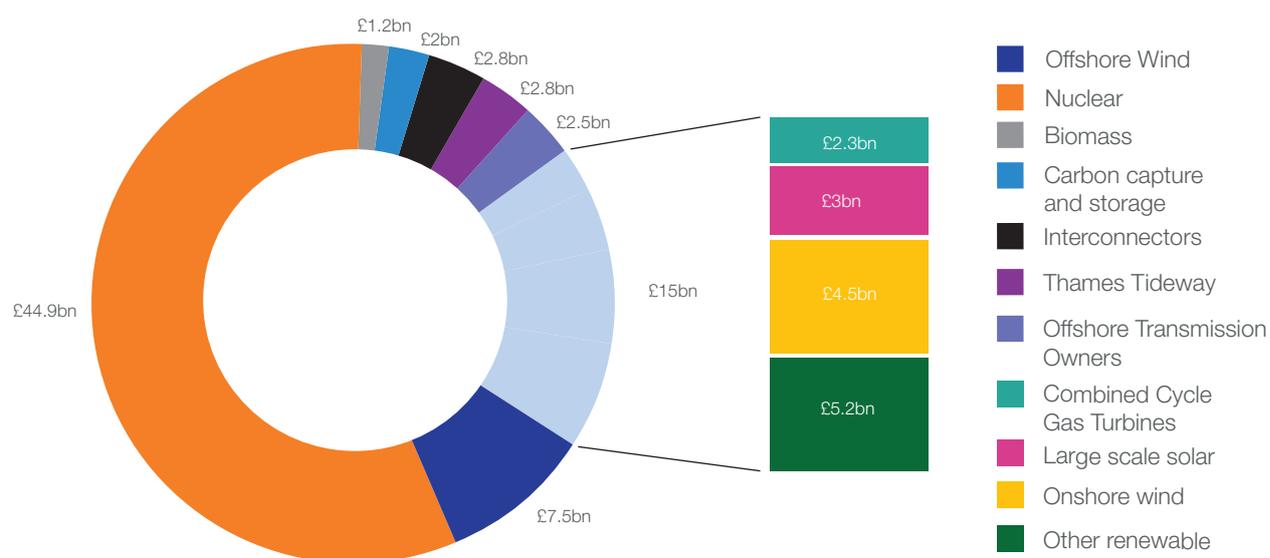
## Breakdown of project specific finance opportunities to 2020-21

14.21 In sectors where some or all investment will be off balance sheet, there are potential investment opportunities in project finance. This includes energy generation, interconnection, offshore transmission, as well as one-off large scale projects like the Thames Tideway Tunnel.

14.22 In the finance update to NIP 2013, published in March 2014, the government set out a total of £125 billion of potential finance opportunities, including £52 billion in projects to 2019-20, and £73 billion beyond 2020. This assessment was based on the capital expenditure required for projects over the course of construction, often extending beyond 2020. For NIP 2014, the methodology has been updated, extending to include the 2020-21 financial year and to reflect the need for projects to have finance committed upfront. This means the full capital expenditure (capex value) of a project is allocated in the year that a final investment decision is expected, where this falls in or before 2020-21. This better reflects when investment will actually need to be committed by the market.

14.23 The stated value of the potential project finance opportunity to 2020-21 has therefore increased, as £31 billion has been brought forward from the post-2020 period into the current decade. This is due to the full capex value for 3 nuclear projects falling within the pre-2021 financing window. Taking into account our expectations on the use of corporate balance sheets in the sectors included, the total project financing opportunity to 2020-21 is therefore £79 billion, based on the updated methodology.<sup>2</sup> It should be noted that it is not the government's policy to pick the electricity mix. Ultimately the amount of investment in the various technologies will be driven by how each can meet our security of supply and low carbon ambitions at least cost to consumers. Furthermore, exact finance structures will ultimately be determined by the project sponsor in any given deal. The assessment provided in Table 14.1 of project finance opportunities, and structures is based on data in the 2014 UK infrastructure pipeline and engagement with developers.

**Chart 14.B: Project finance investment opportunities in UK infrastructure to 2020-21**



Source: HM Treasury

Please refer to 'Methodology and sources for National Infrastructure Plan 2014' for further information

<sup>2</sup> HM Treasury estimates. Please refer to 'Methodology and Sources for National Infrastructure Plan 2014' for further information

**Table 14.1: Breakdown of project finance investment opportunities in UK infrastructure to 2020-21**

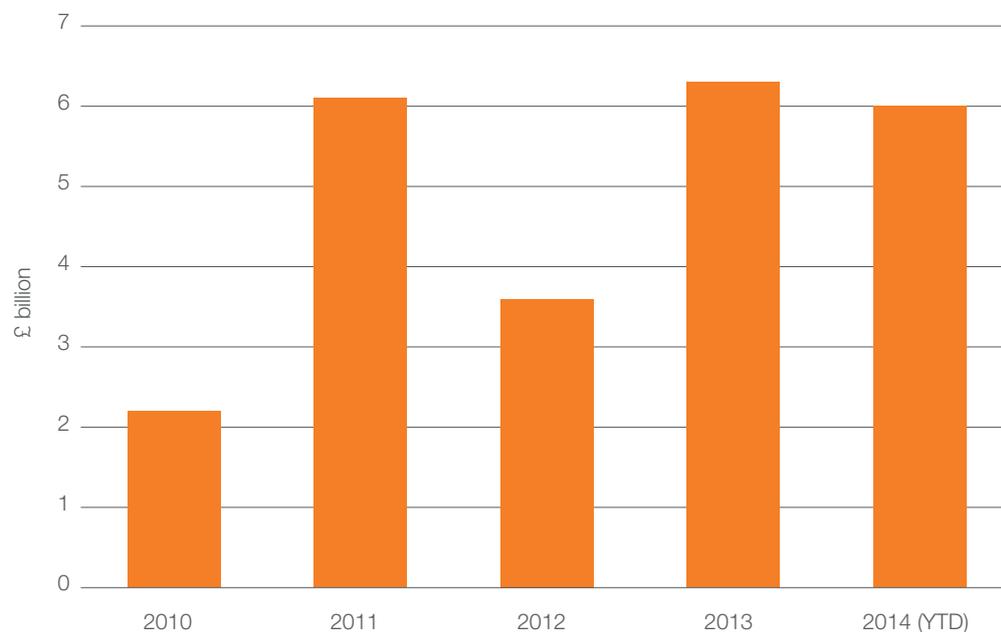
Nuclear	Investment to 2020-21: £45bn Investment opportunity: Up to £45bn Estimated Debt/Equity value: £22.5/£22.5bn	Specific projects:	Hinkley Point C – a 3.2GW facility in Somerset developed by NNB GenCo Moorside – a 3.6GW facility in Cumbria developed by NuGen Wylfa Newydd – a 2.7GW facility in Anglesey developed by Horizon Nuclear Power.
Offshore wind	Investment to 2020-21: £10.1bn Investment opportunity: Up to £7.5bn Estimated Debt/Equity value: £5.7/£1.9bn	Specific projects:	Beatrice – 664MW, Outer Moray Firth, SSE Renewables/Repsol Nuevas Energias Burbo Bank Extension – 258MW, Liverpool Bay, DONG Energy Dudgeon – 402MW, Norfolk coast, Statkraft/Statoil Hornsea – 1.2 GW, Yorkshire coast, DONG Energy Walney Extension – 660MW, Cumbrian Coast, DONG Energy
Carbon capture and storage (CCS)	Investment to 2020-21: ~ £3bn, including up to £1bn of government funding available. Investment opportunity: ~ £2bn	Specific projects:	Peterhead – a post combustion gas fired retro-fit CCS power station capable of capturing 1mt CO2 per year, Aberdeenshire, Shell with SSE Generation White Rose – a new 426MW oxy-fuel coal power station with CCS, capable of capturing 2mt CO2 per year, Yorkshire, Capture Power
Biomass	Investment to 2020-21: £1.2bn Investment opportunity: Up to £1.2bn Estimated Debt/Equity value: £0.7/£0.5bn	Specific projects:	Tees Renewable Energy Plant – 299MW biomass plant, Teeside, developed by MGT Teeside Lynemouth Biomass conversion – 420MW coal to biomass conversion, Northumberland, Lynemouth Power (RWE Npower)
Interconnectors	Investment to 2020-21: £5.3bn Investment opportunity: £2.8bn Estimated Debt/Equity value: £1.6/£1.2bn	Specific projects:	ElecLink – 1GW UK-France, Groupe Eurotunnel/Star Capital Partners FAB –1.4GW France-Alderney-Britain, RTE/Alderney RE/Transmission Investment Greenlink –0.5GW GB-Ireland interconnector, Element Power IFA2 – 1GW UK-France, National Grid and RTE NEMOLink – 1GW UK-Belgium interconnector, National Grid and Elia NSN –1.4GW UK-Norway interconnector, National Grid and Statnett. Viking Link – 0.7-1.4GW UK-Denmark, National Grid and Energinet.dk
Thames Tideway Tunnel	Investment to 2020-21: £4.2bn Investment opportunity: Up to £2.8bn Estimated Debt/Equity value: Up to £1.8bn/Up to £1bn	Specific projects:	Thames Tideway Tunnel – a 25km sewer under the Thames in London being developed by Thames Water
Other energy investment	Investment to 2020-21: Up to £18bn Investment opportunity: Up to £18bn Estimated Debt/Equity value: £13bn/£5bn	Specific sectors:	Offshore Transmission of up to £2.5bn (est. £2.25bn debt/£0.25bn equity) Large scale solar of up to £3bn (est.£2.4bn debt/£0.6bn equity) Onshore wind of up to £4.5bn (est. £3.6bn debt/£0.9bn equity) Gas generation of up to £2.3bn (est. £1.2bn debt/£1.2bn equity) Other renewable generation of up to £5.2bn (est. £3.1bn debt/£2.1bn equity)

Note: Values may not sum exactly due to rounding

## Sources of private finance for the 2014 infrastructure pipeline

14.24 The UK continues to be an attractive place to invest. Nabarro LLP's 2013 infrastructure index assessed the UK as number one for attracting investment. Recent trends suggest both debt and equity markets are increasingly willing and able to invest in UK infrastructure.

### Chart 14.C: Value of private sector investment transactions in UK infrastructure



Source: HM Treasury analysis, using InfraDeals Transactions Database

Please refer to 'Methodology and Sources for National Infrastructure Plan 2014' for further information

## Equity

14.25 Around £33 billion of project investment opportunity is estimated to be equity investment. Equity in UK infrastructure is provided by a range of entities in the market: developers, institutional investors and funds, as well as the supply chain.

14.26 The government expects **developers** to continue to be significant providers of a project's equity. However, large utilities remain balance sheet constrained as many are still highly leveraged, which restricts their capacity to make large-scale greenfield investment.

14.27 Therefore, **institutional investors** such as pension funds and insurance companies are also a potential source of equity investment, investing either directly or through equity funds. Institutional investors are particularly relevant for infrastructure as they are looking for longer-term investments to match defined liabilities that are realised when claims are made for pension or insurance purposes, and government bonds are less attractive as yields are currently low.

14.28 **Equity funds** are playing an important role in allowing developers to recycle their capital by taking stakes in projects. For example, in 2014 Greencoat and Swiss Life acquired developer AES's UK onshore wind portfolio for £175 million, and Equitix acquired a 50% stake in GDF Suez's 70MW UK wind portfolio. The new €150 million Allianz Renewable Energy Fund, managed by Allianz Global Investors, recently made its first investment in a solar farm north-east of London.<sup>3</sup> However this investor class still tend to invest in sectors where there is low regulatory, construction and technology risk.

14.29 There is also equity provision in UK infrastructure from the **supply chain**. Recent examples include equipment manufacturers such as Siemens, where Siemens Project Ventures will invest in a project if there is a strategic reason to do so, ie where it benefits from a supply contract. On the basis of this strategy, Siemens invested in both Gwynt-y-Mor and Lincs offshore wind farms.<sup>4</sup>

14.30 Equity investment in UK infrastructure is unlikely to be delivered by UK institutional investors, existing commercial banks and funds alone: **overseas investors** have a role to play. This is about ensuring deliverability, driving down the cost of capital by broadening the appetite for UK infrastructure, opening up our funding markets, and liberalising our energy markets.

14.31 The UK has attracted over £18 billion of large-scale equity investments in UK infrastructure projects since May 2010.<sup>5</sup> Recent examples are shown in Table 14.2.

**Table 14.2: Examples of foreign investment in UK infrastructure**

Date	Investor	Country	Investment (% stake in project)
Jun '14	Antin IP	France	Central Area Transmission System (Cats) (63%)
Aug '14	Marubeni	Japan	Westermost Rough Offshore Wind (25%)
Sep '14	Ontario Teachers' Pension Plan (OTPP)	Canada	Bristol Airport (49%)
	Abu Dhabi Future Energy Company (Masdar)	UAE	Dudgeon Offshore Wind (35%)
Oct '14	Ferrovial	Spain	Aberdeen/Glasgow/Southampton Airports (50%)
Nov '14	Copenhagen Infrastructure Partners	Denmark	Beatrice Offshore Wind (25%)

14.32 The UK reached a total of \$1,606 billion (£975 billion) last year in Foreign Direct Investment (FDI) stock, which is almost \$500 billion more than any other European country. Over half of the £975 billion FDI in the UK in 2013-14 is in energy or other infrastructure schemes, also creating 31,261 jobs.<sup>6</sup>

<sup>3</sup> InfraNews

<sup>4</sup> InfraDeals

<sup>5</sup> HM Treasury

<sup>6</sup> UNCTAD World Investment Report 2014.

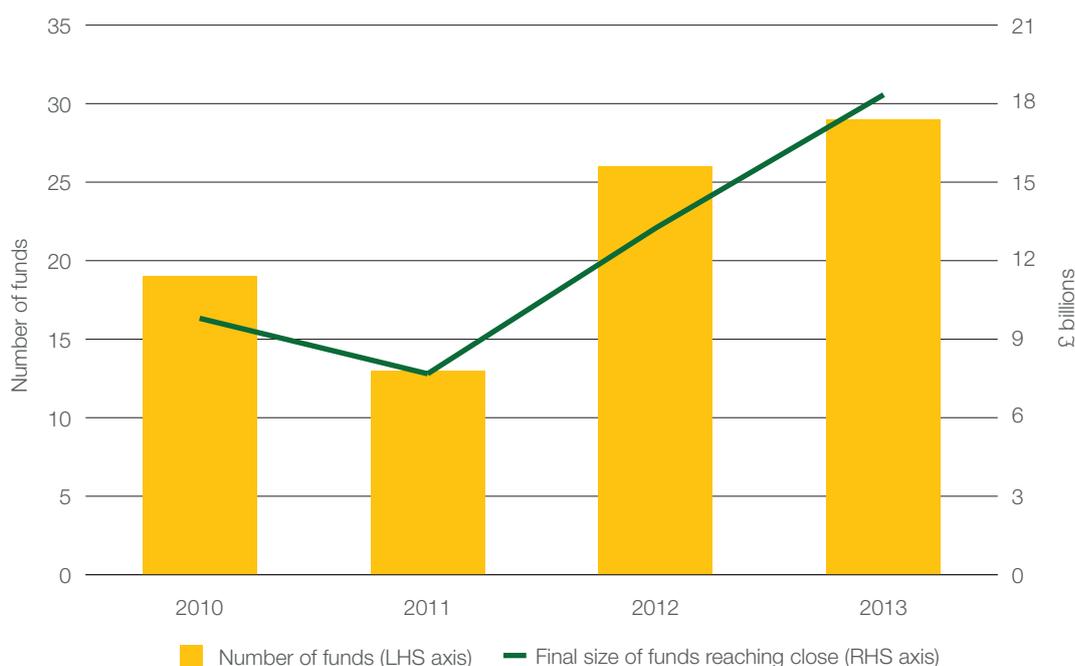
## Debt

14.33 Around £45 billion of the project investment opportunity is estimated to be debt financed. Despite contraction in lending activity as a result of the financial crisis, **commercial banks** are still significant players in infrastructure finance, and are again reporting increasing capacity to provide the longer-term lending required for infrastructure. According to the Deloitte Infrastructure Investors Survey 2013, many investors expect the terms and availability of debt financing for infrastructure to continue to improve over the next two years.<sup>7</sup> There is increasing liquidity in the debt market for new build assets provided that the investment proposition is well structured and the risk profile is appropriate. In the sectors that are more established such as onshore wind and solar, there is debt financing available for UK infrastructure projects in both construction and operational phases. Tenors available are also improving with Japanese banks in particular offering up to 30 years.<sup>8</sup> This is also reflected in debt terms that are again very favourable for investors.

14.34 Recent activity in sectors perceived as more risky, such as offshore wind, has shown some appetite for lending with longer tenors (particularly non-UK lenders) and lower margins. The syndication market has also returned where the project finance debt requirement is underwritten by a small number of lead banks who subsequently pass on some of their exposure to a second tier of banks. Since the financial crisis this market had been largely close and only club deals where the lead banks take and hold their respective commitment had been possible. An example of a recent syndication is the c.£290 million of senior debt raising by Antin to help fund its acquisition of a stake in the Central Area Transmission System (CATS) gas transmission network for the North Sea.

14.35 There are an increasing number of infrastructure debt funds either currently active or being set up. In 2013, ten unlisted infrastructure debt funds reached a final close, raising a record \$8.1 billion<sup>9</sup> globally.

**Chart 14.D: Unlisted infrastructure equity and debt funds with potential to invest in the UK**



Source: HM Treasury analysis, using Preqin data

Note: Please refer to 'Methodology and Sources for National Infrastructure Plan 2014' for further information

<sup>7</sup> Infrastructure Investors Survey, Deloitte, 2013

<sup>8</sup> HM Treasury market engagement, 2014

<sup>9</sup> The Importance of Infrastructure Debt, Preqin, May 2014

- 14.36 As show in Chart 14.D, the scale of equity and debt infrastructure funds with the potential to invest in the UK is increasing. However, appetite in both the debt and equity markets is strongest in established lower risk sectors where assets are operational, and evidence suggests that banks will take construction risk in more established sectors like solar and onshore wind. In general, appetite for less established sectors such as offshore wind is currently confined to around six to eight lenders which limits the size of deals that can be comfortably funded by banks.
- 14.37 However the 600MW Gemini offshore wind project in the Netherlands shows that significant finance can be raised, delivering €2 billion of senior debt with €800 million at risk, from 12 commercial banks and the **European Investment Bank (EIB)**, involving the support of three **export credit agencies (ECA)**.<sup>10</sup> Large deals in sectors such as this, particularly greenfield ones, broadly all involve some public backing either by EIB or ECAs or both. For the most risky and large-scale projects such as nuclear these are unlikely to be financed currently without government support measures such as the UK Guarantee Scheme.
- 14.38 To enable projects to be financed, there has been an emergence of alternative financing structures for infrastructure projects in the form of incorporated or unincorporated joint ventures. For example, in the UK offshore wind sector, DONG Energy – who is the developer for 4 offshore wind projects in the UK – aims to bring in a 50% joint venture partner within 12 months of the final investment decision, ie still during the construction period. The joint venture partner may decide to project finance their part of the investment and would normally aim to raise this finance as soon as practicable after entering the joint venture. In these structures DONG Energy has taken a flexible approach to construction risk. This together with the ability of the joint venture partner to borrow against its share of the project revenues creates a viable structure for attracting project finance in a relatively higher risk/return sector. A recent example of an incorporated joint venture structure is the offshore wind farm Westermost Rough (see Box 14.A).

#### **Box 14.A: Securing project financing: The Westermost Rough Example**

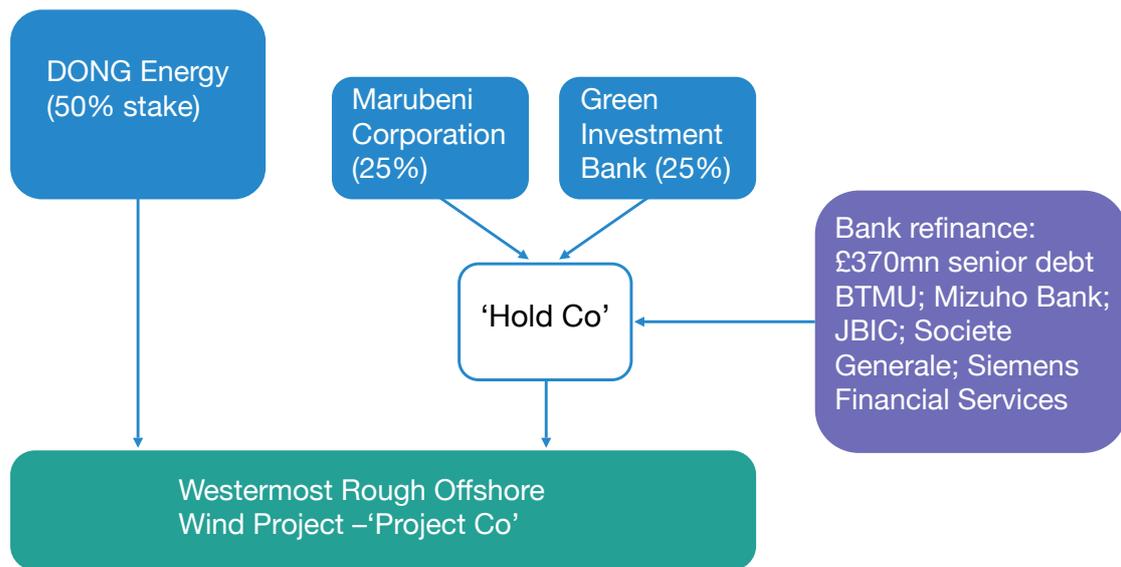
Westermost Rough is a 210MW wind farm off the coast of Yorkshire which was part of the Round 2 offshore wind farm tendering process. In 2007, DONG Energy became the developer of the project and in March 2014, after construction had started, sold a 50% stake to the Green Investment Bank (GIB) and Marubeni Corporation. In August 2014, GIB and Marubeni corporation refinanced most of their investment on the basis of its share of the project revenues by signing an agreement with banks for £370 million of senior debt.

GIB and Marubeni obtained debt financing from lenders including BTMU, Mizuho Bank, Japan Bank for International Cooperation, Societe Generale and Siemens Financial Services as shown in Chart 14.E.<sup>11</sup>

<sup>10</sup> InfraDeals

<sup>11</sup> InfraDeals

**Chart 14.E: Incorporated joint venture structure for Westermost Rough**



## Refinancing

- 14.39 Improvements in the market are also evidenced by the refinancing market. For example, DfT has issued refinancing notices on two significant transport projects: Intercity Express Programme Great Western Rolling Stock (c.£1 billion of commercial debt) and Thameslink rolling stock (c.£1.2 billion of commercial debt) and is actively considering opportunities to refinance and deliver value for the taxpayer on other projects. This reflects the reducing price of credit in the market making refinancing attractive for some infrastructure projects. There has also been significant debt refinancing activity in renewable energy. In addition to developers' equity being recycled by equity funds, developers are also taking out their equity by issuing debt as in the Westernmost Rough example mentioned above. Another example is Lightsource Renewable Energy, one of the UK's biggest solar developers, which has secured almost £200 million in project finance in the last year to support the refinancing of operational solar parks.<sup>12</sup>
- 14.40 With some positive trends in commercial bank lending, debt and equity fundraising and refinancing, as set out above, the government expects appetite for private investment in UK infrastructure to continue to improve, and financing for the infrastructure pipeline to be available. However the government recognises the challenges to securing finance and has put in place a number of policy measures and finance initiatives to promote private investment in UK infrastructure.



<sup>12</sup> InfraDeals

## Action to support private investment

### Box 14.B: Policy measures to support energy investment

New legally-binding Contracts for Difference (CfDs) are supporting investment in low-carbon energy generation. Under a CfD, the electricity generator is paid the difference between the ‘strike price’ – a price for electricity reflecting the cost of investing in a particular low-carbon technology – and the ‘reference price’ – a measure of the average market price for electricity in the GB market. It gives greater certainty and stability of revenues to electricity generators by reducing their exposure to volatile wholesale prices, whilst protecting consumers from paying for higher support costs when the market electricity prices are high. In April 2014, the government awarded investment contracts (early Contracts for Difference) to eight major renewable electricity projects. The first full CfD contract allocation round is due to conclude in early 2015. The budget for the first CfD allocation round is now £300m. The government has held back a significant part of the budget for future allocations within the Levy Control Framework cap. CfDs are available to a range of low-carbon energy generation including nuclear, offshore wind, and biomass.

The government is providing £1 billion of public funding for carbon capture and storage (CCS) technology through a commercialisation competition. £100 million has been set aside for the Peterhead and White Rose CCS projects to undertake FEED (Front End Engineering and Design) studies. In late 2015 the companies will take final investment decisions with the government taking decisions shortly afterwards.

The government recognises that investment in new gas plant capacity will be needed as back-up for less flexible renewable electricity generation to meet demand. The government is supporting investment in these assets via the Capacity Market, providing payment beginning in 2018-19 for reliable sources of capacity, alongside their electricity revenues, to ensure they deliver energy when needed.

Development of offshore projects requires development of offshore transmission infrastructure. Ofgem has introduced a stable and attractive regulatory regime for offshore transmission to secure revenues for Offshore Transmission Owner Assets (OFTOs), which has already secured financing from a wide range of investors in these assets. Ofgem grants licences to operate new offshore transmission assets via a competitive tender process, driving down costs. This innovative, competitive approach has saved generators and consumers £200-£400 million over the first tranche of projects.<sup>13</sup>

Increasing interconnection can reduce bills for consumers. For interconnectors between the UK and other countries, the UK has historically relied on merchant interconnectors, where private developers decide where to build interconnection (and how much to build) and recover their capital and returns by exploiting the price differences between interconnected markets. To support interconnection, Ofgem has launched a new “cap and floor” regulatory regime. Private developers still decide the location and capacity of interconnectors, but consumers guarantee a floor to the developer’s revenues in downside scenarios, in exchange for a cap on the revenues in upside cases. In addition, today the government is announcing that interconnectors will have access to the capacity market from 2015 to provide clarity and confidence to investors.

<sup>13</sup> <https://www.ofgem.gov.uk/publications-and-updates/consultation-cepabdo-evaluation-offshore-transmission-tender-round-1-benefits>

### Finance initiatives

14.42 While the trends in investment are showing signs of improvement and the government has introduced policy to support investment in energy generation and transmission, there are still challenges in securing finance, particularly given the large scale and perceived risks of some types of infrastructure. The government has therefore taken a number of steps to stimulate a range of different types of private investment in UK infrastructure.

14.43 The UK Guarantees Scheme (UKGS) was launched in 2012 to support investment in UK infrastructure. The government will engage with industry on the future of the UKGS, which is currently due to close in 2016.

#### Box 14.C: The UK Guarantees Scheme

UK flagship vehicle, with £40 billion worth of guarantees, to provide certainty to investors.

Government is using the strength of its credit rating to facilitate the provision of debt.

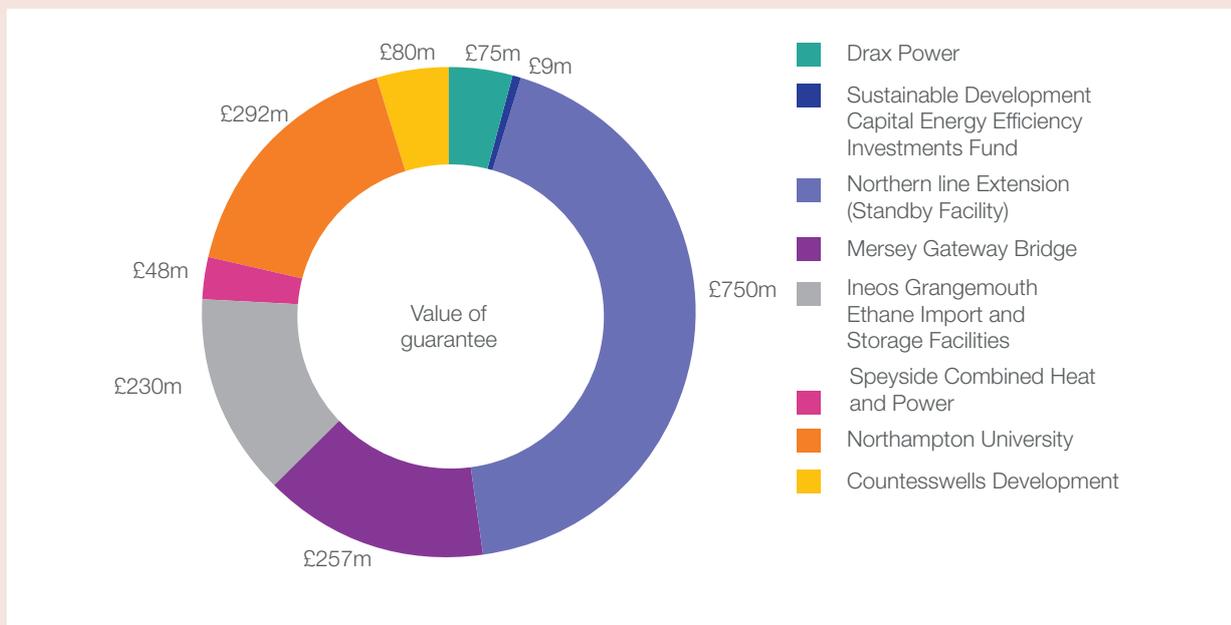
39 projects with a total capital value of £34 billion pre-qualified for the scheme.

7 guarantees and 1 standby facility signed or approved to date with a value of over £1.7 billion, supporting projects worth almost £4 billion.

In 2014, UKGS has underwritten £827 million of senior debt for greenfield projects in the UK – more than any other commercial lender (InfraDeals).

During 2014, over 50 institutional investors have funded infrastructure projects as result of UKGS.

#### Chart 14.F Guarantees and facilities signed or approved under the UK Guarantees Scheme to date



Source: HM Treasury

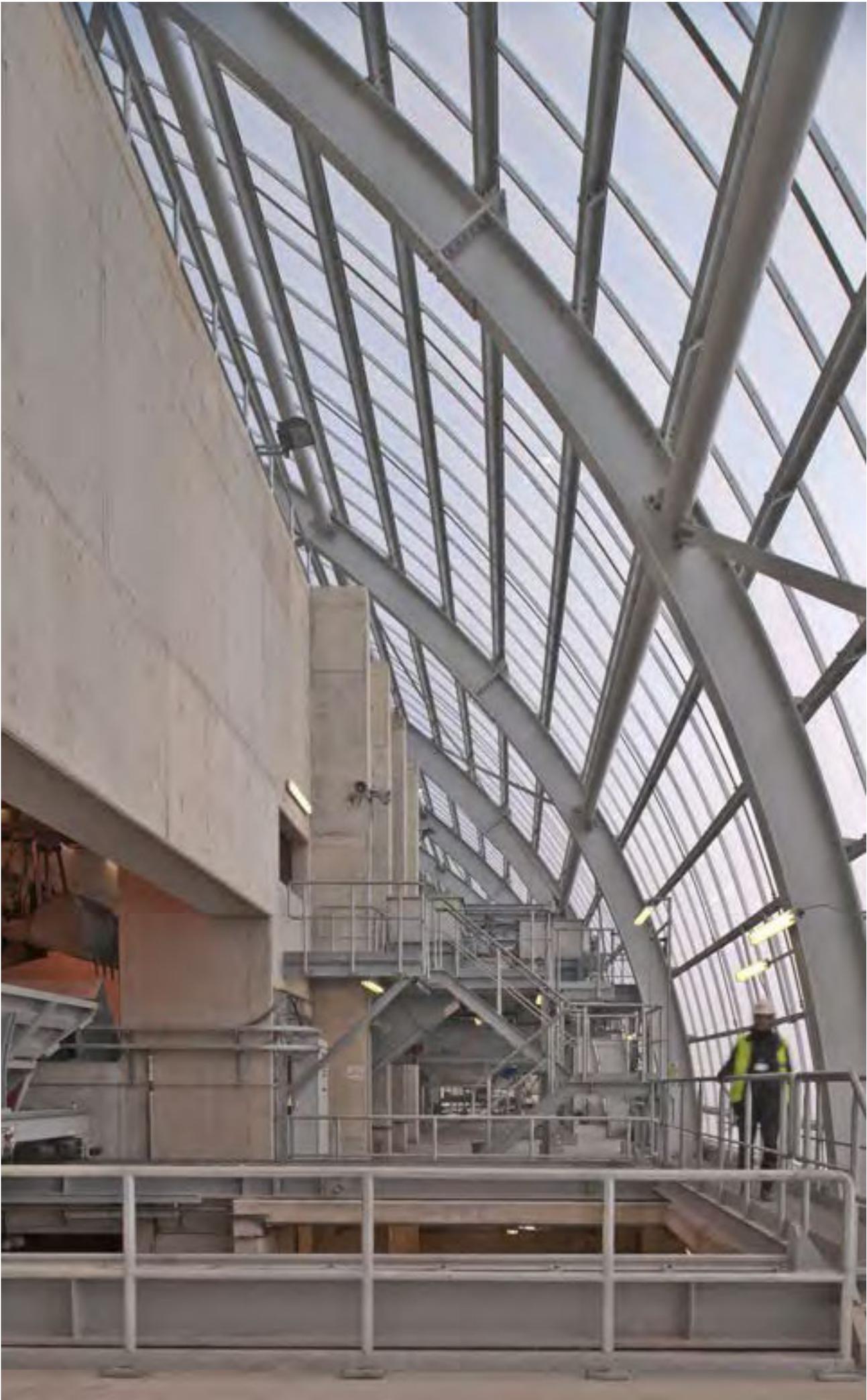
Please refer to 'Methodology and Sources for National Infrastructure Plan 2014' for further information

- 14.44 **The Green Investment Bank (GIB)** is the world's first investment bank dedicated to accelerating the transition to a green economy. With committed funding of £3.8 billion, the GIB is providing debt solutions to innovative, environmentally friendly sectors where the risk profile, particularly in innovative technologies, means there is currently a lack of sufficient support from private markets. The GIB has invested more than £1.4 billion in over 35 projects in over 200 communities across the UK, working with over 70 co-investors. In June 2014 the GIB announced plans to launch a £1 billion fund to acquire equity stakes in operational offshore wind projects in the UK. Equity investments in operational wind farms can offer a compelling opportunity for investors seeking long-term, inflation-linked returns and the GIB is now seeking a suitable group of strategic, long-term co-investors to participate in this innovative capital raising exercise.
- 14.45 The government is also encouraging greater involvement of institutional investors in UK infrastructure.
- 14.46 The government set up the **Insurers' Infrastructure Investment Forum** to give members of the Association of British Insurers (ABI) a direct communication link to government, exploring ways to maximise opportunities for insurance fund managers to invest in UK infrastructure debt instruments via the capital markets. In December 2013, and as a result of the new certainty over Solvency II, six insurers – Aviva, Friends Life, Legal & General, Prudential, Scottish Widows and Standard Life – said they will work alongside partners with the aim of delivering £25 billion of investment in UK infrastructure in the next five years.



- 14.47 As part of the **PF2 Priority Schools Building Programme** the Education Funding Agency (EFA) has developed and procured an innovative senior debt finance vehicle which will fund all five batches of schools under the programme. One of the key features of the **debt aggregator** is the ability to aggregate total financing requirements across all of the batches but without common ownership of equity at the project level. By aggregating the funding requirements, the EFA has been able to access cheaper sources of finance, and streamline its procurement by using standardised finance documents for each batch of schools. EFA has now signed a Funding Procurement Agreement with the aggregator which is a wholly owned subsidiary of International Public Partnerships Limited, with services provided by Amber Infrastructure Limited, and senior funding provided by Aviva and the European Investment Bank. PF2 is a public private partnership model that is used primarily for social infrastructure projects and where government invests equity alongside the private sector to promote closer partnership working.
- 14.48 The **Pensions Infrastructure Platform (PiP)** was announced in 2011 to help make infrastructure investment more accessible to UK pension schemes. HM Treasury signed a memorandum of understanding with the National Association of Pension Funds (NAPF) and the Pension Protection Fund (PPF) to assume an advisory role in establishing the PiP. In February this year, the PPP Equity PIP LP fund was launched. This first PIP fund invests in UK PPP/PFI project equity and is being managed by Dalmore Capital. It has a hard cap of £600 million and currently has commitments of £348 million. Two thirds of this has already been invested into 41 separate projects. In September, PiP appointed its first Chief Executive to accelerate development of the organisation and to promote it to all UK pension schemes. Additional investment funds and co-investment opportunities are being worked on with the support of the PiP's UK Founding Investor pension schemes. PiP retains its original £2 billion target for investment into UK infrastructure by UK pension schemes.
- 14.49 At the European level, the **European Investment Bank (EIB)** is another source of finance for infrastructure projects in the UK. In recent years the EIB has significantly increased its support for long-term investment across a range of sectors in the UK. Record lending last year provided nearly £5 billion for investment in water and energy infrastructure, support for improved rail and port facilities, loans to support new hospitals, housing and development of higher and further education across the country. The EIB has just agreed its largest ever single loan for any project in Europe, £1.5 billion for investment in energy infrastructure by National Grid. The National Grid loan is for a range of capital investments, including the Western Link and London Power tunnels, as well as upgrading transmission infrastructure across the country. Under the EU's recently announced Investment Plan for Europe, further work is underway to use EU resources and institutions to facilitate €315 billion of investment across Member States. The infrastructure pipeline has enabled the UK to be on the front foot in proposing up to £60 billion of investment that could be eligible for support from the proposed €315 billion EU Investment Plan. The UK's approach of producing a clear, rigorous pipeline across all infrastructure sectors is seen as an exemplar for other EU countries looking to identify planned investment and engage the private sector.





# Chapter 15:

## Planning, performance and delivery

### Box 15.A: Announcements on planning, performance and delivery

- **Compulsory Purchase Reforms** – proposals will be published for consultation at Budget 2015 to make processes clearer, faster and fairer, with the aim of bringing forward more brownfield land for development
- **National Transport Policy** – the government plans to lay the National Networks National Policy Statement before Parliament this month for consideration and a formal vote
- **Establishing the principle of development** – the government will take forward measures to ensure that the principle of development need only be established once
- **Section 106 negotiations** – the government will take steps to speed up section 106 negotiations, to reduce delays to the planning process
- **Speed of decisions (DCLG)** – the government will keep the speed of major decisions under review, with minimum performance thresholds increasing to 50% of major decisions made on time as performance improves

15.1 Since 2010 Infrastructure UK has worked closely with other government departments and agencies, the construction industry, regulators, clients and promoters of projects to drive improved infrastructure delivery and performance across both the public and private sectors. Its focus now is to build on this success, and the success of major projects like the Olympics and Crossrail, in addressing the next phase of delivery challenges.

### Improving government client-side capability

15.2 Since 2010, the government has successfully transformed its approach to planning, tracking and delivering its infrastructure programme. This includes:

- using the NIP as a tool for driving delivery of the government's infrastructure agenda, including through the development of a clear set of priority investments (the 'Top 40') with a strong link to the government's overall strategy and objectives in those sectors
- establishing a new Major Infrastructure Tracking (MIT) team within Infrastructure UK to professionalise its approach to programme managing delivery of the government's infrastructure priorities; this includes a more robust and reliable pipeline and much improved monitoring of delivery progress and risks across the different infrastructure sectors, and an enhanced ability to identify where strategic interventions may be required

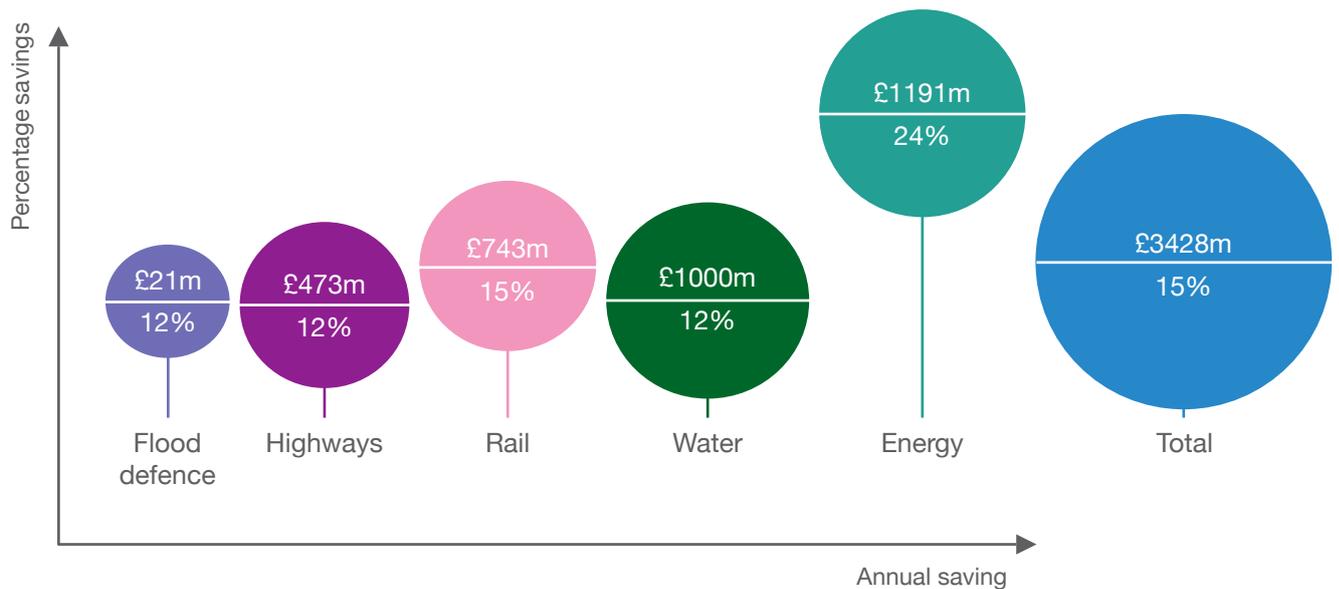
- deploying commercial specialists from IUK alongside government departments to help secure the contractual arrangements for delivery of critical infrastructure projects, including: Mersey Gateway Bridge, the Northern Line Extension to Battersea, rural broadband, Thames Estuary (phase 1), and ongoing negotiations for Hinkley Point C, Thames Tideway Tunnel, Ebbsfleet Garden City and High Speed Two
- creating a dedicated Cabinet Committee for infrastructure, chaired by the Chief Secretary to the Treasury and including Ministers from all the key infrastructure Departments, which oversees progress on the infrastructure programme and agrees early actions to address any obstacles to delivery
- utilising the expertise of key industry stakeholders to help deliver the NIP through the creation of the National Infrastructure Plan Strategic Engagement Forum (NIPSEF); through NIPSEF, the government has developed a strategic dialogue with the finance, asset owner, supply chain and business communities, allowing it to understand industry views, take advice on barriers to delivery and better communicate actions the government is taking
- improving the commercial capability of key infrastructure departments (DFT, DECC, DEFRA and DCMS), through Lord Deighton's work on Infrastructure Capacity Plans and the introduction of a new presumption that significant economic infrastructure projects and programmes should be supported by specialist delivery units with the appropriate commercial expertise

15.3 The government will continue to embed these changes, and ensuring that the right capability and systems are in place for successful delivery will remain a key focus at all levels of government.

## Working with industry to reduce costs and drive performance

### Progress to date

- 15.4 In 2010, Infrastructure UK launched the Infrastructure Cost Review, an investigation into the drivers of higher costs and poor delivery outcomes in the UK. The investigation led to a three-year joint programme with industry to improve infrastructure delivery in the UK. The programme sought to improve pipeline certainty, promote collaborative behaviours and innovation and reduce the costs of delivery by around 15%.
- 15.5 Working with the Infrastructure Client Group (ICG), a group of leading clients from across sectors, the programme has reported annual savings of over £3 billion (as set out in Chart 15.A) and set in place a number of improvements that are helping to improve delivery of our key infrastructure projects.
- 15.6 In 2011, the government published the first infrastructure investment pipeline, setting out in one place the investment plans of infrastructure clients from the public, private and regulated sectors, providing a holistic view of the demand for infrastructure investment across sectors and regions. This allows industry to match their business planning with projections of future demand, enabling industry to invest strategically for the market, rather than simply tactically for a project. The breadth and depth of the pipeline, which is now published twice annually, has increased year-on-year and the government is committed to improving its utility to industry.

**Chart 15.A: Savings as measured in the Cost Review**

Source: HM Treasury

15.7 The Cost Review<sup>1</sup> was one of a number of studies to identify the need for a greater focus on the early stages of projects to ensure that they are set up to succeed. The government has worked with industry to develop a “Project Initiation Routemap”. It provides a framework to help identify and address many common and recurring problems during the early stages of projects. Following an industry-wide consultation in 2013, the government published in July 2014 a refreshed and improved version of the Routemap tools and modules.

15.8 Eleven Routemap assessments have been undertaken for nine different clients in five sectors, helping to support successful project delivery on major infrastructure projects worth over £60 billion.

“Using the Routemap is like holding a mirror up to yourself. It helps you to understand the environment you have and create the one you need”

Andy Mitchell, CEO Thames Tideway Tunnel

15.9 The Cost Review study also set out opportunities to improve procurement outcomes through earlier engagement with supply chains and a more collaborative approach. In October 2014 new guidance was published through the ICG providing support to those wishing to use more collaborative supply chain engagement through alliancing.

15.10 As a result of increasing levels of investment in infrastructure across the public, private and regulated sectors, there is a growing pressure on input costs and demand for skilled workers.

15.11 The Construction Skills Network forecasts overall construction employment rising from 2.54 million in 2014 to 2.73 million in 2019. At the same time, a high proportion of those currently employed in key sectors of the industry will soon retire.<sup>2</sup> These factors suggest that, without appropriate action, the industry could face a skills shortage.

<sup>1</sup> Infrastructure UK Cost Review Report, HM Treasury, 2010

<sup>2</sup> In the power sector, an estimated 50% of current employees are set to leave the sector by 2023, and in rail, 20% of the workforce is over 55

15.12 The government and industry are undertaking a number of initiatives to address skills supply issues that are already well evidenced. These include:

- EngTechNow scheme, aiming to increase “Engineering Technician” professional registrations
- support through BIS competitive funds and the National Colleges programme to develop skills capacity
- £30m fund established by BIS which seeks to increase the supply of engineers, especially female engineers
- individual client led programmes and Joint Ventures – mainly specialist colleges such as the Tunnelling Academy and similar initiatives in highways, power, and flood defence

15.13 The Infrastructure Carbon Review<sup>3</sup> recognised the potential benefits of considering whole life carbon as a driver of lower lifetime costs. The government, infrastructure clients, and suppliers have agreed to incorporate carbon reduction objectives within their infrastructure projects and programmes by 2016. The government will also work alongside the Green Construction Board to develop a new carbon standard.

### Key actions to 2020

15.14 Feedback from industry – both clients and suppliers – suggests that there are further opportunities for improvement. The next stage of the Infrastructure Cost programme was launched in October 2014. The refreshed programme embeds further government’s partnership with industry through the Infrastructure Client Group and will focus on the following areas:

- **improving pipeline visibility and certainty:** the pipeline will only maximise its effectiveness if it gives the supply chain the confidence to invest; the government will continue to develop the pipeline and how it is used to monitor performance, and will work with delivery bodies and clients to ensure that the investment pipeline flows through to the supply chain in work packages; it will also continue to promote the development of more granular local pipelines and delivery plans such as those already being developed in the North West, West Midlands and London
- **whole life planning and cost control:** the roads and flood defence programmes are already building on the benefits of long-term funding, by adopting best practice from private and regulated sectors; IUK will continue to work with departments and industry to support the adoption of improved asset management and whole-life principles alongside the ongoing ICG work on carbon reduction, risk management and standards
- **improving project initiation:** the government will continue to extend the implementation of the Routemap across the Top 40 projects and will incorporate it into the Major Project Authority’s assurance and approval processes; it will also make it a tool available to LEPs in implementing their Strategic Economic Plans
- **improving procurement:** building on work of the Infrastructure Alliancing Group, an overarching set of objectives and principles is being developed to drive smarter, faster and more effective risk allocation in procurements; these objectives will be underpinned by measures to embed alliancing best practice and collaborative working; consideration will also be given to how procurement can be used appropriately to encourage

<sup>3</sup> Infrastructure Carbon Review, HM Treasury, November 2013

investment in innovation and skills and to developing a standardised approach to measuring and sharing information on supplier performance

- **supply chain productivity and skills:** the government is investing to deliver the key skills required to meet the requirements of the infrastructure pipeline and improve delivery productivity; the government will shortly set out more details around the National Colleges programme which will create high status technical training institutions, targeting critical skills gaps; the government has announced its intention to create a National College for High Speed Rail, a college for onshore oil and gas to support the Shale industry and a National Nuclear College; further national colleges are expected to be forthcoming in response to the recent call for engagement; to support further action and coordination across the infrastructure sector and training providers, IUK is using the infrastructure pipeline to build a stronger evidence base of expected demand and the potential skills gaps; the result of this work will be published in spring 2015

15.15 The Infrastructure Cost programme will continue to be coordinated alongside the government's wider ambitions for the construction sector as set out in the Industrial Strategy for Construction, Construction 2025.

### **Box 15.B: Case Study: Rail skills**

The new academy for rail, jointly funded by the government and the rail industry, will give a new generation of young people the skills to succeed.

Opening in autumn 2015, the academy will boost the UK's expertise and skills level in rail engineering, plugging the skills gap that could otherwise become a barrier to growth. Thousands of young people will gain vital training in specialist traction and rolling stock and many others will learn the skills they need to respond to new technology in the UK rail industry.

The Department for Transport, the Department for Business, Innovation & Skills and the National Skills Academy for Rail Engineering have provided £3.5 million for the National Training Academy for Rail (NTAR), with industry partner Siemens contributing the rest.

## **Streamlining the planning and consenting systems**

15.16 Improving the efficiency and speed of the planning process, particularly for infrastructure delivery, is a crucial part of creating the right conditions for sustainable growth.

### **Progress to date**

15.17 The government has taken a number of steps to improve the planning system over this Parliament, including:

- introducing a presumption in favour of sustainable development in the National Planning Policy Framework
- establishing the Major Infrastructure Unit in the Planning Inspectorate to speed up the application process for major infrastructure projects
- establishing a new Planning Court to speed up the judicial review process
- radically streamlining planning policy and guidance
- making changes to the Nationally Significant Infrastructure Planning (NSIP) regime in response to a 2014 review:

- publishing a prospectus to help with the pre-application process, including arrangements for handling early advice provided to the Planning Inspectorate by developers
- improving training and practice to ensure greater consistency of examination hearings
- ensuring applications are published without delay, allowing more time to study documents without lengthening the overall timetable

15.18 These reforms are working. The NSIP regime has bedded in well and 97% of all applications have been approved, with all but one of the decisions made within the prescribed deadlines. The latest figures show that local planning authority approval rates are at a 10-year high, with authorities granting 350,000 permissions (including approvals for 230,000 new homes) in the year to June. 80% of local planning authorities now have at least a published Local Plan (compared to less than a third in 2010), and nearly 60% have an adopted plan in place.<sup>4</sup>

15.19 Early outcomes from the government's new Planning Court show a significant reduction in the time taken to deal with Judicial Review cases. The important early stage of deciding whether a case has the merit to proceed to a hearing has fallen by around 40% from 15 weeks (in the 12 months to April 2013) to 9 weeks (in the 12 months to September 2014). Furthermore, the time taken from lodging a claim to reaching a decision at a final hearing has fallen by around 30% from 54 weeks (in the 12 months to April 2013) to 39 weeks (in the 12 months to September 2014).<sup>5</sup>

### Key actions to 2020

15.20 The Government believes that the compulsory purchase regime would benefit from streamlining and updating. Proposals will be published for consultation at Budget 2015 to make processes clearer, faster and fairer, with the aim of bringing forward more brownfield land for development.

15.21 The government is also continuing to make practical improvements to the Nationally Significant Infrastructure Planning regime and will take forward work to:

- bring more non-planning consents into the Development Consent Order regime, starting with three consents covering water discharge and trade effluent during this Parliament; the European Protected Species licence will be brought into the regime early in the new Parliament, once a legislative vehicle is identified, in a way that ensures robust decision making; the government is currently working towards bringing flood defence consents into the environmental permitting framework next year, followed by water abstraction and impoundment licenses as soon as possible after that.
- consult on options in 2015 for combining the two-stage process of making written and relevant representations into a single longer stage; this could make it easier for communities and others to engage with the regime and reduce the scope for duplication of effort
- create a more proportionate process for handling changes to Development Consent Orders, post consent, (through the Infrastructure Bill)

<sup>4</sup> Department for Communities and Local Government

<sup>5</sup> Ministry of Justice

- allow two inspectors for examinations instead of the current stipulation for one or three, which could save small schemes around £100,000 per application, (through the Infrastructure Bill)
- allow for the appointment of the Examining Authority as soon as an application has been accepted, to make process more efficient, (through the Infrastructure Bill)
- clarify guidance on the expectations for Preliminary Environmental Information and how to make changes to proposals during examinations
- lay the National Networks National Policy Statement before Parliament in December

15.22 The government will continue to improve the planning system for infrastructure outside of the NSIP regime. Autumn Statement 2013 announced a comprehensive package of measures to speed up planning decisions. This included ‘deemed discharge’ of planning conditions and reducing unnecessary statutory consultation, which have been taken forward through the Infrastructure Bill and new regulations.

15.23 Building on this progress, the government will take further measures to speed up the end-to-end planning process, including:

- taking forward measures to ensure that the principle of development need only be established once, to give greater certainty and allow locally-supported development to proceed more quickly
- taking steps to speed up section 106 negotiations, including revised guidance, consulting on a faster process for reaching agreement, and considering how timescales for agreement could be introduced, and improving transparency on the use of section 106 funds
- keeping the speed of decisions on major applications under review, with the minimum performance threshold increasing to 50% of major decisions on time as performance continues to improve

## Infrastructure interdependence, resilience and cross-sectoral working

15.24 The UK infrastructure system is a highly complex, interdependent set of networks and assets that rely on each other to work effectively. The government is working with academia, regulators and industry to develop a more strategic, coordinated and efficient approach to future infrastructure development and delivery, with the aim of saving costs and increasing value – ensuring that we get right what we build, as well as where and how we build it.

15.25 It is also vital that these assets are sufficiently resilient to absorb, adapt to or rapidly recover from a disruptive event whether that be adverse weather, terrorist or cyber-attacks, industrial action or simply degradation over time. Across the UK, some elements of our national infrastructure are designated by government as Critical National Infrastructure (CNI). The concept of CNI exists to enable government, regulators, and industry to prioritise efforts to harden and protect assets essential to daily life, to ensure continuity of service to the public. With an agreed and prioritised list of assets, resources can be deployed as effectively as possible to protect the infrastructure that is deemed most critical. Protecting the UK’s CNI relies upon close co-operation and collaboration between industry and government.

15.26 Departments responsible for CNI have submitted their Sector Resilience Plans (SRPs) to the Cabinet Office. A summary of the SRPs setting out the current level of resilience to risks of UK infrastructure was published in November.<sup>6</sup>

### Progress since 2010

15.27 The UK Regulators Network (UKRN) was formed in March 2014 with the purpose of ensuring effective cooperation between sectors. It will explain and take account of the differences between sectors, while maximising coherence and shared approaches in the interests of consumers and the economy. The UKRN's work programme consists of 8 projects and 6 objectives, including specific workstreams on efficient multi-sector infrastructure investment projects, affordability and cross sector resilience<sup>7</sup>.

15.28 The government initiated the development of a new methodology to assist with the planning and management of interdependencies. The Interdependency Planning and Management Framework (IPMF)<sup>8</sup>, published in November, enables the identification and appraisal of cross-sectoral delivery benefits and facilitates engagement between stakeholders. It was developed in a joint research programme between the University of Bristol and University College London.

15.29 The IPMF is currently being incorporated into Green Book supplementary guidance on valuing infrastructure spend, which is due to be available in early 2015. This work will ensure that interdependencies can be properly identified, valued and the associated impacts realised from the inception of major government-funded infrastructure investments.

15.30 The government is taking advantage of opportunities for synchronised or co-located investment to 'future-proof' our networks and systems. This is considerably cheaper and less disruptive overall in the long term than creating new networks separately at a later date. For example, the HS2 Hybrid Bill includes clauses allowing the inclusion of telecommunications equipment in the future along the route of HS2 Phase One (from London to Birmingham) based on evidence of a projected increase in data capacity requirements. The proposal to allow other types of infrastructure to use the route has also been incorporated into the consultation document for HS2 Phase Two.

15.31 The understanding of interdependence is also being improved by two multi-disciplinary research centres (iBUILD<sup>9</sup> and the International Centre for Infrastructure Futures<sup>10</sup>). These were launched in 2013 to investigate innovative infrastructure business models, and bring together expertise in fields such as economics, engineering and social sciences.

### Key actions to 2020

15.32 The government has recently held a consultation on whether further measures would support and embed the work of the UKRN, and will respond in due course. The UKRN will also publish further reports as part of its work programme, including work on cross-sectoral resilience.

<sup>6</sup> [www.gov.uk/government/publications/sector-resilience-plan-2014](http://www.gov.uk/government/publications/sector-resilience-plan-2014)

<sup>7</sup> UKRN work plan 2014. [www.ukrn.org.uk/wp-content/uploads/2014/05/UKRN-2014-15-work-programme.pdf](http://www.ukrn.org.uk/wp-content/uploads/2014/05/UKRN-2014-15-work-programme.pdf)

<sup>8</sup> Development of a Proposed Interdependency Planning and Management Framework, International Centre for Infrastructure Futures, 2014

<sup>9</sup> <https://research.ncl.ac.uk/ibuild/>

<sup>10</sup> <http://www.icif.ac.uk/index.html>

- 15.33 Organisations across government and the regulated sectors have been working together to investigate how utility connections can be achieved more effectively, to help the development of housing and economic activity. This work covers the co-ordination of new connections and improving the understanding of capacity requirements going forwards. In December, the government will produce a document which will provide a single point of reference for developers on the most up to date roles, responsibilities and expectations of different parties involved in the process of delivering utilities connections.
- 15.34 IUK will explore the technical, commercial and legislative feasibility of using the fibre cabling that supports wind farms for commercial communications services including broadband for rural communities.

#### **Box 15.C: Case Study: Flood defences: resilience and cross-sectoral working**

Coastal flood defences can bring combined benefits of greater resilience and economic growth across a number of sectors. As an example, Mounts Bay in Penzance is currently considering how best it can address the risk of coastal flooding for its community. A breakwater could strengthen flood defences, but also bring much wider benefits such as enabling more local and visiting boats to safely harbour, protecting vulnerable local infrastructure and attracting possible private investment in a marina. Working alongside Cornwall Council and Penzance Town Council, government has now made funding available for a study to appraise the best options going forward. The results will have impact across the community and help this area grow and thrive.

Multiple organisations will also have a role to play in a 20 year action plan to reduce the risk of flooding in Somerset. The plan, developed in March 2014, contains key objectives which go beyond simply reducing the frequency, depth and duration of flooding. It also includes maintaining access for communities and businesses, ensuring strategic transport connectivity, and promoting business confidence and local resilience. Immediate delivery of the Action Plan is being overseen by an Implementation Group, led by Somerset County Council and also consisting of local and national partners. Central government is supporting the delivery of the plan with a £20.5 million contribution, announced in March 2014.



# Chapter 16:

## Top 40 priority infrastructure investments

### Introduction

- 16.1 To support delivery of its objectives in each sector, since 2011 the government has set out its 'Top 40 priority infrastructure investments'. This allows the government to focus on the delivery of those investments which either make the most significant contribution towards achieving a particular objective or carry the most risk should they fail, both strategically and in value for money terms.
- 16.2 As set out in the previous chapter, the government monitors delivery against the Top 40 priority investments, and key projects and programmes within them, through the Major Infrastructure Tracking Unit within Infrastructure UK. A Cabinet Sub-Committee, chaired by the Chief Secretary to the Treasury, meets regularly to scrutinise progress and support as appropriate in tackling specific delivery challenges and cross-cutting issues.
- 16.3 The government has also identified other levers that it can use to support effective delivery of these priority investments. These include operating a presumption in favour of prequalification for the UK Guarantees Scheme for any project that is part of a 'Top 40' priority investment, subject to the Scheme's criteria. The government will also ensure that it gives regard to the 'Top 40' designation when considering applications for the Nationally Significant Infrastructure Planning Regime.

### Selection of Top 40 priority infrastructure investments

- 16.4 Given the scale of the government's infrastructure commitments, the Top 40 is necessarily diverse and spans both the public and private sectors, and includes projects both currently in construction and some which are still in the scoping stages, with delivery milestones stretching beyond 2020. The current full list of Top 40 priority infrastructure investments, including key projects and programmes, is set out in Table 16.1 at the end of this chapter.
- 16.5 Top 40 priority investments, are selected on the basis of three main criteria:
- potential contribution to economic growth
  - nationally significant investment that delivers substantial new or replacement infrastructure with enhanced quality, sustainability and capacity
  - projects that attract or unlock significant private investment

16.6 Priority investments are grouped by sector and are not listed in order of importance. Whilst some individual projects are large or significant enough to be included within the Top 40 in their own right, in many cases the priority investment will be a wider programme, with key projects from within that programme identified for closer scrutiny. Key projects are chosen based on one or more of the following criteria:

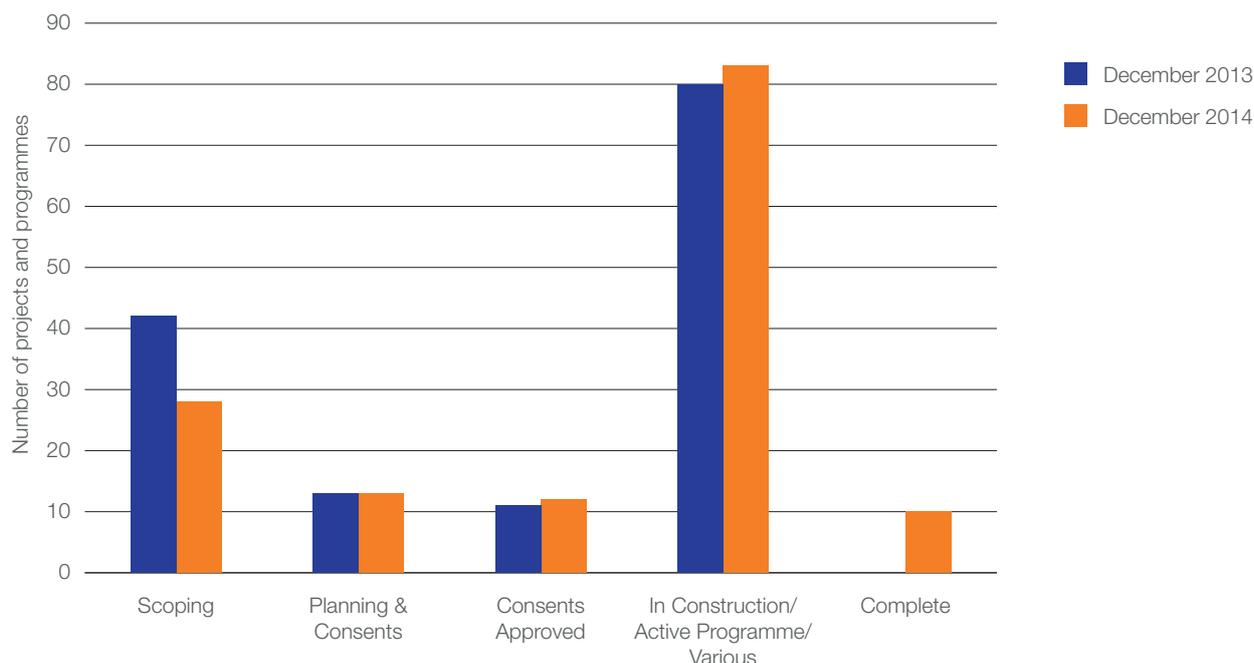
- Strategic importance (SI): project delivers a significant contribution towards an objective
- Capital value (CV): project of significant capital value
- Regional priority (RP): project of high strategic importance or capital value in a region
- Demonstrator (D): project is innovative or novel and could improve future delivery
- Unlocking investment (UI): project enables significant private sector investment

### **Progress on the government's Top 40 investments since NIP 2013**

16.7 Chart 16.A highlights progress on the government's Top 40 priority investments since NIP 13. It demonstrates that, with government support, key projects and programmes are moving from the early stages of delivery (scoping, planning and consents) into construction and completion.

16.8 The chart shows that a number of the key projects within the Top 40 priority investments highlighted in NIP 13 have been successfully delivered during the past year. These are listed below:

- M25 Junctions 5 to 6/7 and Junctions 23 to 27 (Smart Motorways)
- Network Rail Control Period 4 key projects: Southern Train Lengthening, West Coast Main Line and East Coast Main Line (Line Capacity Improvements)
- Peterborough and Reading stations (Major Station Improvements)
- Birmingham runway extension (Regional Airports)
- Heathrow and Gatwick Quinquennial 5 capital investment, including Heathrow Terminal 2 (South East Airports)
- National Composites Centre Expansion (Science and Innovation Catapults)
- Manchester Metrolink Extension (Local Authority Major Transport Schemes)

**Chart 16.A: Status of NIP 2013 Top 40 projects and programmes**

Source: HM Treasury, Major Infrastructure Tracking Unit

## Changes to the Top 40 since NIP 13

- 16.9 The Top 40 is not a static list, but is refreshed on an annual basis to reflect changes in project status and ensure that it continues to reflect the government's priorities in each infrastructure sector. This is essential if it is to remain an effective tool for monitoring and supporting progress in infrastructure delivery. The government particularly focuses on adding new projects that are at an early stage of development, as this is where it can often have most influence in driving progress.
- 16.10 To reflect the progress highlighted above, completed projects have now been removed from the list.
- 16.11 The government has also decided to remove two funding categories from the Top 40, containing three separate infrastructure funds; the Research Partnerships Investment Fund and Local Infrastructure Funding (Regional Growth Fund and Growing Places Fund). This decision reflects that the current phases of these funds have now been fully allocated to a large number of relatively small projects, which are not being delivered directly by central government.
- 16.12 In the rail sector, the government has reorganised the way it categorises investment by introducing a new Rail Investment Strategy priority investment (replacing the previous categories for Electrification, Line Capacity Improvements and Northern Connectivity). This is to better align with reporting structures and public understanding of how this investment is delivered. This includes a number of regional enhancements as key programmes, ensuring that the Great Western Programme, Northern Hub and East-West Rail, amongst others, continue to be effectively monitored and driven forward. A new priority investment, the European Rail Traffic Management System has also been added.

16.13 In the aviation sector the decision has been taken to move away from a geographic split (South East and Regional Airports) to priority investments which address objectives more directly (Airport Infrastructure Improvements and Airport Connectivity). Port Connectivity is also included in the latter category as this supports the government's overall strategic objectives in a similar way.

16.14 In the roads, flood defence and science sectors, the publication of new strategies and more detailed capital investment plans has inevitably required a considered reprioritisation of key projects. This means the A303/A30/A358 Corridor and A1 (North East) road programmes become priority investments in their own right given their significant capital value, strategic and regional importance. The Highways Agency New Capacity category has been renamed as Strategic Road Network Capacity. The A1 Leeming to Barton key project will now be monitored as part of the wider A1 priority investment.

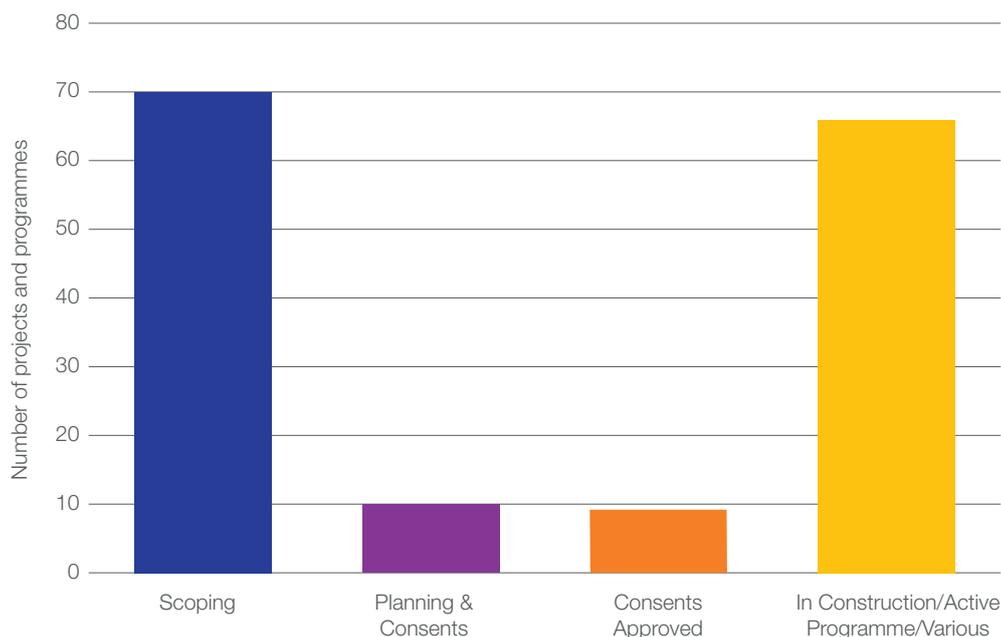
16.15 The government has identified six new flood defence key projects which were included in the Top 40 in NIP 13 combined will cost more than £700 million. Given that all nine flood growth schemes are expected to be under construction by the end of 2014-15, these will no longer be tracked as individual key projects but will still be monitored as part of the wider programme.

16.16 Similarly, the key projects in the Science Majors priority investment were selected based on the capital value of the investment at stake. Reflecting decisions taken since NIP 13, the government is introducing the new Polar Research Ship to its list of Science Majors. Further projects may be added in line with the priorities set out in the forthcoming Science and Innovation Strategy.

16.17 In the energy sector, the government's commitment to increase electricity interconnection is reflected in a new priority investment.

16.18 The delivery status of the new Top 40 is shown in Chart 16.B. As would be expected, there are a higher number of projects in the new Top 40 which are in scoping, reflecting the government's continuing commitment to supporting the development of new infrastructure projects and programmes, particularly in their early stages.

**Chart 16.B: Status of NIP 2014 Top 40 projects and programmes at December 2014**



Source: HM Treasury, Major Infrastructure Tracking Unit

**Table 16.1: Full list of Top 40 priority infrastructure investments in NIP 2014 (including selection criteria)**

Priority investment	Key projects/programmes	Selection criteria
<b>Roads</b>		
1 Accelerated Roads	M3 Junctions 2 to 4a	D
	M6 Junctions 10a to 13	D
	M1 Junctions 28 to 31	D
	A160 / A180 Immingham	D
2 Strategic Road Network Capacity	M1 / M6 Junction 19 Improvement	CV
	A556 Knutsford to Bowdon	CV
	A453 Widening	CV
	A5-M1 Link Road	CV
	A2 Bean and Ebbsfleet	CV
3 Smart Motorways	Manchester Smart Motorways	CV
	M1 Junctions 39 to 42	CV
	M4 Junctions 3 to 12	CV
4 A14		SI CV RP UI
5 Lower Thames Crossing		SI RP UI
6 A303/A30/A358 Corridor		SI RP
7 A1 (North East)		SI RP
<b>Rail</b>		
8 Intercity Express Programme		SI CV
9 HS2		SI CV RP UI
10 European Rail Traffic Management System		SI
11 Strategic Rail Freight	Felixstowe to Nuneaton	SI
	Strategic Rail Freight Interchanges	SI UI
12 Crossrail		SI CV RP
13 Thameslink		SI CV RP
14 Rail Investment Strategy	North of England Programme (including Northern Hub)	SI CV RP
	Great Western Programme	CV RP
	South West Route Capacity Programme	CV RP
	Midland Main Line Programme	CV RP
	East-West Rail and Electric Spine	CV RP
	East Coast Main Line	CV RP
15 Major Stations	Manchester Victoria	SI RP
	Bristol Temple Meads	SI RP
	Birmingham New Street	SI RP

Priority investment		Key projects/programmes	Selection criteria
<b>International Gateways</b>			
16	Airport Infrastructure Improvements	Heathrow Q6	SI CV
		Gatwick Q6	SI CV
17	Port Capacity		SI
18	Airport / Port Connectivity	A6 to Manchester Airport Relief Road	SI CV RP
		M42 Junction 6	SI CV RP
		A5036 to Port of Liverpool	SI CV RP
<b>Local Transport</b>			
19	Transport for London	Sub-surface upgrade	CV RP
		Northern Line upgrade	CV RP
		Bank station upgrade	CV RP
		Victoria and Jubilee Lines (Phase 2)	CV RP
20	Northern Line Extension		CV RP UI
21	Mersey Gateway Bridge		CV RP UI
22	Local Transport Major Schemes	Heysham – M6 Link Road	RP
		Nottingham NET2	RP
		Leeds New Generation Transport	RP
		Norwich NDR	RP
		Sunderland Strategic Corridor	RP
		Kingskerswell Bypass (A380)	RP
		Croxley Rail Link	RP
		Midland Metro	RP
<b>Energy</b>			
23	Electricity Generation – Nuclear	Hinkley Point C	SI CV
		Wylfa Newydd	SI CV
		Moorside	SI CV
24	Electricity Generation – Gas (to 2020-21)		SI
25	Electricity Generation – Wind (to 2020-21)	Onshore	SI
		Offshore	SI CV
26	Electricity Generation – Other Renewables (to 2020-21)	Biomass	SI
		Solar PV	SI
		Marine	SI
27	Carbon Capture & Storage (CCS)	Peterhead CCS project	SI
		White Rose CCS project	SI
28	Electricity Interconnection		SI
29	Energy Transmission & Distribution	Western HVDC Link	SI CV
		Beaulieu-Denny 400kv Line	SI CV
		London Power Tunnels	SI CV

30	Oil & Gas Production	Shale Gas	SI
31	Smart Meters		SI CV

Priority investment	Key projects/programmes	Selection criteria
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### Communications

32	Superfast Broadband		SI CV RP
33	Super-Connected Cities		SI CV RP
34	Mobile Infrastructure Project		SI RP
35	4G Rollout		SI RP

### Water

36	Water Supply & Sewerage (AMP6)		SI CV
37	Thames Tideway Tunnel		SI CV RP

### Flood Defence

38	Flood and Coastal Erosion Risk Management Programme	Lincshore	SI RP
		Thames Estuary Phase 1	SI CV RP D
		River Thames Scheme (Datchet to Teddington)	SI CV RP
		Boston Barrage/Barrier Works	SI RP
		Rossall Coastal Defence Improvement Scheme	SI RP
		Oxford – Western Conveyance	SI RP

### Science & Research

39	Science Majors	Francis Crick Institute	SI
		Polar Research Ship	SI
		Diamond Light Source Phase III	SI
		Pirbright Development Phase II	SI
40	Science & Innovation Catapults	Cell Therapy Manufacturing Centre	SI
		National Biologics Manufacturing Centre	SI

16.19 An online annex provides a more detailed delivery update on each of these priority investments and is available at [www.gov.uk/government/collections/national-infrastructure-plan](http://www.gov.uk/government/collections/national-infrastructure-plan)



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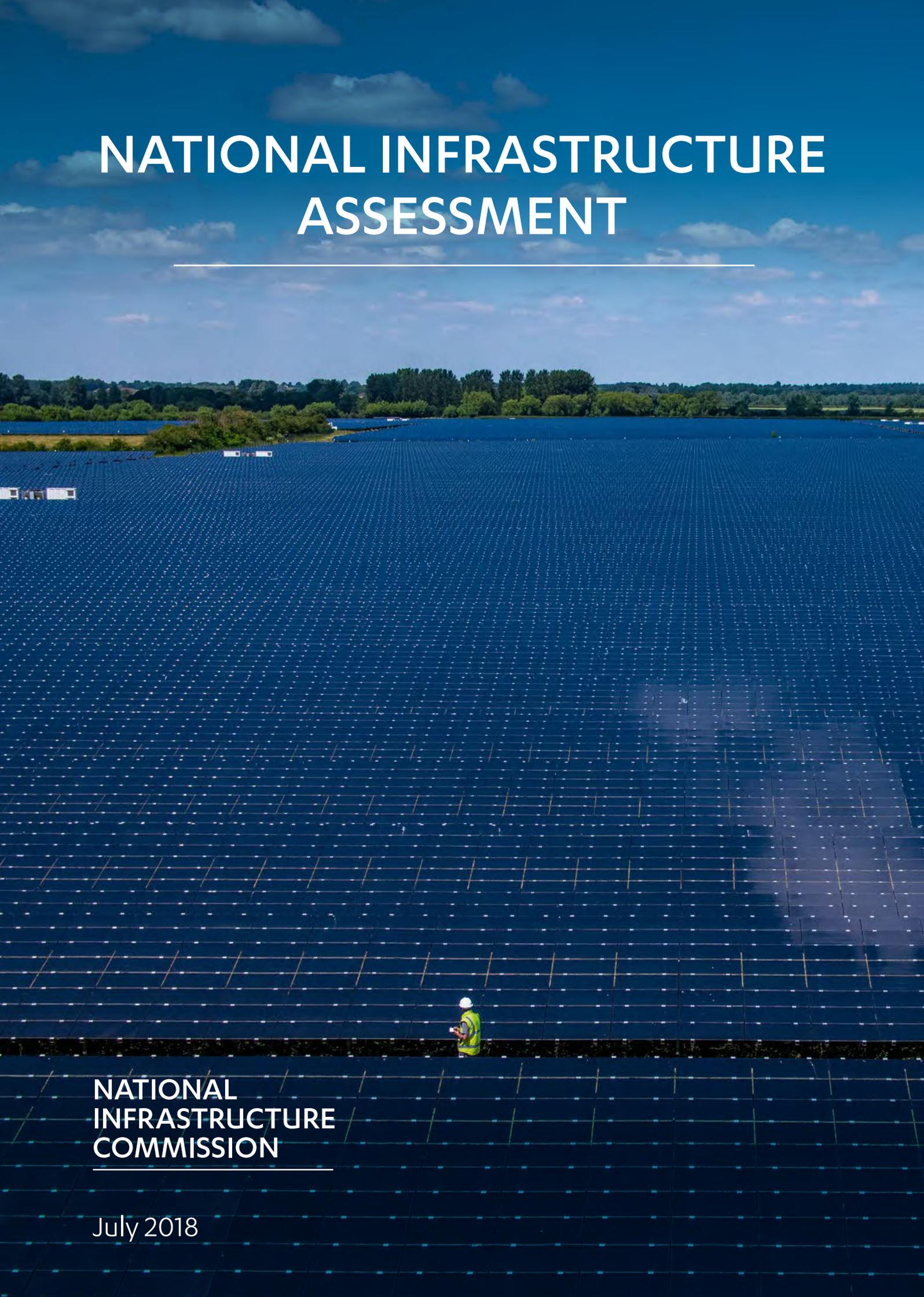
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# NATIONAL INFRASTRUCTURE ASSESSMENT

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An aerial photograph of a large-scale solar farm. The solar panels are arranged in a dense, grid-like pattern across a flat landscape. In the foreground, a worker wearing a white hard hat and a high-visibility vest is visible, providing a sense of scale. The background shows a line of trees under a clear blue sky with some light clouds.

**NATIONAL  
INFRASTRUCTURE  
COMMISSION**

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July 2018



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# The Commission

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The National Infrastructure Commission was established in 2015 to provide independent, impartial advice on the UK's long term infrastructure needs.

As of July 2018, the Commission's members are:

**Sir John Armitt CBE (Chair)** published an independent review on long-term infrastructure planning in the UK in September 2013, which resulted in the National Infrastructure Commission. Sir John is chairman of the National Express Group and the City & Guilds Group and sits on the boards of the Berkeley Group and Expo 2020.

**Dame Kate Barker** sits on the boards of Taylor Wimpey plc and Man Group plc. She is also chair of trustees for the British Coal Staff Superannuation Scheme. She has previously served as an external member of the Bank of England's Monetary Policy Committee (2001-2010).

**Professor Sir Tim Besley CBE** is School Professor of Economics and Political Science and W. Arthur Lewis Professor of Development Economics at the LSE. He has previously served as an external member of the Bank of England Monetary Policy Committee (2006-2009).

**Professor David Fisk CB** is Emeritus Professor at the Centre for Systems Engineering and Innovation at Imperial College London. He has served as Chief Scientist across several Government departments including Environment and Transport, and as a member of the Gas and Electricity Markets Authority.

**Andy Green** holds several Chairman, Non-Executive Director and advisory roles, linked by his passion for how technology transforms business and people's daily lives. This includes chairing IG Group, a global leader in online trading and Digital Catapult, an initiative to help grow the UK digital economy.

**Professor Sadie Morgan** is a founding director of the Stirling Prize winning architecture practice dRMM. She is also chair of the Independent Design Panel for High Speed Two, is deputy chair of the Thames Estuary 2050 Growth Commission and a Mayor's design advocate for the Greater London Authority.

**Julia Prescott** is co founder and Chief Strategy Officer of Meridiam, and sits on the Executive Committee of Meridiam SAS. She has been involved in long term infrastructure development and investment in the UK, Europe, North America and Africa.

**Bridget Rosewell OBE** is a director, policy maker and economist. She has served as Chief Economic Adviser to the Greater London Authority (2002-2012) and worked extensively on infrastructure business cases. She is a director of Network Rail.

# Foreword

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The infrastructure we have now, and the infrastructure we plan to build, will support and sustain us for decades to come. Our quality of life, and our success as an economy in the future, will depend on our infrastructure's ability to respond to future challenges. This will rely on decisions taken now.

Providing the right infrastructure for the future does not just entail delivering the running water, roads and rail that traditionally spring to mind, although these are important. The UK needs fast, reliable internet connections. It needs low cost energy and transport that doesn't harm the planet. It needs to make cities liveable for the growing urban population. It needs to reduce the plastic waste that can end up in our oceans. It needs water supply and flood defences that can respond to the risk of extreme floods and drought. All this needs to be done in a way that is well designed, and affordable for the government and the public.

Over the last 50 years, the UK has seen an endless cycle of delays, prevarication and uncertainty. These have been driven in part by short term considerations, and the lack of a cross-sectoral approach to infrastructure. This approach has limited growth, undermined job certainty, and restricted innovation. And too often the UK has ended up playing catch up. This will not do for the challenges ahead.

In the National Infrastructure Assessment, the first of its kind, the Commission has been able to look across infrastructure sectors, and come to independent conclusions based on the best available evidence. The Assessment sets out a clear, long term strategy for the UK's economic infrastructure from 2020 to 2050, providing long term clarity for industry and the supply chain.

The Commission's interim report, published in October 2017, identified three headline challenges for the UK's infrastructure: congestion, capacity and carbon. The Assessment's recommendations to government tackle congestion by prioritising devolved, stable, long-term funding for urban infrastructure in cities. The recommendations will improve the capacity of our water supply and digital infrastructure. And they will reduce our carbon emissions by leading the move to an energy system that is powered mainly by renewable energy sources such as solar and wind.

However, this is not all: the recommendations will also improve our quality of life by reducing air pollution, protecting our homes from floods, and making cities better places to live. The cost of driving will fall substantially if people can switch to electric vehicles. And they will help the environment by reducing waste that ends up in our landfills, incinerators and oceans.

Over the course of preparing this Assessment, the Commission has consulted and listened to the public, industry, academics, local and national government. Our analysis and proposals will not satisfy everyone. But the recommendations represent our considered view of how we can best create infrastructure which enables a fair, productive and green society for the whole country.

Ensuring that the Commission's recommendations can deliver the benefits we think they can, will require politicians across all parties to build a consensus. We welcome the funding guidelines that government has set for the Commission's recommendations, and have made our recommendations in line with it. We have also taken into account existing government commitments for road, rail and aviation, as well as all of our previous recommendations. We look forward to the government adopting our programme of recommendations as policy, and committing to invest in our infrastructure over the coming years.

I would like to take this opportunity to thank my fellow Commissioners and the excellent team at the Commission secretariat, in particular its Chief Economist, James Richardson, who has led the development of this Assessment from start to finish. I would also like to thank everyone who has contributed to our work over the last two years. We look forward to the response from government and the wider community.



**Sir John Armitt CBE**  
Chair, National Infrastructure Commission

# In brief

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**The first National Infrastructure Assessment sets out the Commission's plan of action for the country's infrastructure over the next 10-30 years. Infrastructure can inspire confidence and growth. But long term projects require a long-term vision, lasting plans, and stable funding. The UK must take decisive action.**

The Commission's recommendations represent a significant programme of upgrades to the nation's infrastructure. But they are not an unaffordable wish list. They have been costed in line with the government's guideline for investment in infrastructure. And they are affordable for households and businesses.

The Commission was set up to address the lack of a long term infrastructure strategy, siloed decision making in infrastructure sectors, fragile political consensus and short termism. The Commission has addressed these issues by taking a long term, cross-sectoral approach, with in-depth analysis and wide consultation.

The government has committed to respond to the Commission's recommendations and to adopt agreed recommendations as government policy.

The recommendations set out a pathway for the UK's economic infrastructure:

- nationwide full fibre broadband by 2033
- half of the UK's power provided by renewables by 2030
- three quarters of plastic packaging recycled by 2030
- £43 billion of stable long term transport funding for regional cities
- preparing for 100 per cent electric vehicle sales by 2030
- ensuring resilience to extreme drought
- a national standard of flood resilience for all communities by 2050.

Alongside these, better design and more efficient funding and financing can save money, reduce risk, add value and create a legacy that looks good and works well.

**These recommendations will equip the UK with the infrastructure it most needs. The Commission will continue to work to build consensus. It will hold government to account for the implementation of its recommendations. And it will continue to work on the nation's most pressing infrastructure issues.**

# Executive summary

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**The UK must take decisive action to have world leading infrastructure. Infrastructure can inspire confidence and growth. But long term projects require a long term vision, lasting plans, and stable funding.**

Too often, the delivery of the UK's major infrastructure projects has been slow and uncertain. Airport expansion in the south east is the best known, but not the only, example. The Mersey Gateway Bridge, which opened in October 2017, was proposed in 1994. Crossrail, due to open this year, was originally proposed in 1974. Consequently, much of the country's infrastructure has not kept pace with population growth, demand and advances in technology. The UK must stop running to stand still.

The National Infrastructure Commission was set up to address the problems with long term infrastructure planning in the UK. This first National Infrastructure Assessment builds on the analysis in the Commission's interim report, *Congestion, Capacity, Carbon: Priorities for national infrastructure*, to set out a long term vision for high quality, good value, sustainable economic infrastructure for the UK, and a clear plan to achieve it.

Its core proposals include:

- nationwide full fibre broadband by 2033
- half of the UK's power provided by renewables by 2030
- three quarters of plastic packaging recycled by 2030
- £43 billion of stable long term transport funding for regional cities
- preparing for 100 per cent electric vehicle sales by 2030
- ensuring resilience to extreme drought through additional supply and demand reduction
- a national standard of flood resilience for all communities by 2050.

It also highlights the most important future challenges. Heating must no longer be provided by natural gas, a fossil fuel. The UK must prepare for connected and autonomous vehicles. These need more time for evidence or technology to develop. The Assessment sets out the actions needed to enable robust decisions to be taken in future.

## The National Infrastructure Assessment

The Commission is required to carry out an overall assessment of the UK's infrastructure requirements once every 5 years. This is the first of those assessments. It covers all the key sectors of economic infrastructure, setting out recommendations for transport, energy, water and waste water, flood resilience, digital connectivity, and solid waste, from now until 2050. The Commission's remit also includes the potential interactions between its infrastructure recommendations and housing, but not housing supply in general. The Assessment is guided by the Commission's objectives to support sustainable economic growth across all regions of the UK, improve competitiveness and improve quality of life. More information can be found in the Commission's **framework document**.

### Thinking long term

By 2050, the UK's population and economy will have grown significantly. This will place substantial pressures on infrastructure. And meeting the challenge of climate change will require a transformation in energy, waste and transport by 2050. Even so, the effects of climate change will still be felt, with higher average temperatures and increased risk of drought and flooding. The UK's infrastructure will need to adapt to these pressures. The Assessment provides a long term strategy for how to do this. More information can be found in the Commission's four papers on **the environment and climate change, economic growth, population change and demography, and technological change**.

### How has the Commission come to these conclusions?

The strategies have been developed considering the responses to the Commission's consultation in **Congestion, Capacity, Carbon: Priorities for national infrastructure**, working closely with experts and other independent organisations, seeking diverse views across sectors and regions, asking the public for their views (via a social research programme), and through the Commission's own internal analysis and modelling. More information and consultants' reports can be found on the Commission's **website**.

### How much will this all cost?

Government has given the Commission a long term funding guideline for its recommendations (the 'fiscal remit'). Where infrastructure is funded by the private sector, and the costs of any recommendations will ultimately be met by consumers, the Commission is also required to provide a transparent assessment of the overall impact on bills. These are set out in Chapter 7. More information on the Commission's fiscal and economic remit can be found in the Commission's **remit letter**.

The Commission's recommendations represent a major long term programme of investment in the UK's infrastructure. The programme includes substantial funding for major schemes such as Crossrail 2 and Northern Powerhouse Rail, as well as to support the delivery of enhanced digital networks and flood protection. The Assessment has been made in the light of existing infrastructure plans and investment. However, this is not an unaffordable wish list, but has been carefully designed to be consistent with the government's long term funding guideline for public investment in infrastructure. Where infrastructure is funded by the private sector, a transparent assessment is provided of costs and savings for each recommendation to ensure that consumer costs are manageable and proportionate to the benefits the infrastructure provides.

The recommendations in this Assessment have all been guided by the objectives set for the Commission by government to: support sustainable economic growth across all regions of the UK; improve competitiveness; and improve quality of life. They have been designed to stand the test of time, and to be robust to a variety of scenarios. Together they comprise an ambitious plan to modernise and enhance the UK's economic infrastructure.

The Assessment's recommendations do not simply comprise a list of projects for the government to build; good infrastructure requires long term planning, stable funding structures and good design. The Commission has also been able to consider interdependencies between sectors: urban infrastructure planning needs to be integrated with housing; the energy system needs to be prepared for an increase in electric vehicle ownership; and digital connectivity on the roads could be necessary for connected and autonomous vehicles.

Further detail on the Commission's analysis is set out in the technical annexes published alongside this report, the Commission's interim report and background papers, and the 31 reports commissioned for the Assessment, available on the Commission's website. Annex C sets out a list of these supplementary documents.

Good infrastructure is essential to the country's future growth and prosperity. Infrastructure is a key pillar of the government's Industrial Strategy. Now is the time to deliver. This Assessment is the plan of action.

## **Building a digital society**

Data and digital connectivity will increasingly drive the country's economic growth, competitiveness, and quality of life. Digital communication makes it easier for customers and suppliers to find each other and exchange goods and services. In future, innovations such as artificial intelligence and the internet of things will bring new applications that rely on digital connectivity, from driverless cars to increased use of virtual reality. Some health services are already moving online, providing better access to specialist services, and reducing the need for patients to sit in waiting rooms where they risk further infection.

The UK already has a strong digital economy underpinned by an extensive broadband network. But the superfast broadband programme that delivered this is coming to an end. While current digital connectivity is enough for current needs, demand for data is rapidly increasing; superfast broadband may not be sufficient for the future.

The Commission's judgement is that the government should act now to deliver full fibre across the country; in the Commission's social research, 86 per cent of people agreed that all parts of the UK should have equal access to broadband. Full fibre broadband is the likely next step in digital connectivity. It is more reliable and cheaper to maintain than today's part copper, part fibre broadband connections. But it will take at least a decade to build nationally. Government needs to make a decision on full fibre now to avoid the risk of the UK being left behind in years to come. Full fibre will deliver benefits compared to current broadband even if the expected demand growth does not materialise. Enhanced digital connectivity will also facilitate the development of smart infrastructure: infrastructure with digital connections, enabling more efficient management and maintenance.

To encourage full fibre rollout, the government should put in place a national broadband plan by the end of 2018. Ofcom should provide certainty to commercial investors and encourage further private sector delivery of full fibre. With this certainty from government and Ofcom, most urban areas are likely to receive full fibre just through the promotion of market competition. However, full fibre will still need to be subsidised in some areas where commercial players are unlikely to deliver it. This should begin with the locations least likely to receive broadband commercially. With these plans in place, nationwide full fibre connectivity should be available no later than 2033.

## Low cost, low carbon

The UK can and should have low cost and low carbon electricity, heat and waste. Ten years ago, it seemed almost impossible that the UK would be able to be powered mainly by renewable energy in an affordable and reliable way. But there has been a quiet revolution going on in this area. There is ample scope to build on this success in years to come. Highly renewable, clean, and low cost energy and waste systems increasingly appear to be achievable.

Furthermore, such a system need not lead to higher bills. Today, consumers pay an average of £1,850 per year for the energy they use, including fuel and equipment for heating and hot water, electricity and transport fuel costs. The same services could be delivered at the same cost (in today's prices) in 2050 by a low carbon energy system. But this will only be possible if the right decisions are taken now.

Sustaining progress on reducing emissions requires government to show ambition. The crucial first step is to enable an increasing deployment of renewables. The Commission's modelling has shown that a highly renewable generation mix is a low cost option for the energy system. The cost would be comparable to building further nuclear power plants after Hinkley Point C, and cheaper than implementing carbon

capture and storage with the existing system. The electricity system should be running off at least 50 per cent renewable generation by 2030, as part of a transition to a highly renewable generation mix. Government should not agree support for more than one nuclear power station beyond Hinkley Point C before 2025.

But there are some changes that will need to be made to enable the increase in renewables. It will require increased system flexibility, in line with the recommendations in the Commission's *Smart Power* report. The Commission favours the use of existing market mechanisms – contracts for difference and the capacity market – where possible, to avoid creating more uncertainty, but incremental improvements could be made. All renewables should be able to compete; there is no longer a case for any bilateral deals, including for tidal.

Even with emissions almost eliminated from power generation, the UK cannot achieve its emissions targets while relying on natural gas, a fossil fuel, for heating. Delivering a low cost, low carbon heating system is the major outstanding challenge. But the electricity system represented just such a challenge ten years ago. There are actions that the UK can and should take now.

As a first step, improving the energy efficiency of the UK's buildings will mitigate some of the emissions from heat. In the meantime, the evidence base must be built up to make decisions on heat in future. The safety case for using hydrogen as a replacement for natural gas should be established, followed by trials for hydrogen at a community scale and alongside carbon capture and storage. At the same time, further data on the performance of heat pumps in the UK should be collected and used to support decisions.

In the waste sector, too, there are lower cost, lower carbon options especially for food waste and plastics. There is public support for greater recycling, but frustration with the complexity of the process.

It is cheaper to collect food waste separately and process it in anaerobic digesters, rather than send it to energy from waste plants (incinerators). Seventy nine per cent of people who do not currently use a food waste bin would be prepared to use one if it were provided by their local council. More plastics should be recycled, including by restricting the use of hard-to-recycle plastic packaging by 2025. Better packaging design, clearer labelling, fewer hard to recycle plastics, and tougher recycling targets (of 65 per cent of municipal waste and 75 per cent of plastic packaging by 2030) could all reduce residual waste and mitigate the need to build additional infrastructure.

## Revolutionising road transport

By 2050, road transport will be unrecognizable from today. Cars and vans will be electric, and increasingly autonomous. Electric, connected and autonomous vehicles will change the nature of the transport debate in the UK.

Electric vehicles are easier to drive, quieter and less polluting than conventional cars and will soon have the same range and be cheaper to buy and maintain. Once

this happens, their take up could increase rapidly. Given their benefits for the environment, this is something government should encourage. A key way to do this is by ensuring that charging an electric vehicle is as easy as refilling a conventional vehicle, or even easier.

The government needs to provide the right environment to support and encourage the switch to electric vehicles. To catalyse this, consumers need to feel confident that they can charge their electric vehicles en route across the country. A core network of fast or rapid chargers should be installed in visible locations across the UK. Government should subsidise charger installation where the private sector will not build them, starting in the locations least likely to be delivered commercially. However, the majority should be built by the private sector. Government should enable commercial investors to build charge points throughout the country, including by requiring local authorities to free up 5 per cent of their parking spaces for electric vehicle charge points by 2020, and 25 per cent by 2025.

The energy system will also need to be prepared for an increase in demand for electricity as the transition to electric vehicles gains traction. Whilst fast and rapid chargers will be needed to tackle range anxiety, most charging should be slow and smart. Done in the right way, using smart charging, electric vehicles can lower electricity system costs: the system will be able to operate closer to full capacity over the course of the day, as electric vehicles can charge primarily at night, increasing network efficiency. And with electric vehicles providing a source of flexible demand, the need for other kinds of flexibility such as battery storage or fossil fuels will be reduced.

In the longer term, connected and autonomous vehicles will bring even greater changes to the UK's roads. They will improve safety, and could allow more people to use personal transport and free up driving time for work or leisure. They may even encourage a shift towards increased vehicle sharing and reduced car ownership. Traffic lights and stop signs may become unnecessary, speed limits could be higher, and the use of road space could be automatically and constantly changing according to need. But, with road and rail projects lasting for decades, government needs to start taking the potential future impacts into account now as it makes investment plans.

A framework should be developed to assess potential impacts, even though these are inevitably uncertain. An initial framework should be put together before the next five year planning cycle for rail and major roads begins in the early 2020s.

## Transport and housing for thriving city regions

Cities can be great places to live, with excellent public transport systems, well-designed public spaces for leisure and social activities, and flourishing, well-connected businesses. They are also engines of economic growth. However, as urban populations increase, many cities are becoming full and congested, and this is inhibiting economic development and reducing quality of life.

The UK has a programme of major strategic transport projects in the pipeline, including a large programme to improve major roads, HS2 and Northern Powerhouse Rail. In planning for the next wave of major investment, attention must be turned to cities. The UK is unusual in that many of its large cities outside of the capital are less productive than the national average. Transport alone cannot drive growth, but the UK should make sure that urban transport enables it.

For all their benefits, neither electric nor connected and autonomous vehicles will solve the problems of urban transport; rather they are likely to increase the number of drivers on the roads. Government and cities need to act now to ensure that space in cities is used effectively, with room allocated for fast, frequent public transport systems, well-connected and affordable housing, and pleasant public spaces. This will require a new approach to governance, strategy and funding.

To deliver thriving cities, metro mayors and other city leaders should develop integrated strategies for transport, employment and housing. Housing and infrastructure should be planned together: new housing requires new infrastructure. These integrated strategies should be backed up by stable, substantial, devolved funding. And for the cities that face the most severe capacity constraints, and with the most potential for growth, there should be additional funding to support major upgrade programmes, which would be agreed between the cities and central government.

Development of regional cities should be in addition to, rather than instead of, continuing to invest in London, whose growth brings benefits across the UK. The Commission will continue to work with government and cities to develop the next wave of infrastructure upgrades across the country.

## Reducing the risks of drought and flooding

Climate change will continue to make extreme weather events such as floods and drought more likely in future years, and cities, towns and villages must be resilient. Decisive policy action is needed to mitigate these risks.

About 5 million properties in the UK are currently at risk of flooding. Protection from floods in the UK over the past years has too often been reactive rather than proactive. Ideally, no one should be exposed to flooding. Flooding has severe impacts on quality of life, particularly mental health.

A long term strategy for flood protection would allow a nationwide standard of resilience to flooding, with catchment based plans. These plans should evaluate the full range of options including traditional flood defences, 'green infrastructure' (whether natural flood management or sustainable drainage systems), individual property measures and spatial planning. In the Commission's social research, 59 per cent of people agreed that everyone should have the same standard of flood resilience, even though some properties cost more to protect.

The Commission believe that a national standard should be set for resilience to flooding with an annual likelihood of 0.5 per cent by 2050, where feasible. Over

longer time periods, higher standards might be achievable. Densely populated areas, where the consequences of flooding are potentially much more serious, should be resilient to flooding with a likelihood of only 0.1 per cent a year by 2050. The Environment Agency should update plans for all catchments and coastal cells in England before the end of 2023.

A reliable water supply is usually taken for granted in UK. But despite its reputation for rain, the country faces a real and growing risk of water shortages, especially in the south east of England. Action is needed to address these challenges, but conflicting incentives, limited cooperation between water companies and a short term focus mean that insufficient progress has been made. In the event of a serious drought, the nation faces an unacceptably high risk of severe supply limitations; homes and businesses could even be completely cut off.

The Commission has published a standalone report, *Preparing for a drier future: England's water infrastructure needs*, which sets out a twin-track approach to manage water supply and demand. The government, working with Ofwat and water companies, needs to ensure the capacity of the water supply system in England is increased to boost the country's resilience to drought whilst also managing demand and reducing leakage. This can be achieved through: delivering a national water transfer network and additional water supply (for example reservoirs or water re use) by the 2030s; and halving leakage by 2050, together with greater smart metering.

## Choosing and designing infrastructure

For government and relevant industries to take decisive action on their infrastructure projects, they need to have confidence that their decision making is as good as possible. Long term decisions inevitably carry risk, but these risks need to be taken, and uncertainty managed as much as possible. Decision making can be improved through robust analysis of the performance of existing infrastructure and recognising the value of good design in infrastructure.

Not everything can be reduced to numbers, but there should be an effective methodology to measure the quality of the UK's current infrastructure to reliably inform assessments of future needs. The assessment of the potential value of new projects could be more effective if there were better data on how past projects have performed. All government departments and agencies should therefore collect and publish costs and benefits estimates and outturns for major infrastructure projects. This would lead to increased scrutiny of costs and benefits estimates, improving quality.

Good design can save money, reduce risks, add value, deliver more projects on time and create infrastructure that looks good and works well for everyone. All nationally significant infrastructure projects should have a board level design champion, and use a design panel to maximise the value provided by the infrastructure. The Commission, advised by a national infrastructure design group, will publish a set of design principles to inform this.

## Funding and financing

While the Commission's recommendations comprise an ambitious programme of investment, this is not an unaffordable wish list. A crucial factor in the development of this Assessment has been the fiscal remit set by government. This provides a long term funding guideline for public investment in infrastructure of 1.0 to 1.2 per cent of GDP, including existing government funding commitments such as HS2.

Where infrastructure is funded by the private sector, and the costs of any recommendations will ultimately be met directly by consumers, the Commission has also provided a transparent assessment of the overall impact on bills. Where recommendations have net costs, the Commission believes that these are manageable and good value relative to the benefits the infrastructure provides.

The recommendations in this Assessment, and the implications for public expenditure and for bills, reflect the judgement of the Commission. In reaching its conclusions, the Commission has drawn on a wide range of evidence. Uncertainty is inevitable given the timescales for infrastructure investment, and so the Commission has also sought to understand how robust its decisions are to uncertainty, seeking solutions that will stand the test of time.

The recommendations are an affordable and deliverable strategy to modernise and strengthen the UK's infrastructure networks. Nevertheless, it is important that these recommendations are paid for at least cost. Part of this comes from improvements in design and delivery. Part comes from ensuring that infrastructure is financed in the best way possible.

These recommendations will require a combination of public and private financing. Financing itself is not in short supply. However, state financing institutions can help to encourage private investment and catalyse activity in new markets. The European Investment Bank does some of this, but there is a risk that access may be lost following the UK's exit from the EU. A UK infrastructure finance institution, focussed on specific objectives, should be established if access to the European Investment Bank ceases after the UK exits the EU.

There is also a need for a better understanding of the costs and benefits of private financing and traditional procurement in the delivery of publicly funded infrastructure. The Commission has developed an analytical framework to be used in the evaluation of the costs and benefits of financing options for new and existing projects, which will enable greater certainty about the costs and benefits of the use of private financing for public sector projects.

Over the Assessment's timeframe, changes to the way road users pay to use roads are inevitable. In particular, fuel duty revenues will continue to decline with the impending shift to electric vehicles. This presents a huge opportunity to design a system that improves on current road taxation by being fairer, more sustainable, more effective at reducing the negative impacts of driving, and attracting greater public support. For years, experts have proposed road pricing, only for it to be opposed by the public. The Commission intends to engage stakeholders and the

public on this topic to identify a new approach that works for the future of transport. Reforming how road use is paid for has been discussed for decades, but the issue is becoming more and more pressing and cannot be avoided forever.

Local funding mechanisms can help to ensure that local infrastructure is funded in a way that is fair, efficient and sufficient to meet local needs. The current system for gathering contributions from developers is complex, but raises more revenue than previous attempts. But the system could be improved still further. More funding mechanisms should also be made available to Local Authorities to enable them to capture a greater share of the uplift in land value that can occur with infrastructure investment. This should include making it easier to raise business rate supplements for up to one third of scheme costs, and giving local authorities powers to levy zonal precepts on council tax where public investments in infrastructure drive up surrounding property values.

## Next steps

The Commission has outlined an ambitious set of recommendations. As the first Assessment, it could never solve everything. The Commission has therefore focused on key priorities to equip the UK with the infrastructure it needs. These recommendations will enable the UK to have a thriving digital economy, a low cost, low carbon energy and waste network, clean air, successful cities, and resilience to extreme weather. But the Commission cannot achieve this alone. Government, regulators, industry, citizens and others will all need to contribute to making this vision a reality. Over the coming months, the Commission will work to build consensus around its recommendations.

Infrastructure delivery depends on the availability of the right skills, the approach to construction and project management, the depth of the supply base, and the capability of government and other infrastructure owners and operators to act as an intelligent client. These are the responsibility of the Infrastructure and Projects Authority which advises on infrastructure delivery. The UK's exit from the EU will impact the UK's skills base and supply chain. There should be a strategic approach to manage this.

As its initial next step, the government has committed to lay the Assessment before Parliament, and to respond to the Assessment within six months (with a final deadline of a year). Its response will set out which recommendations it has agreed to, any further work required to take forward the recommendations, and alternative proposals for any recommendations it has not agreed.

The Commission will monitor progress in delivering government endorsed recommendations, and will report on this in its Annual Monitoring Reports.

The second Assessment, expected around 2023, will build on the recommendations in this report, as well as covering new ground.

## Northern Ireland, Scotland and Wales

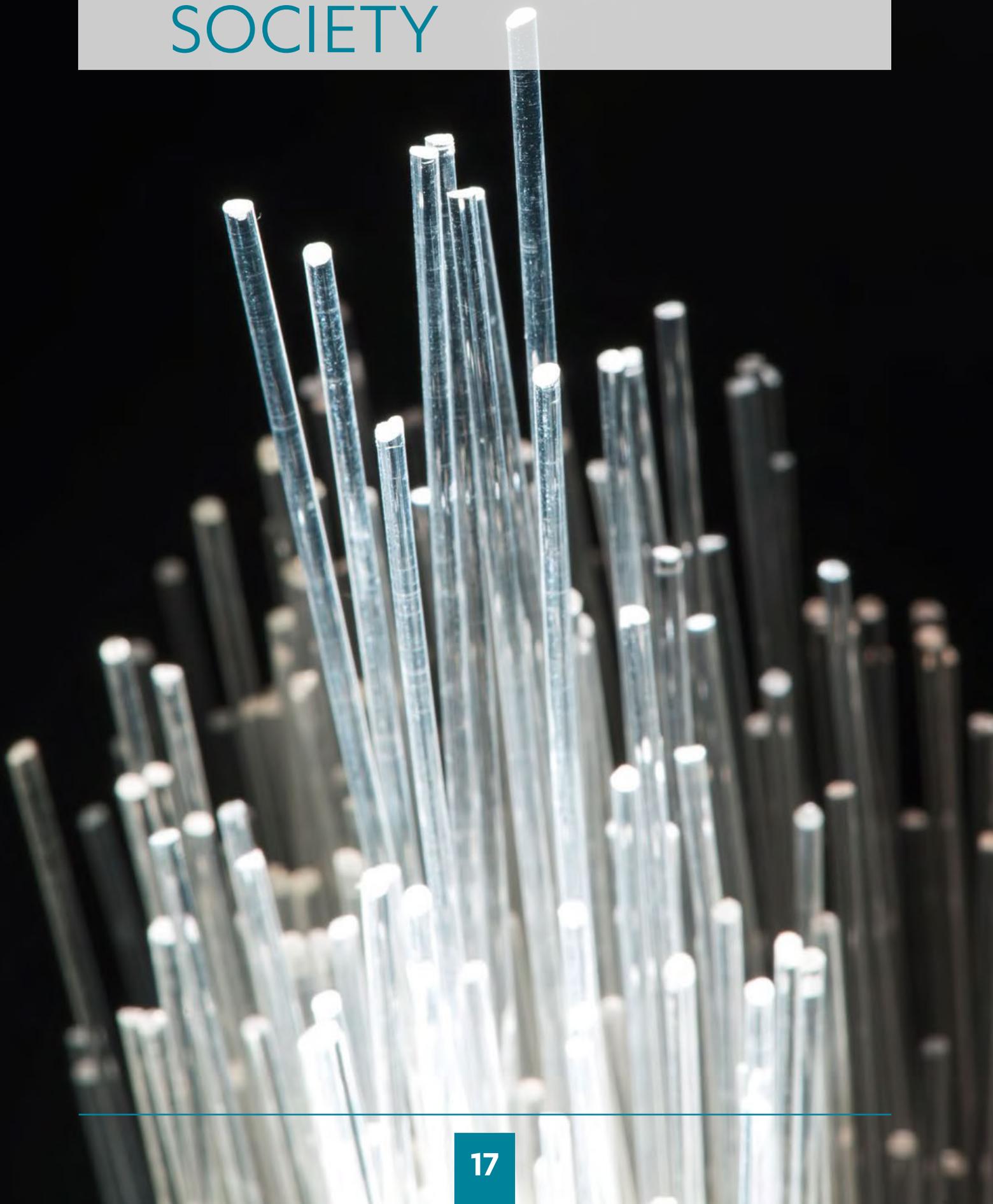
The Commission's remit covers six infrastructure sectors. As summarised in the table below, in four of six sectors covered by the Commission, there is substantial devolution to the devolved governments. Only energy in Great Britain and digital communications in the UK do not entail significant devolution.

The Commission's role is to advise the UK government. But the Commission works with both the UK government and the devolved administrations where responsibilities interact.

Sector covered by the Commission	Devolved administration responsibility		
	Scotland	Northern Ireland	Wales
<b>Transport</b>	Largely devolved	Devolved responsibility	Devolved, aside from rail
<b>Energy</b>	Not devolved, aside from energy efficiency	Devolved, aside from nuclear	Not devolved aside from energy efficiency
<b>Water and sewerage</b>	Devolved responsibility	Devolved responsibility	Devolved responsibility
<b>Flood risk</b>	Devolved responsibility	Devolved responsibility	Devolved responsibility
<b>Digital</b>	Not devolved	Not devolved	Not devolved
<b>Waste</b>	Devolved responsibility	Devolved responsibility	Devolved responsibility

**Table 1: Devolved administration responsibilities, by infrastructure sector**

# 1. BUILDING A DIGITAL SOCIETY



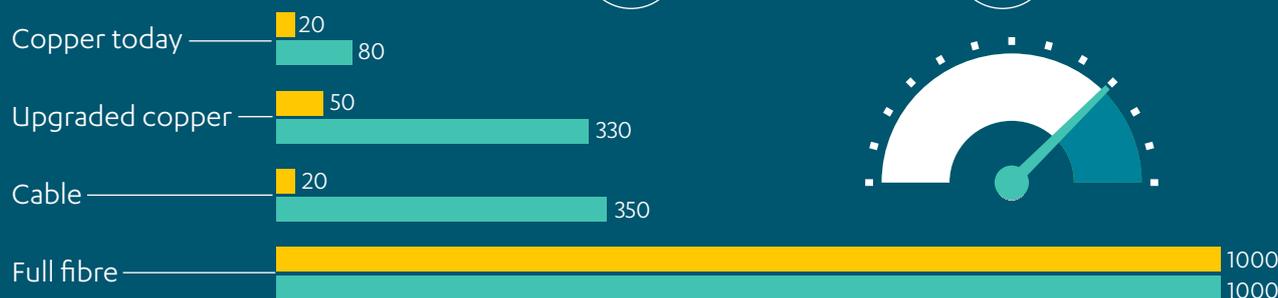
# A FULL FIBRE FUTURE

Digital services are increasingly important for growth, infrastructure, and quality of life.

The superfast broadband programme is coming to an end and full fibre is the next step

## Faster:

offering as much as 1,000 mbps



Upload speeds (mbps)



Download speeds (mbps)



## More reliable:

fibre has 5 times fewer faults than copper connections



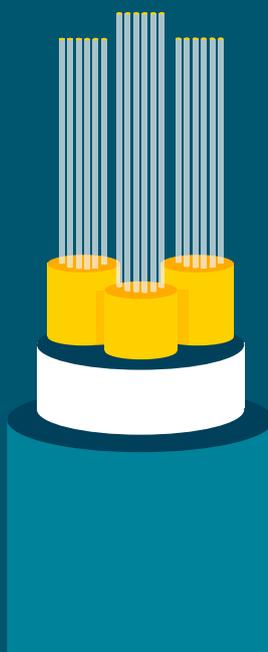
## Cheaper to run:

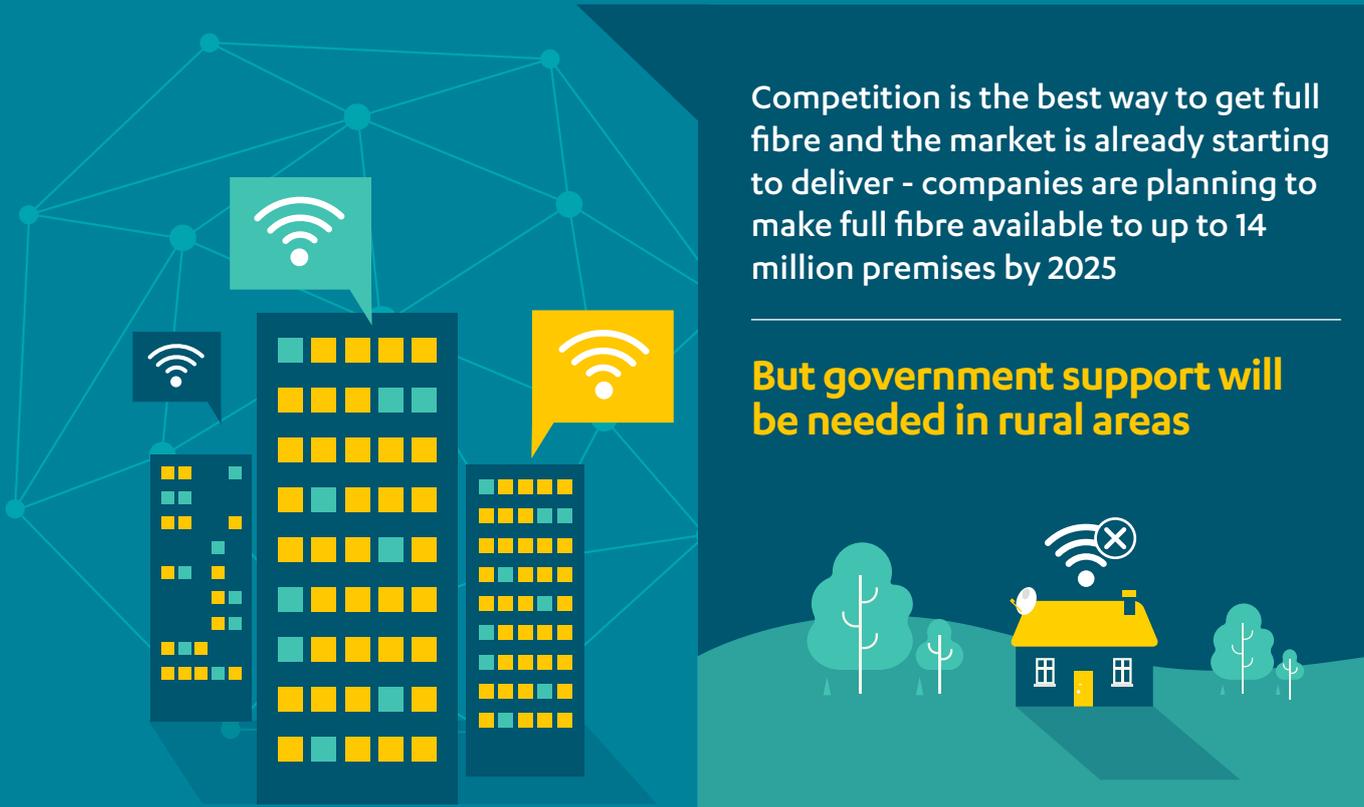
Fibre would save up to £5bn in operating costs over 30 years

The benefits will take time, as full fibre speeds are not yet needed, but delivery will take 10-20 years

## Investment must start now

to avoid being left behind





Competition is the best way to get full fibre and the market is already starting to deliver - companies are planning to make full fibre available to up to 14 million premises by 2025

**But government support will be needed in rural areas**

**THE COMMISSION RECOMMENDS:**



A government strategy to deliver nationwide full fibre by 2033



Ofcom should promote network competition to drive the commercial roll-out of full fibre



Government support in rural areas starting by 2020



Measures aimed at cutting the costs of delivery



Allow for copper switch off by 2025

Sources: DCMS, Ofcom, Prism and Tactis, Frontier Economics

**Digital connectivity is now an essential utility, as central to the UK's society and economy as electricity or water supply. Demand for data, and therefore the speed, reliability and capacity of broadband connections, is growing rapidly. Demand is likely to continue to increase as businesses, homes and infrastructure become smarter. So it is important that quality broadband is available throughout the country. Full fibre can provide this for the future.**

The UK already has a strong digital economy underpinned by an extensive superfast broadband network.<sup>1</sup> There is room for improvement on mobile coverage and rural connectivity but, in general, the UK's digital connectivity meets the needs of today's consumers.<sup>2</sup> The UK compares well internationally for superfast broadband availability, but trails behind other countries such as Spain and Sweden for full fibre availability.<sup>3</sup>

The UK must now prepare for the future. The superfast broadband programme is coming to an end, with 98 per cent of UK premises on track to receive superfast broadband.<sup>4</sup> A guaranteed minimum broadband service will be available to remaining premises by 2020 but provides only a basic service for today's needs.<sup>5</sup>

The Commission's judgement is that a national full fibre rollout programme should be put in place. This will provide fast, reliable broadband, improve connectivity in rural areas, and support 4G and 5G mobile coverage. However, it will take at least a decade to build.<sup>6</sup>

The successful delivery of full fibre will require:

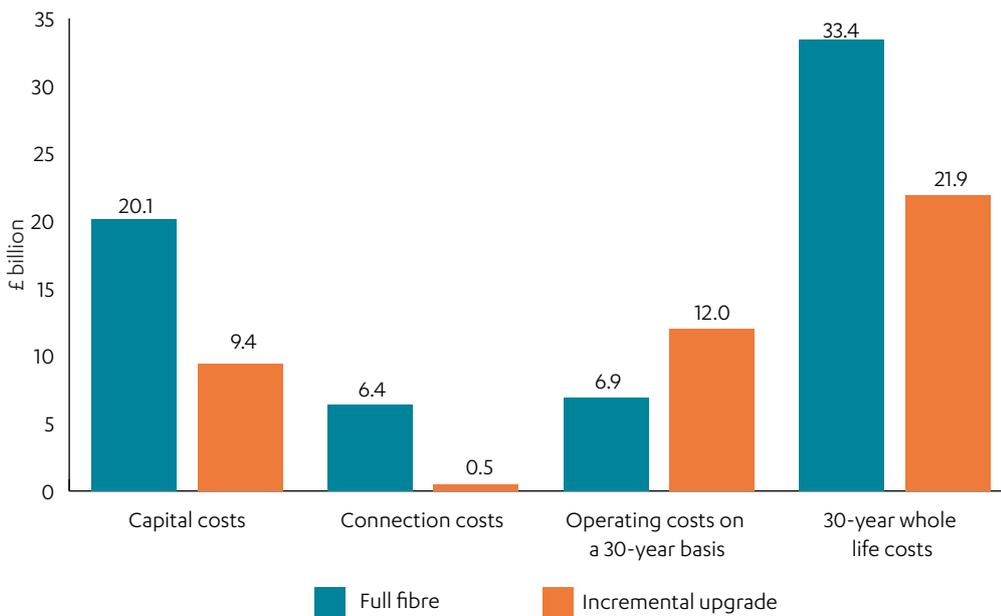
- a nationwide plan to deliver full fibre to all businesses and homes by 2033, with approaches tailored to the needs of different areas
- making the most of fibre deployment to support improved mobile coverage
- allowing for copper switch-off
- tackling the barriers that delay deployment and increase costs.

The Commission has previously examined the infrastructure needed to support 5G mobile in its report *Connected Future*<sup>7</sup> and the Assessment does not re-examine this. The Commission is also carrying out a review of economic regulation, which will report in spring 2019.

## Full fibre for the future

The UK faces a choice between continuing to upgrade the existing copper network, or replacing what is left of it with fibre optics. Full fibre, a connection without any copper, is the best available broadband technology on the horizon. It can provide consistent, gigabit speeds, which are less affected by rain and flooding, uses less energy, costs less to maintain and has no long term foreseeable capacity constraints.<sup>8,9,10,11</sup> Nationwide full fibre would also provide the foundation for 5G mobile connectivity and could improve 4G coverage in harder to reach places.<sup>12</sup>

Choosing to make this investment is not a risk-free decision. In countries with widespread full fibre, take-up of higher bandwidth services is often low.<sup>13</sup> Analysis produced for the Commission estimates that, over a 30 year period, building and maintaining a full fibre network would cost £33.4 billion.<sup>14</sup> This is estimated to be approximately £11.5 billion more than incrementally upgrading the existing infrastructure.<sup>15</sup> But a further incremental upgrade now may still require full fibre in the long term. Figure 1.1 shows the breakdown of costs.



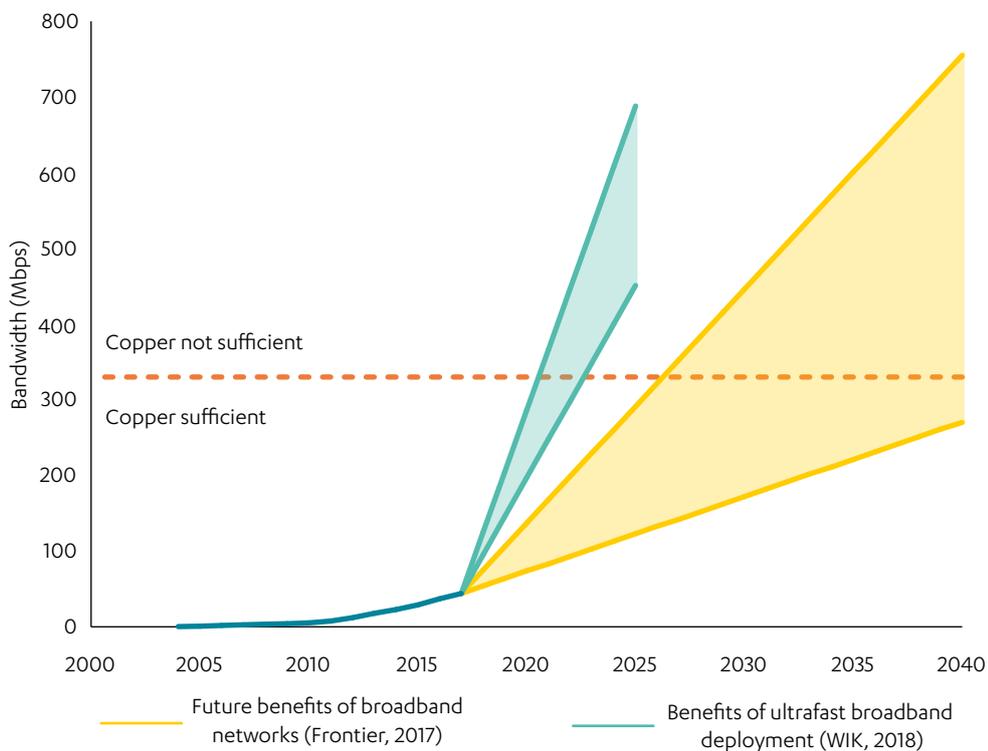
Note: present value in 2020

**Figure 1.1: Estimated costs of deploying full fibre versus upgrading the existing copper/cable infrastructure<sup>16</sup>**

The two alternatives to fibre are G.fast (a copper based technology), and cable (which uses shielding to reduce the electromagnetic interference that affects copper). G.fast might be an appropriate interim solution in some areas, but it is ultimately subject to many of the same limitations as copper. Unlike fibre, speeds on copper lines drop significantly over longer distances.<sup>17</sup> Existing cable networks can be upgraded to compete more effectively with fibre over the long term.<sup>18</sup> But Virgin Media, the UK's main cable provider, is increasingly rolling out fibre as it expands its network into new areas, partly because deploying and maintaining

new cable is more expensive than full fibre.<sup>19</sup> Full fibre also has the potential to deliver much higher upload and download speeds.<sup>20</sup>

Total data demand, based on the time spent on the internet, has risen drastically over the last few years.<sup>21</sup> This is because people are online for more of the day and because the amount of data used at any one time is increasing, requiring higher bandwidth. Figure 1.2 compares projections of bandwidth demand, produced for the Commission and for Ofcom, the regulator, and the level at which a copper network becomes insufficient to meet demand. It is not clear when, or if, bandwidth demand will outstrip the capacity of the existing copper network. But it is possible that bandwidth demand could exceed the capabilities of a copper network within the 10-20 year horizon required to roll out a full fibre network.



Note: the dotted line is the theoretical maximum 'up to speed' on a copper upgrade.

**Figure 1.2: Historic average UK broadband bandwidth and forecasted future bandwidth demand<sup>22</sup>**

However, despite the possibility that demand does not materialise, the Commission's judgement is that investment in full fibre is a risk worth taking. Past investments in digital infrastructure have supported significant economic growth. The rollout of broadband infrastructure in OECD countries from 1997 to 2007 increased annual per capita growth by 0.9 to 1.5 percentage points for a 10 percentage point increase in broadband penetration.<sup>23</sup>

## Potential drivers of future bandwidth demand

**Demand increases to meet supply:** History shows that as consumers' bandwidth increases, sites and applications adapt to make use of faster speeds. Video is the main driver of bandwidth demand. When BBC iPlayer launched in 2007 it required 0.5 megabits per second (Mbps) to watch programmes on demand.<sup>24</sup> Today, the minimum is the same, but iPlayer now offers a range of more sophisticated services that require much faster speeds, including 20 Mbps for Ultra HD programmes such as Blue Planet, and 36 Mbps for live events such as the World Cup.<sup>25</sup>

**Virtual reality:** If the use of virtual (and/or augmented) reality increases for entertainment, simulations, or communication, this will require better, faster broadband connections.<sup>26</sup>

**Internet of things:** Innovations in the network of infrastructure and appliances with digital connections will continue to increase the amount of data being transferred regularly through both the broadband and mobile networks.<sup>27</sup>

**Connected and autonomous vehicles:** Connected vehicles are expected to transmit large amounts of data at high speeds to other connected vehicles and/or road infrastructure. This is likely to require reliable 5G connectivity on roads, which will need to be underpinned by fibre.<sup>28</sup>

Furthermore, a full fibre network still provides several benefits relative to a copper network upgrade. These include operational savings, which would start being realised straight away and could amount to £5.1 billion between 2020 and 2050 (see figure 1.1). Full fibre suffers five times fewer faults than copper-based networks.<sup>29</sup> While not large enough to justify the investment in itself, these savings will continue beyond this timeframe.

## A long term strategy for nationwide full fibre

Network operators are beginning to build new full fibre networks across the UK. However, only 4 per cent of UK premises have access to full fibre.<sup>30</sup>

Delivering a new national full fibre infrastructure network will take at least a decade.<sup>31</sup> Other estimates suggest the programme could be closer to 20 years.<sup>32</sup> If the UK wants to avoid the risk of not having the infrastructure needed to support an increasing demand for data in the future, it will need to start investing soon, even if this is ahead of demand at present.

Transitioning to full fibre from copper is a substantial infrastructure upgrade, and it will be difficult for the market to deliver in the absence of a clear government strategy. Commercial investors will need clarity on government's decision to back full fibre to give them the confidence to invest.

Government must therefore define and deliver the country's full fibre broadband strategy. It should be responsible for the plan, and ensure that Ofcom has the necessary powers to implement and deliver it.

## A nationwide strategy

Recent announcements by network operators already total 14 million premises expected to receive a full fibre connection by 2025,<sup>33</sup> but in reality this number will be lower as the networks will overlap. Therefore, while some areas will receive multiple full fibre networks on a commercial basis, many homes and businesses, particularly in rural areas, will not receive full fibre at all. The government has set a target date of 2033 for national coverage, but should now set out a clear strategy to achieve this, giving commercial investors the confidence they need.

A nationwide broadband plan must reflect the differing economics of delivering full fibre in different areas of the country. Government should promote competition in areas where it is commercially viable for multiple network operators to build and operate full fibre networks. However, some geographic areas are not commercially viable at all, and in others there is only likely to be a commercial case for one network (for example smaller towns and villages). A key part of government's plan must be to ensure that the places that would not otherwise receive full fibre get the connectivity they need.

## Incentivising competition

Competing fibre networks should be encouraged wherever they are feasible. Without infrastructure competition, the existing provider has poor incentives to build new fibre networks, as this undermines its existing copper based services. New entrants do not have existing customers to lose, so they have greater incentives to build. Competition will force the incumbent to build new networks commercially and at a competitive price.<sup>34</sup>

Infrastructure competition has been shown to drive investment in both new and existing broadband networks.<sup>35,36</sup> It has been a key driver of widespread fibre rollout in South Korea and Japan, which have over 95 per cent full fibre availability.<sup>37</sup> There is a strong correlation between cable coverage and full fibre availability internationally.<sup>38</sup>

The UK should therefore stick to a competitive model for commercial investors to deliver full fibre. This will require significant financing and it is essential that investors have confidence that if their business plans are successful, they will be able to make a fair return without the government reneging after the fact. The market must have the freedom to set the price for new services, subject, as now, to regulation of the basic service level. Within a competitive model consumers will have a choice of whether to pay any premium for full fibre. The market will drive full fibre deployment, and government should not intervene by restricting overbuild of new or existing networks, unless it constitutes anticompetitive behaviour.

This requires:

- a clear commitment from government and Ofcom to promote a competitive market wherever possible, with a stable regulatory regime

- a commitment to deregulate in geographic areas where competition is effective
- a commitment to ensuring telecoms providers can make a 'fair bet' for the risks they are taking in building new infrastructure, recognising the long term benefits of the infrastructure
- Ofcom continuing to ensure all providers can access Openreach's ducts and poles on a fair and efficient basis.<sup>39</sup>

## Reaching rural and remote areas

The Commission has concluded that nowhere should miss out on the benefits of full fibre. The Commission's social research found that 86 per cent of people agreed that all parts of the UK should have equal access to broadband.<sup>40</sup> In the past, the UK had the ambition and foresight to connect the whole country to electricity, water and transport networks. The benefits today are obvious. The same ambition is needed now for digital infrastructure.

The capacity constraint of the existing copper network is a particularly critical issue for rural areas with long copper lines. The performance of copper is severely affected by distance, and cannot be upgraded without replacing large parts with fibre, effectively rendering full fibre as the only viable infrastructure upgrade option for most rural areas.<sup>41</sup> In the most remote areas, alternative technologies such as the use of mobile connectivity, fixed wireless or satellite might be more cost effective. Full fibre could also help to improve mobile coverage in hard to reach areas. Mobile 'cells', which transmit and receive data to and from mobile devices, connect to fixed fibre through which they are linked to the global internet.

Without full fibre, rural areas and some deprived communities where full fibre may not be commercially viable will risk falling behind. But everyone stands to gain from ubiquitous connectivity if it enables public services to use digital technology to become more efficient. For example, some health services are already moving online, which can provide better access to specialist services, reduce the need for patients to sit in waiting rooms where they risk further infection, and reduce costs for the NHS.<sup>42</sup> Savings from online provision in rural areas are likely to be particularly large, where the costs of providing traditional services are higher in sparsely populated areas.

The Commission recommends a taxpayer-subsidised infrastructure delivery scheme to uncommercial areas, along the lines of the successful Broadband Delivery UK programme, which directly subsidised up to 50 per cent of the capital expenditure for installing superfast broadband in rural areas. A taxpayer subsidy can take advantage of competitive dynamics, with different companies bidding for tenders. In the short term, this can have positive implications for how quickly and cheaply the infrastructure is deployed. In the longer term, it also enables the costs and performance of subsidised delivery in one region to be measured against others.

Unlike the 'Broadband Delivery UK' programme, government should focus initially on the areas least likely to receive full fibre broadband commercially, and which are also most likely to experience unreliable broadband through long distances of copper cables. Communities within these areas should be eligible to get their full fibre sooner if they volunteer to help build their network at community level, as for example Broadband for the Rural North have done.<sup>43</sup>

However, a reasonable cost threshold will be necessary: the most expensive premises can cost above £45,000.<sup>44</sup> This threshold should be high enough for the programme to cover the vast majority of premises. The few premises which are above the cost threshold should be able to use the subsidy to fund their own solution. The guaranteed minimum broadband service will act as a safety net.<sup>45</sup>

## Completing a nationwide rollout

In some areas of the country, only one fibre operator is commercially viable. It is uncertain whether fibre operators will rush to invest with the aim of becoming the monopoly provider or choose to avoid areas that cannot support multiple networks. In these areas, there is a choice between a targeted solution or relying on the combination of competition and eventual direct government support where the private sector doesn't deliver.

A targeted solution might meet the particular challenge, but would require the government to identify and define the boundaries of these areas upfront. This would rely upon uncertain and evolving assumptions. Changes in the cost of deployment and consumer demand could extend the area where competition is commercially viable, rendering any targeted solution out of date and potentially costly.

Given the pace of innovation in the industry, the potential for significant changes in consumer demand, and the long timescales over which any targeted solution would have to operate, the Commission believes that the boundaries should be allowed to reveal themselves over time. Providing government support for the hardest to reach areas first will allow the market to drive investment in the first instance. The part-subsidy scheme can then be extended in phases to areas that remain unserved, meeting market driven rollout 'in the middle'. If this results in support for provision in areas that are commercially viable, but for only one provider, the taxpayer contribution can be reinvested or refunded through clawback mechanisms.

## Improving mobile connectivity

The Commission was asked in March 2016 to advise government on the steps the UK should take to become a world leader in the deployment of 5G mobile networks, and take early advantage of the applications 5G could enable. The Commission published its report, *Connected Future*, in December 2016.

The Commission's central finding was that mobile connectivity has become a necessity. It recommended that government ensures services are available

wherever people live, work and travel, and that the UK's roads, railways and city centres are ready for 5G.

The government and Ofcom have made some progress; the Department for Digital, Culture, Media and Sport has bolstered its telecoms capabilities and Ofcom has improved its coverage metrics to reflect actual user experience. Ofcom is also currently consulting on new coverage obligations, tied to the 700 MHz spectrum auction, to improve geographic coverage, particularly in rural areas.<sup>46</sup> However, government has made particularly poor progress on road and rail connectivity. It must accelerate its work to ensure 5G-ready infrastructure is available across the UK's motorways and major rail lines by 2025 at the latest.

The Assessment does not reopen the Commission's earlier mobile recommendations. The focus of the Assessment has been on fibre deployment for both fixed and mobile connectivity. Fibre is the necessary underpinning infrastructure for mobile connectivity. Full fibre policies have the potential to improve 4G coverage in hard to reach towns, villages and hamlets. It could also help deliver 5G further, more quickly and cheaply.

Mobile coverage is particularly poor in rural areas; 15 per cent of rural geographic areas cannot receive 4G coverage by any operator, compared to less than 1 per cent of urban areas. The Church of England recently agreed to using its church spires to improve mobile coverage. Two thirds of Anglican churches are in rural areas, situated in the heart of villages with tall spires, ideal for mobile cells. A full fibre connection to the highest point in a local village, whether or not that is the church, could allow mobile cells to be easily installed, improving connectivity in that local area.

Looking ahead, there is an option to preempt where 5G cells might need fibre. Subsidised full fibre rollout could include these locations. This includes lampposts and public buildings. Lampposts could be ideal sites for 5G cells, as well as WiFi and 4G cells today. They have access to power, are high up and evenly spaced out. But they do not automatically have fibre and will not receive it without coordination.

5G is a certain part of the future but what the 5G network will look like is uncertain. It is therefore a gamble to modify full fibre deployment based on any current 5G assumptions. Further evidence is needed to decide whether 5G obligations should be included with full fibre subsidies. The onus should be on wireless infrastructure operators to supply evidence and recommendations to the government.

### **Allowing for copper switch-off**

Copper switch-off should be a key part of the long term national full fibre plan. Running a copper network adjacent to a fibre network will add significantly to overall costs. Switching off the copper network is ultimately a commercial decision for Openreach, the existing operator, but does require some government intervention to allow them to make the decision.

The transition plan will need to include protection for potentially vulnerable consumers. Some consumers will not want fibre but will receive it anyway. Openreach should not be able to charge customers extra that had no need for the upgrade.

## Removing policy barriers

Tackling the barriers that delay deployment and increase costs must be an integral part of the UK's national full fibre broadband plan. Government has set up a Barriers Busting Task Force. This is a good first step and should continue to be prioritised. The Commission has identified four key objectives.

**Give digital infrastructure operators the same rights as utilities:** The process for obtaining rights of way on private land, known as 'wayleaves', should be simplified and standardised, through a notification regime similar to those used for other utilities. All new developments should have full fibre and telecoms duct capacity from the outset, as for other utilities such as electricity and water.

**Prioritise digital connectivity at a local level:** As recommended in *Connected Future*, local government should designate an individual 'digital champion' with responsibility for engaging with telecoms providers. The digital champion in each local planning authority should be responsible for coordinating and facilitating digital infrastructure deployment in their area, acting as the single point of contact for all telecoms providers, and assisting them in delivering better connectivity for the local area. Digital champions should prioritise:

- reforming and streamlining the process around permissions for street works, reducing the variability across the country and removing inefficient delays
- improving the accessibility of their publicly owned assets, making it easier and cheaper for operators to deploy digital infrastructure in the local area.

**Increase infrastructure sharing to push full fibre rollout further:** Access to Openreach's ducts and poles allows alternative operators to deploy fibre more quickly and cheaply. They no longer need to dig their own trenches, which can make up to 60 per cent of total deployment costs.<sup>47</sup> This increases the areas of the country where full fibre can be rolled out commercially. The success of this policy should be monitored by levels of usage to ensure that Openreach's infrastructure is accessible in practice. There may not be benefits from duplicating in-building fibre connections, which are costly and disruptive to install. Countries such as Spain, Portugal and France mandate that in-building fibre is accessible to all operators.<sup>48</sup> Ofcom should consider whether such policies should be applied in the UK.

Making use of other existing infrastructure can also reduce deployment costs. For example, using aerial fibre along existing electricity poles may push some

premises below a reasonable cost threshold in rural areas. Infrastructure re-use should therefore be explored before premises are ruled out for being too costly.

**Ensuring planning is fit for 5G deployment.** The next generation of mobile will require a large number of small cells raising planning issues such as access to street furniture (eg lampposts). This will require collaboration between network operators and local authorities to ensure planning and other permissions are handled swiftly and in a coordinated way. The UK will not get the mobile infrastructure it needs if each individual cell requires separate planning permission. Planning policy, legislation for code powers, and guidelines for deployment at street level will need to be addressed before dense site deployment can take place. The Commission made recommendations on 5G in *Connected Future*.<sup>49</sup>

**The Commission recommends that government should set out a nationwide full fibre connectivity plan by spring 2019, including proposals for connecting rural and remote communities. This should ensure that full fibre connectivity is available to 15 million homes and businesses by 2025, 25 million by 2030 with full coverage by 2033. To achieve these targets:**

- Ofcom should promote network competition to drive the commercial rollout of full fibre, by deregulating where competition is effective and guaranteeing a fair bet on risky investments before regulating any uncompetitive areas.
- Government should part subsidise rollout to rural and remote communities, beginning by 2020, starting with the hardest to reach areas and community self-build.
- Government and Ofcom should allow for copper switch-off by 2025.
- Government and Ofcom should take action to cut the cost of full fibre deployment including:
  - Government should ensure the processes for obtaining wayleaves and connecting new builds are the same for digital infrastructure as other utilities by 2019.
  - Local government should designate ‘digital champions’ to improve telecoms processes such as street work permissions and access to publicly owned assets.
  - Ofcom should monitor the accessibility of Openreach’s duct and pole infrastructure by levels of usage.

## Endnotes

- <sup>1</sup> Department for Digital, Culture, Media and Sport (2017), UK Digital Strategy 2017
- <sup>2</sup> Ofcom (2017), Connected Nations 2017
- <sup>3</sup> Ofcom (2017), International Communications Market Report 2017
- <sup>4</sup> Department for Digital, Culture, Media and Sport (2016), The Great British Broadband Boost
- <sup>5</sup> Department for Digital, Culture, Media and Sport (2018), A new broadband Universal Service Obligation: Government's response to consultation on design
- <sup>6</sup> Prism and Tactis (2017), Cost analysis of future digital infrastructure
- <sup>7</sup> National Infrastructure Commission (2016), Connected Future
- <sup>8</sup> Ofcom (2018), Building a full-fibre future
- <sup>9</sup> Vodafone (2015), Vodafone's call for the Gigabit Society
- <sup>10</sup> Prism and Tactis (2017), Cost analysis of future digital infrastructure
- <sup>11</sup> Frontier Economics (2017), Future benefits of broadband networks
- <sup>12</sup> The Institution of Engineering and Technology (2017), 5G Networks for Policy Makers
- <sup>13</sup> Liberty Global Policy Series, Communications Chambers (2016), Connectivity for the Gigabit Society: A framework for meeting fixed connectivity needs in Europe
- <sup>14</sup> Prism and Tactis (2017), Cost analysis of future digital infrastructure, present value in 2020 (2020 prices)
- <sup>15</sup> Prism and Tactis (2017), Cost analysis of future digital infrastructure, present value in 2020 (2020 prices)
- <sup>16</sup> Prism and Tactis (2017), Cost analysis of future digital infrastructure, present value in 2020 (2020 prices)
- <sup>17</sup> Ofcom (2017), Connected Nations 2017: Data analysis
- <sup>18</sup> Ofcom (2017), Connected Nations 2017: Data analysis
- <sup>19</sup> National Infrastructure Commission (2017), Congestion, Capacity, Carbon: Priorities for national infrastructure consultation response
- <sup>20</sup> Ofcom (2017), Connected Nations 2017
- <sup>21</sup> Ofcom (2017), Communications Market Report 2017
- <sup>22</sup> Study 1: WIK (2018), The Benefits of Ultrafast Broadband Deployment; Study 2: Frontier Economics (2017), Future benefits of broadband networks; Historical average: Ofcom (2004-2018), Connected Nations and infrastructure reports. Accessed at: <https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research>
- <sup>23</sup> Czernich et al (2011), Broadband Infrastructure and Economic Growth, Economic Journal, 121(S52).
- <sup>24</sup> BBC (2009), BT accused of iPlayer throttling. Accessed at: <http://news.bbc.co.uk/1/hi/technology/8077839.stm>
- <sup>25</sup> BBC (2018), Research & Development Blog: World Cup 2018 in UHD HDR on BBC iPlayer. Accessed at: [https://www.bbc.co.uk/rd/blog/2018-05-uhd\\_hdr\\_world\\_cup\\_2018](https://www.bbc.co.uk/rd/blog/2018-05-uhd_hdr_world_cup_2018)
- <sup>26</sup> Frontier Economics (2017), Future benefits of broadband networks
- <sup>27</sup> Frontier Economics (2017), Future benefits of broadband networks; Real Wireless (2016), Future Use Cases for Mobile Telecoms in the UK
- <sup>28</sup> Real Wireless (2016), Future Use Cases for Mobile Telecoms in the UK
- <sup>29</sup> Ofcom (2018), Wholesale Local Access Market Review, Volume 1
- <sup>30</sup> Ofcom (2018), Connected Nations Update Spring 2018
- <sup>31</sup> Prism and Tactis (2017), Cost analysis of future digital infrastructure
- <sup>32</sup> National Infrastructure Commission (2017), Congestion, Capacity, Carbon: Priorities for national infrastructure, BT consultation response
- <sup>33</sup> Ofcom (2018), Wholesale Local Access Market Review, Volume 1
- <sup>34</sup> Ofcom (2016), Strategic Review of Digital Communications: initial conclusions
- <sup>35</sup> Ofcom (2016), Strategic Review of Digital Communications: initial conclusions
- <sup>36</sup> Bruegel Policy Contribution, Briglauger, W., Cambini, C., Grajek, M., (2015), Why is Europe Lagging on Next Generation Access Networks? Issue 2015/14, September 2015.
- <sup>37</sup> Ofcom (2017), The International Communications Market Report
- <sup>38</sup> Ofcom (2015), Strategic Review of Digital Communications: discussion document
- <sup>39</sup> Ofcom (2018), Wholesale Local Access Market Review, Volume 1
- <sup>40</sup> Ipsos MORI (2018), National Infrastructure Commission phase 2: public research
- <sup>41</sup> Ofcom (2017), Connected Nations 2017: Data analysis
- <sup>42</sup> NHS (2018), Empower the Person: roadmap for digital health and care services. Accessed at: <https://indd.adobe.com/view/f1caab26-4963-464e-ba33-6ff71d991a9a>
- <sup>43</sup> B4RN (2017), The World's Fastest Rural Broadband. Accessed at: <https://b4rn.org.uk/>
- <sup>44</sup> Department for Digital, Culture, Media and Sport (2018), A new broadband Universal Service Obligation: Government's response to consultation on design
- <sup>45</sup> Ofcom (2018), Implementing the Broadband Universal Service Obligation
- <sup>46</sup> Ofcom (2018), Consultation: Improving mobile coverage – Proposals for coverage obligations in the award of the 700 MHz spectrum band
- <sup>47</sup> Prism and Tactis (2017), Cost analysis of future digital infrastructure
- <sup>48</sup> WIK-Consult (2017), Best practice for passive infrastructure access
- <sup>49</sup> National Infrastructure Commission (2016) Connected Future

## 2. LOW COST, LOW CARBON



# LOW CARBON INFRASTRUCTURE AT NO EXTRA COST

Reducing emissions has often appeared costly and difficult, but this is no longer the case, if the right decisions are taken now

Today, consumers pay an average of

# £1,850

per year for electricity, heating, hot water and petrol or diesel



The same services could be delivered at the same cost in 2050 by a low carbon energy system



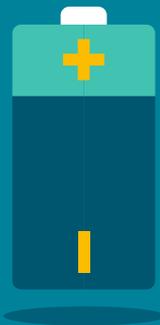
The Commission estimates that an electricity system powered mainly by renewables would cost no more than relying on new nuclear power plants

Renewables need more flexibility to balance variations in weather, but are cheaper to build

Sources of flexibility are getting cheaper: battery prices have fallen

# 80%

since 2010



Burning natural gas for heating and hot water is not a long-term option:

# 22%

of UK's greenhouse gas emissions come from heating



## THE COMMISSION RECOMMENDS:



At least 50% renewable electricity generation by 2030



No more than 1 more contract for new nuclear before 2025



Pilots to test hydrogen and heat pumps as low carbon heating options



Buildings which require less energy to heat

# INCINERATING LESS, RECYCLING MORE

England needs to do as well as Wales – a world leader – at recycling

## PEOPLE ARE WILLING TO DO THEIR BIT:

50%

would pay £30 a year for more recyclable packaging



79%

of people would be willing to separate their food waste

## BUT THEY FIND THE CURRENT SYSTEM TOO COMPLICATED

Higher recycling, especially of plastics, could:



Save £6.2 billion from 2020 to 2050



Avoid the need to build 20 additional incinerators



Reduce greenhouse gas emissions

## THE COMMISSION RECOMMENDS:



Recycling targets: 65% of all waste, 75% of plastic packaging, by 2030



Clearer labelling: recyclable or not recyclable



Restricting use of hard to recycle plastics, by 2025



Separate food waste collection, by 2025

**The UK can have low cost, low carbon electricity, heat and waste. Ten years ago, it seemed almost impossible for the UK to transition to being powered mainly by renewable energy sources such as solar and wind power in an affordable and secure way. Now the same focus needs to be applied to deliver a value for money approach to reducing emissions from heat. Low cost, low carbon energy and waste systems are now possible, and should be delivered.**

The UK is legally bound to reduce its greenhouse gas emissions by at least 80 per cent from 1990 levels by 2050. Today, around 70 per cent of emissions come from electricity, buildings, travel and waste.<sup>1</sup>

Reducing emissions has often appeared costly and difficult, but this is no longer the case. Today consumers pay an average of £1,850 per year for the energy they use, including electricity, transport fuel, and fuel and equipment for heating and hot water.<sup>2</sup> The Commission's analysis shows that the same services could be delivered at the same cost (in today's prices) in 2050 by a low carbon energy system.<sup>3</sup> But this will only be possible if the right decisions are taken now.

The Commission's modelling has shown that delivering a low carbon electricity system for 2050 powered mainly by renewables is a low cost option, cost comparable to building further nuclear power plants after Hinkley Point C. The Commission's modelling also shows that continuing to use fossil fuels with the addition of carbon capture and storage is unlikely to form part of a cost competitive generation mix.

Reducing the waste sent to energy from waste plants (incinerators) by recycling more plastic and converting more food waste into biogas can also help reduce overall emissions. But even with emissions almost eliminated from power generation and waste, the UK cannot achieve its emissions targets without transitioning away from using natural gas, a fossil fuel, for heating. The UK must now address this problem. In the short term, improving the energy efficiency of the UK's buildings will reduce demand for heat and mitigate some of the emissions. In the longer term, it will also reduce the costs associated with delivering low carbon heat infrastructure.

The successful delivery of a low cost, low carbon energy and waste system requires:

- a flexible electricity system and new generation, primarily through renewables
- determining the best way to deliver low carbon heat in the UK

- buildings which require less energy to heat
- encouraging more recycling, and less waste incineration.

## A lower cost, low carbon energy system

Reducing carbon dioxide emissions from the power sector no longer needs to be considered expensive. The Commission's analysis suggests that, across electricity, heat and transport, switching to and using low carbon alternatives does not need to lead to higher costs for consumers in the long term. The need to replace fossil fuels is driving a shift away from technologies, many over 100 years old, that society has become locked into, but which are now beginning to be replaced by more efficient alternatives.

Today, consumers pay an average of £1,850 per year for the energy they use, including electricity, transport fuel, and fuel and equipment for heating and hot water.<sup>4</sup> The Commission's analysis shows that the same services could be delivered at the same cost (in today's prices) in 2050 by a low carbon energy system.<sup>5</sup>

Heating is currently predominantly fuelled by natural gas, a fossil fuel. Transitioning to a low carbon alternative (the two main options are electrified heat, using heat pumps; and hydrogen fuelled heat) will add to household bills. But these extra costs can be outweighed by switching to use electricity rather than petrol or diesel for transport. The cost of supplying low carbon electricity is falling.

These estimates are inevitably uncertain. Savings will only be possible if the right decisions are taken. In particular, these estimates assume investment in cost-effective energy efficiency measures.

The Commission's cost estimates:

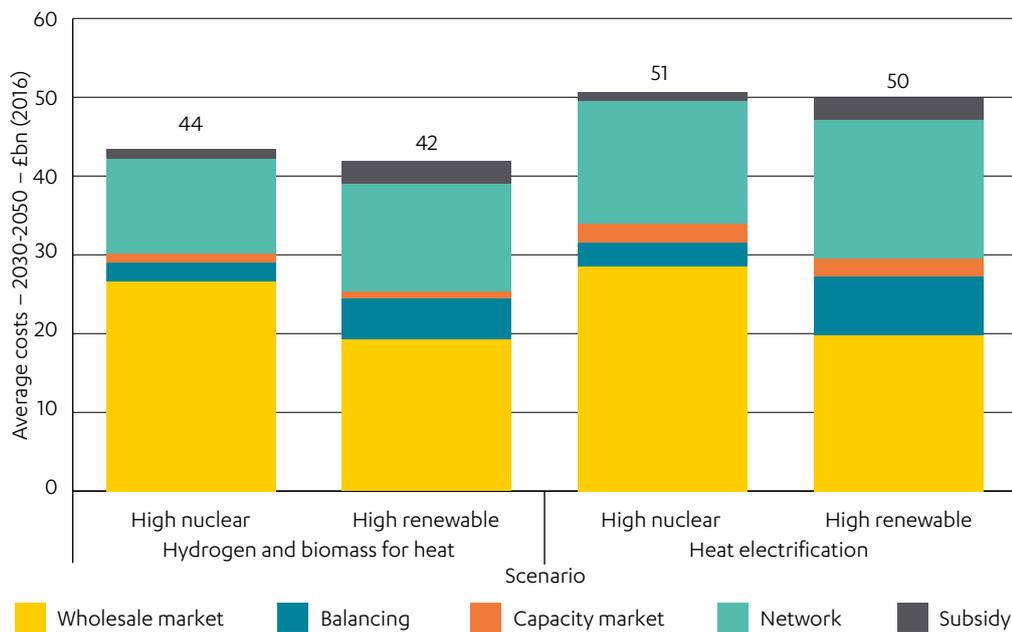
- assume a typical household, consuming the same quantities of energy services today and in 2050
- include the costs of electric vehicle charging infrastructure and home heating appliances (boilers, heat pumps) as well as the costs of energy and fuel
- exclude potential savings on the cost of cars and car maintenance from the switch to electric vehicles, and the one-off costs of energy efficiency measures
- exclude tax – there would be further savings for households from today's tax system (since petrol and diesel are heavily taxed) but these savings would have to be made up elsewhere by the Exchequer
- average the projected costs of predominantly hydrogen and predominantly heat pump scenarios for low carbon heat

- assume continued technology development for existing technologies (eg battery storage) but do not take into account potential new technologies.

Full details are set out in the technical annex: *Energy and fuel bills today and in 2050*.

## Renewables have become cost competitive

It is now possible to conceive of a low cost electricity system that is principally powered by renewable energy sources. The Commission’s analysis has shown that the estimated average cost of the electricity system as a whole between 2030 and 2050 is broadly comparable between investing heavily in nuclear power stations or investing heavily in renewables (there is very little prospect of new nuclear, beyond Hinkley Point C, coming on system before 2030). Figure 2.1 shows slightly lower average costs for a scenario with 90 per cent renewable and less than 10 per cent nuclear compared to a scenario with 40 per cent renewable and around 40 per cent nuclear, regardless of whether heat is predominantly electrified using heat pumps or provided through low carbon hydrogen in the future. The higher cost of managing the variable nature of many renewables (‘balancing’) is offset by the lower capital cost, which translates into lower costs in the wholesale market.



**Figure 2.1: Average cost of the electricity system per year for different proportions of renewables/nuclear and heat decarbonisation pathways<sup>6</sup>**

Estimates over such a long time period, and with considerable technological change, are inevitably uncertain. Specific figures should not be given undue weight. However, the broad conclusion of the analysis implies that an electricity system with no further nuclear plants after Hinkley Point C is likely to be cost comparable with a system which accommodates a new fleet of nuclear reactors.

These estimates assume continued reductions in the costs of renewable technologies. However, in recent years actual cost reductions have exceeded expected reductions.<sup>7</sup> If the trend were to continue, and reductions were to exceed those assumed here, then the case for renewables would be stronger still. Further reductions could arise, for example, from new, cost effective, technologies for energy storage: the modelling does not assume untried technologies.

Historical evidence suggests it is much less likely that nuclear costs will fall. Figure 2.2 shows the construction costs of nuclear power stations in various countries, by construction start date. This shows no discernible trend in construction costs over time. This is true even for countries, such as France, that have built fleets of similarly designed reactors. The issue of long term disposal for nuclear waste is also still unresolved in the UK.

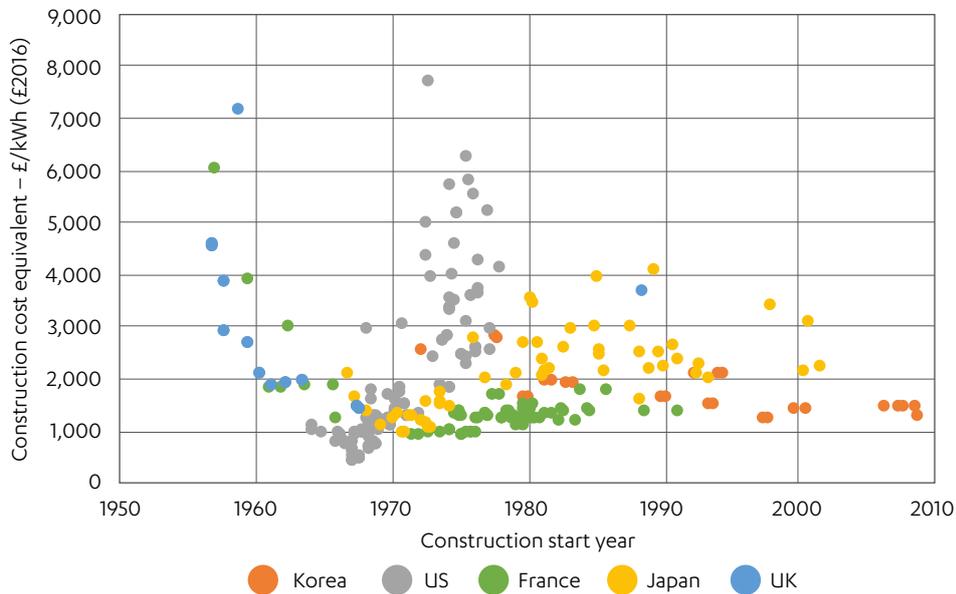


Figure 2.2: Construction costs of nuclear power stations over time<sup>8</sup>

## Paying for nuclear and carbon capture and storage

New nuclear power plants and carbon capture and storage infrastructure will not be built by the private sector without some form of government support. This can come in a variety of forms. Expenditure will be treated as either 'on' or 'off' the public balance sheet (the account of government's assets and liabilities) depending on an assessment by the Office for National Statistics of where the risks and rewards sit.

Off public balance sheet deals, such as the package for Hinkley Point C, leave risks predominantly with the private sector. The National Audit Office found that this procurement model for Hinkley Point C did not provide best value for money for consumers.<sup>9</sup> It is also questionable whether a further deal on this basis could be agreed, given the scale of risk that the private sector is required to hold.

A commonly discussed alternative 'regulated asset base' model, as used for the Thames Tideway Tunnel, could also be classified as off the government balance sheet. In this case, however, consumers hold both some risks and some elements of financing. The Thames Tideway model requires consumers to pay for infrastructure in advance. This makes projects appear cheaper as consumers are effectively financing the projects at zero interest. At least some of the risk associated with construction costs also sit with consumers, a further hidden cost, since consumers are not paid to hold these risks in the way investors would be.

Funding nuclear power stations or carbon capture and storage on the public balance sheet represents a transfer of risk from the private to the public sector. Cost overruns would ultimately be paid for by taxpayers, at least in part. These risks are not reflected in the government's cost of borrowing, since it is taxpayers, rather than the holders of debt, who bear the risk. But this does not mean the risk, and its associated costs, have been avoided. The apparently lower financing costs represent a transfer, rather than a reduction, in risk.

On balance sheet options would need to compete with alternative uses of the government's balance sheet. Chapter 7 sets out the Commission's choices within the resources government have set out (the 'fiscal remit'). The Commission have not assumed any on balance sheet nuclear power stations in making these choices.

It is not clear what the best model for either type of project would be, since this would depend on the commercial terms available and where risk can best be managed. Past experience of on balance sheet nuclear construction in the UK has been mixed. There is limited experience of using the regulated asset base model for anything as complex and risky as nuclear. However, any assessment needs to recognise the full costs and risks. It should not be distorted by hidden costs or used to present costs as artificially lower.

Given the balance of cost and risk, a renewables based system looks like a safer bet at present than constructing multiple new nuclear power plants. But a large amount of uncertainty does remain. No country has yet built an electricity system with very high levels of variable renewables. It will be important to develop a better understanding of how such a system performs under adverse weather conditions, particularly given that climate change itself makes such conditions

harder to predict. The risk is that the extra services required to accommodate large amounts of renewables may be harder, or more expensive, to source than envisaged. But given that some technologies which provide flexibility are still fairly immature, the costs could also be lower than the analysis suggests.

Given these uncertainties, the Commission is recommending a 'one by one' approach to new nuclear plants, as opposed to the current government policy to develop a large fleet. This is preferable to a 'stop start' approach, in which the nuclear programme is cancelled only to be restarted at a later date. It will allow the UK to maintain, but not expand, a skills base and supply chain. This allows the UK to pursue a high renewables mix, which is most likely to be the preferred option, without closing off the nuclear alternative.

The Government should also seek to ensure continuity with current Euratom arrangements as the UK leaves the EU, to ensure that on 29 March 2019 the UK has the necessary measures in place for the nuclear industry to continue to operate.

## A more flexible power system

Matching energy supply and demand means the electricity system needs 'flexibility', both within days and across seasons. This can be provided by a combination of flexible supply (energy that can be generated on demand); energy storage; and flexible demand (demand that can be moved to a time of day when there is more supply).

To date, carbon intensive fossil fuels have met some of this need by providing plenty of flexible supply. But as they come off the system in favour of (mostly variable) renewable energy, flexibility will need to be maintained in other ways. The Commission's analysis takes into account the cost of providing additional flexibility, as well as wider system costs such as the transmission and distribution of electricity. More renewables do lead to more money being spent to match supply and demand: a system with 90 per cent renewables is estimated to cost up to £4.5 billion more per year to balance. But cheaper capital costs are estimated to offset this within the costs for the overall system.<sup>10</sup>

In all scenarios, extra flexibility, which includes technologies such as storage, interconnection and demand side response, is a low regrets investment which reduces estimated total energy system costs by between £1-7 billion per year on average between 2030 and 2050.<sup>11</sup> This finding echoes the conclusions of the Commission's *Smart Power* report.<sup>12</sup> Extended periods of low sun and wind in the winter can be met by a range of flexible technologies or, in the extreme case, by using limited amounts of fossil fuels. These events are rare, so the impact on emissions would remain small.<sup>13</sup>

The Commission's analysis demonstrates that a rapid uptake of electric vehicles in the 2020s (see Chapter 3) can not only be accommodated, but that the batteries in electric vehicles could be a valuable and low cost source of flexibility for the electricity system in future. Provided smart charging is implemented, electric

vehicles can provide demand when it is otherwise low and potentially return power, stored in car batteries, to the grid at peak times ('vehicle to grid').<sup>14</sup>

## A level playing field for different renewables

The existing mechanism for supporting low carbon generation technologies is called 'Contracts for Difference'. To reduce generators' exposure to volatile wholesale electricity prices, Contracts for Difference require generators to sell energy to the market as usual, but contract government to pay generators any difference between the market price and a pre agreed 'strike price', which is usually valid for 15 years. At times of high market prices these payments reverse and the generator is required to pay government back the difference between the market price and strike price.<sup>15</sup>

The Commission favours the use of existing market mechanisms – Contracts for Difference and the capacity market – where possible, to avoid creating more uncertainty, but incremental improvements could be made. The Contracts for Difference mechanism can provide both certainty for generators and a subsidy (depending on the agreed 'strike price'). Low carbon generation technologies have so far not been cost competitive, bringing both of these into play.

Since the introduction of Contracts for Difference, there have been significant reductions in the costs of renewables to consumers, through the competitive allocation of support. For each Contracts for Difference auction, technologies at similar stages of development are grouped together in different 'pots'. Pot 1 was set up for 'established' technologies, including onshore wind and solar, and pot 2 (for 'less established' technologies) contains, amongst other technologies, offshore wind. Only one pot 1 auction has been run to date.

Revising the distribution of technologies between pots and reinstating a pipeline of pot 1 auctions would enable the lowest cost renewable generation mix to be brought forward in the 2020s. Onshore wind, which enjoys strong public support overall,<sup>16</sup> but has been controversial in some communities, would still be subject to planning restrictions in England. Projects in Wales and Scotland would no longer be held back. Pot 2 auctions could be used to allocate small amounts of support to emerging technologies, especially where they are likely to be able to contribute to the reduction of system costs in future.

Low carbon generation technologies should benefit from the support from Contracts for Difference. However, as set out in the Commission's interim National Infrastructure Assessment, it is also important that generators are responsible for costs and benefits they impose on the system, such as those related to where they situate. Some sites impose costs, for example due to the need for new transmission infrastructure, or benefits, for example if local weather conditions complement those elsewhere.

Over time, the different costs and benefits of new generation should increasingly be reflected in the auction process, allowing the lowest cost system to be developed. However, calculating these impacts is very complex, and in practice

a mixture of pricing and other mechanisms will need to be used to ensure total system costs are reflected in the bid price. As the generation mix evolves, it will be essential that both technological and spatial diversity are maintained across the system. This may involve making use of administrative limits for each technology within auctions.

As the prices of low carbon technologies continue to fall, the need to subsidise low carbon generation through Contracts for Difference will reduce and, particularly in later years, the mechanism may require payments from generators. This could result in contracts that provide the certainty required for low cost investment, but which are low cost or cost neutral for consumers over their duration. This may be important, as no one knows what the electricity markets will look like in the long term, or what factors will drive the electricity price. However, contract lengths will also need to reflect the need to retain flexibility in the future development of the electricity market.

## Tidal power

The Commission's analysis suggests that tidal lagoon power will remain an expensive technology in the future. The extra benefits which arise from its predictability are not enough to offset its higher capital costs.<sup>17</sup> And it will never be a large-scale solution: an entire fleet of tidal lagoons would only meet up to 10 per cent of current electricity demand in the UK.<sup>18</sup> This also limits the scope for cost reductions through the kinds of learning and scale economies that have been achieved with wind and solar power. Further details are set out in technical annex: *Tidal power*. Given the broad portfolio of readily available lower cost, low carbon technologies, special treatment for tidal lagoons in the form of bilaterally agreed contracts is not justified. However, tidal should be allowed to compete on an equal basis with other technologies for Contracts for Difference.

## The near term: 2020 – 2030

Increasing population and electric vehicle uptake means that energy demand could increase by 9-26 per cent from today to 2030.<sup>19</sup> And over this period, up to 40 GW of older power stations will come offline.<sup>20</sup> This creates a large opportunity to continue to reduce emissions from the electricity system throughout the 2020s without stranding assets.

New nuclear power stations are unlikely to be an additional source of electricity in the 2020s, with the possible exception of Hinkley Point C. Large scale projects have long construction timelines and often face delays. Smaller reactors are still at an early stage of development and their benefits remain speculative. It is estimated that the end-to-end deployment process will take 12-14 years for the first small modular reactor.<sup>21</sup>

Since a system with a high proportion of renewable generation looks cost effective in the long term, and adding more nuclear to the system in this timeframe is unlikely, it makes sense to continue to add more renewables to the system in the 2020s.

However, not all new sources of supply in the 2020s need be renewable. Interconnectors, of which there is a large pipeline of projects, are likely to become of increasing importance throughout this period, and the Government should ensure that the current pipeline is not affected by the UK's exit from the EU. It may also be cost-effective to deploy a limited amount of new gas power stations, provided they can be accommodated within the carbon budgets, and recognising that load factors are likely to be on a reducing path.<sup>22</sup>

The Commission recommends that in order to keep the option of a highly renewable system in 2050 open, at least 50 per cent of generation (in TWh) should be renewable by 2030. This would be equivalent to between 12 and 19 GW of offshore wind being deployed, in addition to the current pipeline.<sup>23</sup> The Commission's analysis suggests that the budget of £557 million that the government has set aside for future Contracts for Difference auctions may be sufficient to achieve this, depending on the future wholesale price of electricity.<sup>24</sup> However, if interconnectors do not deliver expected benefits, up to 65 per cent of generation may need to be renewable to meet 2030 carbon targets.

**The Commission recommends that government should set out a pipeline of pot 1 Contracts for Difference auctions, to deliver at least 50 per cent renewable generation by 2030, as part of the transition to a highly renewable generation mix. Government should:**

- Move technologies that have recently become cost competitive, such as offshore wind, to pot 1 following the next Contracts for Difference auction in Spring 2019. Pot 1 should be used for the overwhelming majority of the increase in renewable capacity required.
- Publish indicative auction dates and budgets for the next decade by 2020.
- Over time take whole systems costs into account in Contracts for Difference auctions, as far as possible.
- Consider whether there is a case for a small-scale, pot 2 auction in the 2020s, if there are technologies which are serious contenders for future pot 1 auctions.
- Not agree support for more than one nuclear power station beyond Hinkley Point C, before 2025.

## Carbon capture and storage

The Commission's analysis included carbon capture and storage (CCS) as a potential option for the electricity system. Carbon capture and storage would allow the continued use of fossil fuels. However, the Commission's analysis showed that it rarely appeared to be a cost effective option for reducing power sector emissions. In scenarios where small amounts were cost effective, this was in the 2040s. This finding held even when carbon dioxide transport and storage costs were assumed to be very low, indicating the outcome if carbon capture and storage had already been built for other purposes. This shows it does not make sense for electricity consumers to subsidise the development of carbon capture and storage, since it will not benefit them in future.

Generation scenario	Heat decarbonisation scenario	CCS cost assumption	Percentage of CCS in the 2050 generation mix
40% renewable	Hydrogen and biomass	Central	1%
		Low	5%
	Electrification	Central	4%
		Low	8%
90% renewable	Hydrogen and biomass	Central	0%
		Low	0%
	Electrification	Central	0%
		Low	0%

**Figure 2.3: Percentage of generation from fossil fuelled power stations equipped with carbon capture and storage in 2050 under different scenarios for generation mix, heat decarbonisation pathways and carbon capture and storage costs**

There are several other potential uses for carbon capture and storage, including the reduction of emissions from industrial processes and combining it with biomass combustion to create negative emissions. However, the most pressing reason to develop it at scale is likely to be for the manufacture of low carbon hydrogen. This will be required if the UK chooses to remove carbon emissions from heat through diluting or replacing natural gas with hydrogen, especially in the absence of a global hydrogen market. Removing and storing the carbon from natural gas as part of producing hydrogen is a simpler process than capturing it as it is burnt in a power station.<sup>25</sup>

## Informing future decisions on heat

Reducing emissions from heating in an affordable way is the next challenge. Currently 69 per cent of heat is produced through burning natural gas, a fossil fuel.<sup>26</sup> This must be radically reduced. Uncertainties around cost, technology, and consumer behaviour means that it is difficult to decide the cheapest way to replace natural gas to meet future Climate Change Act targets now. However, this uncertainty is not an excuse for inaction in the near term. Low carbon heat at lowest cost will benefit the environment and improve many people's lives.

There are two potential large scale solutions for low carbon heat, and a range of smaller solutions which may complement one of them. The first option is electrification, using heat pumps to increase the efficiency of using electricity for heating. Alternatively, hydrogen from a zero carbon source (which creates only water vapour when burnt) could be used as a direct replacement for natural gas, fuelling boilers and appliances.

Whilst there are incremental steps that can be taken to address some aspects of the challenge, an incremental approach on its own will not be enough. In the 2020s, decisions will be required on whether the gas network should be maintained and converted, or phased out.

The Commission's analysis shows that currently all routes to low carbon heat are more expensive than maintaining the status quo, although the cost of heating as a proportion of GDP in 2050 is estimated to reduce.<sup>27</sup> The impacts of this cost will also be offset by switching to cheaper forms of energy in other areas, particularly transport.<sup>28</sup> Central estimates indicate an average annual cost between now and 2050 of £13 – 16 billion above the current system cost of £24 billion.<sup>29</sup> These figures are highly uncertain. Finding ways to reduce both the uncertainty and magnitude of them must be a priority.

For government to make choices about the decarbonisation of heat in the 2020s, there needs to be a coherent programme to ensure that the evidence to do so is in place. This should include collaborating internationally on research and development, to give government the confidence to invest in the best solution when the time is right. The Commission plans to provide further advice to government on this issue in the next National Infrastructure Assessment, taking into account parallel strategies in Scotland and Wales.

**The Commission recommends that government needs to make progress towards zero carbon heat:**

- **Establishing the safety case for using hydrogen as a replacement for natural gas, followed by trialling hydrogen at community scale by 2021.**
- **Subject to the success of community trials, launching a trial to supply hydrogen to at least 10,000 homes by 2023, including hydrogen production with carbon capture and storage.**
- **By 2021, government should establish an up to date evidence base on the performance of heat pumps within the UK building stock and the scope for future reductions in the cost of installation.**

## **Buildings which require less energy to heat**

Improving the insulation of buildings makes sense both now and in a low carbon future. The Commission's analysis suggests that there are over 21 million individual improvements to buildings in England that together could save billions of pounds. This includes insulating 10 million lofts, 6 million floors and almost

5 million walls. This is equivalent to 21,000 improvements being installed every week between now and 2035.<sup>30</sup> The current rate of progress is around 9,000 improvements installed per week.<sup>31</sup>

Delivering these improvements alone represents a major challenge. Driving widespread improvements in energy efficiency is notoriously difficult. Different interventions to stimulate uptake will be required across different segments of the building stock.

However, an even more ambitious approach may ultimately be required. The optimum level of energy efficiency is partly linked to the choice of heat technology: in particular, heat pumps work best in buildings with reasonably high insulation standards because they provide constant, but low temperature levels of heat.

A range of different initiatives will need to be trialled and fully evaluated, learning from international experience, and progress regularly reviewed. The government will need to prepare for the fact that it is likely that some future energy efficiency initiatives may fail. But this should not lead to a loss of momentum or enthusiasm for energy efficiency. Alongside this, innovation in energy efficiency products and processes should also continue to be supported, particularly for solid walls. An immediate priority is the social rented sector. Under any approach, government will inevitably bear most of the cost of improving energy efficiency either through direct grants, support to social landlords or rental payments via Housing Benefit. The Commission estimates that cost effective improvements to existing socially rented properties would cost £3.8 billion. A ten year programme would meet government's own stated ambition of ensuring social rented properties reach at least Energy Performance Certificate level C by 2030.<sup>32</sup>

**The Commission recommends that government should set a target for the rate of installations of energy efficiency measures in the building stock of 21,000 measures a week by 2020, maintained at this level until a decision on future heat infrastructure is taken. Policies to deliver this should include:**

- Allocating £3.8 billion between now and 2030 to deliver energy efficiency improvements in social housing.
- Government continuing to trial innovative approaches for driving energy efficiency within the owner occupier market.
- Government setting out, by the end of 2018, how regulations in the private rented sector will be tightened and enforced over time.

## Incinerating less, recycling more

Low cost, low carbon waste is also necessary and achievable in the near term. The Commission's remit on waste covers England only, where waste generation is expected to rise as the population grows. Energy from waste plants (incinerators) facilitated the move away from landfill, and make sense when the alternative is

energy from fossil fuels. They incinerate 'black bag' waste and other wastes that cannot be recycled, producing electricity and providing heat where there is a source of demand nearby.

However, lower cost, lower carbon options exist for some types of waste, in particular food waste and plastics. In these areas, England should not settle for the minimum standards set out in EU legislation but should seek to be amongst the best performers, learning from the example set by Wales.

## Separating food waste

As an alternative to incineration, food waste can be treated in 'anaerobic digesters'. Anaerobic digesters break down biodegradable waste in the absence of oxygen, producing biogas and a low grade fertiliser ('digestate') at a fraction of the capital cost of incinerators.<sup>33</sup> In future, technologies such as pyrolysis or gasification, may also become available commercially.<sup>34</sup>

Biogas can be used as a low carbon substitute for natural gas. It can also be converted to a range of biofuels, which may prove especially valuable in sectors where fossil fuels are hardest to replace, such as aviation. Besides treatment, there are benefits to collecting food waste separately, such as preventing the contamination of other recyclable materials.

Using anaerobic digestors requires the separate collection of food waste, which is typically collected weekly in household 'caddies' designed for the purpose. In 2014-15, only 26 per cent of English households had separate food collection.<sup>35</sup> The Commission's analysis shows universal food waste collection would avoid the need to build between 1 and 3 energy from waste plants between now and 2050. It would save up to £400m in capital costs and £1.1bn in operational costs for local authorities in total between 2020 and 2050.<sup>36 37</sup> This includes the cost of weekly collections.

In the Commission's social research, 79 per cent of participants without caddies said they would be willing to use one.<sup>38</sup> A higher recycling rate more generally reduces the demand for residual waste infrastructure. By 2035, a 65 per cent recycling rate, with separate food waste collection, would mean that 7 million tonnes less residual capacity is needed, equivalent to 20 energy from waste facilities.<sup>39</sup>

**The Commission recommends that government should establish separate food waste collection for households and businesses (to enable production of biogas) by 2025.**

## Wales: a world leader in recycling

In 2008, Wales had a similar recycling rate to England (approximately 40 per cent). Today, Wales has the third highest municipal recycling rate in the world (64 per cent).<sup>40</sup>

Wales achieved this through its 'towards zero waste' strategy. The strategy established ambitious recycling targets for local authorities, mandated the separate collection of food waste and provided a blueprint for standardised collection of other materials.<sup>41</sup>

To ensure local authorities had the capacity to deliver effective recycling collection systems, the Welsh Government provided £68 million in capital support for recycling infrastructure.<sup>42</sup> Additionally, the ability to fine local authorities that missed their recycling targets was introduced.<sup>43</sup> In practice, only one local authority has been fined; all that missed the targets were referred to a support program. Communication campaigns were conducted to raise awareness of what could be recycled.

By becoming a leader in recycling, Wales saw the total cost of collection for local authorities fall. In the process, it avoided 105,000 tonnes of carbon dioxide emissions.

## Reducing plastic waste

A more circular economy, with a higher recycling rate that keeps materials in use for longer, could save local authorities a total of £6.2bn between 2020 and 2050.<sup>44</sup> Targeting plastics is particularly important. Increasing the plastic recycling rate will also reduce emissions generated from burning plastics (effectively a fossil fuel) and reduce leachates that can contaminate local water systems when plastic is landfilled.

Despite this, the UK's plastic recycling rate is just 30 per cent.<sup>45</sup> This is due to both household behaviour, and product design. In England, 53 per cent of households throw away items that could be recycled.<sup>46</sup> This appears, at least in part, to be due to a lack of clarity on recycling; the Commission's social research suggests many people would like to recycle more but find it complex and confusing.<sup>47,48</sup>

The first priority should be to reduce unnecessary packaging and other single use plastics. The government have launched a range of consultations in this area. It is important that these lead to action. Thereafter, it is important to target hard-to-recycle materials. The way packaging is designed can alter the cost and viability of recycling. To date, incentives in the waste system have been focused on weight. The government is currently reviewing this approach, as reductions in weight may have reached their limit. Setting incentives to improve product design could help reduce the cost of recycling.

Some materials are particularly problematic. PVC can compromise recycling of PET, which is otherwise widely recycled.<sup>49</sup> Polystyrene is almost never economical to recycle and particularly dangerous to marine life.<sup>50</sup> In the long run, these materials need to be replaced if packaging is to be sustainable. A clear timetable

by which these products would be phased out would allow industry to develop sustainable alternatives.

A package of measures to improve supply of recyclable material, standardise collection regimes and clarify labelling is needed to push recycling rates upwards. Government initiatives and incentives to target specific products such as the Deposit Return Scheme or recent proposals on packaging reform are important steps forward, but they need to work alongside ambitious headline targets.<sup>51</sup>

**The Commission recommends that government should set a target for recycling 65 per cent of municipal waste and 75 per cent of plastic packaging by 2030. Government should set individual targets for all local authorities and provide financial support for transitional costs.**

The government should establish:

- Clear two symbol labelling (recyclable or not recyclable) across the UK by 2022.
- A consistent national standard of recycling for households and businesses by 2025.
- Restrictions on the use of hard-to-recycle plastic packaging (PVC and polystyrene) by 2025.
- Incentives to reduce packaging and for product design that is more easily recyclable by 2022.
- A common data reporting framework for businesses handling commercial and industrial waste by the end of 2019, ideally through voluntary reporting but if necessary by legislation.

## Endnotes

- <sup>1</sup> CCC (2018), Reducing UK emissions: 2018 Progress Report to Parliament
- <sup>2</sup> Technical annex: Energy and fuel bills today and in 2050, July 2018
- <sup>3</sup> Ibid
- <sup>4</sup> Ibid
- <sup>5</sup> Ibid
- <sup>6</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission. Rebased from 2016 prices.
- <sup>7</sup> Jones (2012), UKERC Technology and Policy Assessment, Cost Methodologies Project: Onshore Wind Case Study; Gross et al (2013), Presenting the Future: An assessment of future costs estimation methodologies in the electricity generation sector UKERC (2012), Cost Methodologies Project: Onshore Wind Case Study and UKERC (2013), Presenting the Future: Electricity Generation Cost Estimation Methodologies
- <sup>8</sup> Constructed by the Commission using data from Lovering J. R; Yip A.; Nordhaus T. (2016), Historical construction costs of global nuclear power reactors. Costs calculated on an 'overnight' basis, rebased from 2010 prices.
- <sup>9</sup> National Audit Office (2017), Hinkley Point C
- <sup>10</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission
- <sup>11</sup> Ibid
- <sup>12</sup> National Infrastructure Commission (2016), Smart Power
- <sup>13</sup> Thornton et al (2017), The Relationship between wind power, electricity demand and winter weather patterns in Great Britain, Environmental Research Letters; Sinden (2005), Characteristics of the UK wind resource: long term patterns and relationship to electricity demand, Energy Policy; Brown, T. W. et al (2018), Response to 'Burden of proof: A comprehensive review of the feasibility of 100% renewable electricity systems'
- <sup>14</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission
- <sup>15</sup> Department for Business, Energy and Industrial Strategy (2017), Policy paper: Contracts for Difference
- <sup>16</sup> BEIS (2018), Energy and Climate Change Public Attitudes Tracker (PAT): Wave 25 – summary report
- <sup>17</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission
- <sup>18</sup> Hendry, C. (2016), The role of tidal lagoons
- <sup>19</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission
- <sup>20</sup> Ibid
- <sup>21</sup> Atkins (2016): SMR Techno-Economic Assessment
- <sup>22</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission
- <sup>23</sup> Commission calculations based on Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission and data provided by the Low Carbon Contracts Company.
- <sup>24</sup> Commission calculations based on Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission, data provided by the Low Carbon Contracts Company and Department for Business, Energy and Industrial Strategy (2017), Contracts for Difference: Allocation Framework for the second Allocation Round
- <sup>25</sup> Damen, K. (2007), A comparison of electricity and hydrogen production systems with CO2 capture and storage
- <sup>26</sup> BEIS (2017), Energy consumption in the UK 2017 update
- <sup>27</sup> Element Energy and E4Tech (2018), Cost analysis of future heat infrastructure options, National Infrastructure Commission calculations
- <sup>28</sup> Energy costing note, 2018/19 prices
- <sup>29</sup> Element Energy and E4Tech (2018), Cost analysis of future heat infrastructure options, National Infrastructure Commission calculations
- <sup>30</sup> Element Energy and E4Tech (2018), Cost analysis of future heat infrastructure options
- <sup>31</sup> BEIS (2018), Household Energy Efficiency National Statistics
- <sup>32</sup> HM Government (2017), The Clean Growth Strategy
- <sup>33</sup> Anthesis (2018) National Infrastructure Assessment: Waste Infrastructure Analysis for England, Report for the National Infrastructure Commission
- <sup>34</sup> Energy Technologies Institute (2017), Targeting New and Cleaner Uses for Wastes and Biomass Using Gasification
- <sup>35</sup> WRAP (2016), Household food waste collections guide
- <sup>36</sup> Anthesis (2018) National Infrastructure Assessment: Waste Infrastructure Analysis for England, Report for the National Infrastructure Commission
- <sup>37</sup> Ibid
- <sup>38</sup> Ipsos MORI (July 2018), National Infrastructure Commission phase 2: public research
- <sup>39</sup> Anthesis (2018) National Infrastructure Assessment: Waste Infrastructure Analysis for England
- <sup>40</sup> Eunomia (2017), World Recycling League; Welsh Government (2017) Local Authority Waste Management Report for Wales, 2016-17
- <sup>41</sup> Welsh Government (2018) Evidence submitted to the National Infrastructure Commission
- <sup>42</sup> Ibid
- <sup>43</sup> Ibid
- <sup>44</sup> Anthesis (2018) National Infrastructure Assessment: Waste Infrastructure Analysis for England

<sup>45</sup> Eunomia (2018), Plastic Consumption and Waste Management

<sup>46</sup> Wrap (2017) Recycling Tracking Survey 2017 Behaviours, attitudes and awareness around recycling

<sup>47</sup> Ibid

<sup>48</sup> Ipsos MORI (July 2018), National Infrastructure Commission phase 2: public research

<sup>49</sup> Deloitte (2015), The New Plastics Economy

<sup>50</sup> Nguyen (2012), An Assessment of Policies on Polystyrene Food Ware Bans

<sup>51</sup> Wrap, Incpen (2018) Letter submitted to Rt. Hon. Secretary of State for Environment, Food and Rural Affairs.

# 3. REVOLUTIONISING ROAD TRANSPORT



# GETTING READY FOR THE ROADS REVOLUTION

Vehicles of the future will be cheaper, cleaner, quieter and safer.

As prices fall and range increases, take up of electric vehicles could accelerate rapidly

## ELECTRIC VEHICLES MEAN:

### 1 Cleaner air

vehicles contribute to 80% of air pollution breaches and 34% of greenhouse gas emissions

### 2 Lower costs

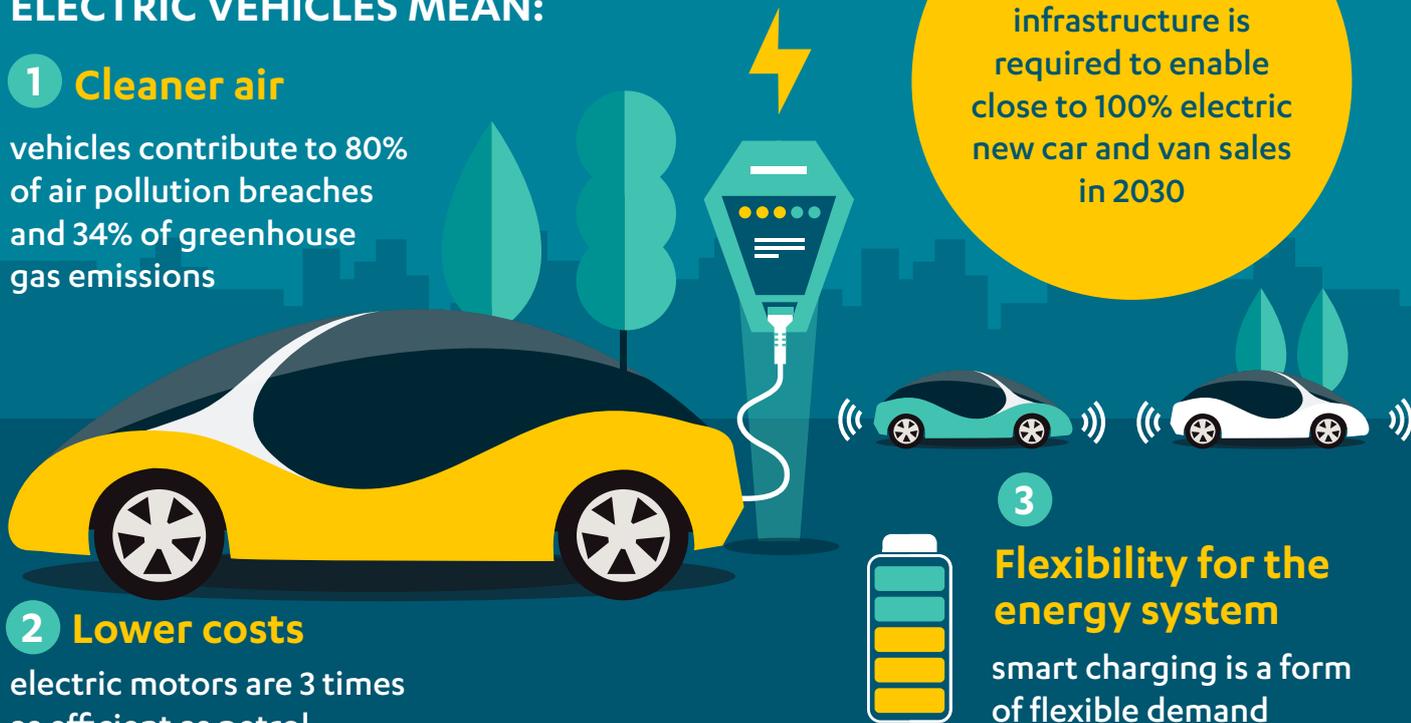
electric motors are 3 times as efficient as petrol

Charge point infrastructure is required to enable close to 100% electric new car and van sales in 2030

### 3

### Flexibility for the energy system

smart charging is a form of flexible demand



## CONNECTED, AUTONOMOUS VEHICLES WILL MEAN:



### Safer roads

over 1,700 people are killed on the roads per year



### Accessibility

more people can travel by car



### Time freed up

driving takes an average of 140 hours per year

## BUT ROADS WILL NEED TO CHANGE. SOME IDEAS ARE:

**1** Connecting cars and traffic signals, instead of waiting at the lights

**2** Flexible curbs changing use through the day, instead of yellow lines

**3** Separate lanes, instead of mixing different types of vehicle

**4** Variable speed limits, smoothing the flow of traffic

**5** Automatic re-routing of journeys, instead of traffic jams

**80** ↑



## THE COMMISSION RECOMMENDS:



Making it easier to convert parking spaces and provide charge points on the street



Investing in the electricity network to achieve the benefits of electric vehicles



Future road and rail investment plans need to reflect the impact of connected and autonomous vehicles



Government support for rural charge points

**Most journeys in the UK are made by road. After 100 years of incremental change, road transport is about to undergo a revolution. More electric cars and vans are being built and sold, and autonomous vehicles could soon be on the roads too. These vehicles will change the nature of the transport debate in the UK. Conventional vehicles bring pollution, noise and accidents; electric vehicles are cleaner and quieter, and connected and autonomous vehicles could make roads safer.**

The UK is one of the top European countries in terms of electric vehicle sales,<sup>1</sup> and government already supports the move to electric vehicles.<sup>2</sup> But the UK should speed up its preparations; electric vehicles are fast becoming cheaper and better, and take up could accelerate. With the right conditions, including a national network of electric vehicle charge points, the UK could become a world leader in electric vehicles.

There is also potential for the UK to become a world leader in connected and autonomous vehicles. KPMG has ranked the UK fifth in the world in terms of readiness for connected and autonomous vehicles,<sup>3</sup> and the UK is home to many companies developing this technology. The Commission has launched an innovation competition for ideas on how to deliver world-class roads ready for this revolution: 'Roads for the Future.'

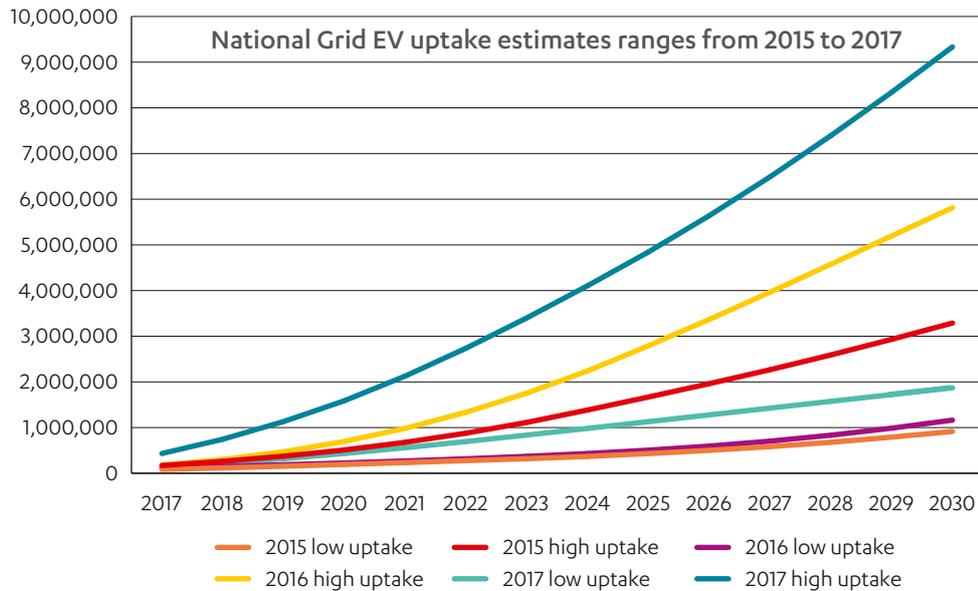
Government must set a clear policy direction to encourage private sector investment in charging infrastructure for electric vehicles, and to prioritise research and innovation for connected and autonomous vehicles in the longer term. This will require:

- enabling electric vehicles to provide additional flexibility to the energy network
- enabling commercial charge point provision, with support in rural areas
- putting connected and autonomous vehicles at the heart of government planning
- preparing roads for connected and autonomous vehicles.

## Electric vehicle uptake predictions

Electric cars and vans could become widespread ahead of most predictions, as prices continue to fall. Price falls are being driven by reductions in the cost of batteries, the most expensive component of an electric vehicle. Battery prices fell by 80 per cent between 2010 and 2016.<sup>4</sup> This initially meant that the range of electric vehicles could be extended: some cars can now travel up to 300 miles

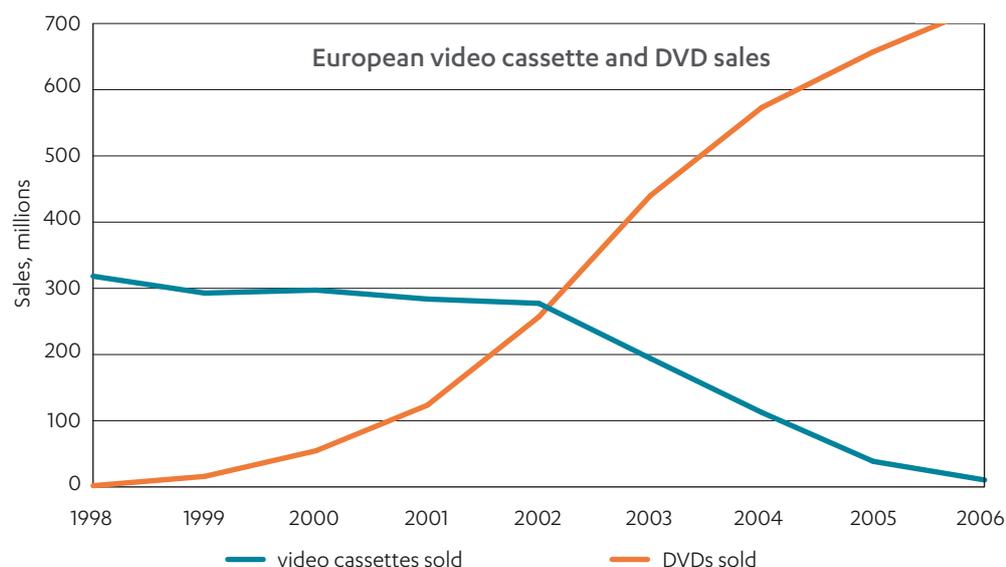
on a single charge.<sup>5</sup> Once ranges are sufficient, further falls in battery prices can translate directly into falls in the prices of the vehicles.<sup>6</sup> Upfront cost parity between electric and conventional vehicles is now expected by the mid-2020s.<sup>7</sup> And as purchase prices become comparable, fully electric vehicles will look increasingly attractive, as they are cheaper to run.<sup>8</sup> As these facts emerge, projections are evolving to reflect them: figure 3.1 shows how National Grid's electric vehicle uptake estimates have increased over the past three years.



**Figure 3.1: Range of battery electric and plug-in hybrid vehicle uptake estimates from National Grid's Future Energy Scenarios<sup>9</sup>**

Given current industry momentum and falling costs, it looks like electric vehicles, rather than alternatives such as hydrogen, will capture the market for low emission cars and vans in the short to medium term. It is too early to know if electric vehicles are the future for larger vehicles. The Commission's study on the future of the freight system, due to report in Spring 2019, will consider how to reduce emissions and congestion from road freight.

New technologies typically follow an s-shaped diffusion curve, which starts to accelerate as uptake moves into the 'take-off' period. This can start when they have reached 5 per cent of their potential market.<sup>10</sup> Figure 3.2 demonstrates how sales of videos declined as consumers switched to purchasing DVDs.



**Figure 3.2: Sales of video cassettes and DVDs in Europe over time showing a typical s-shaped technology diffusion curve.<sup>11</sup>**

In 2017, electric and hybrid vehicles represented 1.8 per cent of all new registrations, up 27 per cent on the previous year.<sup>12</sup> Electric vehicles could therefore soon enter the ‘take-off’ stage in the UK. Some projections suggest that the UK could even see 100 per cent sales of electric vehicles by 2027, and 100 per cent stock by 2042.<sup>13</sup>

A 2016 Department for Transport survey showed concern about recharging was the most significant factor preventing consumers buying an electric vehicle (45 per cent), followed by the distance travelled by one charge (39 per cent).<sup>14</sup> But aside from the need for a charging network, electric vehicles are likely to become increasingly attractive to consumers.

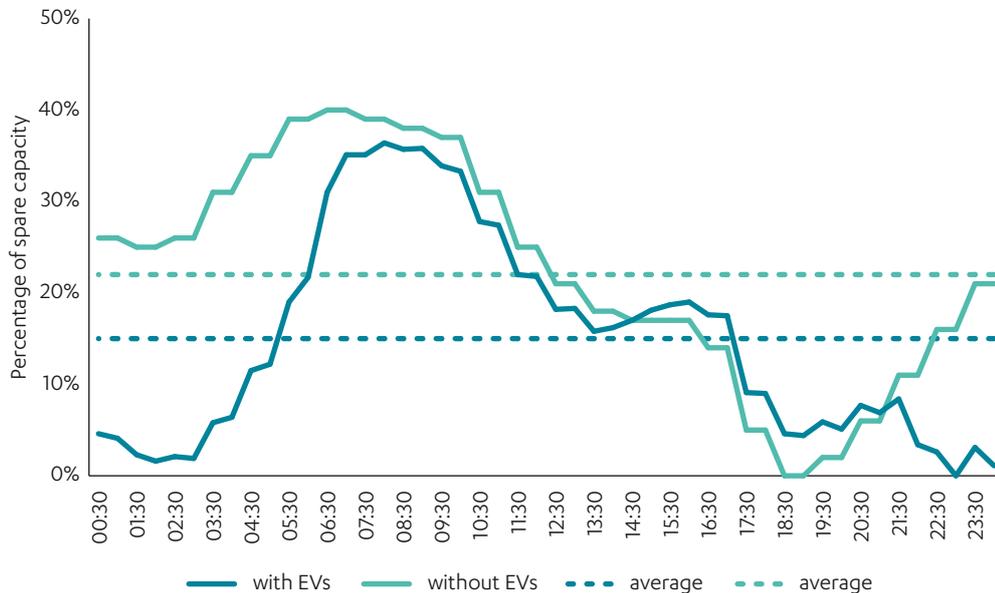
The uptake of electric vehicles will also depend on supply. Car manufacturers are beginning to ramp up electric vehicle production. Ford, the best selling car maker in the UK today, plans to have 40 fully electric or hybrid models in its global line-up by 2022, while Volkswagen, the second best selling car maker, is targeting 80 fully electric or hybrid models by 2025.<sup>15</sup> At Nissan’s factory in Sunderland, electric vehicles roll off the same production line as petrol and diesel vehicles.

A rapid increase in uptake of electric vehicles is not certain. But it is certain that electric vehicles reduce the cost of driving, lower air pollution, and reduce emissions, in addition to supporting a highly renewable energy system. Therefore, government should encourage and facilitate the swiftest possible uptake of electric vehicles.

**The Commission recommends that government, Ofgem and local authorities should enable the roll out of charging infrastructure sufficient to allow consumer demand to reach close to 100 per cent electric new car and van sales by 2030.**

## Electric vehicles and the energy system

The transition to electric vehicles will provide additional, low cost flexibility for the energy system.<sup>16</sup> When electric vehicles are able to follow price signals and charge when demand is low ('smart' charging), they help to smooth out daily electricity demand. As shown in figure 3.3, the daily demand profile with electric vehicles leads to a lower proportion of capacity being spare throughout the day than without electric vehicles. This means that electricity networks are used more efficiently and reduces the need for other types of flexibility, such as small gas engines and batteries. Overall system costs are reduced.<sup>17</sup> Furthermore, batteries considered at the end of their useful life in an electric vehicle may still retain up to 80 per cent of their original capacity.<sup>18</sup> These batteries can provide a source of storage for the grid, reducing the need for further investment (and supporting the price of second-hand electric vehicles).



**Figure 3.3: Percentage of spare generation capacity throughout the day with electric vehicles and without<sup>19</sup>**

The Commission's analysis suggests that a 100 per cent uptake of electric cars and vans could increase total annual electricity demand by 26 per cent by 2050.<sup>20</sup> However, as electric engines are more efficient than petrol or diesel, each car would use less energy overall,<sup>21</sup> and as electricity becomes increasingly low carbon, emissions would reduce. Chapter 2 sets out how the UK can achieve a low cost, low carbon energy system, whilst accommodating an increase in electric vehicles.

### Smart charging

Smart charging is essential for reducing the overall cost of the energy system as the number of electric vehicles increases. Not putting in place the necessary policy incentives could increase power system costs by £2 billion per year on

average (2030-50), adding up to £30 per year on average to consumer bills (2030-50).<sup>22</sup> This would primarily be driven by increased power prices and electricity network reinforcement costs.<sup>23</sup> Smart charging will be much cheaper for the consumer than on-demand, rapid charging, as prices are likely to be lower when there is less demand on the electricity network.

Smart charging should therefore be the default option for home charging. There is likely to be an overall consumer preference for smart and slow charging.<sup>24</sup> But this is not certain. It is slightly less convenient, and carries some risk if a car is needed for a long journey earlier than expected.

## Regulation

The Office for Low Emission Vehicles works to support the early market, and the Automated and Electric Vehicles Bill, which is currently before Parliament, will give government powers to make regulations on the specification of charge points (including requiring all charge points to be smart and interoperable).<sup>25</sup>

Given the importance of managing the interaction between charging and the energy system, it makes sense for Ofgem to take on the role of ensuring that there are arrangements to optimise use of chargers within the energy system. Ofgem should also consider whether there is a need to protect consumers from spikes in energy prices which could make rapid charging prohibitively expensive. Consumers should be able to refuel their car in an emergency without having to pay over the odds.

Government, industry and Ofgem should work together with the Office for Product Safety and Standards, the Institute of Engineering and Technology and the International Standards Organisation to ensure interoperability and the development of minimum standards for charge points.

**The Commission recommends that Ofgem should take on the role of regulating the interaction between electric vehicle charge points and the electricity network immediately, ensuring that electric vehicle charging and vehicle to grid services contribute to the optimisation of the energy system. Government, industry and Ofgem should work together to set minimum standards for a network of interoperable, smart charge points.**

## A national network of charge points

Developing a nationwide, electric vehicle charging network offers the chance for the UK to get ahead. Too often in the past, short-term interests, a lack of coordination, and a tendency to endlessly debate difficult issues and delay difficult decisions have meant the UK has been slower to adopt new infrastructures than other countries. This time can be different.

Government funding is already available in the form of grants for home, workplace and on-street residential charge points. The Autumn Budget 2017 announced a new £400 million Charging Infrastructure Investment Fund,

including £200 million of investment from the private sector.<sup>26</sup> However, so far, no private sector partner has been procured.<sup>27</sup>

## Supporting charge point installation

Building electric vehicle charge points represents a big opportunity for the private sector. Demand for charge points is likely to grow.

Charge points are already being built across the country, growing from a total of 2,880 points in 2012 to 14,160 points in 2017.<sup>28</sup> Chargemaster plc plans to expand its POLAR charging network to 25,000 chargers by 2020.<sup>29</sup> A UK-based energy company, Pivot Power, is working with National Grid to build 45 new charging sites, each with up to 100 charge points, across the country, investing £1.6 billion.<sup>30</sup> And some petrol companies, such as Shell, have already begun installing electric vehicle charge points at their petrol forecourts.<sup>31</sup>

However, some potential charge point providers may be put off by the uncertain cost of connecting new charging infrastructure to the electricity network. New connections can trigger the need for network reinforcement, which the customer pays a proportion of as a connection charge.<sup>32</sup> Ofgem aims to avoid imposing general charges for reinforcement costs, preferring to link them to a customer's own network usage. However, this needs to take into account the indirect system benefits from both rapid and smart chargers.

Rapid charge points are more likely to trigger reinforcements than slow, smart chargers. They do not directly benefit the energy system in the way that smart chargers do. However, at present rapid chargers also provide an indirect benefit to the electricity network by reducing range anxiety, incentivising uptake and therefore incentivising the spread of smart charging.

Passing reinforcement costs on to public charge point providers risks reducing the amount of charge points installed and ultimately ignores the benefits that network users gain from an electric vehicle fleet. Ofgem's recent process to look into whether extra investment was required concluded that given the current pace of change it was unlikely to be needed before 2023. However, this was only done in consultation with network owners and not with the aim of facilitating a rapid uptake of electric vehicles.<sup>33</sup>

The Commission believes that this represents a missed opportunity. Ofgem should take a more proactive approach to preparing for future reinforcement needs for charging points; electricity networks should work with charge point providers to identify likely future reinforcements and invest ahead of time.

**The Commission recommends that Ofgem should commission electricity network operators to work with charge point providers to identify potential anticipatory investments required to accommodate public charging infrastructure. Opportunities for investment within the current price control period should be identified by Summer 2019.**

Furthermore, engagement with local authorities should not hold up the process of delivering charge points. Local authorities should work with commercial investors, make it easy for charge points to be built on their land, require charge points to be built as part of new developments, and free up parking spaces to be used for electric vehicle charging.

If travel patterns and car ownership models are fundamentally disrupted, vehicles may park and charge in different locations to today. But in the short term ensuring that charge points are installed and accessible for electric vehicles, and that this rollout is balanced against the needs of drivers of internal combustion engine vehicles, must be a priority.

On-street charge points for electric vehicles will be particularly important in dense urban areas where access to home off-street parking is limited, but these are the same areas where parking spaces in general will be at a premium. Local authorities will need to work with private sector providers and electricity network owners to identify where demand for charge points is likely to be highest, and ensure that there are sufficient parking spaces available for charge point installation as demand materialises.

**The Commission recommends that government should place a requirement on local authorities to work with charge point providers to allocate 5 per cent of their parking spaces (including on-street) by 2020 and 20 per cent by 2025 which may be converted to electric vehicle charge points.**

## **A visible core network**

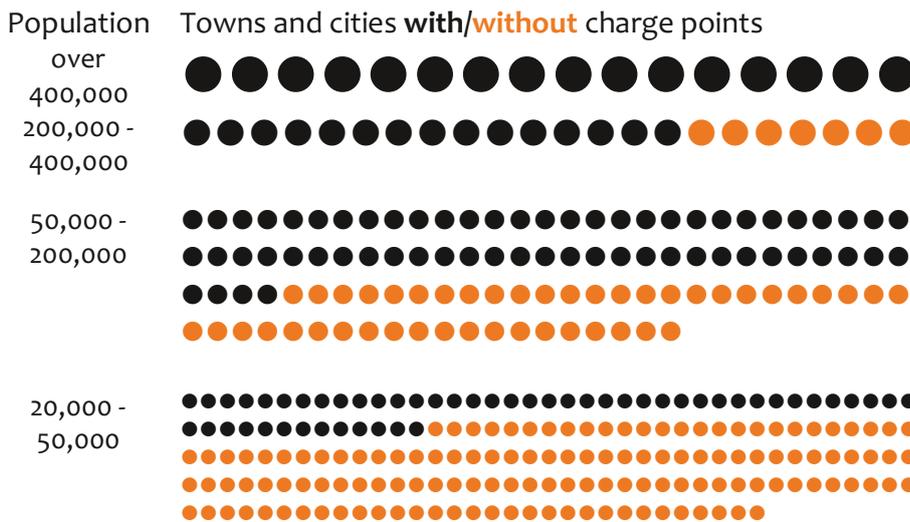
Although the majority of charge points are likely to be slow and smart, having a core network of visible, rapid chargers in place could significantly increase the pace of uptake. This network should provide both sufficient coverage, so that it is possible to find a charge point within a reasonable distance throughout most of the country, and enough power to fully recharge an electric vehicle within a reasonable timescale (for example within 1 hour). To enable close to 100 per cent of new car and van sales to be electric by 2030, the core network would need to be in place in the early 2020s to avoid inhibiting electric vehicle uptake.

The charge point network is often compared to the petrol station network but differs in two respects. Firstly, drivers of petrol and diesel vehicles do not suffer from range anxiety. Consumer confidence already exists in the petrol station network. Visible charge points in more places will combat this issue for potential electric vehicle drivers, and allay their concerns about being able to travel anywhere in the UK.

Secondly, the shape of the charging network is likely to be different to the petrol station network. Electric vehicle owners are more likely to recharge in towns and places where they can undertake other activities, than stop en-route. And petrol stations need to be accessible for fuel deliveries, which is not a consideration for charge points.

The pattern of private sector provision of charge points in the early stages of the electric vehicle market is likely to be similar to mobile and fixed broadband, where provision is strong in densely populated areas, but rural areas are initially underserved. Charge points in rural locations, which benefit users and society by contributing to a complete network providing coverage across the country, will not be as profitable as those in urban centres and main arterial routes, and many of the benefits from providing this network will go to electric vehicle purchasers and manufacturers rather than charge point providers. Therefore, commercial investors are less likely to build charge points in rural areas before electric vehicles become the mainstream choice.

This means there is a case for government support to build charge points in rural areas, to deliver a core national network in the short term, before relying entirely on the private sector to take forward the delivery of the network at scale as the pace of uptake increases. There are 332 'built-up' areas<sup>34</sup> in the UK with populations above 20,000. 187 of these are not served by a rapid charger. There are 145 built-up areas with populations above 50,000, 52 of which are not served by a rapid charger (shown in figure 3.4).



**Figure 3.4: Proportion of built-up areas with at least one rapid charge point in June 2018 (by population)<sup>35</sup>**

At least one rapid charger in each of those places would represent a reasonable core network. The cost of installing a rapid charger is around £50,000, so the costs of installing chargers at 200 currently unserved locations would be around £10 million. Government does not need to directly own or operate these charge points.

**The Commission recommends that government should subsidise, by 2022, the provision of rapid charge points in rural and remote areas, where the market will not deliver in the short term.**

## Preparing for connected and autonomous vehicles

Whilst electric vehicles represent a revolution in how vehicles are powered, the changes delivered by connected and autonomous vehicles could be more profound still. Connected and autonomous vehicles could have implications for the roads themselves, as well as the way people travel.

Connected vehicles can communicate with other vehicles or infrastructure on the road network, to assist with safer and better informed driving. Autonomous vehicles use a range of technologies to reduce the need for human involvement for navigating the road. These vehicles will have impacts on infrastructure design, capacity, demand, travel patterns, land use, and interactions between transport modes. All this is not yet understood. Government should start planning for these changes now.

Connected and autonomous vehicles will create new travel opportunities, free up time focused on driving, and could improve safety. They could also increase road capacity, enable higher speed limits and shorter journey times, encourage vehicle sharing, and release street space currently used for parking. Traffic lights and stop signs may become unnecessary. And the use of road space could be automatically and constantly changing according to need.

It is uncertain when fully autonomous vehicles will be a reality on the roads. Existing technology can already control the vehicle in a wide range of circumstances and is increasingly being deployed within cars on the market today.<sup>36</sup> Some estimates suggest that self-driving cars could be on the road by the 2020s,<sup>37</sup> although others predict this will take much longer. But despite uncertainty about the timetable and extent of change, it is no longer reasonable to assume existing patterns of road use will remain unchanged in future.

Government must first act decisively on the Commission's recommendation in *Connected Future* to roll out digital connectivity across the road network, starting with the strategic roads network by 2025.<sup>38</sup> Research indicates that improved connectivity, either 5G or in other forms, could enhance the road capacity benefits of automation by improving vehicle-to-vehicle and vehicle-to-infrastructure communication.<sup>39</sup>

The potential impacts and benefits of connected and autonomous vehicles vary in different places and on the level of automation. For example, in urban areas, although careful management will be needed to avoid adding to congestion, automated on-demand public transport options could provide more convenience than buses or trams. Road transport is unlikely to supplant rail in its core markets: commuting into city centre (where physical space is a key limitation) and long distance city centre to city centre travel (where rail has a speed advantage). However, overall, connected and autonomous vehicles could have a significant positive impact on interurban connectivity.

## Building the evidence base

Government has made a good start in positioning the UK as a centre of excellence for connected and autonomous vehicles. It has created a conducive environment for trialling, stimulated private sector innovation through various funding initiatives, and launched an extensive review of the regulatory environment. It has also begun to think strategically about the longer-term implications for transport through programmes such as the Industrial Strategy's Grand Challenge on the Future of Mobility.

These key steps are welcomed by the Commission. But the research programme now needs to evolve to ensure that connected and autonomous vehicles are central to transport policy and investment decision-making in future. In October 2017, government was funding at least 53 separate research projects, but the evidence on the impact of connected and autonomous vehicles has so far not been sufficient to influence the latest plans for road and rail (the second Road Investment Strategy and Network Rail's Control Period 6).

Planning for the 2025-2030 investment period, when highly autonomous vehicles are predicted by some to be on sale, will begin in the early 2020s. Government should aim for evidence on the impact of connected and autonomous vehicles to be sufficiently robust to start to factor in policy making for both planning processes.

**The Commission recommends that government should address the implications of technological innovation in long term transport planning processes, including the next rail control period and road investment strategy.**

## A research framework

A research framework is required, focussing on four key areas: technology; legislation and regulation; people; and infrastructure. Extensive work is already being undertaken on the first two areas. Therefore, the priority for new research within the framework should be to focus on people and infrastructure, where research is less advanced. These two areas are fundamentally linked; how roads are changed to accommodate connected and autonomous vehicles will reflect and impact how, where, when and why people choose to use them and other forms of transport.

To assess people's behaviour patterns, trials will need to ensure that the information gathered is useful and reflects a wide cross-section of the public. While reliable forecasts of the take up and use of connected and autonomous vehicles are not likely to be developed until highly autonomous cars are on sale, government should focus on improving existing analytical tools to prepare as far as possible.

In terms of infrastructure, the government will ultimately need to determine changes in the way roads are planned, designed and operated to maximise the potential benefits of connected and autonomous vehicles. A key question will be

how acceptable it is for individual drivers to give up a degree of control, at least on parts of the road network, to improve the outcome for road users. Despite the uncertainty, the process of thinking about how roads should adapt must start now, and take a flexible approach.

## Roads for the future

The Commission launched 'Roads for the Future' in January 2018: an innovation competition on how roads should be designed, managed and used to maximise the benefits of connected and autonomous vehicles. An overall winner will be announced in September. The shortlisted entries are:

**Smart signals, AECOM, York:** Examining how smart signals could alert drivers and vehicles to the speed they should drive at so they arrive at the next set of traffic lights just as they turn green, cutting congestion and ending polluting 'stop-go' driving.

**Active traffic management, Leeds City Council, Leeds:** Examining how the data generated from digitally connected cars could be used to improve traffic light systems, allowing highway authorities to better manage traffic on their roads.

**FlexKerbs, Arup, London:** Looking at how kerbsides with fixed features such as double yellow lines, parking bays and bus stops could become more flexible, changing their use according to the time of day and levels of demand.

**AI short term traffic prediction, Immense Simulations, Oxford:** Using AI to help sat-nav systems to 'learn' better routes to improve the directions given, so that both driven and driverless cars could change course to avoid congestion.

**Segregated connected and autonomous vehicle zones, City Science, Exeter:** Examining how sections of existing roads could be dedicated to driverless cars, making it easier for highways authorities to manage risks, integrate connected and autonomous vehicles into the existing transport network, and encourage take-up.

To ensure that the framework is delivered and connected and autonomous vehicles are fully embedded in long-term transport planning processes the right structures need to be in place within government. At present, there is no single long-term home within government for research and analysis into future disruptive transport technologies.

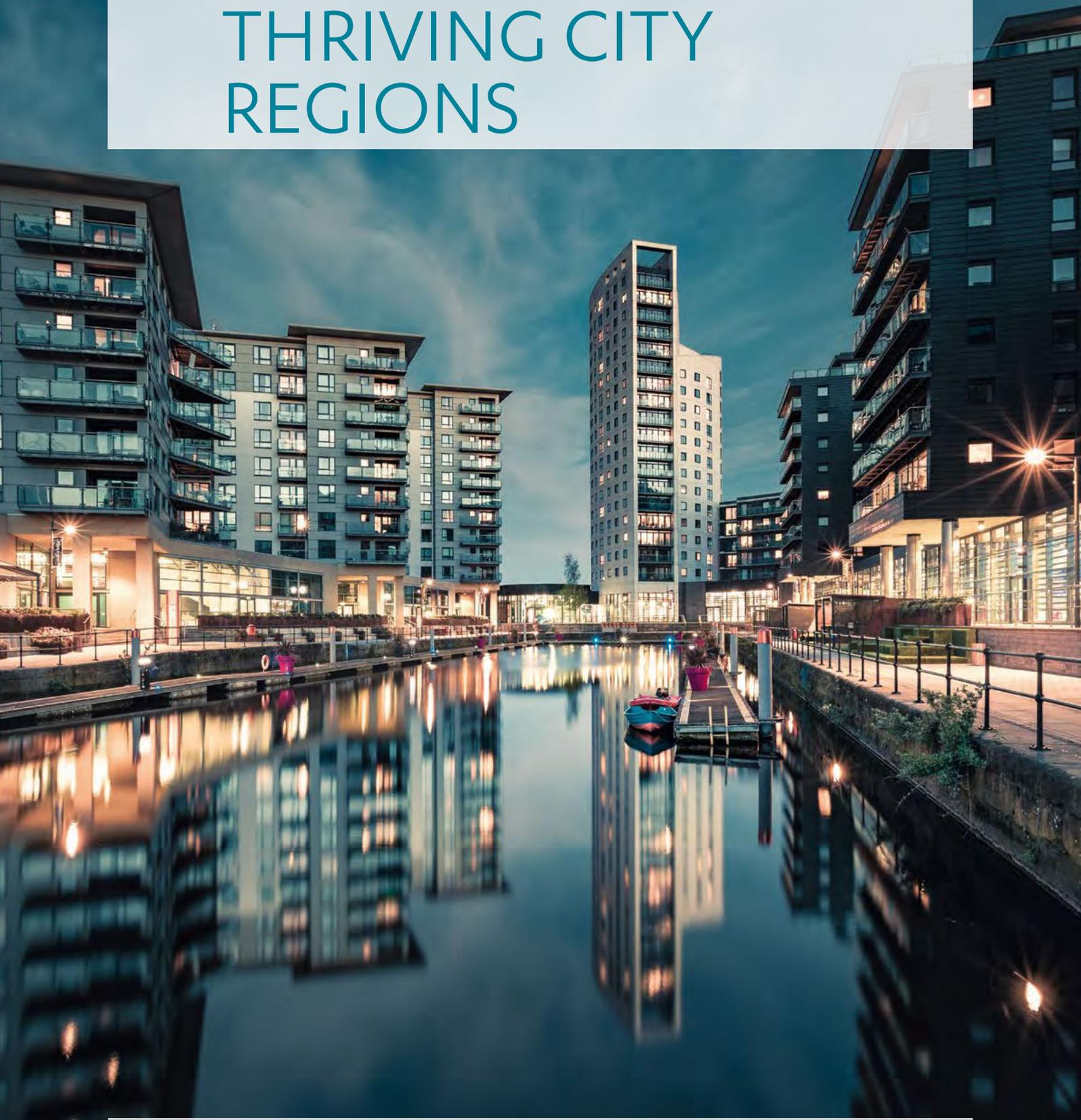
The Commission therefore believes that a new body should be created, subsuming the Centre for Connected and Autonomous Vehicles' current functions but with a wider policy remit and a more influential role in the Department for Transport's long-term transport planning processes. Amongst its responsibilities should be the Commission's proposed connected and autonomous vehicles framework. However, its core focus should be on ensuring that technological innovation is fully embedded in the planning processes for the third Road Investment Strategy and the next rail investment cycle, Control Period 7.

The Commission recommends that government should establish a centre for advanced transport technology in the Department for Transport to bring together work on technological innovation and ensure its implications are central to future investment proposals. This should include developing and overseeing the Commission's proposed connected and autonomous vehicles framework.

## Endnotes

- <sup>1</sup> International Energy Agency (2017), Global EV Outlook 2017
- <sup>2</sup> HM Government (2017), Plan for roadside NO2 concentrations published. Accessed at: <https://www.gov.uk/government/news/plan-for-roadside-no2-concentrations-published>
- <sup>3</sup> KPMG (2018), Autonomous Vehicles Readiness Index
- <sup>4</sup> McKinsey (2017), Electrifying insights: How automakers can drive electrified vehicle sales and profitability
- <sup>5</sup> Tesla (2018), Model S range of around 300-400 miles [https://www.tesla.com/en\\_GB/models](https://www.tesla.com/en_GB/models); and Nissan (2018) Leaf range of 168 miles. In practice, range depends on driving conditions. <https://www.nissan.co.uk/vehicles/new-vehicles/leaf/range-charging.html>
- <sup>6</sup> McKinsey (2017), Electrifying insights: How automakers can drive electrified vehicle sales and profitability
- <sup>7</sup> Bloomberg New Energy Finance (2018), Electric Vehicle Outlook 2018
- <sup>8</sup> Energy Saving Trust (2018), Electric Vehicles. Accessed at: <http://www.energysavingtrust.org.uk/transport-travel/electric-vehicles>
- <sup>9</sup> National Grid, Future Energy Scenarios 2017, 2016 and 2015
- <sup>10</sup> Everett Rogers (1962), Diffusion of Innovations
- <sup>11</sup> International Video Federation (2004–2006). Market information, Europe key data. Accessed at: <http://www.ivf-video.org/index.php?category/Market-information>
- <sup>12</sup> Society of Motor Manufacturers and Traders (2018), EV registrations. Accessed at: <https://www.smmt.co.uk/2018/01/december-ev-registrations/>
- <sup>13</sup> IMF (2017), Riding the Energy Transition: Oil Beyond 2040
- <sup>14</sup> Department for Transport (2016), Public attitudes towards electric vehicles: 2016 (Revised)
- <sup>15</sup> Reuters (2018), Ford plans \$11 billion investment, 40 electrified vehicles by 2022. Accessed at: <https://uk.reuters.com/article/us-autoshow-detroit-ford-motor/ford-plans-11-billion-investment-40-electrified-vehicles-by-2022-idUKKBN1F30YZ> and [https://www.volkswagenag.com/en/news/2017/09/Roadmap\\_E.html](https://www.volkswagenag.com/en/news/2017/09/Roadmap_E.html)
- <sup>16</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission
- <sup>17</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission
- <sup>18</sup> Saxena, Le Floch, MacDonald, Moura (2015), Quantifying EV battery end-of-life through analysis of travel needs with vehicle powertrain models
- <sup>19</sup> National Infrastructure Commission analysis of Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission
- <sup>20</sup> Ibid. This is the same whether smart charging is mandated or not; smart charging reduces peak demand, not annual demand
- <sup>21</sup> AEA Consulting (2012), A review of the efficiency and cost assumptions for road transport vehicles to 2050: Report for the Committee on Climate Change
- <sup>22</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission, 2016 prices
- <sup>23</sup> Aurora Energy Research (2018), Power sector modelling: System cost impact of renewables, Report for the National Infrastructure Commission, 2016 prices
- <sup>24</sup> Ipsos Mori (2018), National Infrastructure Commission, Phase 2: public research
- <sup>25</sup> Automated and Electric Vehicles Bill 2017-2019. Accessed at: <https://services.parliament.uk/bills/2017-19/automatedandelectricvehicles.html>
- <sup>26</sup> HM Treasury (2017), Autumn budget 2017
- <sup>27</sup> Hansard (2018), Parliamentary question on the timetable for the Charging Infrastructure Investment Fund. Accessed at: <https://www.parliament.uk/business/publications/written-questions-answers-statements/written-questions-answers/?page=1&max=20&questiontype=AllQuestions&house=commons&member=4320&keywords=electric%2cvehicles>
- <sup>28</sup> Zap-map (2018), Charging connectors by type 2011-2017. Accessed at: <https://www.zap-map.com/statistics/#charger-type>
- <sup>29</sup> Chargemaster plc (2018), One million public EV charging sessions per year by 2020 on POLAR network
- <sup>30</sup> Pivot Power (2018), Pivot power to work with national grid to future-proof energy system and accelerate electric vehicle revolution. Accessed at: <https://www.pivot-power.co.uk/pivot-power-work-national-grid-future-proof-energy-system-accelerate-electric-vehicle-revolution/>
- <sup>31</sup> Shell (2017), Shell launches electric vehicle charging service in the UK. Accessed at: <https://www.shell.co.uk/about-us/latest-news-and-features/2017-news-and-features/shell-launches-electric-vehicle-charging-service-in-the-uk.html>
- <sup>32</sup> Ofgem (2017), Written evidence to the Department for Business, Energy and Industrial Strategy Select Committee. Accessed at: [http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/business-energy-and-industrial-strategy-committee/electric-vehicles-developing-the-market-and-infrastructure/written/72781.html#\\_ftn37](http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/business-energy-and-industrial-strategy-committee/electric-vehicles-developing-the-market-and-infrastructure/written/72781.html#_ftn37)
- <sup>33</sup> Ofgem (2018), Decision on a Mid-Period Review for RIIO-ED1
- <sup>34</sup> ONS definition of built-up area is 'land which is irreversibly urban in nature', meaning they are characteristic of towns or cities
- <sup>35</sup> Commission analysis from <https://data.gov.uk/dataset/1ce239a6-d720-4305-ab52-17793fedfac3/national-charge-point-registry>
- <sup>36</sup> National Infrastructure Commission (2017), Congestion, Capacity, Carbon: Priorities for National Infrastructure
- <sup>37</sup> National Infrastructure Commission (2017), Congestion, Capacity, Carbon: Priorities for National Infrastructure
- <sup>38</sup> National Infrastructure Commission (2016), Connected Future
- <sup>39</sup> Atkins (2016), Research on the Impacts of Connected and Autonomous Vehicles (CAVs) on Traffic Flow

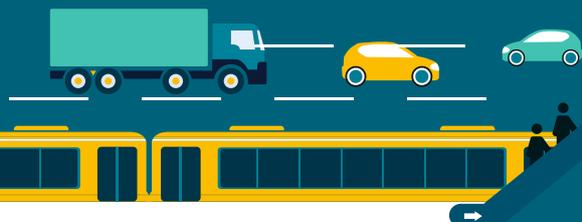
# 4. TRANSPORT AND HOUSING FOR THRIVING CITY REGIONS



# CITIES ARE THE PRIORITY FOR FUTURE TRANSPORT INVESTMENT

Investing in urban transport can support productivity and quality of life

Intercity transport is getting the investment it needs



Highways England  
**4 billion**  
per year (2020-25)



Network Rail  
**6 billion**  
per year (2019-24)



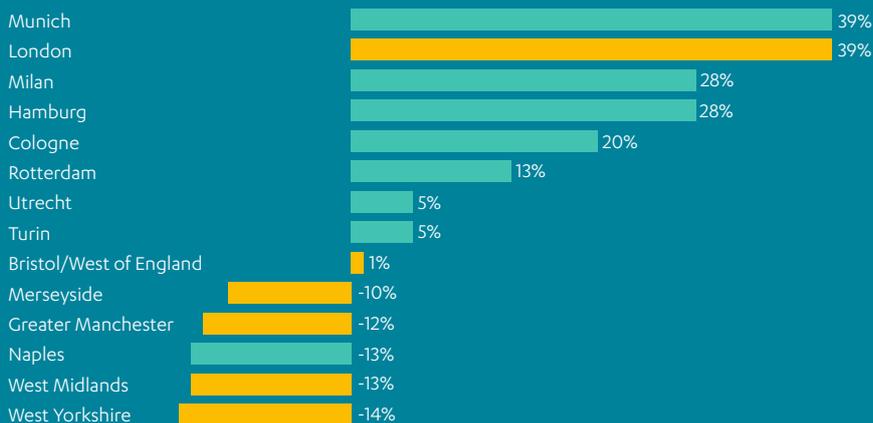
High Speed 2  
**4 billion**  
per year (2020-30)

**BUT:**

productivity is low in too many UK cities, unlike in Europe



GVA per capita relative to national average for relevant country



Transport networks are close to capacity in many UK cities

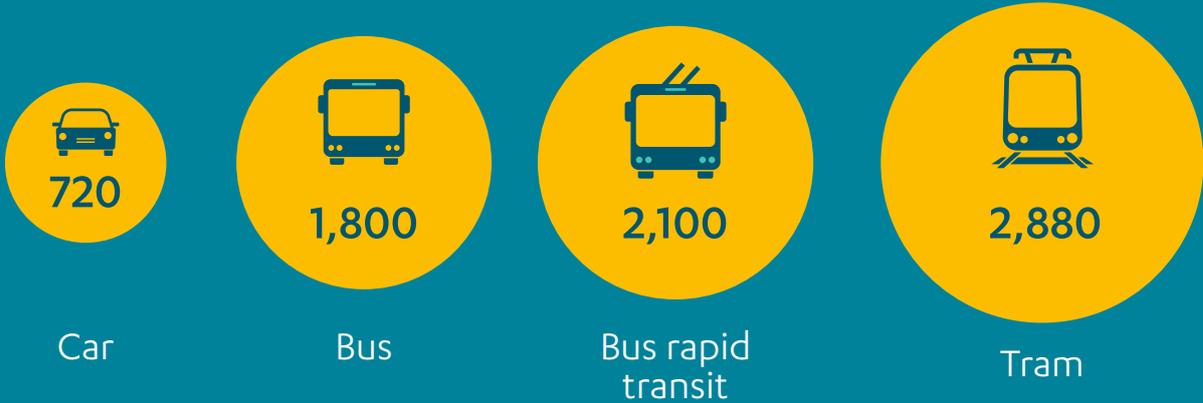


In cities, better cars can't solve the problem as there isn't enough space



## Mass rapid transport is needed to increase accessibility

Typical maximum capacity per lane (inbound passengers per hour)



But transport alone isn't enough – cities need skills, green space, cultural and leisure activities



### THE COMMISSION RECOMMENDS:



City-led plans for transport to connect housing and jobs



Devolved, long-term funding to give certainty to all cities



Major projects in the fastest growing, most congested cities

Sources: HM Treasury, Network Rail, Department for Transport, Eurostat, ONS, Steer Davies Gleave

**Cities can and should be great places to live and work. But their increasing popularity means they are becoming full and congested, and this risks inhibiting growth and undermining quality of life. Space in cities should be used effectively, with room allocated for fast, frequent public transport systems, well connected and affordable housing, and pleasant public spaces. This will require a new approach to governance, strategy and funding for urban transport.**

In recent years, government has prioritised major upgrades to transport between cities. The next wave of major upgrades should increase the focus on transport within cities. Infrastructure cannot drive growth alone; other factors, especially skills, are essential. But lack of infrastructure can inhibit growth.

The UK is unusual in that most large cities outside of the capital are less productive than the national average; cities such as Birmingham and Leeds should have the potential to be as successful as major cities elsewhere in Europe which boost their countries' productivity.<sup>1</sup> But this will require vision and planning. London, and to some extent Manchester, have benefitted from having a mandate to transform their cities' transport infrastructure. Other cities, large and small, need to be able to take the same approach.

Unlocking growth in cities requires:

- developing integrated strategies for housing, employment and transport, to allow cities to grow and people to live and work where they want
- devolving planning and funding for urban infrastructure to all cities
- prioritising major upgrades for cities with the most growth potential and capacity constraints
- £43 billion of additional investment in urban transport by 2040

## Cities as social and economic hubs

Cities<sup>2</sup> are increasingly critical to the UK's economy and international competitiveness. The benefits of firms in knowledge based services clustering together in close proximity has made city centres attractive places for firms to locate, leading to a revival in many cities' fortunes.<sup>3</sup> They are hubs for high value industries and employment; 60 per cent of all jobs and 71 per cent of knowledge intensive business service jobs are in cities.<sup>4</sup> Supporting growth in city-regions is essential to providing balanced growth across the UK, as cities provide employment and a range of specialist services across a whole region.

Cities have also become more attractive places to live as they have attracted highly skilled workers and cultural and leisure amenities have grown.<sup>5</sup> More than half of the UK's population live in cities, and as the UK economy has become more city focused, the popularity of cities has grown.<sup>6</sup> London's population fell from 8.6 million in 1939 to 6.7 million in 1988, but this huge shift has since reversed, with London growing 30 per cent to 8.8 million in 2016.<sup>7</sup> In other major cities, recovery started later, but in almost all cases population growth was stronger in the 2000s than in the 1990s and has accelerated in the current decade.<sup>8</sup>

## Unlocking growth

Enabling people to work and live in or around cities is a key way in which infrastructure investment can support growth in every region. There are fast growing, infrastructure constrained cities spread across the regions of the UK,<sup>9</sup> and addressing these constraints is the greatest opportunity for infrastructure to help each region to do better.

Most major UK cities lag behind national productivity levels. This contrasts with large cities in many other European countries, which add to their countries' productivity.<sup>10</sup> Infrastructure cannot drive growth alone; other factors, especially skills, are essential. But lack of infrastructure can inhibit growth. To sustain future growth, transport policy must reflect the economic and structural changes that are shaping the UK's transport needs.

The priorities for transport investment should be growing and congested urban areas and their catchments, the key interurban corridors, and the key international gateways.<sup>11</sup> There has been welcome progress on the latter two areas in recent years. After years of delays, decisions on aviation capacity are being made following the report of the independent Airports Commission.<sup>12</sup> Investment in interurban corridors has increased sharply and is planned to increase further in the 2020s. Chapter 7 sets out the Commission's proposals for future investment in the strategic road and rail networks, with substantial continued investment. Chapter 3 sets out the need for future plans to respond to the opportunities from connected and autonomous vehicles.

However, investment in urban transport outside of London continues to lag behind.<sup>13</sup> Urban transport networks underpin commuter journeys that create deep labour markets, and enable people to access cultural and leisure activities. Most urban journeys are short, relying predominantly on urban transport networks. The average trip length for people who live in cities and towns is under 10 miles, with fewer than 5 per cent of journeys over 25 miles.<sup>14</sup> Rail journeys tend to be longer, but most start or end in cities.<sup>15</sup> Infrastructure to support public transport in growing and congested cities offers some of the highest returns for transport investment.<sup>16</sup>

## Investment in local and strategic transport

### Intercity networks

Investment in national road and rail has been increasing, with further investment forthcoming to improve interurban transport. Highways England is proposing to spend more than £4 billion per year from 2020 to 2025; the government has committed around £6 billion per year for Network Rail between 2019 and 2024; in addition, HS2 is expected to cost around £4 billion per year on average throughout the 2020s.<sup>17</sup> Northern Powerhouse Rail will deliver long overdue improvements in travel times between the major cities of the North of England.

Continued focus is needed to deliver these major commitments. Sub-national transport bodies will need to work with government on the development and delivery of these programmes and will play an important role in ensuring that they are integrated with regional and local networks.

### Local road maintenance

In recent years, insufficient funding has led to poor conditions on local roads, affecting road users throughout the country. Six per cent of urban local A roads are considered to be in poor or very poor condition, and 3 per cent of rural A roads.<sup>18</sup> This creates hazards for road users, and also increases the long term cost of maintenance. The economic case for maintenance is very strong, since inadequate upkeep creates a risk that roads may need to be closed for emergency repairs.<sup>19</sup>

The major funding decisions for transport in the first half of the 2020s – Road Investment Strategy 2 for Highways England, Control Period 6 for Network Rail and major projects such as HS2 – have already been made or are shortly to be decided. They therefore fall outside the scope of the Assessment, since the Commission’s remit states that the Commission “will not reopen decision making processes where programmes and work have been decided (or are due to be decided immediately after a [Commission] report is published)”.<sup>20</sup>

It is for the Department for Transport to prioritise in the early 2020s between providing the funding needed to maintain the existing road network or to deliver the full programme of enhancements. In the later 2020s, the Commission believes that £500 million a year of funding should be made available for local highways authorities to address the local road maintenance backlog probably through to the early/mid 2030s.

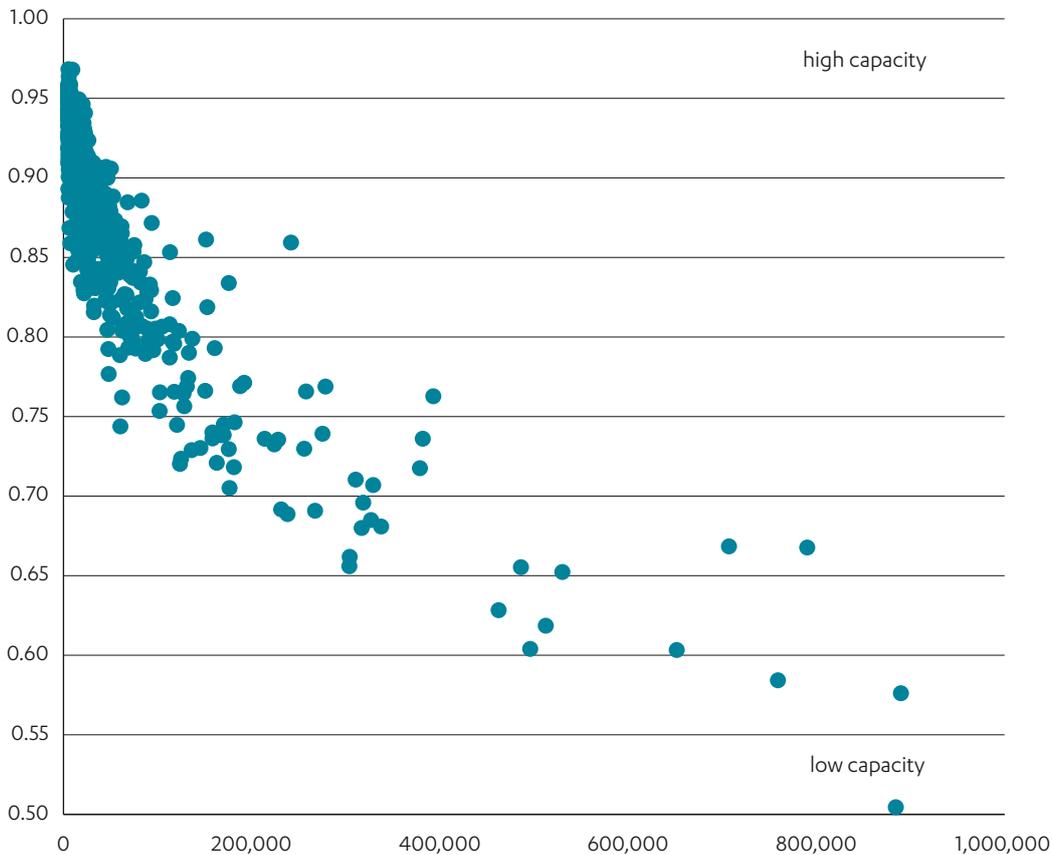
**The Commission recommends that government should make £500 million a year of funding available from 2025/26 to 2034/35 for local highways authorities to address the local road maintenance backlog.**

### Urban transport

In growing urban areas, transport networks are coming under increasing pressure. Cars and buses in central Manchester or Bristol experience delays of more than 100 seconds per mile travelled.<sup>21</sup> This compares to an average of 78 seconds on all urban A roads, 22 seconds on rural A roads and 9 seconds on

the intercity road network.<sup>22</sup> Crowding on the railway is also focused on cities, particularly London, Manchester, Birmingham and Leeds.<sup>23</sup>

Figure 4.1 shows that the capacity of road networks to deal with peak traffic falls with increases in the size of towns and cities, particularly in areas with populations above 100,000. The chart uses the Commission's newly developed measure of how quickly people can travel from where they live in a town or city (using the Office for National Statistics' 'built up areas' definitions) to that town or city's centre of employment. The dataset and technical details are available on the Commission's website. The chart uses the ratio of peak to off-peak connectivity for towns and cities to assess capacity constraints. A value of 1 implies that the connectivity is the same at peak and off-peak times. Lower values imply constraints at peak times. As settlement size increases, road networks become increasingly less effective at managing peak demands.<sup>24</sup>



**Figure 4.1: Built up area population and ratio of peak to off-peak connectivity for built up areas with population under 1 million<sup>25</sup>**

### Making best use of limited space

More investment in public transport, alongside the promotion of safe cycling and walking, is the only way that cities can increase their infrastructure capacity to support growth. Connected and autonomous vehicles could have a positive impact on intercity transport, but they will never be an effective replacement

for high capacity public transport in dense city centres and may simply increase pressures on road space.<sup>26</sup>

New forms of public transport – from dockless cycle or even electric scooter hire to autonomous buses – are emerging. City leaders need to consider how to manage the impacts of changing travel patterns in their transport planning. But the basic challenge of urban transport is still the same: there is simply not enough space in cities for everyone to travel by car.

Typically new roads lead to new journeys, filling up the additional space.<sup>27</sup> But, as shown in figure 4.2, it is possible to increase capacity by investing in high capacity public transport.

Transport mode	Typical maximum capacity per lane (inbound passengers per hour)
Car (1.2 people – current commuter average)	720
Bus	1,800
Bus rapid transit	2,100
Tram	2,880

**Figure 4.2: Maximum system capacity for different modes of transport<sup>28</sup>**

A less car focused approach to urban transport can also bring other benefits, including:

- the opportunity to build well designed city centres focused on people's needs
- reallocating space from roads and parking to pedestrianised areas, leisure amenities and green space
- better, safer provision for cycling and walking
- improved transport networks that are more accessible for older and disabled people
- infrastructure aligned with schemes to bring brownfield land back into use, which can help regenerate inner cities.<sup>29</sup>

Poor air quality is also a significant cost of cities dominated by petrol and diesel cars, and has a damaging impact on health. However, in the long term widespread adoption of electric vehicles will reduce the harm caused by this, so it is important that cities help to facilitate the rapid uptake of electric vehicles, as set out in Chapter 3.

## Improving transport in every city

Government should make sure all cities are able to deliver the appropriate transport infrastructure in their area. This requires changes in strategy development, funding and governance for urban infrastructure in cities outside London.

### Strategy development

Transport policy should not be about schemes. Investment needs to enable the journeys that allow people to live and work where they want to, and to connect people to wider services. Decision makers need to understand all the characteristics of the local economy, environment and geography. Transport policy needs to be integrated with a clear strategy for where housing growth can be accommodated in and around cities, and where employment growth is likely to occur. Linking transport enhancements to housing growth is essential to get the most value from investment.

City leaders should implement long term plans for their city-region reflecting their own economic and social priorities, based on their own local knowledge and accountability. These need to integrate transport, housing and employment. Other urban infrastructure, such as digital (see Chapter 1), electric vehicle charging (see Chapter 3) and flood resilience (see Chapter 5) also needs to be considered.

Recent government policy on devolution has meant cities increasingly have the right powers and governance to tackle these issues, particularly in cities with mayors. However, integration of strategies for transport and housing requires integration of decision making. Currently, leaders in large cities need unanimous approval from individual districts to all aspects of any integrated development plan, limiting the level of ambition. This needs to be addressed to maximise the value from new urban transport infrastructure.

Beyond this, a lack of long term funding means that, outside of London and Manchester, few cities have developed integrated strategies, since there has been no realistic prospect of being able to implement them. In some cities, this has also led to a lack of strategic capacity.

### Funding

Local leaders making long term plans for their cities need long term certainty on funding. There is a lack of long term, stable and certain funding structures to support investment in urban transport outside London. City and local leaders have to bid to many different government competitions, which provide an unpredictable and short term funding stream and place a significant strain on the limited revenue funding available for transport planning.<sup>30</sup> The government's recently created Transforming Cities Fund improves on previous funding arrangements by giving mayors more flexibility over their funding allocations,

and simplifying requirements before funding decisions can be made. But more progress is needed.

Local transport authorities outside London should have stable, devolved infrastructure budgets, as Highways England and Network Rail have. The devolved budget should comprise of five year settlements, with fixed annual budgets set at least two years before the start of the five year period. This budget should be sufficient to cover all maintenance, small to medium enhancement projects and programmes to deploy or pilot new smart infrastructure technologies.

Devolved infrastructure budgets will be a replacement for Department for Transport and Local Growth Fund grants for local infrastructure, and they will be complementary to the funding that authorities can raise locally through fare income and other local revenue sources.

Maintenance allocations should be determined according to the cost of keeping the relevant infrastructure assets held by the authority in working order. Funding for small to medium enhancement projects in cities should be allocated according to the size of the city, the city's density, and evidence that the city's projected growth will outstrip its existing infrastructure capacity.

Increased funding for cities should be available to all cities with a population over about 100,000 to reflect the higher infrastructure needs of denser urban areas. This broadly matches the definition of 'primary urban areas' (54 cities in England outside London).<sup>31</sup> Whilst there is no perfect boundary, a population of around 100,000, as shown in figure 4.1, is the point at which capacity constraints become most serious.

The level of funding for devolved infrastructure budgets in cities should ensure their spending power increases by around 10 per cent during the 2020s compared to current urban transport investment, an increase of approximately £300 million per year, and increases by around 30 per cent or over £1 billion per year by the mid 2030s. This totals around £12 billion from 2020 to 2040. Chapter 7 sets out the choices that the Commission has made within the resources set out by the government. With large existing commitments, such as HS2, in the 2020s, new funding for cities has to build up gradually. Funding for authorities outside cities should remain broadly at current levels.

To ensure the long term stability of funding for cities and local authorities, government should legislate for an obligation to publish infrastructure allocations in advance. In the future, government should also consider whether local tax raising may be more appropriate than central government grants.

As well as increased funding for investment, it is important that local infrastructure authorities have the resources they need to increase their transport capacity. Government should therefore ensure sufficient revenue funding is available for local project development, network management and bus operations, especially in cities.

## Governance

The appropriate authority to make decisions on how to invest devolved urban infrastructure funding will usually be one that already exists: a mayoral combined authority, combined authority or unitary authority. But some cities have no urban infrastructure authority of their own and are served by a county council. In these cases government should ensure that arrangements are put in place for an appropriate urban infrastructure authority.

Once funding is devolved to local authorities, central government should not have powers over how it is spent. Cities will need to coordinate with Highways England and Network Rail and may, in some cases, choose to use some of their resources for enhancements to the strategic networks in partnership with them. Local authorities should be expected to make evidence based decisions, evaluate performance of their investments and publish information enabling them to be held to account by local people on how they have invested in infrastructure. Chapter 6 sets out the Commission's proposals on how to use better data to improve the appraisal and selection of projects. In cases of serious failure, government could withdraw funding devolution.

**The Commission recommends that cities should have the powers and funding they need to pursue ambitious, integrated strategies for transport, employment and housing.**

- **By 2021, metro mayors and city leaders should develop and implement long term integrated strategies for transport, employment and housing that will support growth in their cities.**
- **By 2021, government should ensure city leaders have the right powers to deliver these integrated strategies, including the power for metro mayors to make decisions on major housing development sites.**
- **Government should set out devolved infrastructure budgets for individual cities for locally determined urban transport priorities in line with the funding profile set out by the Commission. Budgets for 2021-2026 should be confirmed by mid 2019. Government should pass legislation, by 2020, requiring cities to be given regular five year infrastructure budgets.**

## Infrastructure to support housing

Infrastructure needs to promote new housing and new communities in areas where they are needed. Infrastructure alone will not solve the UK's housing challenges, but better coordination of infrastructure with new developments is vital if infrastructure is to be deployed effectively.

Siloed planning and delivery of utilities infrastructure and housing means that providing utilities to new housing developments can often be a cause of delay to construction. Consultation responses to *Congestion, Capacity, Carbon: priorities for national infrastructure* identified three causes.

Firstly, there is a tension between the requirements on regulators to protect consumers from price rises and to invest in future infrastructure provision, which can generate perverse outcomes for the delivery of timely infrastructure. In particular there is a lack of incentive for utility companies to develop increased capacity in advance of development, putting these costs on housebuilders. This can create coordination failures where upgrades are large and exceed the needs of any individual development.

Secondly, the diversity of organisations (the Distribution Network Operators, the industry regulators, local planning authorities) involved in the planning, design and delivery of utilities infrastructure in England leads to division and poor communication. And thirdly, there is a lack of mechanisms to improve coordination between housing and infrastructure for smaller scale housing developments.

The Commission will conduct more detailed analysis on the role of utilities in the delivery of housing, working with stakeholders and liaising with ongoing studies.

## The next wave of infrastructure upgrades

Substantial funding must be set aside for major upgrade programmes in the city-regions that need them the most, in addition to the devolved funding for small to medium enhancements. London has had the advantage of receiving exceptional funding for upgrades to capacity such as Crossrail. Other cities should have this benefit too. This could provide cities in the UK with major capacity upgrades such as metros or bus rapid transit.

Major upgrade programmes require higher levels of funding to be concentrated in a few areas temporarily, and even fast growing cities do not require transformative upgrades on a continuous basis, meaning that a process of prioritisation is required. Funding should be agreed for major new capacity programmes in cities where infrastructure is the most significant constraint on growth. Identifying programmes will take time; most cities have not developed plans at this scale because they have lacked funding streams that could realistically deliver them. In some cities, it will be important to build capability in strategy, procurement and delivery before launching major investment programmes.

Before funding is agreed, cities should commit to additional housing development alongside new transport, linking employment growth to new homes. They should also be able to demonstrate that they can provide a local contribution to project costs, as for Crossrail 2, although the proportion may need to vary to reflect regional circumstances.<sup>32</sup> This contribution should include local fundraising, potentially through fares or local taxes.

Central government should work closely with cities before making final commitments to funding. Not everywhere will need major investment. The initial phase should identify priority cities. Figure 4.3 illustrates how capacity constraints and expected employment growth vary considerably between cities. This uses the Commission's new measure of transport connectivity (see figure 4.1)<sup>33</sup> and employment growth estimates<sup>34</sup> derived from Office for National Statistics' population projections (which roll forward data from the recent past, adjusting for demographics, and are not forecasts).

Having identified priority cities for the first wave, government should work with them as they develop specific project proposals to support growth. When final proposals are submitted to government, they should also be reviewed by the Commission. The government should then make final decisions on major upgrade programmes and allocate funding, making long term commitments into future spending review periods where necessary.



**Figure 4.3: Capacity constraints on the roads and employment growth projections for 2018-50 within city centres outside London, based on Commission analysis.**

Note: The 25 largest cities by employment are shown in orange, with smaller cities in grey. Cities further to the right are projected to grow faster in their city centre, while cities nearer to the top have greater capacity constraints into the city centre.<sup>35</sup>

Not all cities will need large scale investments. In some, existing capacity and incremental enhancements will be sufficient. Others that are not included in the first wave should be considered for inclusion in future rounds of funding, especially where lower cost interventions, such as bus schemes, have identified demand in key transport corridors. Given the long term funding being proposed

(major capacity programmes could easily need to be funded for 5-10 years) future rounds should take place no more than once or twice per parliament. It is essential that the process makes choices about the most important investments rather than giving many small funding grants. Around £31 billion is required by 2040 for major urban transport capacity programmes, delivering on growth needs over that period and preparing for future growth.

**The Commission recommends that government should allocate significant long term funding for major capacity upgrades in selected growth priority cities, in line with the funding profile set out by the Commission. Cities benefiting from major projects should make commitments on housing delivery and provide at least 25 per cent of funding. Priority cities should be identified by mid 2019, with long term investment commitments agreed by 2020. Future rounds should take place no more than twice a parliament.**

## London

Development of regional cities should be in addition to and not instead of continuing to invest in London. The UK's highest value jobs continue to be in London and it is projected to grow faster than anywhere else, with employment growing 18 per cent to 6.7 million by 2041.<sup>36</sup> Taxes paid in London and its surrounding regions fund infrastructure and other services in other regions of the UK, contributing £3,070 per person to the rest of the UK in 2016.<sup>37,38</sup> And it is an internationally competitive city; infrastructure constraints on London's growth are as likely to cause displacement overseas as they are to elsewhere in the UK.

London's transport networks are already more congested and overcrowded than anywhere else in the country. Future growth will not be possible without substantial increases in capacity. The Commission has already recommended that Crossrail 2 should go ahead to increase capacity into central London. The Mayor's Transport Strategy sets out a wider range of interventions that will be needed, including improvements to bus networks, cycling infrastructure, the Underground and suburban rail lines.<sup>39</sup>

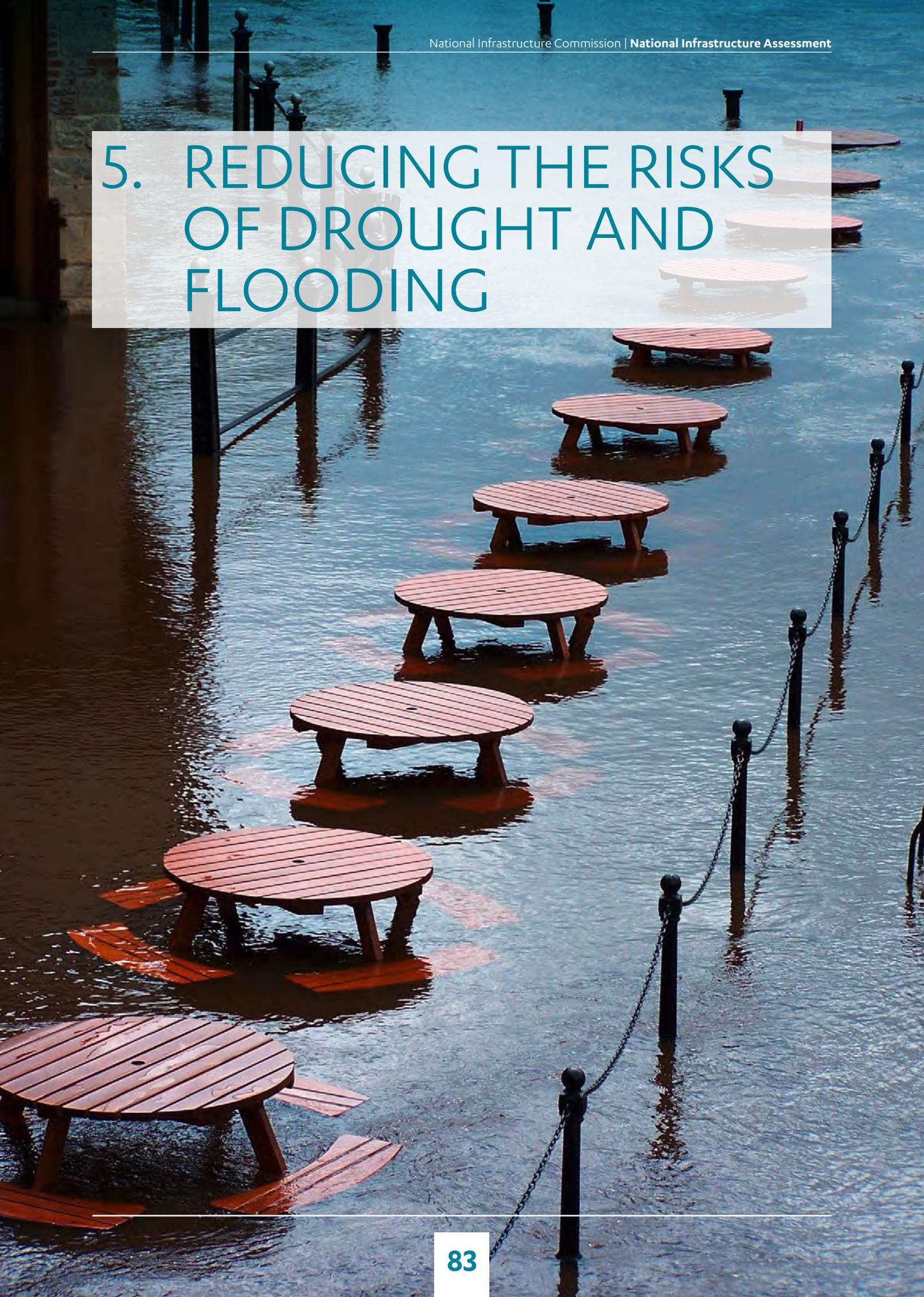
Most of the proposals contained in the Mayor's Transport Strategy would be delivered by Transport for London. Transport for London plans to cover all its operational expenditure through its own operational income in future, but it will still need support for investment, which should be sustained at current levels. The government should continue to work with the Mayor to fund Crossrail 2 as recommended by the Commission.

## Endnotes

- <sup>1</sup> Eurostat (2018), Gross value added at basic prices by NUTS 3 regions; Eurostat (2018) Employment (thousand persons) by NUTS 3 regions; ONS (2018) Annual population survey – workplace analysis (accessed through Nomis)
- <sup>2</sup> There is no single UK definition of a city. Except where stated otherwise, this chapter uses the “primary urban area” definition originally developed for the State of the English Cities reports (Office of the Deputy Prime Minister, 2006 and Department for Communities and Local Government, 2011) and updated by the Centre for Cities in 2016, corresponding to cities with a population of around 110,000 or over. Under this definition there are 55 cities in England.
- <sup>3</sup> National Infrastructure Commission (2017), Economic growth and demand for infrastructure services
- <sup>4</sup> Centre for Cities (2018), Cities Outlook 2018
- <sup>5</sup> Martin et al. (2016) Future of Cities: Working Paper. Divergent cities in post-industrial Britain, report prepared for Foresight, Government Office for Science
- <sup>6</sup> Centre for Cities (2018), Cities Outlook 2018
- <sup>7</sup> London Datastore (2015), Population Change 1939-2015; ONS (2017), Population estimates (accessed from Nomis)
- <sup>8</sup> National Infrastructure Commission (2016), The impact of population change and demography on future infrastructure demand
- <sup>9</sup> See figure 4.3
- <sup>10</sup> Centre for Cities (2016), Competing with the continent, how UK cities compare with their European counterparts
- <sup>11</sup> Eddington (2006), The Eddington transport study, the case for action: Sir Rod Eddington’s advice to government
- <sup>12</sup> Airports Commission (2015), Final report
- <sup>13</sup> Commission calculations based on: Ministry of Housing, Communities and Local Government (2017), Local authority capital expenditure, receipts and financing; HM Treasury (2018), Central government own capital expenditure on services by sub-function (data provided to the Commission)
- <sup>14</sup> Department for Transport (2016), National Travel Survey Table NTS9911, average number of trips by trip length, region and rural-urban classification, England, 2014/15
- <sup>15</sup> Department for Transport (2017), Rail factsheet: 2017
- <sup>16</sup> Eddington (2006), The Eddington transport study: the case for action: Sir Rod Eddington’s advice to government; Department for Transport (2016), Value for money assessment for the integrated transport block
- <sup>17</sup> See figure 7.1
- <sup>18</sup> TRL (2017/18), Carriageway Condition Index (CCI), sourced from national SCANNER data
- <sup>19</sup> Department for Transport (2015), Road investment strategy, economic analysis of the investment plan; Urban Transport Group (2015), A bumpy ride
- <sup>20</sup> HM Treasury and National Infrastructure Commission (2017), National Infrastructure Commission framework document
- <sup>21</sup> Department for Transport (2017), Average speed on local A roads (CGN0502); Department for Transport (2018), Average speed, delay and reliability of travel times on the SRN (CGN0402)
- <sup>22</sup> Department for Transport (2018), Travel time measures for the Strategic Road Network and local ‘A’ roads: January to December 2017
- <sup>23</sup> Department for Transport (2017), Rail passenger numbers and crowding on weekdays in major cities in England and Wales: 2015 (revised)
- <sup>24</sup> The chart shows settlements with population size up to 1 million. Larger settlements show the same pattern, but are hard to show on the same chart without distortion, since their population is so much greater. Values for the ratio of peak to off-peak connectivity are: Greater London 0.24, Greater Manchester, 0.46, West Midlands, 0.56, West Yorkshire 0.59.
- <sup>25</sup> Prospective (2018) Transport connectivity final report, report for the National Infrastructure Commission
- <sup>26</sup> Wadud et al (2016), Help or Hindrance? The travel, energy and carbon impacts of highly automated vehicles, Transportation Research
- <sup>27</sup> Duranton and Turner (2011) The fundamental law of road congestion
- <sup>28</sup> Steer Davies Gleave (2018), Urban transport network review, report for the National Infrastructure Commission
- <sup>29</sup> Urban Transport Group (2018), Active Travel: solutions for changing cities; Mayor of London (2017), Healthy Streets for London; Centre for Cities (2014), Delivering change: building homes where we need them
- <sup>30</sup> Urban Transport Group (2016), Policy Futures for Urban Transport
- <sup>31</sup> Centre for Cities (2018), City Definition, [www.centreforcities.org/puas](http://www.centreforcities.org/puas)
- <sup>32</sup> National Infrastructure Commission (2016), Transport for a World City
- <sup>33</sup> Prospective (2018) Transport connectivity final report, report for the National Infrastructure Commission
- <sup>34</sup> Lomax and Smith (2018), Effect of capacity constraints on population and employment distribution, report for the National Infrastructure Commission
- <sup>35</sup> Lomax and Smith (2018), Effect of capacity constraints on population and employment distribution, report for the National Infrastructure Commission; Prospective (2018) Transport connectivity final report, report for the National Infrastructure Commission
- <sup>36</sup> Transport for London (2017), Mayor’s Transport Strategy: supporting evidence challenges & opportunities
- <sup>37</sup> Office for National Statistics (2017), The wealth of regions – measuring the UK’s tax and spending imbalance
- <sup>38</sup> Office for National Statistics (2017), Country and regional public sector finances: Financial year ending March 2016
- <sup>39</sup> Mayor of London (2018), Mayor’s Transport Strategy



# 5. REDUCING THE RISKS OF DROUGHT AND FLOODING



# BEING RESILIENT TO EXTREME WEATHER

Climate change increases the risk of both flooding and drought in England

This is already having an impact, and will do in the future:

**High flood risk:**

**1 million**

homes have more than 1% chance of flooding in any given year



**But also a strong risk of drought:**

**1 in 4**

chance of a severe drought between now and 2050



## RESILIENCE SAVES PEOPLE FROM THE TRAUMA OF FLOODING AND THE COSTS OF DAMAGE AND INSURANCE

The Commission have proposed a national standard so that by 2050 communities will be resilient to flooding

**99.5%**

of the time wherever feasible



This means that someone living in a house at risk of flooding for 20 years would face only a 1 in 10 chance of flooding over that time

## BUT WE ALSO NEED TO BE MORE RESILIENT TO DROUGHT

Relying on emergency measures would cost an estimated

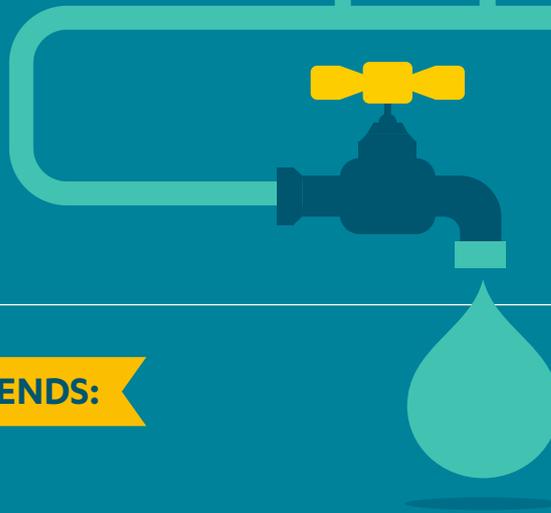
# £40 billion

Over the next 30 years – being resilient would cost only £21 billion

The UK needs an extra

# 4,000MI

of water a day to assure long-term supply



### THE COMMISSION RECOMMENDS:



A national standard of flood resilience with a higher standard in major urban areas



A national water transfer network and new water supply, such as reservoirs



Nationwide, catchment-based plans combining green and grey infrastructure



Halving leakage by 2050 and reducing demand through efficiency and smart metering

Sources: Commission calculation using inputs from Atkins, Environment Agency, ITRC and Regulatory Economics

## Climate change will increase the risk of both flooding and drought. Despite several significant incidents over recent years, the risks continue to rise, and planning has been disjointed. Action is needed now to make communities resilient for the future, rather than waiting until the situation gets worse.

About 5 million properties in England are currently identified to be at risk of flooding. Of these, about 600,000 homes have more than a 1 per cent chance each year of being flooded by rivers and the sea.<sup>1</sup> A similar number have more than a 1 per cent chance each year of flooding from surface water.<sup>2</sup> Floods affect people's lives and health as well as causing economic damage.

While it will never be possible to prevent all flooding, the current approach is too piecemeal and too reactive. Government should ensure that all communities are resilient, so they are able to cope with, and recover from, flooding. There should be a long term national programme: resilience cannot be increased everywhere overnight and the extra funding needed will only become available gradually. But a long term strategy, with long term funding, can deliver a national standard by 2050.

At the same time, households and businesses in large and densely populated parts of England face significant risk of having their water supplies rationed because of drought. While water companies' plans show some progress in addressing this risk, they fall short of what is needed. The Commission's 2018 report *Preparing for a drier future: England's water infrastructure needs*<sup>3</sup> set out the action needed for drought resilience.

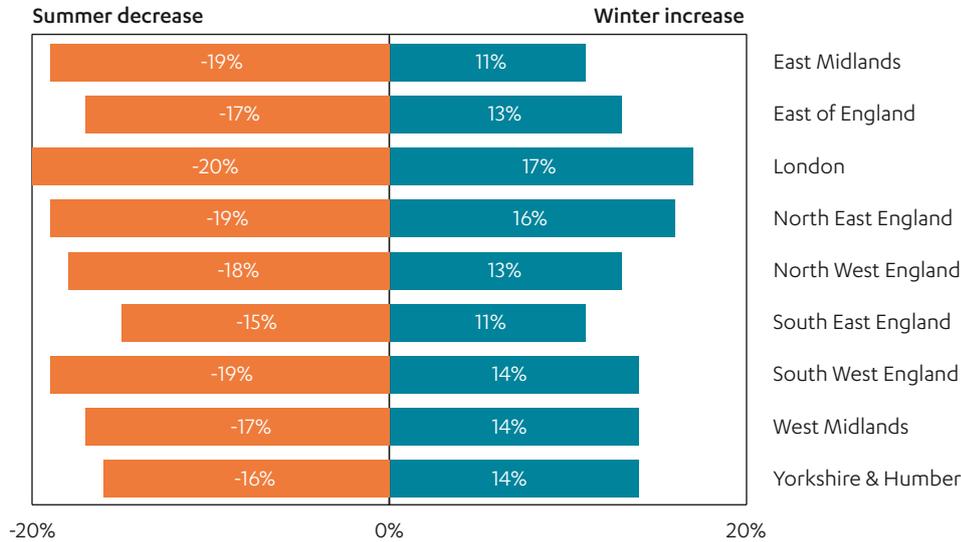
To minimise the impact of severe weather and climate change, England requires:

- a long term strategy to ensure that all communities are resilient to severe flood events by 2050, with higher standards for the most densely populated areas
- increased resilience to drought through a national water network, halving the water lost through leaks, and reducing demand through smart metering

A lack of reliable data has meant that it has not been possible to consider surface or waste water in detail for this Assessment. Surface water flooding is significant<sup>4</sup> and there has been little progress in the decade since the Pitt review.<sup>5</sup> Further work is needed urgently.

## The risk of flooding

Climate change is expected to both increase rainfall in winter and decrease it in summer, as shown in figure 5.1. Together with population growth, this will lead to greater risks of both flooding and drought.

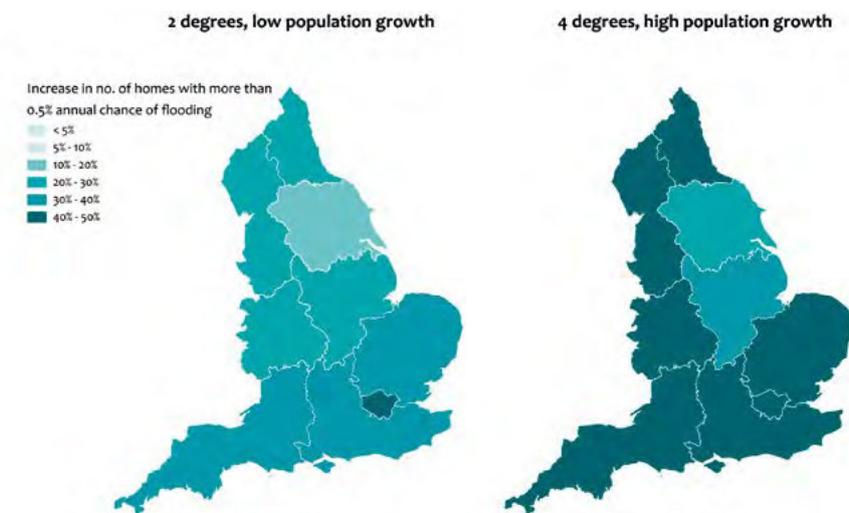


**Figure 5.1 Projected changes in summer and winter precipitation by 2050<sup>6</sup>**

Note: changes for 50% probability in the 2050s assuming medium emission scenario.

The likelihood of drought and flooding is expressed as an annual probability. For example, a 1 per cent annual probability of flooding corresponds to a 1 in 100 chance of a particular area being affected each year. As there are many areas at risk of flooding across England, there is a high chance that at least one will be flooded by a 1 per cent event in any year. Probabilities can only be an estimate: in particular, the uncertain impacts of climate change limit the ability to forecast future risk precisely. Care should be taken in interpreting specific figures, but scenarios allow a broad assessment of plausible future flood risk. Further details and references to the assumptions and analysis are in the technical annexes: *Flood modelling and Analysis of drought resilience*.

Increasing numbers of households across England are at risk of flooding in severe events (shown in figure 5.2), but long term objectives for flood risk management are unclear. Levels of risk and investments vary widely across otherwise similar places and there is no certainty of whether or when preventative action will be taken.



**Figure 5.2 Percentage increase in homes at 0.5 per cent or greater annual chance of flooding in future population and climate change scenarios<sup>7</sup>**

Flooding has significant impacts on the local community including disruption, loss of employment, and mental ill health as well as direct impacts on buildings and property.<sup>8</sup> Insurance can help, and is currently subsidised for homes at most risk, but only covers some of the impacts.

## A national standard of flood resilience

Management of flood risk over recent years has too often been short term and reactive. In the past, government budgets for flood risk management have been reduced, only to be increased again after floods: budgets were reduced in 2006/7 and 2007/8 but then increased following floods in 2007, and cut again in 2011/12 with a large increase following floods in the winter of 2013/14.<sup>9</sup> It would clearly be better to build flood resilience before it is needed. The six year capital programme agreed for 2015/16 – 2020/21 provides greater certainty and should result in more efficient planning. However, there is no clear long term objective for the level of flood resilience that the government is seeking to achieve.

Decisions about capital investment in flood risk management have generally been made on the basis of cost benefit analysis. Essentially, this involves an assessment of whether it is ‘worth’ protecting particular homes and commercial properties. This is not a sustainable basis for decision making. Properties at risk of flooding are seldom abandoned or adapted to cope with the risk, so people are left to live with the risk. Subsidised insurance can incentivise homeowners in flood risk areas not to take any action. Without a clear objective, it is harder for the Environment Agency to take a strategic view across a whole catchment, although some catchment based plans have been made.

A better approach would be to set a nationwide objective for a minimum level of resilience wherever feasible. This has public support: the Commission’s social research showed that 59 per cent of people thought everyone should receive the

same level of protection, even though in some areas it would cost more, with only 16 per cent against.<sup>10</sup> However, a national standard should not be statutory or imply a right to compensation if not achieved.

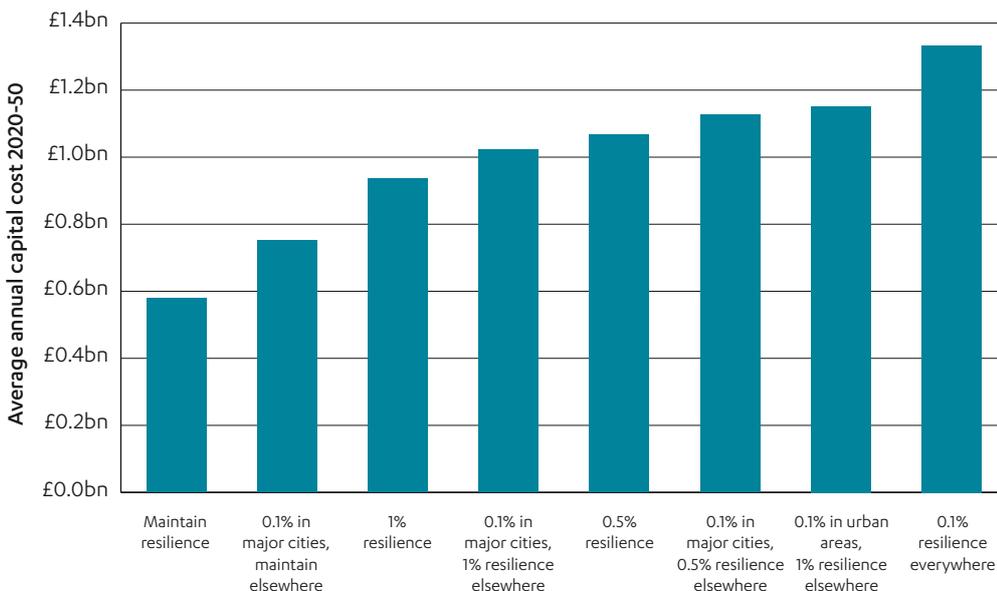
## Setting a standard

There is no absolute way of setting the right standard. What is affordable and achievable will vary over time. The Commission has considered what standards would be reasonable by 2050. Over longer time periods, higher standards might be achievable.

The Commission has analysed the investment that would be required to provide a range of resilience standards across different settlement types for river and sea flooding. Average annual capital costs between 2020 and 2050 are shown in figure 5.3, based on a climate change scenario equivalent to a 2°C increase in global mean temperatures.

The costs were estimated using recent Environment Agency data on flood risk management activities. The modelled cost per property varies depending on the property's current and future risk, whether it benefits from existing flood defences, property density and source of flooding.<sup>11</sup> The baseline assumes that current resilience is maintained, broadly following the Environment Agency's Long Term Investment Scenarios.<sup>12</sup> Further details are in the technical annex: *Flood modelling*.

The modelling produces estimates of the costs of a national standard of resilience to flooding with 1 per cent, 0.5 per cent or 0.1 per cent annual probability, and additional costs for providing higher standards in the most densely populated areas.



**Figure 5.3 Estimated average annual public capital costs for different standards of resilience to flooding from rivers and the sea, 2°C increase in global mean temperatures climate scenario, 2017 prices, in England**

The annual ongoing cost of a particular standard can be compared to the estimated avoided damage, including property damages, emergency response costs, risk to life and physical injury, mental health effects and impacts on infrastructure, transport, schools and leisure. Setting a national standard will ensure that society as a whole is better off, but without requiring that each home or commercial property justifies its level of flood resilience.

Whilst the estimated costs of nationwide flood resilience are up to three times current investment, the benefits (reduced damages) exceed costs for the range of standards. Estimates are inevitably uncertain; climate change means weather patterns, and therefore the scale of impacts, may fall outside the range of available data.

The Commission's judgement is that all properties, wherever feasible, should be resilient to severe flooding, with a 0.5 per cent annual probability, by 2050. This is consistent with the advice provided to government by the Natural Capital Committee for the 25 year Environment Plan.<sup>13</sup> Under this standard, someone living in a house at risk of flooding for 20 years would face less than a 1 in 10 residual chance of being flooded.

### **Densely populated areas**

A higher standard should be provided for the largest cities, with populations over half a million. This reflects the lower cost per property for protecting densely populated areas<sup>14</sup> and the potential for natural disasters in cities to result in cascading failures, putting severe pressures on disaster response. The largest cities provide a range of economic and social services to their region as a whole, not just to those who live within them, so the potential impact of flooding is greater.

Precise estimates of probability for extreme events are hard to obtain. Economically important locations should be stress tested against a range of plausible extreme events. The Thames Barrier was designed for sea levels with an annual probability of 0.1 per cent. The Commission's analysis has assumed the same standard for the largest cities.

### **Climate change scenarios**

The Commission undertook similar analysis for a climate change scenario equivalent to a 4°C increase in global mean temperatures. The costs of achieving each resilience standard in a 4°C world are much higher than for the same standard in a 2°C world, but so are the benefits.

This might suggest a precautionary approach of building resilience against higher climate change. However, flood resilience can be designed to be enhanced incrementally. Measures that provide resilience in a 2°C world can be upgraded if it becomes apparent that a 4°C world is more likely. This 'adaptive management' is consistent with catchment based approaches using a range of interventions, rather than just conventional flood defences. This is the most appropriate

approach until there is more certainty on climate change impacts, allowing resilience standards to be increased over time.

**The Commission recommends that government should set out a strategy to deliver a nationwide standard of resilience to flooding with an annual likelihood of 0.5 per cent by 2050 where this is feasible. A higher standard of 0.1 per cent should be provided for densely populated areas where the costs per household are lower.**

## A long term strategy for flood resilience

A clear objective will allow for a long term, national strategy for flood resilience. The Environment Agency are due to update their National Flood and Coastal Erosion Risk Management Strategy in 2019. This should expand on the 25 Year Environment Plan to set out how these standards of flood resilience can be achieved by 2050.

Delivering the strategy will require action on long term funding, updated catchment and shoreline management plans, surface water management and development control. Environment Agency monitoring of the strategy should include data on the number, locations and resilience of properties flooded from different sources and events each year.<sup>15</sup>

The strategy should set out a clear plan to deliver the proposed resilience by 2050, as well as ensuring that different aspects of flood management are joined up. It should make clear what is expected of different stakeholders and maximise the opportunities for partnership working. This should be backed up by a long term funding commitment, building on the existing six year capital programme, enabling efficient planning and delivery of projects to address the risk from all sources of flooding.

### Catchment and shoreline plans

Existing Catchment Flood Management Plans and Shoreline Management Plans should be updated to take account of the new standard and set out long term plans for flood risk management across catchments and coastal cells. These plans should use the latest evidence to evaluate the full range of options to achieve the proposed resilience standard including traditional flood defences, 'green infrastructure' (whether natural flood management or sustainable drainage systems), individual property measures, spatial planning and coastal realignment or 'managed retreat.' They will need to take account of the replacement of the Common Agricultural Policy following the UK's exit from the EU which should support natural flood management. As risk can never be eliminated, flood warning, response and recovery will also continue to be important.

The plans will need to show how risk can be managed for all plausible climate futures. They should ensure interventions are adaptable to different futures and that climate change is factored into the design and construction of all

infrastructure. This should be undertaken in such a way that the plans can be updated to reflect new information on climate change with the minimum of effort.

## Surface water management

The data needed to robustly assess the costs and benefits of different resilience standards for surface water flooding is currently unavailable. All relevant organisations should ensure data is available in good time for the next Assessment. Water companies are developing Drainage and Wastewater Management Plans. Water companies and local authorities should work together to build on their existing plans and take action on local flood risk where this is possible. This should include identifying communities at greatest risk from severe surface water flooding and developing joint plans, including investment requirements, to ensure resilience. These plans should inform the next Price Review and Assessment.

## Development control

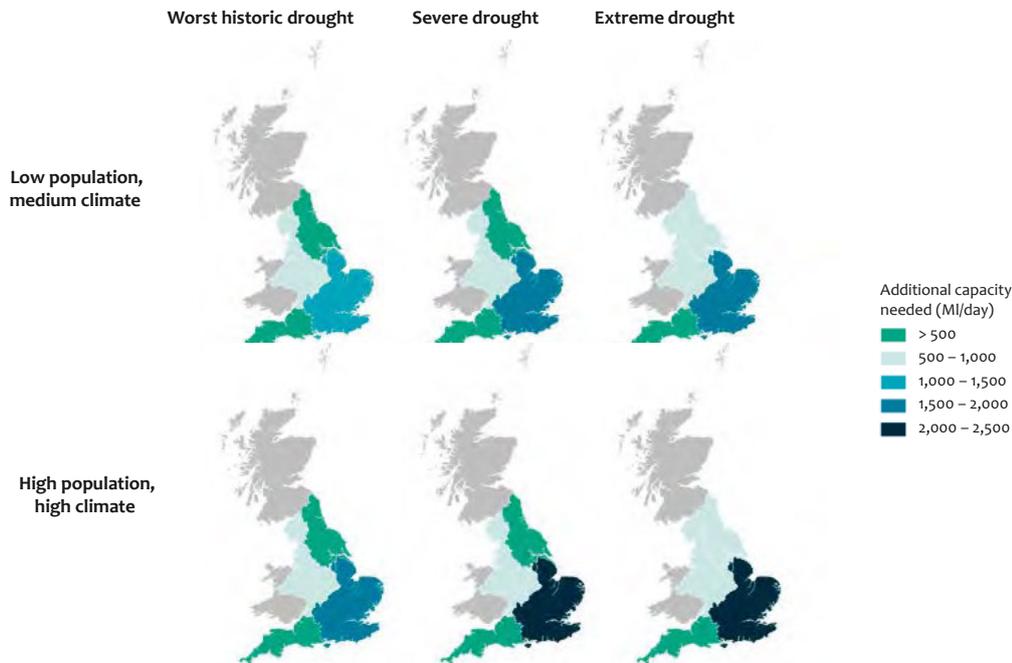
Preventing inappropriate housing development is essential for effective long term flood risk management. In 2016/17, 11 per cent of new homes were built in the floodplain<sup>16</sup> and while many will have been designed to minimise the risk, long term sustainability and compliance is difficult to demonstrate. Consideration should also be given to development outside the floodplain which could increase risk, for example through increased surface water runoff.

**The Commission recommends that, to deliver the strategy:**

- **By the end of 2019, government should put in place a rolling 6 year funding programme in line with the funding profile set out by the Commission. This should enable efficient planning and delivery of projects and address the risks from all sources of flooding.**
- **The Environment Agency should update plans for all catchments and coastal cells in England before the end of 2023. These should identify how risk can be managed most effectively using a combination of measures including green and grey infrastructure, spatial planning and property level measures.**
- **Water companies and local authorities should work together to publish joint plans to manage surface water flood risk by 2022.**
- **The Ministry of Housing, Communities and Local Government and planning authorities should ensure that from 2019 all new development is resilient to flooding with an annual likelihood of 0.5 per cent for its lifetime and does not increase risk elsewhere.**

## Drought resilience

A reliable water supply is usually taken for granted in the UK. But the country faces a real and growing risk of water shortages, especially in the south east of England. Climate change, an increasing population, and the need to protect the environment are bringing further challenges for an already strained system. And the pressure will only rise over the coming decades as shown in figure 5.4.



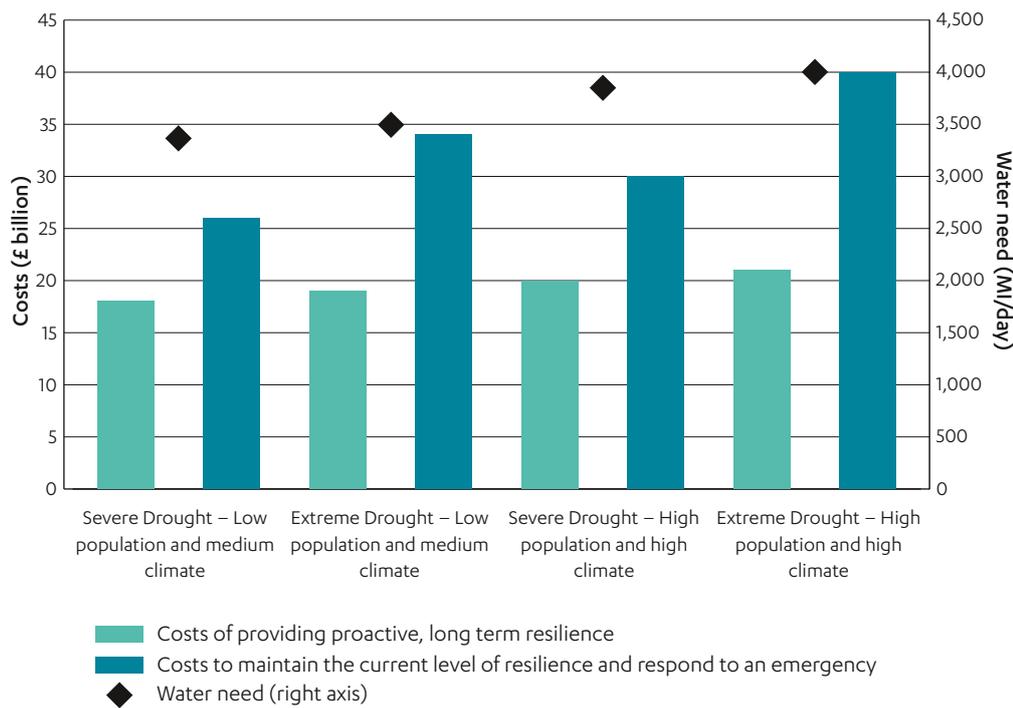
**Figure 5.4 Additional water capacity for droughts with different population and climate scenarios<sup>17</sup>**

Note: medium climate refers to an average medium emission scenario, high climate refers to a drier, medium emissions scenario with less water in the south east.

The full analysis is shown in the Commission's report *Preparing for a drier future* and the technical annex: *Analysis of drought resilience*. Conflicting incentives, limited cooperation between water companies and a short term focus have constrained action. As a result a serious drought would lead to an unacceptably high risk of severe supply limitations; homes and businesses could even be completely cut off.

Maintaining current levels of resilience until 2050 in the face of rising population, environmental and climate pressures, would require additional capacity of about 2,700-3,000 million litres per day (Ml/day) in England.<sup>18</sup> Additional capacity required to protect the UK from extreme drought (0.2 per cent annual chance) is between 3,500 and 4,000Ml/day as shown in figure 5.5.<sup>19</sup> The Commission's analysis shows that the costs of providing proactive long term resilience are less than those for relying on emergency response.

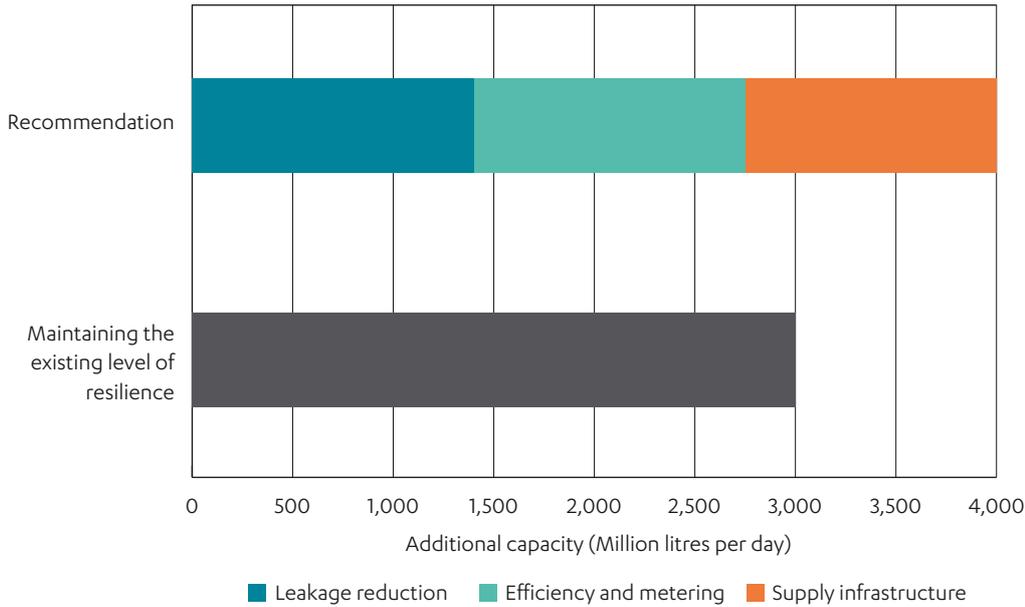
The Commission therefore believes that additional supply and demand reduction totalling 4,000Ml/day should be delivered by 2050.



**Figure 5.5 Costs of providing proactive, long term resilience and relying on emergency response for droughts beyond current resilience levels<sup>20</sup>**

Note: Costs are expected present values to 2050 (in 2018 prices) and include maintaining 1 per cent resilience, which is considered to be ‘business as usual’.

A ‘twin-track’ approach of reducing demand and increasing supply is the lowest cost and most sustainable way to increase resilience. And more ambitious long term plans are needed, as shown in figure 5.6. These should address leakage, enable water companies to undertake more comprehensive water metering and demand management, and ensure the delivery of a national water network, and other options for additional supply infrastructure.



**Figure 5.6 Twin-track approach addressing demand and supply<sup>21</sup>**

## Supply

Even with ambitious action to reduce demand, more supply infrastructure will be needed. Aiming for additional capacity of 4,000ML/day will require a minimum of 1,300ML/day additional supply infrastructure.<sup>22</sup> Different options are available, including transfers, reservoirs, reuse and desalination. A range of studies have all found a positive cost benefit case for greater transfers and water trading.<sup>23</sup> A network of strategic water transfers, which can move water from areas with a surplus to those where it is needed, could provide about 700ML/day more capacity at comparable cost to other options and with increased adaptability of the overall system.<sup>24</sup> The remaining capacity should be provided by the most cost effective combination of supply infrastructure.

The scale of this infrastructure goes well beyond that seen in the draft plans proposed by water companies. It is likely to need strengthened regional approaches and an independent national framework. Ofwat has developed a 'direct procurement' mechanism for large infrastructure projects which could form the basis of open and transparent competition ensuring all options for significant additional supply capacity can be considered.

## Demand

Demand reduction, including addressing leakage, can deliver the remaining 2,700ML/day needed. Today, around 2,900ML/day (20 per cent) of water put into the public supply is lost through leakage.<sup>25</sup> An ambitious long term strategy to reduce leakage would encourage action by customers and incentivise technological innovation, which should drive down the costs of managing leaks. Halving leakage should save over 1,400ML/day by 2050.

Conventional metering can reduce demand by around 15 per cent and smart meters are expected to reduce this further (to about 17 per cent) and help identify leaks.<sup>26</sup> Water companies can introduce compulsory water metering in water stressed areas. About 50 per cent of homes in England are currently metered and this is expected to reach around 80 per cent by 2050, saving around 400ML/day. Bringing forward metering more quickly would result in a further 400ML/day reduction in demand by 2050. In addition, efficiency improvements (as washing machines and toilets use less water, for example) are expected to reduce demand by around 600ML/day. There might be potential to go further in increasing efficiency, for example through local reuse schemes or labelling appliances, and companies should be more ambitious and show what can be achieved.

**The Commission recommends that government should ensure that plans are in place to deliver additional supply and demand reduction of at least 4,000ML/day. Action to deliver this twin-track approach should start immediately:**

- **Ofwat should launch a competitive process by the end of 2019, complementing the Price Review, so that at least 1,300ML/day is provided through (i) a national water network and (ii) additional supply infrastructure by the 2030s.**
- **The Department for Environment, Food and Rural Affairs should set an objective for the water industry to halve leakage by 2050, with Ofwat agreeing 5 year commitments for each company (as part of the regulatory cycle) and reporting on progress.**
- **The Department for Environment, Food and Rural Affairs should enable companies to implement compulsory metering by the 2030s beyond water stressed areas, by amending regulations before the end of 2019 and requiring all companies to consider systematic roll out of smart meters as a first step in a concerted campaign to improve water efficiency.**

## Joining up flood and water management

A healthy aquatic environment is important for water supply and flood management as well as for biodiversity. Interventions to improve flood and drought resilience should consider the range of interactions that water has with people and the environment. There are opportunities for green infrastructure approaches that deliver multiple benefits including groundwater recharge, water quality and flood risk management.

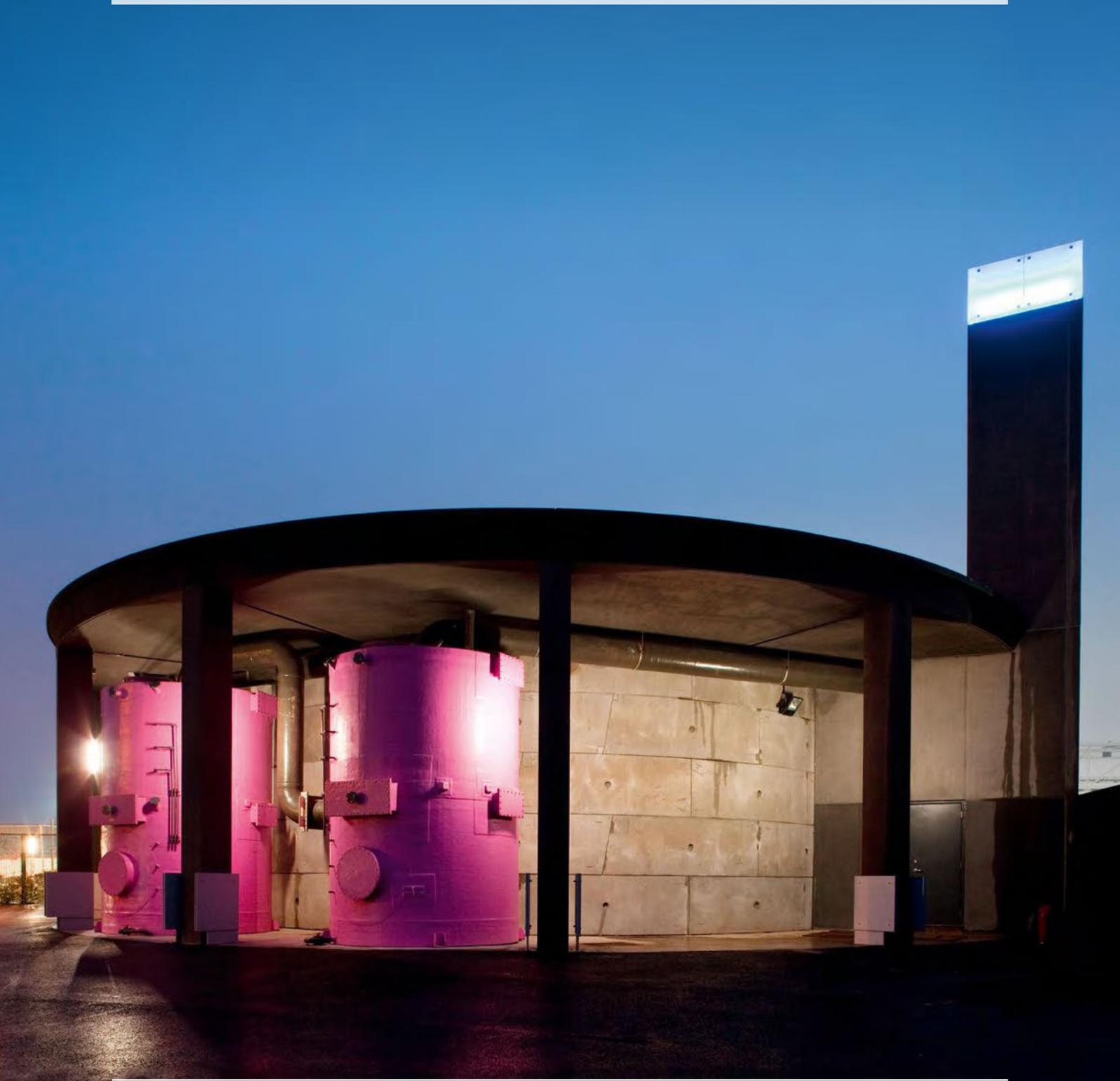
The Environment Agency, local authorities and water companies should all work together to better coordinate their plans. The Environment Agency has a key role through its strategic overview for all flood and coastal erosion risk management as well as regulatory responsibility for water quality and abstraction. Appraisal and funding should encourage interventions that improve both drought and flood

resilience. Decisions on flood and water infrastructure should take into account the full range of potential benefits as well as wider impacts to ensure that all objectives can be delivered effectively.

## Endnotes

- <sup>1</sup> National Audit Office (2014), Strategic flood risk management and Environment Agency (2018), Risk of flooding from rivers and sea – key summary information
- <sup>2</sup> Environment Agency (2014), Flood and coastal erosion risk management: Long-term investment scenarios
- <sup>3</sup> National Infrastructure Commission (2018), Preparing for a drier future: England’s water infrastructure needs
- <sup>4</sup> Pitt (2008), Learning lessons from the 2007 floods.
- <sup>5</sup> Committee on Climate Change (2017), Progress in preparing for climate change
- <sup>6</sup> Met Office (2014), UK Climate Projections: Medium emission scenario
- <sup>7</sup> Commission calculations using input from Sayers and Partners and JBA Consulting, for more details see technical annex: *Flood modelling*
- <sup>8</sup> Public Health England (2017), The English National Study for Flooding and Health: First year report
- <sup>9</sup> DEFRA (2017), Funding for flood and coastal erosion risk management in England
- <sup>10</sup> Ipsos MORI (2018), National Infrastructure Commission Phase 2: public research
- <sup>11</sup> Sayers and Partners and JBA Consulting for the National Infrastructure Commission (2018), Floods standard of protections and risk management activities
- <sup>12</sup> This is the same baseline assumed for the Committee on Climate Change (2017), UK Climate Change Risk Assessment 2017 Evidence Report
- <sup>13</sup> Natural Capital Committee (2017), Advice to Government on the 25 Year Environment Plan
- <sup>14</sup> Sayers and Partners and JBA Consulting for the National Infrastructure Commission (2018), Floods standard of protections and risk management activities
- <sup>15</sup> Section 18 of the Flood and Water Management Act (2010), requires the Environment Agency to report to the Minister about flood and coastal erosion risk management, including the application of the national strategy
- <sup>16</sup> Ministry of Housing, Communities & Local Government (2018), Land Use Change Statistics in England: 2016-17
- <sup>17</sup> Commission calculations, based on data from Water UK, water companies and the Environment Agency and using the NISMOD model developed by the Infrastructure Transitions Research Consortium
- <sup>18</sup> To put this in context, the typical volume of water available to supply households and businesses averages 15,000 Ml each day
- <sup>19</sup> This represents the need beyond intra-company transfers and small interventions needed to maintain existing capacity
- <sup>20</sup> Commission calculations and analysis, using input from Atkins, Infrastructure Transitions Research Consortium and Regulatory Economics. See technical annex: *Analysis of drought resilience* for more details and references
- <sup>21</sup> Commission analysis, using input from Infrastructure Transitions Research Consortium and Regulatory Economics, see technical annex for more details and references
- <sup>22</sup> This represents the need beyond intra-company transfers and small interventions needed to maintain existing capacity
- <sup>23</sup> Deloitte (2015), Water trading – scope, benefits and options; Cave (2009), Independent Review of Competition and Innovation in Water Markets; Ofwat (2010), A study on the potential benefits of upstream markets in the water sector in England and Wales; Ernst and Young (2011), Changing course through water trading
- <sup>24</sup> However, there are also risks; for example, transfers can enable invasive species and pathogens to spread, so options need to be considered on a case by case basis
- <sup>25</sup> National Infrastructure Commission (2017), Congestion, Capacity, Carbon: Priorities for National Infrastructure
- <sup>26</sup> Based on expert consultation, and averaging values in literature including Sonderlund et al. (2014), Using Smart Meters for Household Water Consumption Feedback, *Procedia Engineering* 89, 990 – 997; Ornaghi and Tonin, The Effects of the Universal Metering Programme on Water Consumption, Welfare and Equity; evidence provided by Thames Water, Anglian Water and Severn Trent water. See also the technical annex *Analysis of drought resilience*

# 6. CHOOSING AND DESIGNING INFRASTRUCTURE



## The UK needs to have confidence in its decision making and its ability to deliver innovative, world-leading, well designed infrastructure projects. It must make effective and timely decisions, and prioritise getting the best value out of its infrastructure projects over their lifetime.

The Commission was established to address many serious weaknesses in infrastructure decision-making. Policy uncertainty, reversals and prevarication have driven up costs and hampered delivery, with short term considerations often leading to decisions on controversial projects being postponed or, alternatively, taken in a rush without considering the evidence.

Better decisions can be taken. Part of this is to improve the processes by which individual projects are assessed and designed. This requires:

- improving project appraisal by collecting better data on outturn costs and benefits of major infrastructure projects
- ensuring quality design in future nationally significant infrastructure projects
- developing a clear framework for measuring infrastructure performance.

Delivery of high quality infrastructure also depends on the availability of the right skills, the approach to construction and project management, the depth of the supply base, and the capability of government and other infrastructure owners and operators to procure and act as an intelligent client for infrastructure. The UK's exit from the EU will impact the UK's skills base and supply chain; there should be a strategic approach to manage this. These areas are the remit of the Infrastructure and Projects Authority, rather than the Commission. Therefore, they are not covered in this chapter, but they remain critical.

## Choosing projects

Government needs a robust approach to assessing the costs and benefits of infrastructure projects. Cost benefit analysis (also known as economic appraisal) is widely used to assist in deciding between infrastructure projects in the public sector, especially for transport projects. The UK is generally thought to be a leader in cost benefit analysis.<sup>1</sup> The Commission has engaged with a range of experts and interested stakeholders over the past year to better understand the limitations of existing methods and assess where improvements could be made.<sup>2</sup> Issues include:

- capturing system wide effects, rather than simply the marginal impact of individual projects

- the treatment of uncertainty – too often a single number is presented which does not reflect the range of possible outcomes
- ensuring the process does not become overly precise and focused on a preferred option at too early a stage.

## Improving data

These are not straightforward issues to address. The Commission intends to continue working with experts and interested parties to find solutions. One key area where immediate progress could be made is in addressing the lack of consistent and publicly available outturn data on the costs and performance of infrastructure projects. In many cases, considerable time and energy is devoted to estimating expected costs and benefits but very little on establishing actual costs and benefits when projects are built.

Better data would allow:

- decision makers to understand the range of uncertainty in project appraisals by showing how outcomes have varied for similar projects, mitigating the natural tendency to optimism in assessing costs and benefits<sup>3</sup>
- consideration of a wider range of approaches at an early stage, by highlighting historic examples of successful alternatives to decision makers
- simplification of the early stages of appraisal, basing initial estimates on results from comparable projects
- greater scrutiny of proposals, at a stage when decisions are still open
- a more balanced understanding of past success and failure, in place of an excessive focus on the best or worst cases
- a better understanding of how different procurement and financing models affect outcomes (see Chapter 7).

The Commission's technology study, *Data for the public good*, identified the potential economic benefits from collecting and sharing infrastructure data. It recommended that the Infrastructure Client Group should cultivate a shift towards minimum levels of commercial confidentiality in the infrastructure industry.

Highways England routinely publish outturn project evaluations of major investments. This system has led to more accurate estimates of the likely costs of future projects, reducing the average error in forecast costs by 20 per cent between 2000 and 2009.<sup>4</sup> Other public bodies could adopt a similar approach.

Historic outturn costs and performance data from major projects, which are appraised individually to a high level of detail, will be of greatest value. The

inclusion of historic data is vital to ensure that these datasets can inform decision making. Data should be reported on at least projects with a whole life cost above:

- £10 million for flood management
- £100 million for roads
- £500 million for rail

Cost data should be routinely comparable between initial estimates and actual outturns. Similarly, direct measures of benefit, such as whether passenger numbers meet expectations, should be straightforward to compare. More complex impacts, such as those on GDP or natural capital, can be hard to separate out from other background changes. But this should not be an excuse for failing to publish simpler measures.

Commercial considerations are sometimes stated as a reason for non disclosure but these can be overblown: projects which go wrong are scrutinised in public, so it is only success stories which are not available.

Full evaluation should more often be undertaken to estimate impacts. In many areas, very few robust evaluations exist. For example, the What Works Centre for Local Economic Growth has only identified two high quality evaluations worldwide of the economic impacts of high speed rail and none for trams or cycling schemes.<sup>5</sup>

**The Commission recommends that government should publish good quality data on infrastructure costs and performance. All public bodies taking decisions on strategic economic infrastructure should publish the forecast costs and benefits of their major infrastructure projects at each appraisal stage and at a suitable point after completion, by the end of 2019. The Infrastructure and Projects Authority should work with departments to ensure that costs are comparable between sectors.**

## The value of good design

Once a decision is taken, infrastructure needs to be designed and built well. This Assessment demonstrates the need for investment in the nation's infrastructure, and the Commission is committed to ensuring this is of the highest quality. Now is the time to embed design into the culture of infrastructure planning, saving money, reducing risk, adding value, supporting environmental net gain and creating a legacy that looks good and works well.

### Design Task Force

In February 2018, the Commission announced a Design Task Force chaired by Commissioner Professor Sadie Morgan, to advise on how best to ensure quality design in future major infrastructure.<sup>6</sup>

The Task Force has concluded that achieving the Commission's design ambitions requires two things: advocacy for design at the highest level within projects and access to design expertise. Major projects, including HS2 and Crossrail already do this, embedding design in the procurement and delivery process. This approach should be adopted for all Nationally Significant Infrastructure Projects (as defined within the Planning Act 2008) and those which require Parliamentary approval. Similar arrangements should be encouraged for all other infrastructure projects. The approach could also be amplified in the Government's National Policy Statements for infrastructure.

A new independent National Infrastructure Design Group, to be established by the Commission, will develop infrastructure design principles to guide design panels, which will be published in 2019. This group will also act as a champion of design quality in the nation's infrastructure, by:

- promoting new national infrastructure design principles
- commissioning and publishing research to promote continuous improvement in infrastructure design quality
- providing inspiration and intelligence on good infrastructure design
- promoting and supporting public debate on infrastructure design.

**The Commission recommends that government should be embedded into the culture of infrastructure planning, to save money, reduce risk, add value, support environmental net gain and create a legacy that looks good and works well, by:**

- **Government ensuring that all Nationally Significant Infrastructure Projects, including those authorised through hybrid parliamentary bills, have a board level design champion and use a design panel to maximise the value provided by the infrastructure.**
- **Design panels for nationally significant infrastructure projects having regard to design principles to be published by the National Infrastructure Commission based on advice received from the national infrastructure design group.**

## **Smart, resilient design**

Smart capability and resilience should form an important part of the infrastructure design process.

New data capture and processing technologies such as sensors, artificial intelligence and digital twins can generate better quality data about infrastructure, and be used to improve the way that infrastructure is planned and maintained. They can help to optimise networks, prevent failures, and better target maintenance and renewals. The Commission set out recommendations in

*Data for the public good* to support infrastructure becoming increasingly smart. All new projects should consider data collection and use at the design stages.

Resilience is also a key dimension in the design and management of infrastructure, including adaptation to climate change. Resilience needs to be considered both at the level of individual projects and at the level of wider systems. Individually small scale failures can multiply up in complex systems to far more serious impacts.<sup>7</sup>

The Commission recognised in its initial consultation on process and methodology that, given the breadth and complexity of resilience, it would not be possible to consider the issue fully in this first Assessment.<sup>8</sup> The Commission intends to carry out a more in-depth analysis of resilience as a theme, working with key stakeholders, to inform a future approach ahead of the next Assessment.

## Measuring infrastructure performance

Measuring the quality of the UK's current infrastructure systems can reliably inform the assessment of the UK's future infrastructure needs, and in turn enable the delivery of high quality infrastructure. Currently, the assessment of how well infrastructure is doing too often focuses on the amount of money being spent.<sup>9</sup> But infrastructure has a long lifetime, and so its performance should consider the quality of service delivered by the whole infrastructure system, including its impact on natural capital. Understanding how the performance of each system changes over time could form a crucial part of the Commission's decision making in future.

The Commission intends to measure the quality of the UK's current infrastructure systems based on the framework presented in table 6.1 below. The measures in the framework work across most sectors, allowing the Commission to compare different infrastructure systems. They have also been designed to measure the performance of infrastructure against the Commission's objectives. These measures were developed following consultation on an earlier set published in the Commission's interim report, *Congestion, Capacity, Carbon: Priorities for national infrastructure*.

Table 6.1 – Performance measures

Domain	Sub-domain	Transport	Energy	Waste	Water and wastewater	Flood risk	Digital communications	
Volume	Volume of consumption	Passenger/tonne km travelled (e)	Energy consumed (e)	Total waste generated (e)	Water consumed (e)	N/A	Gigabytes of data consumed (fixed and mobile) (e)	
		Number of trips (e)		Residual waste generated (e)	Wastewater produced (n)		Voice minutes (fixed and mobile) (e)	
Resilience	Resilience to large shocks	Stress test (n)	Stress test (n)	Stress test (n)	Security of supply index (e)	Risk of flooding and coastal erosion (e)	Stress test (n)	
			Capacity margin (e)		Probability of drought (n)	Standard of protection (n)		
			Expected loss of load (e)					
	Everyday resilience	Travel time reliability (n)	Time that properties lose access to energy (e)	N/A	Time that properties lose access to water (e)	Number of properties flooded (n)	Number of serious incidents reported to Ofcom (e)	
Quality	Service quality	Connectivity (n)	N/A	Gross value added from waste material recovery (e)	Number of water quality incidents (e)	N/A	Coverage by technology (e)	
				Recycling rates (e)			Actual speed at peak time (n)	
	Quality of user experience	Satisfaction derived from survey (e)	Satisfaction derived from survey (c)	Design quality (n)	Satisfaction derived from survey (e)	Design quality (n)	Satisfaction derived from survey (e)	Design quality (n)
		Design quality (n)	Design quality (n)		Design quality (n)		Percentage of all 90-second calls completed without interruption (e)	Percentage of mobile data connections which deliver a speed of at least 2 Megabits per second (e)

Note: (e) denotes existing measures; (n) denotes new measures; and (c) denotes measures constructed by the Commission using existing measures

Domain	Sub-domain	Transport	Energy	Waste	Water and wastewater	Flood risk	Digital communications	
Cost	Cost	Cost per passenger/tonne km (c)	Cost per kilowatt hour of energy (c) Average annual energy bill (e)	Cost per tonne of waste collected and disposed/treated (c)	Cost of water per litre (c) Cost of wastewater treated per population equivalent (c) Average annual water and sewerage bill (e)	Cost per property protected (c) Cost incurred on flood risk insurance claims (e)	Cost per gigabyte of data (fixed and mobile) (e) Average monthly bill (fixed and mobile) (e)	
		CO2e emissions per passenger/tonne km (e)(c)	CO2e emissions per kilowatt hour used (c)	CO2e emissions per tonne of waste produced (c)	CO2e emissions per litre of water consumed (e) Total CO2e emission from water and wastewater (e)	N/A	CO2e emissions per gigabyte of traffic used (n) Total CO2e emissions from digital comms (n)	
Environment	Emissions	Total CO2e emissions from transport (e)	Total CO2e emissions from energy (e)	Total CO2e emissions from waste (e)	Total CO2e emission from water and wastewater (e)	Measure of habitat improved or created (e)	N/A	
		Air quality (e)	Air quality (e)	Waste generated per capita (e)	Number of serious pollution incidents caused by water companies (e) Percentage of water bodies with unsustainable levels of abstraction (e) Average concentration of reactive phosphorus in rivers (e)			
	Environmental externalities	Noise (e)	Ground pollution from waste (n)	To be developed	Value of water services provided by natural environment (e) Cost that energy services impose on the natural environment (e)	Value of water services provided by natural environment (e)	To be developed	To be developed
		Value of energy services provided by natural environment (e) Cost that energy services impose on the natural environment (e)						
Efficiency	System efficiency	Congestion (e)	Energy efficiency of buildings (e) Transmission/distribution losses (e) Ratio of average to peak demand (c)	Reject rates from sorting facilities (e) Capture rate of recyclable materials (e)	Leakage (e)	N/A	N/A	

Note: (e) denotes existing measures; (n) denotes new measures; and (c) denotes measures constructed by the Commission using existing measures

Details on responses to the consultation and how these informed the framework and the measures will be provided in a separate technical annex, to be published after this Assessment. The annex will also set out how the Commission intends to further develop performance measures that do not yet exist, including measures linked to natural capital (working with the Natural Capital Committee), design quality and stress tests. The measures in the framework are a work in progress and the Commission expects to update them as new measures are developed or better data becomes available.

The Commission has gathered data on many of these measures, which will also be published on the Commission's website in September 2018. This data gathering process has highlighted two significant gaps so far:

- commercial and industrial waste, where government has launched a competition to develop a new digital solution to track waste.<sup>10</sup>
- the number of properties that are flooded where data recorded by local authorities is not aggregated and published centrally.<sup>11</sup>

Recommendations on filling these gaps have been set out in earlier chapters of the report.

## Endnotes

- <sup>1</sup> Institute for Government (2017), How to value infrastructure
- <sup>2</sup> See National Infrastructure Commission (2017), **Congestion, Capacity, Carbon: priorities for national infrastructure**, pp.38-39
- <sup>3</sup> National Audit Office (2013), Over-optimism in government projects
- <sup>4</sup> Highways England (2015), Post Opening Project Evaluation (POPE) of Major Schemes
- <sup>5</sup> What Works Centre for Local Economic Growth (2015), Evidence Review 7, Transport
- <sup>6</sup> The Design Task Force was announced in the interim National Infrastructure Assessment *Congestion, Capacity, Carbon* in October 2017 and launched by Professor Sadie Morgan at the Institution for Civil Engineers in February 2018. Its members are Lucy Musgrave, Hanif Kara and Isabel Dedring. It is chaired by Commissioner Professor Sadie Morgan and advised by Tony Burton.
- <sup>7</sup> Perrow (1984), Normal Accidents
- <sup>8</sup> National Infrastructure Commission (2016), The National Infrastructure Assessment, process and methodology consultation response.
- <sup>9</sup> Institute for Government (2017), What's wrong with infrastructure decision making?
- <sup>10</sup> See SBRI: smart waste tracking data collection, storage and reporting services: <https://apply-for-innovation-funding.service.gov.uk/competition/175/overview>
- <sup>11</sup> According to internal communication between the Commission and the Environment Agency.

# 7. FUNDING AND FINANCING



**The recommendations set out in this Assessment are not simply a wish list. The recommendations are affordable within the resources set out by the government and provide a fully costed plan for infrastructure spending without significant additional costs to billpayers.**

The recommendations in the Assessment have all been carefully considered by the Commission bearing in mind its objectives. The implications of the recommendations for public expenditure and for bills have been weighed up. The Commission has made judgements on priorities for expenditure within the government's infrastructure funding guidelines. In reaching its conclusions, the Commission has drawn on a wide range of evidence and considered the outcomes of its recommendations under a range of scenarios.

The cost of infrastructure services affects business competitiveness and households' quality of life. The Assessment therefore sets out recommendations to ensure that infrastructure projects are paid for at the lowest whole life cost. Efficient delivery and management of assets and good design have a part to play in this. But it also requires improvements in funding and financing arrangements:

- A UK infrastructure finance institution if the UK loses access to the European Investment Bank
- Improving the analysis of costs and benefits of private financing and traditional procurement
- Engaging stakeholders and the public on paying for road use, recognising that the existing approach is unsustainable
- Expanding and strengthening the range of mechanisms for capturing a share of increases in land value associated with infrastructure.

## Paying for infrastructure

The costs of the Commission's recommendations and who will pay are included in the tables below. These set out planned infrastructure spending in the period from 2020 to 2050.

Households ultimately fund all new infrastructure. This occurs through a variety of channels. Government funded infrastructure is paid for via tax. Infrastructure paid for in this way is covered in the 'fiscal remit' table. Infrastructure funded by the private sector is paid for through bills and charges paid by households, businesses, and the public sector (for example water and gas bills). Higher costs to businesses ultimately feed through to households via the costs of goods and services. Infrastructure paid for in this way is covered in the bills table.

## Fiscal remit

The government has given the Commission a long term funding guideline for public capital expenditure, the ‘fiscal remit’. The Commission “must be able to demonstrate that its recommendations for economic infrastructure are consistent with, and set out how they can be accommodated within, gross public investment in economic infrastructure of between 1.0% and 1.2% of GDP in each year between 2020 and 2050.”<sup>1</sup>

The fiscal remit covers capital expenditure by the public sector, including both local and national expenditure. It does not include spending by the devolved administrations, nor does it include day to day spending (‘resource’ spending).<sup>2</sup>

The fiscal remit does not only cover new projects. Existing commitments and ongoing investment in maintenance and renewals must also be accommodated alongside the Commission’s recommendations. The Commission’s remit specifically excludes consideration of decisions that have already been made, and spending that has already been committed, such as HS2. Committed spending, such as HS2; Crossrail 2 and Northern Powerhouse Rail; and maintaining current assets together add to 1.1 per cent of GDP from 2020-2025 and 0.9 per cent from 2025-2030.

Table 7.1 sets out the Commission’s proposals for the fiscal remit.

**The Commission recommends that government should deliver long term certainty over infrastructure funding by adopting the funding profile set out in the ‘fiscal remit’ table in Spending Review 2019 and other future spending plans.**

## Bills

Households typically pay for infrastructure via bills where consumers can choose how much, or what level, of a service to purchase. For example, linking households’ energy bills to their usage helps to keep total consumption at an efficient and sustainable level.

The Commission is required to provide “a transparent assessment of the overall impact on costs to businesses, consumers, public bodies and other end users of infrastructure.”<sup>3</sup> Table 7.2 sets out these impacts. Detailed analysis of this is included in *National Infrastructure Assessment impact and costings notes*.

Where recommendations have net costs, the Commission believes that these are manageable and good value relative to the benefits the infrastructure provides.

Table 7.1: The fiscal remit

Average annual expenditure (£ million, 2018/19 prices)	2020-2025	2025-2030	2030-2035	2035-2040	2040- 2045	2045-2050
<b>Transport</b>						
HS2	4,500	3,900	900			
Crossrail 2	200	2,200	2,900			
Northern Powerhouse Rail	200	1,100	1,700	1,800		
Network Rail	6,100	6,100				
Highways England	4,300	3,200				
Strategic Transport*			10,500	11,400	11,200	11,600
Devolved Cities	3,300	3,600	4,600	5,400	6,100	6,800
Transport for London	2,600	2,900	2,200	2,000	2,200	2,400
Urban Major Projects	500	400	2,400	3,100	3,500	3,900
Non-urban local transport	2,700	2,900	3,400	3,800	4,200	4,700
Local Roads Backlog		500	500			
Housing Infrastructure Fund	500	200	200	200	200	200
<b>Energy</b>						
Energy efficiency	100	300	300	100		
EV Charging	2**					
<b>Digital</b>						
Rural fibre	400	300	100			
<b>Waste</b>	600	500	500	500	500	500
<b>Flood Resilience</b>	600	700	900	1,300	1,300	1,300
<b>Studies Contingency</b>	300	400	400	400	400	400
<b>Total expenditure on infrastructure</b>	<b>26,900</b>	<b>29,200</b>	<b>31,500</b>	<b>30,000</b>	<b>29,600</b>	<b>31,800</b>
<b>As a % of GDP</b>	<b>1.2%</b>	<b>1.2%</b>	<b>1.2%</b>	<b>1.0%</b>	<b>0.9%</b>	<b>0.8%</b>

\*combined allocation for road and rail.

\*\*£10m funding in 2020/21.

Table 7.2: The impact on bills

Average annual aggregate impact (£ million, 2018/19 prices)	2020-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050
Heat trials and energy efficiency	+110	+270	+190	+180	+180	+180
Waste	+140	+110	+50	-10	-30	-60
Flood risk – lower insurance costs	-60	-240	-420	-610	-790	-980
Water – resilience to drought	+310	+640	+280	+280	+280	+280
<b>Total impact on households, businesses and public sector</b>	+510	+780	+100	-150	-370	-580
<b>Total impact on households</b>	+440	+650	+120	-60	-240	-420
<b>Average impact per household (£/year)</b>	<b>+£20</b>	<b>+£20</b>	<b>£0</b>	<b>£0</b>	<b>-£10</b>	<b>-£10</b>
<b>Total impact on businesses</b>	+50	+90	-20	-70	-100	-130
<b>Total impact on public sector resource spending</b>	+20	+40	0	-20	-30	-30

Impacts are shown relative to a baseline without the recommendation. This is different to the energy bills impacts described in the *Low Cost, Low Carbon* chapter which compare 2050 to today. Negative figures denote savings. Columns may not sum to totals due to rounding

## The Commission's choices

The recommendations in this Assessment, and the implications for public expenditure and for bills, reflect the judgement of the Commissioners. In reaching its conclusions, the Commission has drawn on a wide range of evidence, including scenario based modelling, stakeholder expertise and opinions, social research, and specially commissioned studies (which are available on the Commission's website). Further details on the Commission's approach are set out in *The National Infrastructure Assessment: process and methodology* and the interim report *Congestion, capacity, carbon: priorities for national infrastructure*.

### Meeting the Commission's objectives

These recommendations reflect the Commission's objectives: to support sustainable economic growth in every region; improve competitiveness; and improve quality of life.

**Sustainable economic growth in every region:** Full fibre digital infrastructure and urban transport networks lower the costs of connecting firms, workers and consumers; capture the benefits of higher productivity in dense clusters of firms; and enable innovation.

**International competitiveness:** Low cost energy supports international competitiveness as an input to all economic activity. Promoting electric, connected and autonomous vehicle infrastructure supports the UK motor industry to stay at the forefront of innovation.

**Quality of life:** Better air quality from electric vehicles, warmer homes from energy efficiency and a better designed public realm can improve people's quality of life. Resilience to floods and droughts protects people against natural disasters.

## **Prioritising within the fiscal remit**

Resources are inevitably limited. This has required the Commission to prioritise between available options in some areas.

### **Prioritise support for new infrastructure networks in the short term:**

Broadband and electric vehicle charging have been prioritised in the short term, when resources are most constrained. These new technologies represent major opportunities for growth and are particularly time critical if the UK is to remain internationally competitive.

**Prioritise urban transport over intercity networks in the 2030s:** Most spending on major upgrades to urban infrastructure, recommended in Chapter 4, will come in the late 2020s and especially in the 2030s. This profile reflects the overall availability of resources, as well as the need for local capability and for proposals to be developed by cities. In later years, urban spending will be balanced by reduced spending on major enhancements on the intercity networks, which will have seen at least a decade of sustained high investment.

**Focusing on low regret options on the motorway and major road network while the impact of new technology is uncertain:** Figure 7.1 sets out the enhancement budget for Road Investment Strategies 1 to 3, together with historic estimates of equivalent spending in the past. For future Road Investment Strategies, maintenance, renewals and incremental enhancements should be prioritised over 'mega projects' given the increased uncertainty that new technology creates for projects with very long payback periods. Large road and rail projects should compete for the same funding, as indicated in the fiscal remit table, to ensure the most beneficial projects are taken forward regardless of mode. An additional £500m a year should be spent on basic maintenance for local roads between 2025-2035.

### **Balance increased rail expenditure in the late 2020s with other priorities:**

There is a major increase in rail expenditure in the 2020s from HS2, Northern Powerhouse Rail and Crossrail 2, as shown in figure 7.2. Continuous change is not sustainable for the rail network and there are other priorities; sums for further enhancements in Network Rail in the late 2020s ('Control Period 7') should be correspondingly lower, although funding for maintenance and renewals should be protected.

**Provide an indicative budget for Northern Powerhouse Rail of £24 billion from 2023-24 to 2039-40:** The business case for Northern Powerhouse Rail remains under development. It is important that Transport for the North sets its priorities for the region and a clear budget will allow that to happen. However, city leaders in the region should have the freedom to shift additional funding from urban budgets to Northern Powerhouse Rail if they choose.

**Provide an indicative budget for Crossrail 2 of £27.7 billion from 2023-24 to 2035-36:** In line with *Transport for a world city*,<sup>4</sup> this reflects the need for Transport for London to reduce and phase the costs of the scheme. London should contribute at least half of the scheme costs.

**Provide a gradual increase in the budget for flood protection:** This reflects the long term strategy proposed in Chapter 5. Spending is weighted towards later years due to other priorities in the 2020s and the time needed for the development of robust plans to achieve the required level of protection.

**Apply efficiency savings to renewals spending:** These are in line with the government's *Transforming Infrastructure Performance*<sup>5</sup> productivity programme.

**Maintain the Housing Infrastructure Fund outside cities:** Within cities, this funding should be merged into wider devolved funding for strategic transport and housing strategies.

**Leave headroom in the later period:** Some recommendations, such as flood protection, involve spending to 2050. But overall there is considerable space in later years. This will be needed for future priorities such as zero carbon heat, surface water flooding or even completely new infrastructure that may be needed in decades to come.

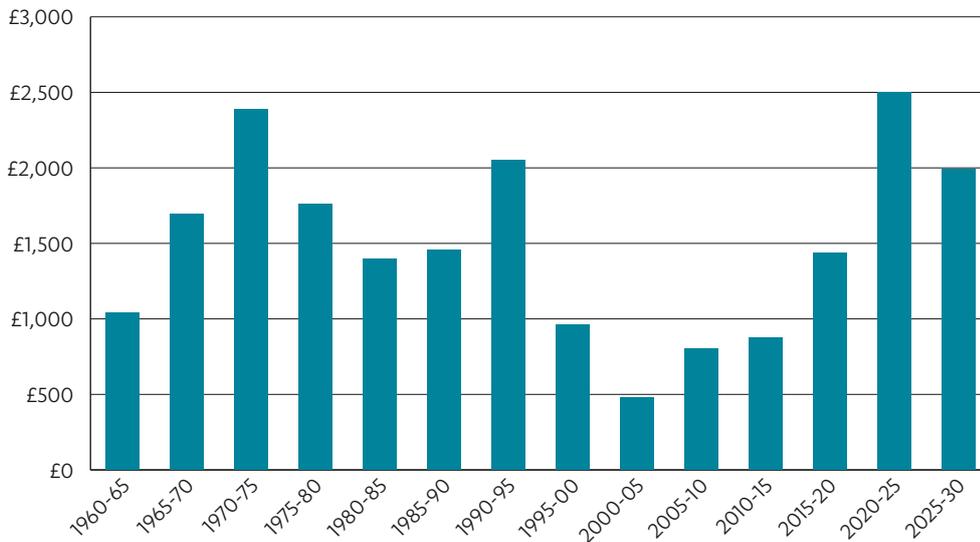


Figure 7.1: Historic and planned enhancement spending on strategic roads<sup>6</sup>

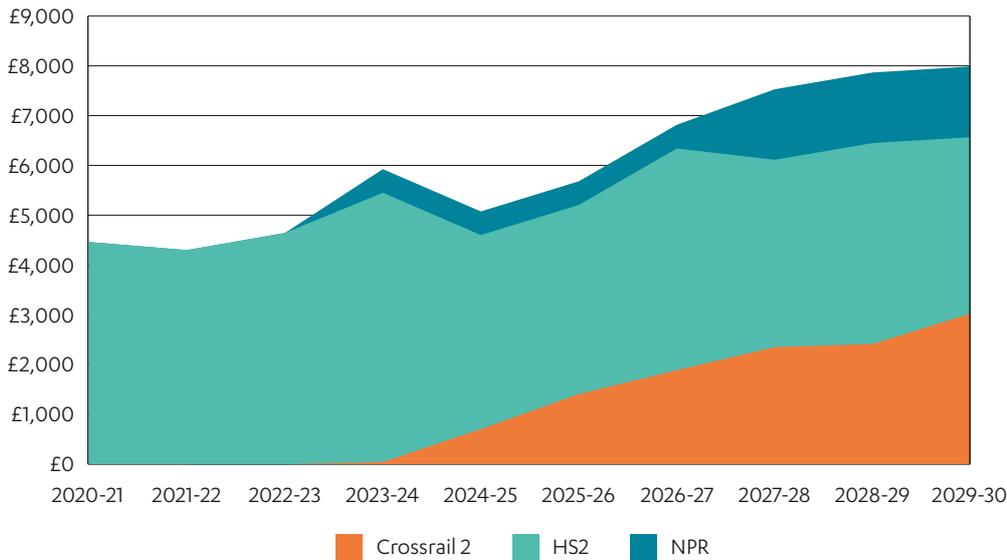


Figure 7.2: Capital Investment in rail 'mega projects' (£m, 2018/19 prices)

## Managing uncertainty

The Commission has also considered how the impact of its recommendations may be affected by uncertainty, focusing particularly on technology, population, economic growth and climate change.<sup>7</sup> The Commission has sought to understand how robust its decisions would be to uncertainty, seeking solutions that will stand the test of time, but recognising that some uncertainty is unavoidable given the timescales for infrastructure investment.

**Balancing the risks of major investments:** For full fibre and water, the potential costs of inaction are much higher than those of action. For flood protection, a more 'adaptive' approach can be taken because defences can be added to incrementally if risks turn out higher. For energy, the Commission's judgement is that the supply chain for nuclear power should be maintained by agreeing a further plant beyond Hinkley Point C, even though renewables look like an increasingly viable alternative, as the costs of re-establishing the nuclear supply chain would be very high.

**Making complementary recommendations:** Investing in both urban transport and rural fibre mitigates uncertainty about the future location of economic activity. Electric vehicle charging helps reduce the cost of more renewables intensive electricity generation by providing more flexible demand and potentially lowering the cost of storage.

**Planning for future decisions:** Investing in renewables in the 2020s will improve understanding of system balancing costs for the 2030s and 2040s. Separation of food waste is good value for money today, but also maximises the availability of biogas. Biogas has a range of potentially high value uses replacing hard to substitute fossil fuels in future. Assessing the potential impact of connected, autonomous vehicles on road and rail investment could reduce the risk of costly long term investments being overtaken by technology.

## Strategic use of public and private financing

Infrastructure typically requires large up front investment ('financing') followed by a long period in which these costs, plus on going maintenance and operational costs, are repaid by users or taxpayers ('funding'). The Commission's recommendations will require a combination of public and private financing mechanisms and these arrangements should be as efficient and as cost effective as possible.

Finance itself is not in short supply.<sup>8</sup> However, in some cases public sector support can ease constraints on the financing of projects in the private sector. In other cases, private finance could increase the efficiency of projects in the public sector and share risks.

### UK infrastructure finance institution

The UK has a high proportion of privately owned, operated and financed infrastructure.<sup>9</sup> Almost half of the planned pipeline of infrastructure projects to 2020/21 will be delivered and funded privately.<sup>10</sup> It has well developed capital markets which generally help to facilitate this private finance. And there is an appetite on the part of institutional investors to increase both the scope and scale of their investment in infrastructure projects.<sup>11</sup>

Both government and arms length independent state institutions can help to support this investment, by absorbing risk that the market finds hard to manage and supporting due diligence functions for innovative projects. The government already has some established mechanisms to support private investment such as the UK Guarantee Scheme.

There is an ongoing market failure around innovation in the infrastructure sector; the risks associated with innovative technologies, techniques and financial products can be too high for the private sector without government support.<sup>12</sup> For example there is strong evidence that the Green Investment Bank helped to catalyse private investment in offshore wind.<sup>13</sup> And there is a role for government in easing liquidity constraints in the infrastructure market during times of crisis.<sup>14</sup>

Independent financing institutions can mitigate some of the risks involved in public sector support for private investment. Independent institutions can provide policy stability in areas which exist outside of the short term political cycle. They can also develop expertise and credibility, which can be used to build the understanding and capabilities of both private investors and local government.<sup>15</sup> A portfolio of investments allows an institution to take risk without imposing an overall cost on the public purse.

In the past, the European Investment Bank and the recently privatised Green Investment Bank have provided this kind of function in the UK.<sup>16</sup> The government has indicated that it may be mutually beneficial to maintain a relationship between the UK and the European Investment Bank<sup>17</sup>, and the Commission

has heard from a wide range of stakeholders that this would be their preferred outcome. However, it may not be possible: a contingency plan is needed.

Any new domestic institution would not score within the Commission's fiscal remit, since its activities would score as 'financial transactions' rather than as capital expenditure. However, unlike the European Investment Bank, lending by any domestic institution would score within the government's main debt measure, Public Sector Net Debt.<sup>18</sup> A new institution would therefore need a clear remit, and robust processes, to ensure additionality and 'sound banking' (measuring project returns in terms of risk adjusted interest rates and lending at market rates).<sup>19</sup>

**The Commission recommends that government should maintain access to the European Investment Bank if possible. If access is lost, a new, operationally independent, UK infrastructure finance institution should be established by 2021. To enable this, government should consult on a proposed design of the new institution by Spring 2019. The consultation should cover:**

- **Functions, including provision of finance to economic infrastructure projects in cases of market and coordination failures; catalysing innovation; and acting as a centre of excellence on infrastructure project development, procurement and delivery**
- **A clear mandate, including sound banking, additionality and having a wider economic and social impact**
- **Governance to safeguard the operational independence of the institution.**

## **Evaluating the performance of private financing and traditional procurement**

As well as the public sector supporting private financing, private finance can support public sector projects. The introduction of private financing into public infrastructure delivery came following a poor record of public sector delivery.<sup>20</sup> It has led to quicker delivery of projects, enabling society to access infrastructure services earlier, and contributed to better public sector commercial capability.<sup>21,22</sup>

Private financing, in comparison to traditional procurement, encourages a whole life approach to project design. The transfer of risk to the private partner incentivises efficiency in delivery over the project lifecycle but can sometimes create challenges where requirements change during the project lifetime. There is a residual level of risk that can never be transferred, since in extreme circumstances projects can return to the public sector where private providers go bankrupt.

There has been a slowdown in the use of private financing in recent years due to uncertainties about its cost effectiveness and the rationale for its use.<sup>23</sup> The overall performance of private finance has not been robustly evaluated.<sup>24</sup>

The Commission proposes an analytical framework for whole life analysis of the costs and benefits of private financing and traditional procurement, set out in the technical annex *Proposed analytical framework for evaluating the performance of private financing and traditional procurement*. It builds on past studies considering performance and costs during construction by covering the whole lifespan of projects and a wider range of potential benefits.

Consultation has found a wide consensus on the dimensions in the framework. The immediate next steps are for the framework to be piloted to develop insights on its practical application and identify where it needs to be revised.

Following the pilot, the Commission aims to develop a consistent evidence base of costs and benefits of financing models through more detailed analysis. This independent source of evidence should lead to the more strategic use of private financing and traditional procurement, and improve the design of existing models to build more collaborative long term approaches.

## Additional funding mechanisms

### Paying for road use

Road use is a notable exception to the general principle that infrastructure is paid for through bills where consumers can choose their level of usage.

Over the Assessment's timeframe changes to the way drivers pay as they use roads are inevitable. Fuel duty revenues will decline with the impending shift to electric vehicles.<sup>25</sup> Technological change has the potential to radically change driving patterns and vehicle ownership. The current system of road taxation is not sustainable.

One option might be to introduce a 'road pricing' scheme to charge drivers according to where and when they drive, which could deliver valuable benefits. Road pricing can:

- Pay for new and better road infrastructure; creating a revenue stream from roads can attract private investment, as with some toll roads
- Reduce congestion; congestion is estimated to cost the economy over £35 billion a year, and pricing congestion has been shown to reduce traffic volumes<sup>26,27</sup>
- Protect tax revenue; fuel duty will decline and road pricing is a sustainable alternative

The changing use of roads presents an opportunity to design a road pricing scheme that improves on current road taxation by being fairer, more sustainable and more effective at reducing the negative impacts of driving. Developments in technology provide new ways to implement road pricing that have previously been too expensive or impractical. Some possible changes, such as 'mobility

as a service', where people pay for journeys rather than car ownership, would naturally fit with alternative forms of road pricing.

There has often been a disconnect between theoretically perfect road pricing systems suggested by policymakers and the perceived fairness and practicality of those systems by the public.<sup>28</sup> Rather than propose a further technocratic recommendation the Commission will explore new ways to engage stakeholders and the public on this topic, looking at a full range of potential options in light of the major changes in road use and taxation that are inevitable. Reforming how road use is paid for has been discussed for decades,<sup>29</sup> but the issue is becoming more and more pressing and cannot be avoided forever.

## Land value capture

Local funding for infrastructure can strengthen local accountability, sharpen the incentives for scheme designers to maximise local benefits, and improve the fairness of the funding regime as local beneficiaries contribute to the scheme costs. One approach to raising funding locally is to capture part of any increase in land values from infrastructure development or planning permission for new developments. But the Commission's analysis suggests this is not the silver bullet for funding local infrastructure.<sup>30</sup>

Whilst the current system, comprising Section 106 contributions from developers and the Community Infrastructure Levy, is complex, it is more successful at raising funding than previous approaches.<sup>31</sup> Other parts of the tax system, such as Capital Gains Tax and Stamp Duty, also capture a proportion of land value increases, although there are no reliable measures of how much. Some have argued for radical reform of local funding.<sup>32</sup> However, without a full picture of existing receipts it is unclear this would increase total revenues, and the history of previous reforms argues for caution.<sup>33</sup> Reform would undoubtedly lead to costs and delays in the short term as land owners and developers sought to understand new liabilities before making major decisions.

The sums potentially available would vary significantly across the country. Analysis undertaken for the Commission indicates that roads investment which reduces travel times by 10 per cent in the Cambridge – Milton Keynes – Oxford Growth Arc is associated with higher average property values of over £3,000 per property; a similar scheme in the East Midlands is associated with higher values on average of £2,000 per property and in Yorkshire of £1000 per property.<sup>34</sup>

The Commission's remit covers the interaction between infrastructure and housing, but not housing itself. The Commission has therefore looked at local funding mechanisms from the perspective of infrastructure funding and has concluded that the existing system should be improved rather than replaced, identifying three policies to help raise local revenues.

## Business rates and council tax

London used a business rate supplement to help fund Crossrail 1.<sup>35</sup> This supplement, charged at 2p for every £1 paid by businesses above a certain threshold, will eventually provide nearly one third of Crossrail 1's costs. Applying a small charge to a large base of rate payers is a simple way to gather a contribution to scheme costs. The same approach could be applied to council tax, where a precept could be applied to reflect part of the increase in property values that result from new transport infrastructure.<sup>36</sup> To protect existing residents, the precept could be applied only to new residents that move into the area. To ensure the precept is genuinely related to project costs, it could be time-limited.

Changes in the 2011 Localism Act now require a majority of business rate payers to agree to the supplement, both in number of rate payers and by the value of the rates paid.<sup>37</sup> This is difficult to coordinate; introducing a threshold of one third of scheme costs before ballots are used would make the funding tool simpler to use while retaining safeguards. In this way, future infrastructure projects could benefit from Crossrail 1's innovative funding structure.

## Community Infrastructure Levy

The government are currently consulting on changes to improve the Community Infrastructure Levy. Pooling section 106 agreements across several projects was an important means for local authorities to develop bespoke funding solutions such as the Milton Keynes Tariff. However local authorities are currently not allowed to do this.<sup>38</sup> The government's proposals would remove pooling restrictions in some but not all cases, which would create further complexity and limit flexibility. A simpler approach would be to remove all pooling restrictions which would allow local authorities to use section 106 more effectively.

## Compulsory purchase regime

The compulsory purchase regime, whereby local authorities can buy land as a last resort, could be strengthened. The current regime is costly, time consuming and uncertain.<sup>39</sup> Conducting an independent assessment of site value at the start of the process could save money and provide more certainty for the parties involved in a compulsory purchase order.

**The Commission recommends that local authorities should be given further powers to capture a fair proportion of increases in the value of land from planning and infrastructure provision. To enable this, government should:**

- Remove pooling restrictions on Section 106 in all circumstances, through forthcoming secondary legislation by 2020
- Remove the ballot requirement for upper tier authorities' powers to levy a business rate supplement of 2p or less in the pound for infrastructure, except where the supplement exceeds one third of scheme costs by 2021

- Give local authorities powers to levy zonal precepts on council tax, where public investments in infrastructure drive up surrounding property values by 2021
- Provide greater certainty in compulsory purchase compensation negotiations by including independent valuations early in the process to be paid for by the acquiring authority by 2021.

## Endnotes

- <sup>1</sup> HM Treasury (2016), National Infrastructure Commission Remit letter
- <sup>2</sup> Further details are set out in the Charter for the National Infrastructure Commission, the Government's Remit letter for National Infrastructure Commission of 23 November 2016 and in the Commission's interim report Congestion, Capacity, Carbon: Priorities for national infrastructure
- <sup>3</sup> HM Treasury (2016), National Infrastructure Commission Remit letter
- <sup>4</sup> National Infrastructure Commission (2016), Transport for a world city, converted to 2018/19 prices
- <sup>5</sup> Infrastructure and Projects Authority (2017), Transforming infrastructure performance
- <sup>6</sup> Historic data from Department for Transport (2014), Road Investment Strategy: Strategic Vision, 2013/14 prices
- <sup>7</sup> The Commission has published discussion papers on each of these topics, which are available on the Commission's website
- <sup>8</sup> Cambridge Economic Policy Associates (October 2017), Financing for infrastructure summary report
- <sup>9</sup> Eunomia Consulting (2018), Comparative Study of National Financing Institutions – commissioned by the National Infrastructure Commission
- <sup>10</sup> Infrastructure and Projects Authority (2017), Analysis of the National Infrastructure and Construction Pipeline
- <sup>11</sup> Pensions Infrastructure Platform (2018), Response to Congestion, Capacity, Carbon
- <sup>12</sup> HM Government (2011), Update on the design of the Green Investment Bank
- <sup>13</sup> Vivid Economics (2018), The role and impact of the EIB and GIB on UK infrastructure investment
- <sup>14</sup> Ibid
- <sup>15</sup> LSE Growth Commission (2013), Chapter IV: Investment in Infrastructure, LSE Growth Commission Report (2013), Investing for Prosperity – Skills, Infrastructure and Innovation; Vivid Economics (2018), The role and impact of the EIB and GIB on UK infrastructure investment
- <sup>16</sup> Vivid Economics (2018), The role and impact of the EIB and GIB on UK infrastructure investment
- <sup>17</sup> Mansion House 2017: Speech by the Chancellor of the Exchequer, 20 June 2017
- <sup>18</sup> ONS (2017), Wider measures of public sector liabilities. As a public corporation, a domestic institution would not score within the more widely used international measure of General Government Gross Debt. The government has also introduced a new measure, Public Sector Net Financial Liabilities, which would more accurately reflect the impact of any new institution on overall fiscal risk, by including both assets and liabilities.
- <sup>19</sup> 'Additionality' and 'sound banking' are two of the three core lending principles used by the European Bank for Reconstruction and Development. See: Besley, Dewatripont and Guriev (2010), Transition and transition impact: A review of the concept and implications for the EBRD, Report for the EBRD's Office of the Chief Economist
- <sup>20</sup> National Audit Office, Modernising Construction HC-87, Session 2000-01
- <sup>21</sup> Romboutsos, (2016), Public Private Partnerships in Transport Infrastructure, Transport Reviews and Boardman, et al (2015), Comparative Analyses of Infrastructure Public Private Partnerships
- <sup>22</sup> The Allen Consulting Group (2007), Performance of PPPs and Traditional Procurement in Australia; Makovsek (2013), Public – Private Partnerships, Traditionally Financed Projects, and their Price, Journal of Transport Economics and Policy
- <sup>23</sup> National Audit Office (2018), PFI and PF2
- <sup>24</sup> Ibid
- <sup>25</sup> National Infrastructure Commission (2017), Congestion, Capacity, Carbon: Priorities for national infrastructure
- <sup>26</sup> Cookson, INRIX Research (2018), INRIX Global Traffic Scorecard
- <sup>27</sup> Transport for London (2007), Central London Congestion Charging Scheme: ex-post evaluation of the quantified impacts of the original scheme
- <sup>28</sup> RAC Foundation (2011), The Acceptability of Road Pricing [https://www.racfoundation.org/wp-content/uploads/2017/11/acceptability\\_of\\_road\\_pricing-walker-2011.pdf](https://www.racfoundation.org/wp-content/uploads/2017/11/acceptability_of_road_pricing-walker-2011.pdf)
- <sup>29</sup> Ibid
- <sup>30</sup> Institute for Fiscal Studies (Forthcoming), Property Value Uplift Tool
- <sup>31</sup> Crook, T., Henneberry, J., Whitehead, C. (2012), Planning Gain – Providing Infrastructure and Affordable Housing, Wiley Blackwell
- <sup>32</sup> Centre for Progressive Policy (2016), Bridging the infrastructure gap
- <sup>33</sup> Ibid
- <sup>34</sup> Institute for Fiscal Studies (Forthcoming), Property Value Uplift Tool
- <sup>35</sup> Greater London Authority (2018), Crossrail Business Rate Supplement 2018/9 ratepayer leaflet
- <sup>36</sup> Transport for London (2017), Land Value Capture
- <sup>37</sup> The Localism Act (2011)
- <sup>38</sup> National Infrastructure Commission (2017), Partnering for Prosperity, and Regulation 123 of the Community Infrastructure Levy Regulations 2010
- <sup>39</sup> Compulsory Purchase Association (2017), Annual Law Reform Lecture 2017 pre-event reading material, available at: <http://www.compulsorypurchaseassociation.org/cpa-law-reform-lecture-2017.html>



# 8. NEXT STEPS



**This is the Commission's first Assessment of the UK's economic infrastructure. Since its establishment, the Commission has been working to identify the key priorities for the nation's infrastructure, culminating in the recommendations set out in this Assessment. But the work does not stop here. These recommendations need to be implemented. Government, regulators, industry and others will all need to contribute to making this a reality. The Commission will report on progress in its Annual Monitoring Report. And the second Assessment, expected in around 5 years' time, will develop on these themes and identify future priorities for the UK's infrastructure.**

Over the coming months and years, the Commission will:

- seek consensus on its recommendations
- work with government to establish its recommendations as government policy
- monitor the implementation of the recommendations set out in the Assessment alongside those in its earlier studies
- carry out further work on some of the areas outlined in this Assessment, including housing, design and economic regulation
- begin work on the second National Infrastructure Assessment, expected around 2023.

## Consensus building

Too often in the past, a lack of political consensus has led to delays and extra costs in infrastructure. The Commission was established to provide independent advice and analysis and to move away from a position where the main promoters of infrastructure are either politicians or scheme developers, whose arguments, however well made, are often treated with scepticism. Ultimately, it is for government to decide on the Commission's recommendations. However, over the coming months, the Commission will endeavour to build consensus around its recommendations and engage across parties and with the public, policy makers, infrastructure experts and relevant bodies, as set out in its framework document.

As set out in the Executive summary, the Commission's remit extends to economic infrastructure within the UK government's competence, and will

evolve in line with devolution settlements. This means the Commission's recommendations will apply to non devolved UK government infrastructure responsibilities in Scotland, Wales and Northern Ireland (and all sectors in England). The Commission will continue to engage closely with devolved administrations and bodies under their jurisdictions as appropriate, particularly on matters where the respective infrastructure policy responsibilities of the UK government and devolved administrations interact.

## Government response

The Commission's framework document states that:

"The government will lay the [Commission's] reports before Parliament, and will respond to the [Commission's] national infrastructure assessment and specific studies. The government will respond as soon as practicable; it will endeavour to respond within 6 months, and not longer than a year. The response will set out clearly any further work required to take forward the recommendations. Recommendations the government agrees should be taken forward will become known as 'endorsed recommendations'. Where the government does not agree with a Commission recommendation, it may put forward an alternative proposal.

"Where the government is responsible for delivering endorsed recommendations, the government's endorsement will be a statement of government policy. Where recommendations have wider implications for the planning regimes, the government will highlight any further steps needed to confirm the endorsed recommendation as planning policy. The government will use the levers at its disposal to deliver endorsed recommendations – whether through spending, regulation, deregulation, market stimulation, or by setting strategic priorities for regulators as appropriate. In some cases, endorsed recommendations will not be directly taken forward by the government, but may be relevant for decisions made by other bodies such as economic regulators."

The Commission will provide support to government as it makes its decisions on the Assessment's recommendations, including as it prepares for the forthcoming Budget and Spending Review, to ensure that the analysis and conclusions in the Assessment are fully understood and any questions are answered accurately.

## Monitoring

The Commission has been established as a permanent, independent body, and so has a role in holding the government to account for implementing its recommendations, where they have been agreed. The Commission's framework document states that "the [Commission] will hold the government to account for delivering [Commission] recommendations that the government has endorsed and agreed to take forward."

The Commission will monitor the government's progress in delivering endorsed recommendations, and will comment on this in its Annual Monitoring Report.

Where the recommendations have implications for other bodies, such as economic regulators, the Commission will also comment on the progress made by the relevant bodies.

## Further work

The Commission has set out an ambitious set of recommendations in this Assessment. However, in some areas there is still further work to do. Alongside its study programme, which is currently focusing on the future of the UK's freight network, the Commission has identified the following priorities for further work:

- developing the Commission's work on the link between infrastructure and housing
- developing further the work of the design task force to champion design quality in the nation's infrastructure
- addressing the evolution of the regulatory framework and its adaptability to different models of utility service provision
- continuing development of the ideas generated by the Commission's 'Roads for the Future' innovation competition, which concludes in September
- continuing to develop the Commission's performance measures, both by filling gaps – including establishing measures linked to natural capital, design quality and resilience – and by progressively updating the measures set out in Chapter 6 as new approaches are developed or better data becomes available
- continuing work on cost benefit analysis, including developing alternative approaches where current methods perform less well
- developing the analytical framework for the performance evaluation of public private partnership projects.

The Commission also intends to work with a small number of urban authorities to explore how the national strategies set out in this Assessment could inform long term infrastructure planning for cities and city regions.

## The second National Infrastructure Assessment

The Commission publishes an Assessment once every five years. Work on the next Assessment will begin as soon as the first is published.

Given that this kind of cross-sector assessment has not been undertaken at a national level before in the UK, as a first step the Commission will carry out a 'lessons learnt' review shortly after the publication of the Assessment, informed by stakeholder views.

Drawing upon the outputs from this review, the Commission will prepare the process and methodology for the next iteration of the Assessment, on which it expects to engage with stakeholders before carrying out a public consultation. Alongside this, it will develop its evidence base and identify the key areas for further research and analysis.

An important priority will be to undertake more in-depth analysis of infrastructure resilience, as previously indicated in the Commission's Process and Methodology consultation.<sup>1</sup> In addition, a number of other areas have been identified, which the Commission will return to in its next Assessment, in the light of developing evidence and technology. They include: the future of heat, as set out in Chapter 2; a national transport strategy that considers the potential changes to travel patterns by road and rail as connected and autonomous vehicles become more widespread, discussed in Chapter 3; the use of data in improving the performance and planning of infrastructure as data is becoming part of infrastructure; surface water, building on the joint plans to manage surface water flood risk to be developed by local authorities and water companies, covered in Chapter 5; and paying for road use, where the Commission will explore new approaches to public engagement to identify options which are fair, sustainable and reduce the negative impacts of driving, covered in Chapter 7.

The second Assessment is expected to be published around 2023.

## Endnotes

<sup>1</sup> National Infrastructure Commission (2016), National Infrastructure Assessment: Process and methodology consultation

# Annex A: Glossary

Term	Meaning
<b>1. Building a digital society</b>	
4G	Fourth generation of mobile systems. 4G provides faster data speeds than previous generations.
5G	The fifth generation of wireless networks beyond 4G mobile networks. 5G is expected to deliver even faster data rates and better user experience, although international standards have not yet been set.
Anti-competitive behaviour	Strategies designed to limit and prevent fair competition, for example predatory pricing and collusion.
Augmented reality	Augmented reality is a technology that overlays computer generated enhancements on the real world.
Broadband	A type of high speed internet connection.
Capital costs or expenditure	Fixed one-time expenses that are incurred upfront, usually when paying for assets such as buildings, construction or equipment (ongoing costs are usually referred to as operational costs).
Clawback mechanism	A special contractual clause which allows money that has already been spent to be paid back under certain conditions.
Connected and autonomous vehicles (CAV)	Connected vehicles can communicate with their surrounding environment. Autonomous vehicles can operate with little or no human input (be driverless) for some, or all, of the journey. Connected and autonomous vehicles can do both.
Deregulation	Deregulation is the removal of regulation, usually with the aim of increasing competition and innovation.
Digital economy	The digital economy refers to the economic activity that is based around digital technologies.
Ducts	A tube or passageway to hold cables, usually underground.
Economic regulation	Economic regulation applies the principles of competitive markets to network industries to achieve greater efficiency and to move away from monopolistic outcomes.
Fair bet	This is a regulatory principle which recognises that an investing firm needs to benefit from sufficient upside potential from any investment to offset the downside risk of failure. The regulator should only impose regulation once a 'fair' return has been made.

Term	Meaning
Gigabit speeds	Download speeds above 1000 megabits per second. 1 gigabit is 1,000 megabits.
Megabits per second (Mbps)	A measure of the rate at which data can be transmitted. One megabit per second is 1 million bits per second (bps). One bit is a single binary digit: 1 or 0
Mobile coverage	The geographic area covered by mobile services.
Openreach	Openreach is the UK's telecoms incumbent network operator. It owns, operates and maintains the UK's main broadband and landline network.
Operating costs or expenditure	Day-to-day spending on running services and maintenance.
Reasonable cost threshold	A reasonable cost threshold is the cost limit at which government will subsidise up to. The costs above this threshold are not deemed reasonable or fair to impose upon taxpayers or billpayers.
Superfast broadband	Broadband services that deliver download speeds of at least 30 megabits per second (mbps).
Ubiquitous connectivity	Digital connectivity everywhere.
Virtual reality	Virtual reality (VR) is an artificial, computer-generated and immersive simulation usually through a headset.
WiFi	A wireless connection which allows devices to connect to the internet.

## 2. Low cost, low carbon

Balancing	The processes and systems required to balance supply with demand in the electricity system. A range of technologies can provide balancing services.
Biogas	A gas produced by breaking down organic matter in the absence of oxygen. This gas can be used in a similar manner to natural gas to produce heat or electricity but unlike natural gas, biogas from sustainable sources is a renewable fuel.
Biomass	A renewable fuel of organic material, such as wood, plants or other waste. Biomass can be burned directly or processed into biofuels such as ethanol and methane.
Black bag waste	Black bag waste is household items which cannot be recycled.
Capacity market	In the capacity market the government determines what level of system security is required for four years ahead and then commissions National Grid to calculate the amount of generating capacity that would deliver this. National Grid then runs an auction to procure this capacity at the lowest price.
Carbon capture and storage (CCS)	A process to capture, transport and store carbon dioxide emissions from fossil fuel use. It prevents the carbon dioxide from entering the atmosphere, usually by storing it underground.

Term	Meaning
Climate Change Act	The Climate Change Act, established in 2008, sets legally binding targets to reduce carbon dioxide emissions in the UK by at least 80% by 2050, from 1990 levels.
Decarbonisation	Decarbonisation refers to the removal or reduction of carbon dioxide (a greenhouse gas) from energy sources with the purpose of reducing the impact of climate change.
Deposit Return Scheme	Consumers pay a deposit for an item, such as a single use drink container, which is redeemed on return of the item.
Digestate	Digestate is the solid residue left over from anaerobic digestion which can be used as fertilizer.
Distribution of electricity	The lower voltage (as compared with the transmission of electricity), local, electricity network which is used to deliver electricity to most customers.
Electric vehicle	For the purposes of this report, 'electric vehicles' refers to fully electrified plug-in vehicles that run entirely from an electric battery that must be recharged. This is distinct from hybrid and plug in hybrid vehicles which have both a conventional and an electric motor.
Energy Performance Certificate level C	An Energy Performance Certificate is required for properties when constructed, sold or let. It provides details on the energy performance of the property and what can be done to improve it. The levels range from A-G, A is the most energy efficient whilst G is the least energy efficient.
Energy system	The energy system is the combination and interaction of supply and demand for energy. Energy is used for a range of different activities, such as: transport, heating and powering homes and in industrial processes. Energy is created from a variety of sources including renewables, fossil fuels and nuclear.
Fossil fuel	Fossil fuels are hydrocarbons formed in the earth from biological origin such as coal, oil and natural gas. They are non-renewable and produce greenhouse gases when burnt for energy which cause global warming.
Gasification	Gasification is a process of converting biomass and waste into fuel. It uses little or no oxygen to convert carbon-based materials into synthetic gas which can be used to generate electricity or in place of natural gas.
Greenhouse gas emissions	Greenhouse gases trap heat in the atmosphere which leads to global warming and climate change. Carbon dioxide is the most prevalent of the greenhouse gases and is emitted from activities such as burning fossil fuels.
MW, GW, TW	A watt is a unit of power, which quantifies the rate of energy transfer. A megawatt (MW) is 1,000,000 watts, a gigawatt (GW) is 1,000 megawatts and a terawatt (TW) is 1,000 gigawatts.

Term	Meaning
MWh, GWh, TWh	A watt hour is a measure of energy. It is equal to the total energy delivered by a rate of energy transfer of one watt, provided for one hour. A megawatt hour (MWh) is 1,000,000 watt hours. A gigawatt hour is 1,000 MWh and a terawatt hour is 1,000 gigawatt hours (GWh).
Incinerators	Facilities in which waste is burned in a controlled fashion, either to reduce its volume or its toxicity. Energy from waste plants use incineration of waste to generate electricity, and in some cases heat for domestic or industrial heating.
Interconnector	Electricity interconnectors are physical links which allow the transfer of electricity across country borders. Britain's electricity market currently has links with France, the Netherlands, Northern Ireland and the Republic of Ireland.
Landfill	Area of land where waste is disposed of, either on top or buried.
Load factors	The load factor is the ratio of total energy used in a period to the maximum possible energy use in that period.
Natural gas	Natural gas is a fossil fuel used as a source of energy for heating, cooking, and electricity generation. It is mainly composed of methane, which burns to give carbon dioxide and water vapour.
Nuclear power plant	Power plants make electricity. A nuclear power plant does this through nuclear reactions relying upon uranium (a non-renewable energy source). Nuclear power plants do not emit greenhouse gases but they do produce radioactive waste.
PET	PET (polyethylene terephthalate) is a very common plastic widely used for packaging food and drinks.
Power generation	Power generation refers to the creation of electricity.
Power station	A power station is where electricity is generated.
PVC	PVC (polyvinyl chloride) is a very common plastic used in packaging.
Pyrolysis	The burning of waste in a controlled (oxygen-depleted) environment to generate a combustible gas (syngas).
Recycling	The process of converting waste into reusable material.
Renewable energy	Renewable energy is generated from natural resources, such as sunshine and wind.
Small modular reactor	Small modular reactors generate electricity by a nuclear reaction. These reactors are smaller than conventional nuclear reactors, with power outputs of around 300 MW compared to around 1000 MW or more. No small modular reactors are currently in commercial operation.
Tidal lagoon	A tidal lagoon is a power station which generates tidal power. It is an enclosed area of coastline with a high tidal range which drives turbines and generates electricity.

Term	Meaning
Tidal power	Tidal power is the production of electricity using the ocean's tide. It is a renewable and predictable source of energy.
Transmission of electricity	The high voltage electricity network, used to move electricity long distances across the country.
Wholesale market	Great Britain has a liberalised electricity wholesale market where prices are not set by a regulator. The wholesale market is where retail suppliers, traders and large consumers purchase energy in bulk from those that generate energy.

### 3. Revolutionising road transport

Centre for Connected and Autonomous Vehicles (CCAV)	The organisation which works across government to support the market for connected and autonomous vehicles.
Charge point	A charge point is the infrastructure which supplies the electricity to recharge electric vehicles.
Control Period 6/7	Network Rail, which owns and operates the railway infrastructure in England, Wales and Scotland, has 5-year 'control periods' to decide investment priorities. Control Period 6 and 7 refer to the periods 2019/20-2023/24 and 2024/25-2028/29 respectively.
Freight	Freight is the term used to define the transportation of goods rather than people.
Hybrid vehicle	A hybrid vehicle is one which uses two different energy sources, such as petrol or diesel with electricity.
Internal combustion engine vehicle	An internal combustion engine vehicle is a conventional vehicle which runs by burning a fuel, usually petrol or diesel, inside the engine.
Interoperable	Interoperability refers to the ability of a product or system to operate with other products or systems without any restrictions.
National Grid	A British multinational electricity and gas utility company whose operations include owning and operating electricity transmission network assets and part of the national gas grid
Rapid chargers	Rapid charge points, of 43kW or above, can charge an electric vehicle battery in 20-30 minutes. Some 'fast' chargers, of 22kW, can charge current models of electric vehicle in about an hour.
Road investment strategy (RIS)	The government's investment plans for 5 year periods for the Strategic Road Network of 4,400 miles of motorways and major 'A' roads managed by Highways England. Road investment strategy 1 covers 2015/16-2019/20; Road investment strategy 2 will cover 2020/21 to 2024/25.

Term	Meaning
S-shaped diffusion curve	The diffusion of an innovation is said to follow an S-shaped curve. This involves three phases: slow initial uptake by a few early adopters; uptake rapidly increases as the innovation gains popularity and finally; uptake slows down and levels off as the innovation reaches maturity.
Vehicle to grid	Vehicle to grid systems involve electric vehicles returning power, stored in car batteries, to the electricity grid at peak times.
<b>4. Transport and housing for thriving city-regions</b>	
Brownfield	Brownfield land refers to urban sites that have had previous developments on them but are now vacant, derelict or contaminated.
City	Cities are large urban areas. There is no single definition in use in the UK. Generally, the Assessment uses the 'primary urban area' definition originally established for the State of the English Cities report. Under this definition, there are 63 cities in the UK. This equates to cities with a population of around 110,000 or larger. 'Major cities' refers to the largest UK cities, with a population of around 500,000 or larger (Birmingham, Bristol, Glasgow, Liverpool, Leeds, London, Manchester, Newcastle, Nottingham and Sheffield on a primary urban area definition). However, note that in figure 5.3, the definition of major cities relies on Office for National Statistics rural-urban classification data for 'major' and 'minor' conurbations, which excludes Bristol.
Combined authority	Combined authorities are corporate bodies formed of two or more local government areas.
County council	Many areas in England have two tiers of local government: (1) county councils and (2) district, borough or city councils. County councils cover the whole county and are responsible for services which include transport, education and social care.
Crossrail	Crossrail, also known as the Elizabeth Line, is a new railway running for more than 60 miles from Reading and Heathrow in the west, underneath London and out to Shenfield and Abbey Wood in the east. Crossrail is expected to open at the end of 2018.
Crossrail 2	Crossrail 2 is a proposed new rail line which would run from the south-west to the north-east of London. Construction is expected to start in the early 2020s with the line opening in the early 2030s.
District council	Many areas in England have two tiers of local government: (1) county councils and (2) district, borough or city councils. District councils cover areas within county councils and are responsible for services which include housing and planning applications.
Dockless cycle	Dockless cycle is a service in which bikes can be located, hired and unlocked using a smartphone app and does not require a docking station.
Highways England	The publicly owned organisation which operates, maintains and improves England's 4,400 miles of motorways and major A roads.

Term	Meaning
HS2	High Speed 2 is a planned new high-speed rail network linking London, the West Midlands, Leeds and Manchester. The project is expected to be completed by 2033.
Integrated development plan	A single plan for urban development covering transport, housing and related infrastructure.
Interurban transport	Transport between cities.
Mayoral combined authority	Mayoral combined authorities are corporate bodies formed of two or more local government areas with an elected mayor. There are currently 7 mayoral combined authorities in the UK.
Metro mayor	A metro mayor is a person elected to chair a combined authority with powers to make decisions across the whole city region. There are currently 7 metro mayors in the UK.
Network Rail	Network Rail is the publicly owned organisation which owns and operates the railway infrastructure in England, Wales and Scotland.
Northern Powerhouse Rail	Northern Powerhouse Rail, also known as High Speed 3 (HS3) or Crossrail for the North, is a proposed strategic rail programme to connect the major cities in the North of England.
Transport for London (TfL)	Transport for London is the authority responsible for the transport system in London.
Unitary authority	In some parts of the country, one tier of local government provides all the local services, these are known as unitary authorities.
Urban transport	Transport within cities.

## 5. Reducing the risks of drought and flooding

Catchment Flood Management Plans	Catchment Flood Management Plans assess all types of inland flooding from rivers, groundwater, surface water and tidal flooding. Their purpose is to help the Environment Agency and their partners to plan and agree the most effective way to manage flood risk.
Common Agricultural Policy	The Common Agricultural Policy is a European Union system of subsidies and support programmes for agriculture.
Desalination	Desalination is the process of removing salt and other minerals from water.
Drainage and Wastewater Management Plans	Drainage and Wastewater Management Plans are long term plans for drainage and wastewater services. The framework for developing these plans is currently being defined by the 21st Century Drainage Programme.

Term	Meaning
Drought	<p>Drought is defined for this report as a period of such low rainfall that companies have to impose restrictions on households' water supply, by providing water only at certain times of the day or through temporary taps (standpipes) in the streets. The likelihood of a drought occurring is measured by its annual probability. Typically, the lower the chance of a drought occurring, the worse the drought is likely to be. The probabilities mentioned in this report are:</p> <p>1 per cent annual probability: approximately a 1 in 4 chance of drought by 2050; this is used as a proxy for the worst recorded drought in recent history</p> <p>0.5 per cent annual probability: approximately a 1 in 7 chance of drought by 2050</p> <p>0.2 per cent annual probability: approximately a 1 in 17 chance of drought by 2050.</p>
Grey / green infrastructure	Grey infrastructure refers to man-made, constructed assets such as pipes, sewers and dams. Green infrastructure makes use of natural processes to provide infrastructure services, such as wetlands, which can provide flood resilience and wider benefits such as enhancing biodiversity.
Managed retreat	Managed retreat is also known as coastal or defence realignment. It refers to the controlled flooding of a defined area to manage the risk of flooding or coastal erosion in the wider area.
Megalitre per day (Ml/day)	One Megalitre is equal to 1000 cubic metres or 1 million litres.
National water network	Coordinated and strategic transfers to move water between water companies and regions based on their needs.
Price Review	The process undertaken every five years by Ofwat to determine water company price controls for the next five years.
Shoreline Management Plans	Shoreline Management Plans identify the most sustainable approach to managing the flood and coastal erosion risks to the coastline looking up to 100 years ahead.
Surface water	Surface water is rain water that collects on the earth's surface. Surface water flooding occurs when intense rainfall overwhelms the capacity of local drainage systems.
Waste water	Water that has been affected by human use such as flushing and washing.
Water supply	The source, means and process of supplying water for people to use.
Water transfer	Water transfers involve water supply infrastructure to move water from one place to another. They can be made of man-made structures such as pipes and canals or a combination of such structures with rivers or other existing water courses.

Term	Meaning
<b>6. Choosing and designing infrastructure</b>	
Artificial intelligence	The development of machines that can perform tasks normally requiring human intelligence.
Digital twin	A digital model of infrastructure which will be able both to monitor infrastructure in real-time and to simulate the impacts of possible events such as a natural disaster or a new train line.
Hybrid bill	A hybrid bill is a set of proposals for introducing new laws, or changing existing ones. They are generally used to secure powers to construct and operate major infrastructure projects of national importance. Hybrid bills address both public and private matters.
Infrastructure and Projects Authority	The IPA is the government body responsible for supporting the delivery of infrastructure and other major projects, reporting to Cabinet Office and HM Treasury.
Infrastructure Client Group	The Infrastructure Client Group supports the development and exchange of best practice to improve the efficiency of the construction sector and help deliver major cost savings. It is made up of government and industry representatives from the major infrastructure clients.
National Policy Statements	National Policy Statements were established under the Planning Act 2008. They set out national policy for a sector in one place and are intended to provide greater clarity and certainty for the planning process to deliver Nationally Significant Infrastructure Projects.
Nationally Significant Infrastructure Projects	Nationally Significant Infrastructure Projects are large scale developments relating to energy, transport, water, or waste. They require only a single type of planning consent, known as a Development Consent Order, which is designed to be a much quicker process than applying for several individual planning consents separately. This was established under the Planning Act 2008 and amended by the Localism Act 2011.
Natural capital	Natural capital is the 'stock' of natural assets. These include: waters, land, air, species, minerals and oceans
Resilience	The United Nations defines resilience as the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner.
What Works Centre for Local Economic Growth	The What Works Centre for Local Economic Growth was set up in 2013 to analyse which policies are most effective in supporting and increasing local economic growth. It is an independent organisation funded by the Economic and Social Research Council and government.

Term	Meaning
<b>7. Funding and financing</b>	
Capital Gains Tax	Capital Gains Tax is a tax on the profit of the sale of an asset that has increased in value.
Capital markets	The part of the financial system involved in raising long term financing to support investment. It involves the issue and trading of equity (company shares), debt (corporate and government bonds), and other long term financial instruments.
Community Infrastructure Levy (CIL)	A fixed charge based on the development of new floor space. The money can be used to fund infrastructure that is needed as a result of development. It came into force in April 2010.
Economic infrastructure	Economic infrastructure refers to assets which facilitate economic activity such as: transport, energy, digital communications, water supply, waste management and flood risk management.
European Investment Bank (EIB)	The European Investment Bank is the European Union's bank for providing finance and expertise for sustainable investment projects that contribute to EU policy objectives.
Fuel duty	Fuel duty is a tax on petrol, diesel and other fuels used in vehicles or for heating.
Green Investment Bank (GIB)	The UK Green Investment Bank (now the Green Investment Group) was publicly owned, but is now an independent organisation owned by Macquarie Group Limited. The GIB was established in 2010 to increase the UK's ability to meet its environmental targets and commitments by getting green infrastructure projects financed more quickly than would otherwise have been the case.
Housing Infrastructure Fund	The Housing Infrastructure Fund is a government capital grant programme to help unlock new homes in areas with the greatest housing demand. The fund is £5 billion and funds the local infrastructure necessary before homes can be built.
Localism Act 2011	An Act of Parliament which amended powers for local authorities, including housing and planning.
Pooling restrictions	Limits on the number of number of Section 106 agreements which can be used to fund projects or types of infrastructure. According to Regulation 123 of the Community Infrastructure Levy regulations, they must be five or fewer.
Precept	A precept is an additional levy within Council Tax

Term	Meaning
Private finance Initiative (PFI)	The Private finance initiative is a method for the private sector to finance public infrastructure. In the UK, the original private finance initiative has been replaced by 'Private Finance 2'. The private partners invest equity, and take on significant levels of borrowing to finance the upfront costs of infrastructure projects. The project is then leased back to the relevant government body which makes regular payments to the project company, typically over 25 years. More generically, the term 'public private partnership' is used to cover a range of cooperative arrangements between public and private sector bodies, including private finance initiative type arrangements.
Risk-adjusted interest rates	The risk-adjusted interest rate refers to the rate of interest on debt financing that is adjusted to reflect project specific risks, adding a premium to the cost of debt financing.
Section 106 agreements	Legal agreements between local authorities and developers to mitigate the impact of new developments through contributions towards site-specific infrastructure, including affordable housing. They arise from section 106 of the Town and Country Planning Act 1990.
Spending Review 2019	Spending Reviews set out the government's spending plans. The next Spending Review will take place in 2019.
Stamp Duty	Stamp Duty is a tax paid when purchasing a property. It is calculated based on the purchase price of the property.
Whole life cost	The whole life cost is the amount that a product or service costs over its lifetime. It includes the initial capital cost, the costs to run, maintain, repair and upgrade, as well as the eventual disposal costs.

# Annex B: Acknowledgements

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The Commission is grateful to everyone who has engaged with the National Infrastructure Assessment process. The list below sets out organisations that have engaged with the Commission since publication of its interim report *Congestion, Capacity, Carbon: Priorities for National Infrastructure* through at least one of the following means:

- submitting consultation responses to the interim report
- participating in roundtables
- attending meetings with members of the Commission Secretariat.

Former Commissioners Lord Adonis, Demis Hassabis, Lord Heseltine and Sir Paul Ruddock were all members of the Commission at earlier stages of the Assessment process and contributed to it throughout their tenure.

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## Organisations engaged

360 Environmental  
 ABB Group  
 Adaptation Sub-Committee of the Committee on Climate Change  
 Adelard LLP  
 AECOM  
 Affinity Water  
 Air Broadband  
 Airport Operators Association  
 Alan Turing Institute  
 Allerdale Borough Council  
 Allen & Overy  
 Amey  
 Anaerobic Digestion and Bioresources Association  
 Anglian Central Regional Flood & Coastal Committee  
 Anglian Water  
 Anthesis Group  
 Arqiva  
 Arriva  
 Ascential  
 Asian Infrastructure Investment Bank  
 Association for Consultancy and Engineering  
 Association for Decentralised Energy  
 Association for Project Management  
 Association for the Conservation of Energy  
 Association of British Insurers  
 Association of Directors of Environment, Economy, Planning and Transport  
 Atkins  
 Atlantic Gateway  
 Atlantic SuperConnection LLP  
 Aurora Energy Research  
 Aviva  
 BAI Communications  
 Bath and North East Somerset Council  
 Biffa  
 Biofuelwatch  
 Birmingham City Council  
 Bit Commons  
 Blueprint for Water  
 Borough of Poole  
 Bournemouth Borough Council  
 BPP Consulting  
 Bright Blue  
 Bristol City Council  
 British Broadcasting Corporation  
 British Ceramic Confederation  
 British Chambers of Commerce  
 British Glass  
 British Motorcyclists Federation (Enterprises) Limited  
 British Plastics Federation  
 British Ports Association  
 British Property Federation  
 British Retail Consortium  
 British Standards Institute  
 British Telecom  
 Broadband for the Rural North Ltd  
 Broadband Stakeholder Group  
 Brownsholme Hall  
 Buckinghamshire Thames Valley Local Enterprise Partnership  
 Building Research Establishment  
 Business in the Community  
 Cabinet Office  
 Cadent Gas  
 Cambridge Centre for Smart Infrastructure and Construction  
 Cambridge Econometrics  
 Campaign for Better Transport  
 Campaign to Protect Rural England  
 Campbell Lutyens

Carbon Capture and Storage Association  
Carbon Connect  
Carbon Trust  
Cardiff Council  
Central Bedfordshire Council  
Centre for Cities  
Centre for Progressive Policy  
Centre for Transport Studies, Imperial College London  
Centre for Urban and Regional Development Studies, Newcastle University  
Chargemaster  
Chartered Institute of Highways and Transportation  
Chartered Institute of Housing  
Chartered Institute of Transport and Logistics  
Chartered Institution of Building Services Engineers  
Chartered Institution of Civil Engineering Surveyors  
Chartered Institution of Wastes Management  
Chartered Institution of Water and Environmental Management  
Chatham House  
Cheshire and Warrington Local Enterprise Partnership  
Cheung Kong Hutchison Holdings  
Cisco  
City and Financial Global  
City of Bradford Metropolitan District Council  
CityFibre  
Clarion Housing Group  
Climate Genocide Act Now  
Coca-Cola  
Commission on Travel Demand  
Committee on Climate Change  
Committee on Fuel Poverty  
Common Futures Network  
Community Futures  
Community R4C  
Compulsory Purchase Association  
Confederation of British Industry  
Confederation of Paper Industries  
Confederation of Passenger Transport UK  
Connect Plus  
Constructing Excellence in Wales  
Construction Industry Research and Information Association  
Consumer Council for Water  
Core Cities  
Cornwall and Isles of Scilly Local Enterprise Partnership  
Cornwall Council  
Cory Riverside Energy  
Country Land & Business Association  
Crossrail 2  
Cumbria County Council  
David Lock Associates  
db symmetry  
Deloitte  
Design Commission for Wales  
Design Council  
Digital Lancashire  
Dorset Local Enterprise Partnership  
Drax Group plc  
Drinking Water Inspectorate  
E.ON UK plc  
E3G  
East Northants District Council  
Eden Council  
EDF Energy  
EE Limited  
EEF Limited  
Electric Infrastructure Security Council  
Electricity North West  
Element Energy

ELEXON  
Ellen MacArthur Foundation  
Ely Group of Internal Drainage Boards  
ENCORE+  
Energy & Utilities Alliance  
Energy Agency  
Energy Insight Limited  
Energy Networks Association Limited  
Energy Systems Catapult  
Energy Technologies Institute  
Energy UK  
EngineeringUK  
Environment Agency  
Environmental Change Institute  
University of Oxford  
Environmental Services Association  
Essex and Suffolk Water  
Essex County Council  
Eunomia  
European Bank for Reconstruction and Development  
European Commission  
European Investment Bank  
European PPP Expertise Centre  
Existing Homes Alliance Scotland  
FCC Environment  
Federation of Master Builders  
FirstGroup plc  
Fitch Ratings  
Flood Hazard Research Centre  
Middlesex University  
Flood Re  
Flood Limited  
Food and Drink Federation  
Ford  
Francis Taylor Building  
Freight on Rail  
Freight Transport Association  
Freightliner Group Limited  
Friends of the Earth England, Wales and Northern Ireland  
Frontier Economics  
FTTH Council  
Funding Group for River Thames Flood Alleviation Scheme  
Future Cities Catapult  
GB Railfreight Limited  
Geovation  
Gigaclear  
Global Change Institute  
Global Infrastructure Hub  
Global Infrastructure Investor Association  
Gloucestershire County Council  
Go-Ahead  
Greater London Authority  
Greater Manchester Combined Authority  
Green Alliance  
Green Investment Group  
Greenpeace  
Greenwood Consultants  
Hafren Power Limited  
Halcyon Tidal Power LLC  
Hampshire & Isle of Wight Wildlife Trust  
Hampshire County Council  
Hastoe Housing Association and Sustainable Homes Limited  
Health and Safety Executive  
Heart of the South West Local Enterprise Partnership  
High Speed Rail Industry Leaders  
Highways England  
Historic England  
Home Builders Federation  
Homes England  
Horizon Nuclear Power  
HR Wallingford  
HS2 Limited

Hull City Council  
Hutchison 3G UK Limited  
Hyperoptic  
ifibre  
Imperial College London  
INCPEN  
Independent Networks Cooperative Association  
Infrastructure Ontario  
Infrastructure Operators Adaptation Forum  
Infrastructure Transitions Research Consortium  
InLinkUK  
Innovate UK  
INRIX  
Institute for Fiscal Studies  
Institute for Government  
Institute for Public Policy Research  
Institute for Transport Studies  
Institute of Asset Management  
Institution of Engineering and Technology  
Institution of Civil Engineers  
Integrated Transport Planning  
International Monetary Fund  
Ipsos MORI  
ITS Technology Group  
Jacobs Engineering Group Inc.  
Jaguar Land Rover  
JBA Consulting  
Kent County Council  
Kettering Borough Council  
Kilbride Rail  
Kingspan Insulation Limited  
KPMG  
Laing O'Rourke  
Lancashire Care NHS Foundation Trust  
Lancashire County Council  
Lancaster & District Chamber of Commerce  
Lancaster City Council  
Lancaster University  
Legal & General  
Leicester City Council  
Lincolnshire County Council  
Liverpool City Region Combined Authority  
Living PlanIT  
Lloyds Register Foundation  
Local Authority Recycling Advisory Committee  
Local Government Association  
Local Government Association Coastal Special Interests Group  
Local Government Flood Forum  
Local Government Technical Advisers Group  
London and Quadrant Housing Trust  
London Councils  
London School of Economics and Political Science  
Long Term Infrastructure Investors Association  
Longbay Seapower Limited  
Low Carbon Contracts Company  
Luton Borough Council  
M&G Investments  
Mace  
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Manchester Airports Group  
Markides Associates  
Marks and Spencer  
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Mayor of Greater Manchester  
Mayor of Liverpool City Region  
Mayor of London  
Mayor of the Tees Valley

Mayor of the West Midlands  
Mayor of the West of England  
Merseytravel  
Met Office  
Metronet UK (now M24Seven)  
Middlesex University  
Midlands Connect  
Milton Keynes Council  
Mineral Products Association  
Mineral Wool Insulation Manufacturers Association  
Ministry for the Economy and Finances (France)  
Ministry of Transport & Communications (Norway)  
Mitsubishi UFJ Financial Group  
Mobile UK  
Motorcycle Industry Association  
Mott MacDonald  
MWH Global  
National Association of Waste Disposal Officers  
National Audit Office  
National Energy Action  
National Farmers Union  
National Flood Forum  
National Grid  
National Infrastructure Planning Association  
National League of Cities  
National Nuclear Laboratory  
Natural Capital Committee  
Natural Energy Wyre  
Natural England  
NERA Economic Consulting  
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Network Rail  
New Civil Engineer  
Newcastle City Council  
Newcastle University  
Nexus  
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North East Combined Authority  
North West Business Leadership Team  
Northamptonshire County Council  
Northern Gas Networks  
Northern Ireland Executive  
Northern Ireland Fuel Poverty Coalition  
Northumberland County Council  
Northumbrian Water  
Norton Rose Fulbright  
Nottingham City Council  
Nuclear Industry Association  
O2  
Ofcom  
Office of Road and Rail  
Ofgem  
Ofwat  
Old Oak and Park Royal Development Corporation  
OMEGA Centre  
Openreach  
Orbit Group Limited  
Ordnance Survey  
Organisation for Economic Co-operation and Development  
Ørsted  
Packaging Federation  
Peabody  
Peel Energy  
Peel Land and Property  
Pegasus Group  
Pennon Group  
Pensions Infrastructure Platform  
Pinsent Masons  
Pipe Jacking Association  
Plymouth City Council  
Policy Connect  
Policy Exchange

Pöyry  
Prism Consulting Group LLC  
Proctor and Gamble  
Prospective  
RAC Foundation  
RAC  
Radioactive Waste Management  
Rail Delivery Group  
Rail Freight Group  
Railway Industry Association  
Recycling Technologies  
Regulatory Economics  
Renewable Energy Association  
Resource and Waste Solutions Partnership  
Resource Futures  
Resources and Waste UK  
Ricardo  
Risk Management Solutions  
Road Haulage Association Limited  
Rod Rainey & Associates Limited  
Rolls Royce  
Royal Academy of Engineering  
Royal Institution of British Architects  
Royal Institution of Chartered Surveyors  
Royal Society  
Royal Society for the Protection of Birds  
Royal Town Planning Institute  
RWE Generation UK  
SAID Business School  
Savills plc  
Sayers and Partners  
Scottish and Southern Energy Enterprise  
Scottish Association for Public Transport  
Scottish Carbon Capture & Storage  
Scottish Environment Protection Agency  
Scottish Federation of Housing Associations  
Scottish Futures Trust  
Scottish Government  
Scottish Power  
Severn Trent Water  
SGN  
Sheffield City Region  
Shropshire Council  
Siemens  
Skanska  
Sky  
Smarter Cambridge Transport  
Society of Motor Manufacturers and Traders  
South East England Councils  
South East Essex Action Group Alliance  
South East Water  
South Gloucestershire Council  
South West Water  
South Yorkshire Passenger Transport Executive  
Southern Water  
SSE  
Stagecoach  
Steer Davies Gleave  
SUEZ UK  
Surrey County Council  
Sustainable Energy Association  
Sustrans  
Sweco  
Swindon Borough Council  
Tactis  
TalkTalk  
Tantalum Corporation  
Tarmac  
Taylor Wimpey  
Tech UK  
Technical University Bergakademie Freiberg  
Tees Valley Combined Authority  
Teesside Collective  
Tesco

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Thames Water	University of Glasgow
The Infrastructure Forum	University of Hull
The Law Society of England and Wales	University of Leeds
The Society for Poole	University of Manchester
Three	University of Northampton
Tidal Lagoon	University of Oxford
Tolvik Consulting	University of Sheffield
Town and Country Planning Association	University of Sussex Science Policy Research Unit
Trades Union Congress	Urban Transport Group
Transition Town Brixton	Urban Water Cycle Solutions
Transport for Greater Manchester	Urbed
Transport for London	Urenco
Transport for the North	Valpak
Transport for West Midlands	Vattenfall
Transport Research Laboratory	Veolia
Transport Systems Catapult	Virgin Media
TravelWatch NorthWest	Viridor
Trees and Design Action Group	Vivid Economics
Turner & Townsend	Vodafone
UCL Institute for Innovation and Public Purpose	Waste and Resources Action Programme
UK Broadband Limited	Water Resources East
UK Collaboratorium for Research on Infrastructure and Cities	Water Resources in the South East
UK Energy Research Centre	Water UK
UK Green Building Council	Waterscan
UK Power Networks	Waterwise
UK Rainwater Management Association	Welsh Government
UK Regulators Network	West of England Combined Authority
UK Water Industry Research	West Yorkshire Combined Authority
Unilever	Westinghouse Electric Company LLC
Uniper SE	Westminster Energy Environment & Transport Forum
United Kingdom Onshore Oil and Gas	Westminster Energy Forum
United Kingdom Without Incineration Network	Wheels for Wellbeing
United Utilities	Wildfowl & Wetlands Trust
University College London	Wildlife and Countryside Link
University of Cambridge	Wiltshire Council
University of Edinburgh	Wood Plc
University of Exeter Energy Policy Group	Woodland Trust

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WSP Global

WWF

Yorkshire Water

Zero Carbon Futures

ZTE Corporation

# Annex C: Supplementary documents

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The Commission has produced or commissioned the reports listed below as part of the analysis supporting the National Infrastructure Assessment. All reports are available on the Commission's website or will be when published.

## National Infrastructure Commission reports

National Infrastructure Assessment impact and costings notes, July 2018

Technical annex: Analysis of drought resilience, July 2018

Technical annex: Flood modelling, July 2018

Technical annex: Energy and fuel bills today and in 2050, July 2018

Technical annex: Tidal power, July 2018

Technical annex: Power system effects of electric vehicles, July 2018

Technical annex: Proposed analytical framework for evaluating the performance of private financing and traditional procurement, July 2018

Preparing for a drier future: England's water infrastructure needs, April 2018

Congestion, Capacity, Carbon – Priorities for National Infrastructure, October 2017

    Congestion, Capacity, Carbon – Modelling annex, October 2017

    Congestion, Capacity, Carbon – Modelling annex data, October 2017

The impact of the environment and climate change on future infrastructure supply and demand, June 2017

Economic growth and demand for infrastructure services, March 2017

The impact of population change and demography on future infrastructure demand, December 2016

The impact of technological change on future infrastructure supply and demand, December 2016

National Infrastructure Assessment: Call for evidence, October 2016

The National Infrastructure Assessment process and methodology: Consultation response, October 2016

Annex: Responses to National Infrastructure Assessment process and methodology consultation overview, October 2016

National Infrastructure Assessment process and methodology: a consultation, May 2016

## Reports commissioned for the Assessment

Institute for Fiscal Studies (forthcoming), Property Value Uplift Tool

Arup (July 2018), Congestion, Capacity, Carbon: priorities for national infrastructure, report on consultation responses

Ipsos MORI (July 2018), National Infrastructure Commission phase 2: public research

Anthesis Consulting (July 2018), Waste infrastructure analysis for England

Atkins (July 2018), Analysis of the costs of emergency response options during a drought

Aurora Energy Research (July 2018), Power sector modelling: system cost impact of renewables

Energy Systems Catapult (July 2018), Electric vehicle charging cost analysis

Economia (July 2018), Comparative study of national infrastructure financing institutions

Gibbons and Graham (July 2018), National Infrastructure Commission urban capacity economic analysis.

JBA Consulting (July 2018), Flood standards of protection and risk management activities

Lomax and Smith (July 2018), Effect of capacity constraints on population and employment distribution

Prospective (July 2018), Transport connectivity

Publica (July 2018), Design Task Force, Design and Infrastructure – Sector review of attitudes

Publica (July 2018), Design Task Force, Developing design principles for national infrastructure

Regulatory Economics (July 2018), Analysis of the costs of water resource management options to enhance drought resilience

Steer Davies Gleave (July 2018), Urban transport network review

Expedition Engineering and Marko&Placemakers (July 2018), Design Task Force, The value of design in infrastructure delivery

Vivid Economics (July 2018), The role and impact of the EIB and GIB on UK infrastructure investment

Element Energy (May 2018), Cost analysis of future heat infrastructure options

Arup and University College London (December 2017), Infrastructure and digital systems resilience, literature review

Arup and University College London (December 2017), Infrastructure and digital systems resilience

Frontier Economics (December 2017), Future benefits of broadband networks

Tactis and Prism Business Consulting (December 2017), Costs for digital communications infrastructures

Simpson and Ives (November 2017), Scenarios of future water availability in the UK

BritainThinks (October 2017), National Infrastructure Commission report from citizen research

Arup (October 2017), International infrastructure governance report

Cambridge Economic Policy Associates (October 2017), Financing for infrastructure summary report

Cambridge Economic Policy Associates (October 2017), Review of the UK infrastructure financing market

Cambridge Economic Policy Associates (October 2017), UK infrastructure pipeline analysis

JBA Consulting, SDG Economic Development, Temple and GreySky (October 2017), National Infrastructure Commission, performance measures

International Transport Forum (March 2017), Strategic infrastructure planning; international best practice

# Annex D: Recommendations

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## 1. Building a digital society

The Commission recommends that government should set out a nationwide full fibre connectivity plan by spring 2019, including proposals for connecting rural and remote communities. This should ensure that full fibre connectivity is available to 15 million homes and businesses by 2025, 25 million by 2030 with full coverage by 2033. To achieve these targets:

- Ofcom should promote network competition to drive the commercial rollout of full fibre, by deregulating where competition is effective and guaranteeing a fair bet on risky investments before regulating any uncompetitive areas.
- Government should part subsidise rollout to rural and remote communities, beginning by 2020, starting with the hardest to reach areas and community self-build.
- Government and Ofcom should allow for copper switch-off by 2025.
- Government and Ofcom should take action to cut the cost of full fibre deployment including:
  - Government should ensure the processes for obtaining wayleaves and connecting new builds are the same for digital infrastructure as other utilities by 2019.
  - Local government should designate ‘digital champions’ to improve telecoms processes such as street work permissions and access to publicly owned assets.
  - Ofcom should monitor the accessibility of Openreach’s duct and pole infrastructure by levels of usage.

## 2. Low cost, low carbon

The Commission recommends that government should set out a pipeline of pot 1 Contracts for Difference auctions, to deliver at least 50 per cent renewable generation by 2030, as part of the transition to a highly renewable generation mix. Government should:

- Move technologies that have recently become cost competitive, such as offshore wind, to pot 1 following the next Contracts for Difference auction in Spring 2019. Pot 1 should be used for the overwhelming majority of the increase in renewable capacity required.

- Publish indicative auction dates and budgets for the next decade by 2020.
- Over time take whole systems costs into account in Contracts for Difference auctions, as far as possible.
- Consider whether there is a case for a small-scale, pot 2 auction in the 2020s, if there are technologies which are serious contenders for future pot 1 auctions.
- Not agree support for more than one nuclear power station beyond Hinkley Point C, before 2025.

The Commission recommends that government needs to make progress towards zero carbon heat:

- Establishing the safety case for using hydrogen as a replacement for natural gas, followed by trialling hydrogen at community scale by 2021.
- Subject to the success of community trials, launching a trial to supply hydrogen to at least 10,000 homes by 2023, including hydrogen production with carbon capture and storage.
- By 2021, government should establish an up to date evidence base on the performance of heat pumps within the UK building stock and the scope for future reductions in the cost of installation.
- Set a target for the rate of installations of energy efficiency measures in the building stock of 21,000 measures a week by 2020, maintained at this level until a decision on future heat infrastructure is taken. Policies to deliver this should include:
  - Allocating £3.8 billion between now and 2030 to deliver energy efficiency improvements in social housing.
  - Government continuing to trial innovative approaches for driving energy efficiency within the owner occupier market.
  - Government setting out, by the end of 2018, how regulations in the private rented sector will be tightened and enforced over time.

The Commission recommends that government should set a target for recycling 65 per cent of municipal waste and 75 per cent of plastic packaging by 2030. Government should set individual targets for all local authorities and provide financial support for transitional costs. The government should establish:

- Separate food waste collection for households and businesses (to enable production of biogas) by 2025.
- Clear two symbol labelling (recyclable or not recyclable) across the UK by 2022.
- A consistent national standard of recycling for households and businesses by 2025.

- Restrictions on the use of hard-to-recycle plastic packaging (PVC and polystyrene) by 2025.
- Incentives to reduce packaging and for product design that is more easily recyclable by 2022.
- A common data reporting framework for businesses handling commercial and industrial waste by the end of 2019, ideally through voluntary reporting but if necessary by legislation.

### 3. Revolutionising road transport

The Commission recommends that government, Ofgem and local authorities should enable the roll out of charging infrastructure sufficient to allow consumer demand to reach close to 100 per cent electric new car and van sales by 2030. Government should address the implications of technological innovation in long term transport planning processes, including the next rail control period and road investment strategy.

- Ofgem should take on the role of regulating the interaction between electric vehicle charge points and the electricity network immediately, ensuring that electric vehicle charging and vehicle to grid services contribute to the optimisation of the energy system. Government, industry and Ofgem should work together to set minimum standards for a network of interoperable, smart charge points.
- Ofgem should commission electricity network operators to work with charge point providers to identify potential anticipatory investments required to accommodate public charging infrastructure. Opportunities for investment within the current price control period should be identified by Summer 2019.
- Government should place a requirement on local authorities to work with charge point providers to allocate 5 per cent of their parking spaces (including on-street) by 2020 and 20 per cent by 2025 which may be converted to electric vehicle charge points.
- Government should subsidise, by 2022, the provision of rapid charge points in rural and remote areas, where the market will not deliver in the short term.
- Government should establish a centre for advanced transport technology in the Department for Transport to bring together work on technological innovation and ensure its implications are central to future investment proposals. This should include developing and overseeing the Commission's proposed connected and autonomous vehicles framework.

## 4. Transport and housing for thriving city regions

The Commission recommends that government should make £500 million a year of funding available from 2025/26 to 2034/35 for local highways authorities to address the local road maintenance backlog.

The Commission recommends that cities should have the powers and funding they need to pursue ambitious, integrated strategies for transport, employment and housing.

- By 2021, metro mayors and city leaders should develop and implement long term integrated strategies for transport, employment and housing that will support growth in their cities.
- By 2021, government should ensure city leaders have the right powers to deliver these integrated strategies, including the power for metro mayors to make decisions on major housing development sites.
- Government should set out devolved infrastructure budgets for individual cities for locally determined urban transport priorities in line with the funding profile set out by the Commission. Budgets for 2021-2026 should be confirmed by mid 2019. Government should pass legislation, by 2020, requiring cities to be given regular five year infrastructure budgets.
- Government should allocate significant long term funding for major capacity upgrades in selected growth priority cities, in line with the funding profile set out by the Commission. Cities benefiting from major projects should make commitments on housing delivery and provide at least 25 per cent of funding. Priority cities should be identified by mid 2019, with long term investment commitments agreed by 2020. Future rounds should take place no more than twice a parliament.

## 5. Reducing the risks of drought and flooding

The Commission recommends that government should set out a strategy to deliver a nationwide standard of resilience to flooding with an annual likelihood of 0.5 per cent by 2050 where this is feasible. A higher standard of 0.1 per cent should be provided for densely populated areas where the costs per household are lower. To deliver the strategy:

- By the end of 2019, government should put in place a rolling 6 year funding programme in line with the funding profile set out by the Commission. This should enable efficient planning and delivery of projects and address the risks from all sources of flooding.
- The Environment Agency should update plans for all catchments and coastal cells in England before the end of 2023. These should identify how risk can be managed most effectively using a combination of measures

including green and grey infrastructure, spatial planning and property level measures.

- Water companies and local authorities should work together to publish joint plans to manage surface water flood risk by 2022.
- The Ministry of Housing, Communities and Local Government and planning authorities should ensure that from 2019 all new development is resilient to flooding with an annual likelihood of 0.5 per cent for its lifetime and does not increase risk elsewhere.

The Commission recommends that government should ensure that plans are in place to deliver additional supply and demand reduction of at least 4,000 MI/day. Action to deliver this twin-track approach should start immediately:

- Ofwat should launch a competitive process by the end of 2019, complementing the Price Review, so that at least 1,300 MI/day is provided through (i) a national water network and (ii) additional supply infrastructure by the 2030s.
- The Department for Environment, Food and Rural Affairs should set an objective for the water industry to halve leakage by 2050, with Ofwat agreeing 5 year commitments for each company (as part of the regulatory cycle) and reporting on progress.
- The Department for Environment, Food and Rural Affairs should enable companies to implement compulsory metering by the 2030s beyond water stressed areas, by amending regulations before the end of 2019 and requiring all companies to consider systematic roll out of smart meters as a first step in a concerted campaign to improve water efficiency.

## 6. Choosing and designing infrastructure

The Commission recommends that government should publish good quality data on infrastructure costs and performance. All public bodies taking decisions on strategic economic infrastructure should publish the forecast costs and benefits of their major infrastructure projects at each appraisal stage and at a suitable point after completion, by the end of 2019. The Infrastructure and Projects Authority should work with departments to ensure that costs are comparable between sectors.

The Commission recommends that design should be embedded into the culture of infrastructure planning, to save money, reduce risk, add value, support environmental net gain and create a legacy that looks good and works well, by:

- Government ensuring that all Nationally Significant Infrastructure Projects, including those authorised through hybrid parliamentary bills, have a board level design champion and use a design panel to maximise the value provided by the infrastructure.

- Design panels for nationally significant infrastructure projects having regard to design principles to be published by the National Infrastructure Commission based on advice received from the national infrastructure design group.

## 7. Funding and financing

The Commission recommends that government should deliver long term certainty over infrastructure funding by adopting the funding profile set out in the ‘fiscal remit’ table in Spending Review 2019 and other future spending plans.

The Commission recommends that government should maintain access to the European Investment Bank if possible. If access is lost, a new, operationally independent, UK infrastructure finance institution should be established by 2021. To enable this, government should consult on a proposed design of the new institution by Spring 2019. The consultation should cover:

- Functions, including provision of finance to economic infrastructure projects in cases of market and coordination failures; catalysing innovation; and acting as a centre of excellence on infrastructure project development, procurement and delivery.
- A clear mandate, including sound banking, additionality and having a wider economic and social impact.
- Governance to safeguard the operational independence of the institution.

The Commission recommends that local authorities should be given further powers to capture a fair proportion of increases in the value of land from planning and infrastructure provision. To enable this, government should:

- Remove pooling restrictions on Section 106 in all circumstances, through forthcoming secondary legislation by 2020.
- Remove the ballot requirement for upper tier authorities’ powers to levy a business rate supplement of 2p or less in the pound for infrastructure, except where the supplement exceeds one third of scheme costs by 2021.
- Give local authorities powers to levy zonal precepts on council tax, where public investments in infrastructure drive up surrounding property values by 2021.
- Provide greater certainty in compulsory purchase compensation negotiations by including independent valuations early in the process to be paid for by the acquiring authority by 2021.





**NATIONAL  
INFRASTRUCTURE  
COMMISSION**

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# National Infrastructure Strategy

Fairer, faster, greener



HM Treasury

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# National Infrastructure Strategy

Presented to Parliament  
by the Chancellor of the Exchequer  
by Command of Her Majesty  
November 2020

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# Foreword

## Fairer, faster, greener

For decade after decade, governments of every political stripe have failed to invest enough in the UK's regions and nations. It is one of the reasons why the quality of our national infrastructure has fallen behind that of other countries. This Strategy will change that.

In almost my first words as Prime Minister, I promised to unite our country by physically and literally renewing the ties that bind us together. I promised to unleash the productive power not just of London and the South East, but of every corner of England, Scotland, Wales and Northern Ireland. I want to bring hope and opportunity for each part of the UK. Levelling up is my government's core purpose.

Our roads and our railways and our full-fibre cables join us together as one nation - the thigh bone connected to the hip bone, connected to the back bone, connected to the shoulder bone - but our national anatomy is creaking. Some of our organs, the cities, are congested and need relief. Some of our towns and villages, the largest part of the national body, are neglected and need attention. Some of our spine, the inter-city road and rail network, is old and needs renewal.

This document sets out our plan for a renaissance, backed by hundreds of billions of pounds of public and private investment. It is a response to the outstanding work done by the National Infrastructure Commission in assessing what the country needs. We will build that infrastructure, and redress long-standing inequalities, particularly in transport, between different parts of the UK. In recent years, we have spent heavily on the rail and road networks of London and the south-east, whose prosperity benefits us all. The fruits of that investment - Thameslink, Crossrail, new trains on the Underground, the future Lower Thames Crossing to relieve the M25 - will serve our economic engine well for many years.

But in the period covered by this strategy, we will significantly shift spending to the regions and nations of the UK. On our major A roads and motorways, two-thirds of our upgrades are outside south-eastern England, including dualling the A303 to the south-west and completing the first trans-Pennine dual carriageway in fifty years.

In public transport, all but one of the major new capital projects in the next few years will be outside the south-east. Northern Powerhouse Rail will connect Leeds and Manchester, and we will help make bus and rail networks in those and other city regions as good as Greater London's.

I know, too, that a multitude of smaller, local projects - better buses, and bypasses, and new stations, and cycle lanes - will do at least as much good as the megaschemes, and help more people. This strategy funds them too. We will restore many of the rail services lost in the Beeching cuts, pump money into local roads, and are providing £5 billion of extra funding to improve buses and cycling across the country, again on the model of London.

The Union Connectivity Review will examine new ways to bind together our United Kingdom, improving the links between our four nations. We have changed the Green Book, the government's guidance on how to assess potential investments, to help us address regional and Union imbalances.

And our environmental agenda, set out in our recent ten-point plan, is fully reflected in this Strategy, with ambitious commitments on energy, decarbonisation and clean economic growth driving us towards net zero in 2050. Our new industrial revolution will create and support up to 250,000 green jobs.

About half of all infrastructure spending is private, especially in energy, water and telecoms. We will reduce policy uncertainty that holds back investment and create a new national infrastructure bank to co-invest with private-sector partners. It will be available to metro mayors and local authorities. And it will be headquartered in the North of England: the place where the first infrastructure revolution, and arguably the modern world, was born.

The projects in this strategy, including £27 billion of public funding next year, will create wealth and thousands of jobs to repair some of the scars from the pandemic. We must build back better, not the same as before.

So we also start to ask how we should answer the new challenges caused by COVID-19, such as increased demand for roads; and how we can use the new levers the crisis has given us. We have learned, since March, that we can build new hospitals and testing labs more quickly than we ever imagined. We will use that experience to deliver motorway junctions, railways, and power stations more quickly too. We are in the buyer's market of a lifetime; we will use our weight as a major client to drive best practice in procurement.

In a world likely to be working less from the office, our massive gigabit-capable broadband programme looks more important than ever. It has enormous potential for levelling-up: with cheaper property, more relaxed lifestyles and superb internet connections, previously left-behind towns could become homeworking hubs.

Yet I also deeply believe in the future of cities and of other places where people can meet each other, challenge each other, spark off other people and create those magical flashes of creativity and invention. After months trapped on endless flickering video-conferences, we will want face-to-face contact more than ever. Some of our infrastructure needs will change because of COVID-19. Many will not.

Infrastructure will not, of course, level up Britain on its own. We must work on skills, on research and on innovation to create new, wealth-generating clusters - new Cambridges, new Thames Valleys - across the country. But this Strategy will put the calcium in our national bone structure and the collagen in our national skin tissue.

**Boris Johnson**  
Prime Minister



# Executive Summary

Infrastructure underpins the economy. Transport, digital, energy and utility networks are vital for jobs, businesses and economic growth. But they also have a profound impact on people's daily lives.

The government wants to deliver an infrastructure revolution: a radical improvement in the quality of the UK's infrastructure to help level up the country, strengthen the Union, and put the UK on the path to net zero emissions by 2050.

This Strategy sets out the government's plans to deliver on this ambition. It is the first of its kind: **rooted in the expert advice of the highly respected National Infrastructure Commission (NIC) and responding to its ground-breaking 2018 assessment of the country's infrastructure needs.**

**Infrastructure is long-term.** Decisions taken today on new rail lines, power plants, or road upgrades, will affect lives and livelihoods for decades to come. But infrastructure investment also has an important short-term role to help support jobs and stimulate the economy. This Strategy brings together the government's long-term goals with the short-term imperative to rebuild the economy following the COVID-19 pandemic.

COVID-19 continues to pose a huge challenge to the UK, as it does with every other major global economy. **The government will do whatever it takes to ensure the economy recovers as swiftly as possible.** In the summer, the government brought forward £8.6 billion of investment to support jobs during the pandemic. This Strategy sets out the government's plans to go further, to drive a strong and jobs-rich recovery.

**As the government helps the economy to recover it will also seek to address the long-term issues that have held back UK infrastructure.** These issues include 'stop-start' public investment, insufficient funding for regions outside of London, slow adoption of new technology, policy uncertainty that undermines private investment, and project delivery plagued by delays and cost overruns.

This Strategy sets out how the government will address these issues and do things differently: how it will build back fairer, faster and greener. It describes how the government will:

- **Boost growth and productivity across the whole of the UK, levelling up and strengthening the Union:** the government wants to level up communities and nations across the UK through investment in rural areas, towns and cities, from major national projects to local priorities;
- **Put the UK on the path to meeting its net zero emissions target by 2050:** bold action is needed to transform the UK's infrastructure to meet net zero and climate change commitments. The government will continue to decarbonise the UK's power, heat and transport networks – which together account for over two-thirds of UK emissions - and take steps to adapt to the risks posed by climate change;
- **Support private investment:** the UK has a proud record of attracting private investment into its infrastructure. But the government recognises investors have faced uncertainty in the past few years. This Strategy – and *the Energy White Paper* which will follow shortly – are aimed at providing

investors with clarity over the government's plans, so they can look to the UK with confidence and help deliver the upgrades and projects needed across the country; and

- **Accelerate and improve delivery:** the government wants to transform the way infrastructure projects are delivered in the UK. This will be achieved through wide-ranging reforms from speeding up the planning system, to improving the way projects are chosen, procured and delivered, and greater use of cutting-edge construction technology.

This approach is underpinned by high levels of government investment, with record levels of investment for the railways, strategic roads, broadband networks and flood defences.

**This Strategy also puts innovation and new technology at the heart of the government's approach.**

Every infrastructure sector could face transformative technological change over the next twenty years. From electric vehicles, to hydrogen heating systems, to 5G and its successors, new technologies have enormous potential to improve the environment and the daily lives of people across the UK. This Strategy will ensure the UK is at the forefront of this technological revolution.

**The whole of the UK will benefit from this Strategy.**

Where policy is reserved for the UK government, this Strategy includes measures which will benefit every nation, such as a radical improvement in mobile coverage in rural areas. Where policy sits with the devolved administrations, Scotland, Wales and Northern Ireland will receive commensurate funding through the Barnett formula.

# Driving recovery and rebuilding the economy

The COVID-19 pandemic has caused hardship for individuals, families and businesses across the UK. The health emergency has been accompanied by an economic shock of historic proportions. The government has responded with an unprecedented economic support package, and will do whatever it takes to ensure the economic recovery from COVID-19 is as swift and strong as possible.

Infrastructure investment will have a key role to play in the recovery, both by maintaining jobs in the short term, and creating the conditions for long-term sustainable growth. In the summer, the government brought forward £8.6 billion of capital investment in infrastructure, decarbonisation and maintenance projects, supporting thousands of jobs.

Now the government is going further. To support the recovery, government investment in economic infrastructure will be £27 billion in 2021-22. The government is also setting out longer-term settlements for key infrastructure programmes, with record levels of investment in strategic roads, rail, broadband and flood defences. Economic infrastructure is one part of overall public investment, which also includes other areas such as schools, hospitals, and defence. Spending Review 2020 delivers £100 billion total investment in 2021-22 to support the recovery.

This decision to press on with high levels of investment, despite the fiscal pressures COVID-19 presents, marks the government's commitment to end the stop-start pattern of investment that has been common in the UK in the past. Next year the government will review the fiscal remit for the National Infrastructure Commission, to ensure it reflects the government's long-term ambitions.

Public investment is only part of the story. Private infrastructure investment will be crucial for the UK's economic recovery from the pandemic. This Strategy sets out how the government will support private sector investment, including through a new infrastructure bank for the UK which will co-invest with the private sector, and through the Prime Minister's Ten Point Plan for a Green Industrial Revolution, which will mobilise tens of billions of pounds of private investment.

Finally, the pandemic has had a profound impact on the way people use infrastructure. Many of these changes will be temporary: aided by government, city centres will bounce back; aviation will return. But in some areas changes could endure: more home working is likely in future, and the surge in cycling seen in the past six months could continue. The government will work closely with the NIC and industry to understand the longer-term effects COVID-19 may have on UK infrastructure, and the implications for policy.

# Levelling up and strengthening the Union

The government wants to use infrastructure to unite and level up the UK, delivering a stronger Union, thriving regions, cities living up to their full potential and revitalised towns and communities. To deliver this, the government is investing across the country, prioritising those areas that have received less support in the past.

## Leaving no community or business behind

- £5 billion to support UK-wide gigabit broadband roll-out, a Shared Rural Network extending 4G mobile coverage to 95% of the UK, and £250 million to ensure resilient and secure digital networks;
- £5 billion over this parliament for buses and cycling; and
- A new £4 billion cross-departmental Levelling Up Fund that will invest in local infrastructure in England (which will attract funding for Scotland, Wales and Northern Ireland in the usual way).

## Creating regional powerhouses, making cities the engines of growth and revitalising towns

- Supporting the largest city regions outside of London with £4.2 billion intra-city transport settlements;
- Backing new green growth clusters in traditional industrial areas, with carbon capture and storage, offshore wind, port infrastructure and low carbon hydrogen;
- Bringing jobs, investment and prosperity to some of the most deprived communities across the UK through the freeports programme;
- Revitalising over 100 town centres and high streets through the Towns Fund; and
- Restoring many of the rail services lost through the Beeching cuts of the 1960s.

## Connecting the regions and nations of the UK, and creating a united and global Britain

- Backing HS2 to deliver essential North-South connectivity, with an Integrated Rail Plan to deliver transformational improvements in the Midlands and the North;
- Record investment in strategic roads (over £27 billion), including the A66 between Penrith and Scotch Corner, Lower Thames Crossing, and the A303 Stonehenge; and
- Delivering a Union Connectivity Review reviewing options to improve transport links across the four nations of the UK.

## And changing how decisions are taken:

- Increasing the UK government's ability to invest directly in Scotland, Wales and Northern Ireland through the UK Internal Market Bill;
- Changing the way projects are appraised to support levelling up through the Green Book Review;
- Expanding devolution within England, and implementing the devolution deal in West Yorkshire;
- Relocating 22,000 civil servants out of London and the South East by 2030.

# Decarbonising the economy and adapting to climate change

As set out in the Prime Minister's Ten Point Plan for a Green Industrial Revolution, infrastructure investment is fundamental to delivering net zero emissions by 2050. The government will unlock private sector investment to accelerate the deployment of existing technology, such as retrofitting the UK's building stock and electrification of vehicles, while advancing newer technologies such as carbon capture and low-carbon hydrogen. The government's approach will create jobs to support the recovery from COVID-19, and support the government's levelling up agenda by ensuring key industrial areas are at the heart of the transition to net zero. The UK is already decarbonising faster than any other G20 country. As hosts of the UN Climate Change Conference COP 26 next year, the UK will go even further to promote the importance of low-carbon infrastructure and support its commitment to the Paris Agreement. Key measures include:

- Significant investment in offshore wind and into modern ports and manufacturing infrastructure to expand the share of energy generation from renewables;
- Providing up to £525 million to bring forward large-scale nuclear and invest in the development of advanced nuclear technologies;
- £1 billion to support the establishment of carbon capture and storage in four industrial clusters;
- Investing in hydrogen to scale up the UK's capacity to produce both 'blue' and 'green' hydrogen;
- Investing £1.3 billion in charging infrastructure to accelerate the mass adoption of electric vehicles ahead of ending the sale of new petrol and diesel cars by 2030;
- Enabling heat decarbonisation by supporting the roll-out of existing technologies like heat pumps and development of emerging technologies like hydrogen;
- Funding to help England to meet its share of the Climate Change Committee's recommendations to plant 30,000 hectares of trees a year in the UK; and
- Investing £5.2 billion by 2027 to better protect 336,000 properties and boost resilience of communities to the increased risk of flooding and coastal erosion resulting from climate change.



## Supporting private investment in infrastructure

Private investment has delivered major benefits for UK infrastructure and will be critical over the coming decades as the UK moves towards meeting net zero in 2050. The government is committed to supporting private investment and is taking action across the following areas:

- The government is setting up a new UK infrastructure bank, to co-invest alongside the private sector in infrastructure projects;
- The bank will operate UK-wide, be based in the North of England, and support the government's ambitions on levelling up and net zero;
- The bank will also be able to lend to local and mayoral authorities for key infrastructure projects, and provide them with advice on developing and financing infrastructure;

- The government is committed to the model of independent economic regulation, but will refine it to ensure it provides a clear and enduring framework for investors and businesses and delivers the major investment needed in decades to come, while continuing to deliver fair outcomes for consumers;
- The government will produce an overarching policy paper on economic regulation in 2021, which will consider regulator duties, how to inject more competition into strategic investments and the benefits of a cross-sectoral Strategic Policy Statement; and
- The government will continue to develop new revenue support models and consider how existing models – such as the Regulated Asset Base model and Contracts for Difference – can be applied in new areas, and remains open to new ideas from the market. The government will not reintroduce the private finance initiative model (PFI/PF2).

# Accelerating and improving delivery

The government wants to deliver infrastructure projects better, greener and faster. That means addressing longstanding challenges such as complex planning processes, slow decision-making, and low productivity in the construction sector. It also means learning lessons from the COVID-19 pandemic, for instance from the approaches that built Nightingale Hospitals in record time, and saw the UK move swiftly to secure access to a range of promising vaccines. Further, there is a clear opportunity with EU exit to change how this government delivers projects, using the flexibility the UK has as a sovereign country to do things differently.

The government set up Project Speed in the summer, to review every part of the infrastructure project lifecycle and identify where improvements could be made. Project Speed has developed a comprehensive package of reforms, including:

- Reform of environmental regulations to deliver a quicker and simpler framework for assessing environmental impacts and secure better outcomes for the environment;
- Landmark reform of the planning system including consulting on amending permitted development rights, to let schools and hospitals be expanded quickly;
- Transforming the construction sector to enable it to become more productive, more sustainable and more internationally competitive, with better use of data and modern methods of construction;
- Ensuring more effective decision making with streamlined approval processes, more emphasis on quality design, and better monitoring and evaluation;
- Embedding good design in all infrastructure projects through planning reforms; and

- Bringing about a step change in capability and leadership, accelerating investment in major project expertise and delivery skills and improving the skills base across the country to ensure every area can deliver the infrastructure it needs.

These reforms have already driven substantial progress, and in future mean the UK's vital infrastructure like schools, hospitals, transport and other networks will be delivered better, greener and faster:

- Better, because the process of assessing infrastructure projects under the revised methodology will ensure the government is valuing the wider economic, social and environmental benefits of a project. The government will set projects up to succeed by strengthening the assurance and decision-making regime.
- Greener, because the requirements of the net zero commitment will be considered in every stage of the project lifecycle and underpin decisions on the technical solutions chosen to achieve the required outcomes.
- Faster, by simplifying and shortening the processes through which projects secure the consents they need to proceed, procure contracts and deliver; while using modern methods of construction, new skills and a strategic relationship with industry which will improve productivity.

# Conclusion and next steps

This Strategy clearly sets out the government's long-term infrastructure ambitions:

- **It provides a long-term perspective** without ignoring shorter-term imperatives;
- **It sets out clear goals and plans to achieve them**, with more detail to come in some areas over the coming weeks and months;
- **It announces multi-year funding commitments** for many key infrastructure programmes; and
- **It confirms the government's commitment to fundamentally change** the way it considers and delivers infrastructure across the whole of the UK.

However, this isn't the final word on the government's infrastructure plans – it instead represents the first step of a multi-year process to transform the UK's infrastructure networks. This Strategy will also be followed by a series of detailed publications setting out further details on key areas of infrastructure policy, including the Construction Playbook, Energy White Paper, English Devolution and Local Recovery White Paper, a refreshed Industrial Strategy, Union Connectivity Review and an updated National Infrastructure and Construction Pipeline.

The government is also setting out new priorities for the National Infrastructure Commission, including commissioning a new study on greenhouse gas removal technologies, and preparing to appoint additional Commissioners.

# Introduction

This National Infrastructure Strategy comes at an historic time. COVID-19 has caused a significant health and economic shock. The UK has left the European Union and is fully independent and self-governing for the first time in 45 years, creating new opportunities to do things differently. **This is the moment to build back better, to create world-class infrastructure across the whole UK, and to transform people's lives for decades to come.**

Infrastructure is the backbone of the economy – vital to jobs, economic growth and quality of life for people across the UK. It affects everybody's daily lives in profound ways. The government's commitment to unite and level up the UK is more urgent than ever, and infrastructure will be crucial in renewing the fabric of the country.

The UK has a proud history of building infrastructure – from the railways that brought forth the industrial revolution to the Thames Barrier that protects millions from flooding each year. **But there are long-standing challenges that have held back the UK's infrastructure:** insufficient and costly 'stop-start' public investment; a lack of focus on the potential of great urban centres; slow adoption of new technology; policy uncertainty undermining private investment; and sluggish delivery, with projects too often delayed.

**This National Infrastructure Strategy tackles these challenges.** Rooted in the authoritative and impartial advice of the National Infrastructure Commission (NIC), it sets out how infrastructure can support the immediate economic recovery and the government's ambition to transform the UK's infrastructure networks over the next decade and beyond.

This Strategy marks the first decisive step change in the nation's infrastructure ambitions. The government's vision is for:

- **A united UK with thriving communities, cities, regions and nations,** with quality infrastructure giving everyone, everywhere opportunities to succeed. Communities will be brought together, broadband connectivity will be better, commutes will be shorter and delays will be fewer;
- **Greener and more beautiful places,** with cleaner air, more green spaces, green buses, more cycling, low-carbon and energy efficient homes, and better high streets for UK towns;
- **The UK to be a world leader in new technologies,** including wind power, hydrogen production carbon capture and storage, nuclear power, electric vehicles and zero emission planes; and
- **A stable and robust regulatory and delivery system,** leading to sustained public and private investment to support innovation, delivering projects better, faster and greener.

## Addressing long-standing challenges

The COVID-19 pandemic has introduced enormous short-term disruption, and may have long-term effects on the way people live, for instance with less daily commuting. However, this does not undermine the long-term arguments for infrastructure: the UK still needs to invest in digital, transport and utilities networks to underpin economic recovery and growth. It does mean that the government will have to continue to refine its approach to infrastructure investment in response to the impacts of COVID-19 in the years to come.

**Chapter 1 of this Strategy focuses on how infrastructure can boost short term economic growth and drive the recovery from COVID-19.** It sets out how *Spending Review 2020* delivers high levels of investment to support the economic recovery, with long-term settlements for key infrastructure programmes.

**Chapter 2 focuses on levelling up the economy.**

The UK's major cities and regions are not as productive as international comparators. Towns and regions are held back by inadequate and out of date infrastructure, making it hard for people to get to work, run businesses and attract international investment. The UK's transport networks are ageing and congested and UK gigabit broadband coverage lags behind many competitor countries. There are also problems with poor infrastructure connecting the four nations of the UK. **This strategy announces an ambitious package of plans to level up the nations, regions, cities and towns of the UK and strengthen the Union** – with vastly improved broadband, road and rail networks connecting up the country, investments to boost cities, towns and communities, and getting the basics right everywhere with better roads, buses and cycling infrastructure. This is underpinned by changes in how and where decisions are made, to better reflect local and national needs.

The UK has made substantial progress in reducing carbon emissions from its power networks and the cost of renewables has fallen sharply – **but bold action is now needed to transform the UK's infrastructure to meet net zero and climate change commitments** as one of the world's leading, modern, sustainable economies.

In line with the Prime Minister's *Ten Point Plan for a Green Industrial Revolution*, **Chapter 3 sets out the government's plans to decarbonise power, heat, heavy industry and transport networks** - which together account for over 80% of UK emissions - and how to adapt to the risks posed by climate change.<sup>1</sup>

The UK has a proud record of attracting private investment into its infrastructure, and this will be even more vital in delivering on its net zero targets. But the government recognises that investors have faced some uncertainty in the past few years. **Chapter 4 of this Strategy sets out the government's plans to support private investment in infrastructure**, including by establishing a **new UK infrastructure bank**, to harness private capital investment.

**Finally, infrastructure delivery in the UK has been too slow for too long.** The COVID-19 pandemic has shown that this doesn't have to be the case; for instance the Nightingale hospitals were assembled in record timescales. **Chapter 5 sets out the steps the government is taking to accelerate and improve infrastructure delivery.** This will be achieved through wide-ranging reforms coming out of the Project Speed taskforce, from speeding up the planning system, to improving the way projects are chosen and run, reforming the way the government procures, and using cutting edge construction technology.

**The whole of the UK will benefit from this Strategy.**

Where policy is reserved for the UK government, this Strategy includes measures which will benefit every nation of the UK, such as a radical improvement in mobile coverage in rural areas. Where policy sits with the devolved administrations, those governments will receive funding through the Barnett formula for the benefit of Scotland, Wales and Northern Ireland.

**The journey doesn't stop here.** Successful delivery of this plan will require collaboration across all parts of government, industry and civil society. The government will be following up this Strategy with further detail on a number of areas – including the English Devolution and Local Recovery White Paper and the Energy White Paper. The final chapter of this strategy sets out what the government will do next to deliver on its ambitions.

# The case for infrastructure investment

High quality infrastructure is crucial for economic growth, boosting productivity and competitiveness. It helps connect people to each other, people to businesses, and businesses to markets, forming a foundation for economic activity. Infrastructure acts as a direct 'input' for businesses, which rely on energy, transport and waste collection to operate. Well-developed transport and digital networks allow businesses to grow and expand, enabling them to extend supply chains, deepen labour and product markets, collaborate, innovate and attract inward investment. These 'agglomeration' effects are particularly powerful in city regions, where high quality infrastructure can play a substantial role in boosting productivity. But they also apply more broadly.

Infrastructure can also support other government policy objectives. For instance, it can improve skills and education through investment in digital technology and buildings. It is a key factor in determining where firms choose to locate and grow, and people's ability to access resources.

However, the size of the UK's capital stock (a measurement of the value of the UK's current infrastructure networks) is generally considered to be smaller than comparable economies.<sup>2</sup>

In 2019 the World Economic Forum (WEF) ranked UK infrastructure 11th in the world, behind comparable European economies such as France, Germany and the Netherlands.<sup>3</sup> The UK also falls well behind other countries on a sector-by-sector basis. For instance, WEF rank the UK 36th for the quality of its road infrastructure, and 79th on fibre internet subscriptions.

Businesses and communities also need consistency and certainty about planned infrastructure. For a long time, investment in UK infrastructure has been volatile and stop start. Previous governments have increased investment and then cut back. This has created a fractured supply chain, exposed to significant vulnerability, and is part of the reason why the UK has a lower infrastructure stock than in many other countries.

This means that increasing both public and private investment, whether in order to reduce some of the highest levels of road congestion in Europe,<sup>4</sup> or increasing gigabit-capable broadband access to continue to catch up to international competitors,<sup>5</sup> would have a relatively larger impact on growth and living standards in the UK.<sup>6</sup>

# The National Infrastructure Commission

The government set up the NIC in 2015, with the aim of providing impartial, expert advice on major long-term infrastructure priorities. The NIC published its first *National Infrastructure Assessment* in July 2018.<sup>7</sup> This comprehensive report set out the Commission's assessment of the UK's infrastructure needs over the next 30 years, and made a series of recommendations to the government across all areas of economic infrastructure: energy, transport, water and wastewater (drainage and sewerage), waste, flood risk management and digital communications.

**The NIC recommendations have already substantially influenced the government's infrastructure agenda** and provided the foundations for many of the measures announced in this Strategy and at previous fiscal events. This Strategy provides the government's formal response to the NIC's recommendations. But it also goes further, setting out the next steps in the government's plans for a step change in UK infrastructure policy. A detailed response to each NIC recommendation is provided alongside this Strategy in *Response to the National Infrastructure Assessment*.

This is the first time the government has responded to such a comprehensive assessment of the UK's infrastructure needs: the government intends to undertake a similar exercise and update this Strategy every five years, in response to future National Infrastructure Assessments.

**In line with the NIC's remit, this Strategy focuses on economic or networked infrastructure:** energy, transport, water, waste, flood risk management and digital communications. However, the reforms to project delivery will clearly benefit all forms of capital projects, including social infrastructure such as schools, hospitals and prisons. Further detail on the government's plans for social infrastructure investment are set out in *Spending Review 2020*.

# Recovery and rebuilding the economy

## At a glance

The COVID-19 pandemic has caused hardship for individuals, families and businesses across the UK. The health emergency has been accompanied by an economic shock of historic proportions. The government has responded with an unprecedented economic support package, and will do whatever it takes to ensure the economic recovery from COVID-19 is as swift and strong as possible.

Infrastructure investment will have a key role to play in the recovery, both by maintaining jobs in the short term, and creating the conditions for long-term sustainable growth. In the summer, the government brought forward £8.6 billion of capital investment in infrastructure, decarbonisation and maintenance projects, supporting thousands of jobs.

Now the government is going further. To support the recovery, government investment in economic infrastructure will be £27 billion in 2021-22. The government is also setting out longer-term settlements for key infrastructure programmes, with record levels of investment in strategic roads, rail, broadband and flood defences. Economic infrastructure is one part of overall public investment, which also includes other areas such as schools, hospitals, and defence. Spending Review 2020 delivers £100 billion total investment in 2021-22 to support the recovery.

This decision to press on with high levels of investment, despite the fiscal pressures COVID-19 presents, marks the government's commitment to end the stop-start pattern of investment that has been common in the UK in the past. Next year the government will review the fiscal remit for the National Infrastructure Commission, to ensure it reflects the government's long-term ambitions.

Public investment is only part of the story. Private infrastructure investment will be crucial for the UK's economic recovery from the pandemic. This Strategy sets out how the government will support private sector investment, including through a new infrastructure bank for the UK, which will co-invest with the private sector, and through the Prime Minister's Ten Point Plan for a Green Industrial Revolution, which will mobilise tens of billions of pounds of private investment.

Finally, the pandemic has had a profound impact on the way people use infrastructure. Many of these changes will be temporary: aided by government, city centres will bounce back; aviation will return. But in some areas changes could endure: more home working is likely in future, and the surge in cycling seen in the past six months could continue. The government will work closely with the NIC and industry to understand the longer-term effects COVID-19 may have on UK infrastructure, and the implications for policy.

The UK is experiencing a health and economic shock of historic proportions. The threat posed by COVID-19 has forced governments around the world to restrict activity to control the virus. The government fully recognises what a challenging period this is for the British people and for businesses across the economy, and will do whatever it takes to ensure the UK recovers as quickly and strongly as possible.

The government has responded with an unprecedented set of economic support measures, including the Coronavirus Job Retention Scheme (CJRS) which has supported millions of jobs across the economy, and further tax cuts and deferrals, grants and loans for businesses.

**The pandemic has also profoundly affected the way people use infrastructure** – planes have been grounded, trains left empty. Digital infrastructure has been crucial in keeping people connected. The number of people cycling has surged. There has been additional pressure on parts of the road network.

Within infrastructure, the transport sector has been the most heavily impacted, with dramatic falls in demand across many modes. Over the period, the government has responded with a series of targeted aid packages:

- The government is supporting the aerospace sector and its aviation customers with over £9 billion support through the Bank of England's COVID-19 Corporate Financing Facility, grants for research and development, loan guarantees and support for aerospace exports. In addition, the government has provided £5.7 million funding to air passenger services between Great Britain and Northern Ireland to ensure those who needed to travel could continue to do so;
- The government is safeguarding vital transport links to the mainland for people living on the Isle of Wight and the Isles of Scilly, including an emergency package of up to £10.5 million for lifeline ferry services;

- The government has provided more than £3 billion to support local light rail and bus networks, across the country to keep cities moving, including London, and maintain connectivity; and
- The government has stepped in to keep train services running in spite of severely reduced passenger demand. While these temporary arrangements are in place, the government will make an early start on key reforms and ensure a new and better type of rail network emerges following the pandemic.

The breakthroughs that have been achieved in vaccine development shows that an end to the pandemic is in sight. But some of the behavioural changes seen through this period are likely to endure. For instance, people are likely to spend more time working from home in future, making the government's plans to deliver gigabit broadband across the country even more important. Many people who have started cycling to work will continue to do so.

But in other areas, the economy may return to similar patterns to before the pandemic. For instance, cities will still be key engines of growth, with people and businesses clustering to drive and benefit from innovation. The government's plans for greater funding for city-regions will be key.

All of this creates questions for the government, such as how to address increased demand for space on the roads? And how to rebuild confidence in public transport as the pandemic eases? The government will work closely with industry, consumers and the NIC to address these questions.

It is also clear that COVID-19 has had a particularly harsh impact on the North of England, making the government's levelling up agenda even more pressing than before.

**The government's immediate focus now is on ensuring infrastructure investment and policy support the recovery.** Infrastructure investment can boost jobs, while also increasing growth and productivity. That is the government's aim through *Spending Review 2020*.

# Infrastructure and public health

As well as being vital for the economy and productivity growth, infrastructure is also a key driver of public health outcomes.

The pandemic has proven that taking steps now to increase overall public health – by improving air quality and encouraging cycling and walking to fight obesity – will pay dividends over the longer-term as the UK focuses on economic and physical recovery. The government is reflecting this priority in its approach to infrastructure investment.

The COVID-19 pandemic has shown that many people need to think harder about their health, and the lifestyle changes which might help them be more active and stay fit. Investment in active travel is critical to this. Government support for cycling and walking helps tackle obesity by providing ways for people to exercise as well as get from A to B, while measures to decarbonise the economy and reduce congestion will help improve air quality – and therefore health – across the UK.

This year has also highlighted the benefits of having truly local green space for mental and physical health and wellbeing, as well as highlighting the deficit in accessible green space for some communities and in deprived areas. The government is developing a National Framework of Green Infrastructure Standards for England that will show what good green infrastructure looks like, and help local authorities, developers and communities to improve provision in their area.

# Infrastructure and the recovery: the 2020 Spending Review

As well as setting budgets for next year, the Spending Review announces longer-term budgets for key capital programmes and projects. This includes funding for HS2 – the biggest infrastructure project in Europe – and record levels of investment in programmes for strategic roads, flood defences and broadband. Further details are set out in *Spending Review 2020*.

**Taken together, these spending commitments mark a clear step change in the UK’s approach to infrastructure investment.** Too often in the past, governments have invested too little in infrastructure, or investment has been done on a stop-start basis. This government is committed to end that, recognising that climate change, regional inequality and low productivity are long-term challenges that require a sustained commitment.

**The government is committed to major investment, not just in the infrastructure sectors covered in this document, but also in other sectors including health, education, science and defence. Spending Review 2020 delivers £100 billion total investment in 2021-22 to support the recovery.** This is part of the government’s plans to invest over £600 billion over the next five years, delivering the highest sustained levels of public sector net investment as a proportion of GDP since the late 1970s.

The economic infrastructure sectors covered in this document, such as transport, energy and digital communications form a key part of these plans. **Next year the government will spend £27 billion in these sectors.<sup>8</sup>**

Public investment is only part of the story. Much of the UK’s infrastructure is financed by the private sector, and **private investment will be crucial for the UK’s economic recovery from the pandemic.** This Strategy sets out how the government will support private sector investment. This includes the introduction of a major new national infrastructure bank to catalyse investment in infrastructure projects. And this Strategy delivers on the Prime Minister’s *Ten Point Plan for a Green Industrial Revolution*, which is intended to mobilise tens of billions of pounds of private investment.

Public sector net investment since 1984-85 to 2025-26



Source: OBR. Sharp increase in 2020-21 is driven by the upfront cost of expected future calls on government guaranteed loans and a fall in GDP

# The National Infrastructure Commission's fiscal remit

The National Infrastructure Commission's (NIC's) Charter commits the government to setting a binding fiscal remit to ensure that the NIC's recommendations remain affordable. While the need for infrastructure investment is clear, the government remains committed to fiscal sustainability, and is mindful of the significant fiscal pressures that exist over the short- and medium-term. The fiscal remit aims to strike an appropriate balance.

The fiscal remit refers to investment in those sectors covered by the NIC: transport, energy, flood risk management, digital communications, water, and waste. The fiscal remit is designed to ensure that the NIC clearly prioritise their recommendations and explain which they consider are most critical in addressing the country's long-term infrastructure needs.

In 2016 the government set the NIC's fiscal remit at between 1-1.2% of GDP. This means that the NIC must be able to demonstrate that its recommendations are consistent with gross public investment in economic infrastructure of between 1% and 1.2% of GDP in each year between 2020 and 2050. This remit applies to both the National Infrastructure Assessment and specific studies.

The government is committed to increasing infrastructure investment to drive the economic recovery and make progress against its longer-term plans, and it is important that the NIC's fiscal remit reflects these ambitions. However, given current economic uncertainty, now is not the right time to definitively update the remit. Instead, the government will review the NIC's fiscal remit in detail next year, to ensure it continues to reflect the government's ambitions as the NIC prepare to publish their second National Infrastructure Assessment. In the meantime, the government will maintain the NIC's fiscal remit at a minimum of 1-1.2% of GDP.

# Delivering on these commitments

The construction industry is essential to maintaining and delivering vital infrastructure services, including transport and utilities networks, and ensuring public safety by delivering critical public health facilities and remediating unsafe buildings. But the sector also faces long-term challenges. It is fragmented when compared to those in other countries; struggles to raise investment for innovation; and in the UK has had to manage significant cycles of public investment increases and cuts.

The construction sector has responded well to the pandemic, working closely with government and key stakeholders to ensure sites can remain open and activity can continue safely. But the government recognises the challenges the sector is still facing now, with uncertainty weighing on private investment. While the majority of construction sites have now reopened, the sector still faces significant challenges as a result of reduced private sector demand and the knock-on impact this has for job retention and financial health.

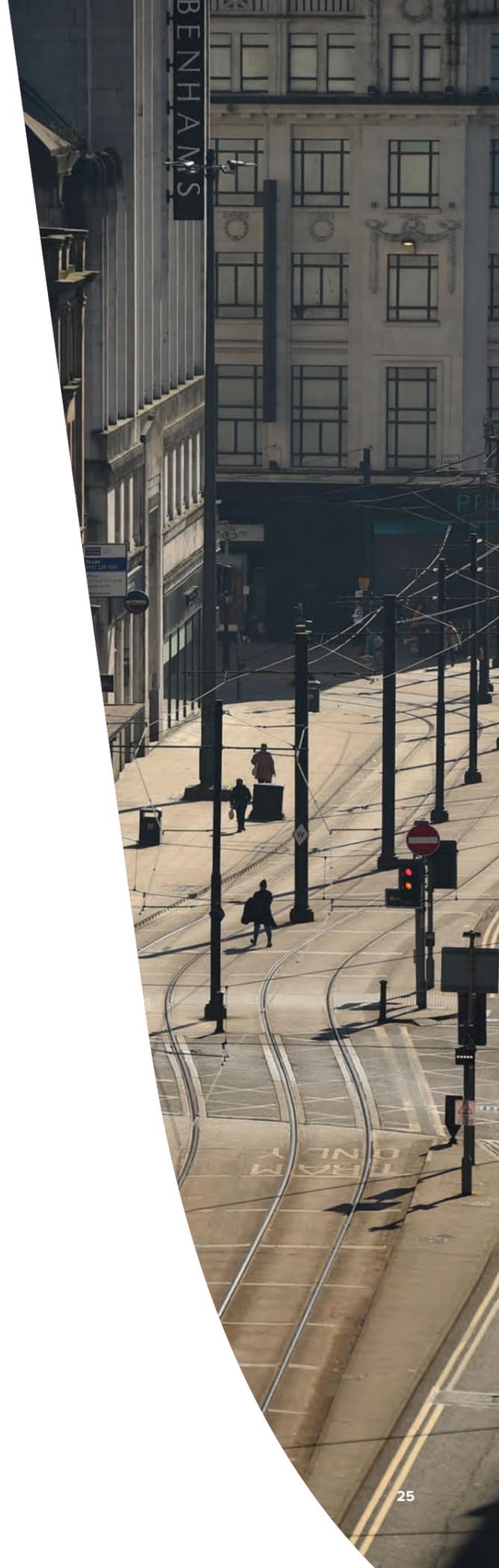
Continuing to progress the UK's ambitious infrastructure plans in all parts of the country is vital to the recovery of the construction sector, and the economy as a whole. The government is continuing to do everything it can to ensure that construction sites are able to remain open and operate safely, so that the industry emerges from the pandemic with the capability and capacity to deliver this Strategy.

By ramping up investment progressively in a structured way, the government's ambition is to eliminate the peaks and troughs that have proved destabilising for the supply chain in the past. The government has taken a balanced approach between new and existing assets, as well as delivering more local and regional enhancements to create a varied pipeline in terms of the size and location of projects. This will result in commercial opportunities to small and medium-sized enterprises as well as large contractors.

Alongside ongoing major projects such as HS2, in the immediate-term new investment will be targeted at smaller local schemes to upgrade existing infrastructure. These projects can be taken through planning and development quickly to provide employment opportunities in the UK construction sector that would otherwise be affected by COVID-19 and decreasing private sector demand.

HM Treasury is strongly encouraging all government departments and their agencies to progress approved and funded projects into procurement and contract without delay (subject to good project discipline). This includes continuing to publish a comprehensive *National Infrastructure and Construction Pipeline*, with the next update in Spring 2021.

The government is also urging local authorities to take steps to preserve construction jobs in their areas by progressing funded projects as soon as practicable. Finally, the government will use its weight as a major construction client to transform and modernise the industry, through the publication and implementation of the *Construction Playbook*.



# Levelling up the whole of the UK

## At a glance

The government wants to use infrastructure to unite and level up the UK, unleashing the potential of the Union, thriving regions, cities living up to their full potential and revitalised towns and communities. To deliver this, the government is delivering major investment across the country, prioritising those areas that have received less support in the past.

### Leaving no community or business behind

- £5 billion to support UK-wide gigabit broadband roll-out, a Shared Rural Network extending 4G mobile coverage to 95% of the UK, and £250 million to ensure resilient and secure 5G networks;
- £5 billion over this parliament to transform bus services and cycling infrastructure;
- A new £4 billion cross-departmental Levelling Up Fund that will invest in local infrastructure in England (which will attract funding for Scotland, Wales and Northern Ireland in the usual way); and
- £5.2 billion by 2027 to better protect communities from flooding and coastal erosion.

### Creating regional powerhouses, making cities the engines of growth and revitalising towns

- Supporting the largest city regions outside of London with £4.2 billion intra-city transport settlements;
- Backing new green growth clusters in traditional industrial areas, with carbon capture and storage, offshore wind, port infrastructure and low carbon hydrogen;
- Bringing jobs, investment and prosperity to some of the most deprived communities across the four nations of the UK through the freeports programme;
- Revitalising over 100 town centres and high streets through the Towns Fund; and
- Restoring many of the rail services lost through the Beeching cuts of the 1960s.

### Connecting the regions and nations of the UK, and creating a united and global Britain

- Backing HS2 to deliver essential North-South connectivity, with the Integrated Rail Plan delivering transformational improvements in the Midlands and the North;
- Record investment in strategic roads (over £27 billion), including the A66 between Penrith and Scotch Corner, Lower Thames Crossing, and the A303 Stonehenge; and
- Delivering a Union Connectivity Review identifying options to improve transport links across the four nations of the UK.

### And changing how decisions are taken

- Increasing the UK government's ability to invest directly in Scotland, Wales and Northern Ireland through the UK Internal Market Bill;
- Changing the way projects are appraised to support levelling up through the Green Book Review;
- Expanding devolution within England, and implementing the devolution deal in West Yorkshire; and
- Relocating 22,000 civil servants out of London and the South East by 2030.

The government's vision is to level up the whole of the UK and deliver a stronger Union between Scotland, Wales, Northern Ireland and England. The growth of every region and nation in the UK is vital, not just to boost economic growth and productivity, but to create a stronger, fairer and more inclusive society.

Great nations, where opportunity and talent are spread evenly, depend on great infrastructure. Although not the only factor – skills, local leadership and business environment are also fundamental – infrastructure plays a crucial role in resolving disparities between places. Better infrastructure networks can have a transformative effect on economic and social outcomes as they connect people, either physically or digitally, to opportunities.

Some parts of the UK lead the world as great places to live, work and do business, in part due to excellent infrastructure. The government will draw on its experience in these places to **create a new infrastructure anatomy that unites and levels up the whole of the UK.**

First, **the government will ensure that no citizen, community or business is left behind**, by connecting them to the next stage of the digital revolution and ensuring that they can get around their local community with well-maintained local roads. The government is also improving the essential, everyday features of peoples' lives; faster and greener buses that markedly improve the commute, and high quality, well integrated cycling infrastructure that sparks a gear change in the way people ride.

Second, **re-balancing the UK relies on boosting the cities and towns** most in need. Cities are the anchors of successful regions across the world; they are engines of growth. To drive economic growth across all regions of the UK, the government is investing in growth in cities. But over half the UK's population live in towns, many of which have suffered economic and social decline over decades. The government is investing in infrastructure to revitalise towns, as well as to drive their economic regeneration.

Third, the government will **connect the nations and regions of the UK**, building infrastructure networks that bring together the whole of the UK. To level up and unite the country, cities across the UK must also be accessible to each other, to support trade across regions and spread growth from south to north, east to west and back again. The government is investing in national transport and pivoting investment away from London, ensuring every region has great connectivity.

Fourth, **maintaining the UK's position as a global trading nation** also requires infrastructure that connects the country to its international partners - linking businesses to valuable markets and to support trade and investment. The government is supporting private sector investment to improve infrastructure for international freight and aviation.

Finally, **this will require doing things differently**, including changing how investment and policy decisions are made. This means ensuring that decisions are not just made in Whitehall but reflect the diversity of this country, empowering local areas and leaders, but also ensuring decisions can be made for the UK as a whole where appropriate. It is vital that decision-making frameworks such as the Green Book also reflect the government's levelling up agenda.

### Infrastructure across the Union

As responsibility for much infrastructure is devolved, the devolved administrations receive funding through the application of the Barnett formula in line with investment decisions taken by the UK government. This funding ensures the devolved administrations have the means to invest in infrastructure to support people and businesses in Scotland, Wales and Northern Ireland.

Infrastructure sector	Devolved Administration responsibility		
	Scotland	Wales	Northern Ireland
Transport	Largely devolved	Largely devolved, aside from rail and aviation	Devolved
Energy	Not devolved, aside from energy efficiency	Not devolved, aside from energy efficiency	Devolved, aside from nuclear
Digital	Not devolved	Not devolved	Not devolved
Waste and sewage	Devolved	Devolved	Devolved
Flood risk	Devolved	Devolved	Devolved
Waste	Devolved	Devolved	Devolved

Source: National Infrastructure Commission



## Leaving no community or business behind

From Teeside to Tonbridge, from Bury to Bristol, from Lewis to Lewes, and from Portadown to Penzance, the government is determined to level up the opportunities available everywhere, boosting jobs, wages and prospects for all communities. The economic opportunities available to many people depend on where they were born, grew up and still live – around 40% of the UK population live within the local area where they were born.<sup>9</sup> These economic opportunities are therefore dictated in practice by the nature of their local economy.

**This is why the government is also taking action to deliver** local roads, buses, cycling, better digital connectivity and flood defences across the country. Where policy is devolved the devolved administrations will receive funding through the application of the Barnett formula in line with the decisions taken by the UK government. Where policy is reserved - for example digital infrastructure - the UK government is focused on improving connectivity for the whole of the UK.

**Rural communities in particular rely on strong infrastructure networks to support their local economies**, and these must be well-thought through and maintained. The government's long-term ambition is for people and businesses in rural areas to be able to easily access and unlock opportunity, as in other parts of the UK by improving connectivity.

### Investing in local priorities

The government is creating a new £4 billion Levelling Up Fund that will invest in local infrastructure that has a visible impact on people and their communities and will support economic recovery. Moving away from a fragmented landscape with multiple funding streams,

this new cross-departmental fund for England will invest in a broad range of high value local projects up to £20 million, or more by exception, including bypasses and other local road schemes, bus lanes, railway station upgrades, regenerating eyesores, upgrading town centres and community infrastructure, and local arts and culture. It will be open to all areas in England and prioritise bids to drive growth and regeneration in places in need, those facing particular challenges, and in areas that have received less government investment in recent years. This fund will attract funding for Scotland, Wales and Northern Ireland in the usual way.

### Local roads

This Strategy, will transform the journeys people make every day. Local roads make up 98% of the network and are used in almost every journey. They are estimated to be worth £400 billion – one of the UK's most valuable public assets.<sup>10</sup> Well-maintained local roads allow for faster and more reliable journeys, boosting local businesses and serving all road users. High quality local roads are also central to the future of transport, playing an important role in the take-up of autonomous vehicles and greener forms of transport such as cycling and buses.

**The Spending Review commits £1.125 billion of local roads maintenance funding in 2021-22**, including £500 million for the Potholes Fund to fix potholes and resurface roads. **This will be supported by £260 million allocated to Local Authorities in 2021-22 for shovel-ready local transport schemes** through the Integrated Transport Block, including public transport and active travel upgrades.

**The government is also investing £310 million in 2021-22 in upgrading the road network**, reducing congestion and making it better able to cope with demand by adding capacity. This will support investment in over 50 schemes in this Parliament such as North Hykeham relief road and crossings in both Lake Lothing and Great Yarmouth due to start construction shortly. **Altogether, this means the government is investing £1.7 billion in local roads in 2021-22.**

**Buses and active travel**

Road-building alone cannot solve congestion: the UK also needs to use limited road space more efficiently. **This forms part of the government’s broader agenda for driving improvements in local transport across the country through £5 billion for buses and cycling over this Parliament.** Increasing cycling and walking can help tackle some of the most challenging issues facing UK society: improving air quality, combatting climate change, improving health and wellbeing, addressing inequalities and tackling congestion on the roads. There has already been progress in this space – despite fewer people travelling overall during the pandemic, in the summer there was around a 100% increase in weekday cycling, and on some weekends the increase has been around 200%, compared to early March, prior to the lockdown.<sup>11</sup>

**In May, the government announced a £2 billion active travel package in order to make it easier and safer for people to walk and cycle.** This investment will support the delivery of the priorities set out in Gear Change, the government’s new long-term walking and cycling strategy,<sup>12</sup> which will ensure high design standards, and help integrate new cycling infrastructure into cities, alongside other road users, with thousands of miles of safe, continuous and direct cycling routes. **This funding included £225 million in emergency funding in 2020-21 for local authorities to help them create cycle lanes and more space for pedestrians.**

Buses are the workhorses of public transport, accounting for over 50% of journeys.<sup>13</sup> Yet domestic bus use has been in decline, falling by over 10% since 2009-10 outside London.<sup>14</sup> The government is investing to build back better by supporting local authorities and operators to work together to coordinate timetables and ticketing to meet shifting patterns of demand, deliver bus priority measures that tackle congestion, and employ open data and demand-responsive technologies to improve the customer experience. **The Spending Review commits £300 million in 2021-22 to drive transformation, maintain essential services as long as necessary, and support the industry through the COVID-19 recovery.** This combination of measures will make trips smoother and faster than ever before.

**Digital connectivity**

The UK is a nation that thrives on digital connectivity, with some of the highest rates of digital adoption in the world. The UK has the fifth largest number of broadband and mobile subscriptions in the OECD,<sup>15</sup> and more people in the UK shop online than in any EU member state.<sup>16</sup> The government wants to deliver high quality, reliable digital infrastructure that works across the UK, so that mobile calls do not drop, video calls don’t freeze, and people working from home can do their jobs and run their businesses with ease.

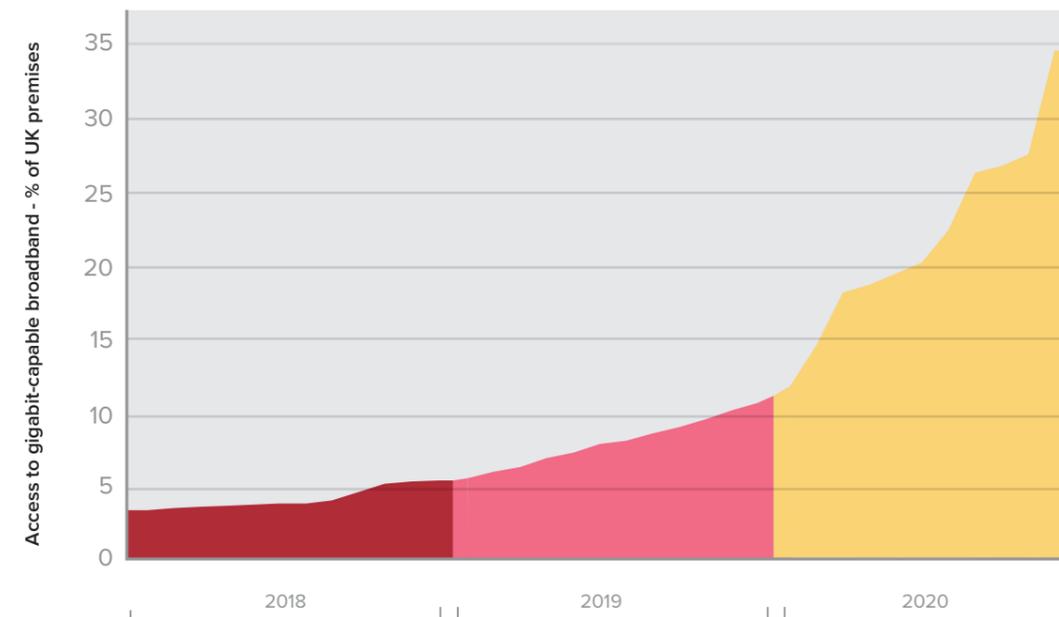
**Fast, reliable digital connectivity can deliver economic, social and well-being benefits for the whole of the UK.** Never has this been more important than as the country deals with the impact of COVID-19, when digital infrastructure has enabled home working, home learning, and kept families in touch with each other in extraordinary circumstances.

**Digital infrastructure is particularly important for the UK’s rural communities in all four nations.** Greater connectivity can help rural businesses innovate, grow, and create jobs. In doing so, it can help rural areas attract and retain young people and families, supporting thriving rural societies.

Gigabit-capable broadband, such as full fibre, can provide speeds of over 1,000Mbps, over forty times faster than standard superfast broadband and fast enough to download an HD film in seconds. These speeds provide new opportunities across the UK, for consumers and businesses alike, and enable 5G technology.

**The government’s programme for gigabit-capable broadband has made dramatic progress.** More than a third of UK premises now have access to gigabit-capable connections, up from 9% when the government took office in July 2019. By next year, more than half of all premises will have access. During the COVID-19 pandemic, operators have rightly focused on network resilience at a time of unprecedented need for good connectivity. The government has also announced restrictions on the use of Huawei equipment. The government is working with industry to target a minimum of 85% gigabit capable coverage by 2025, but will seek to accelerate roll-out further to get as close to 100% as possible. The government will continue to implement an ambitious programme of work to remove barriers to broadband deployment and maximise coverage in the hardest to reach areas of the country.

**Gigabit-capable broadband coverage in the UK**



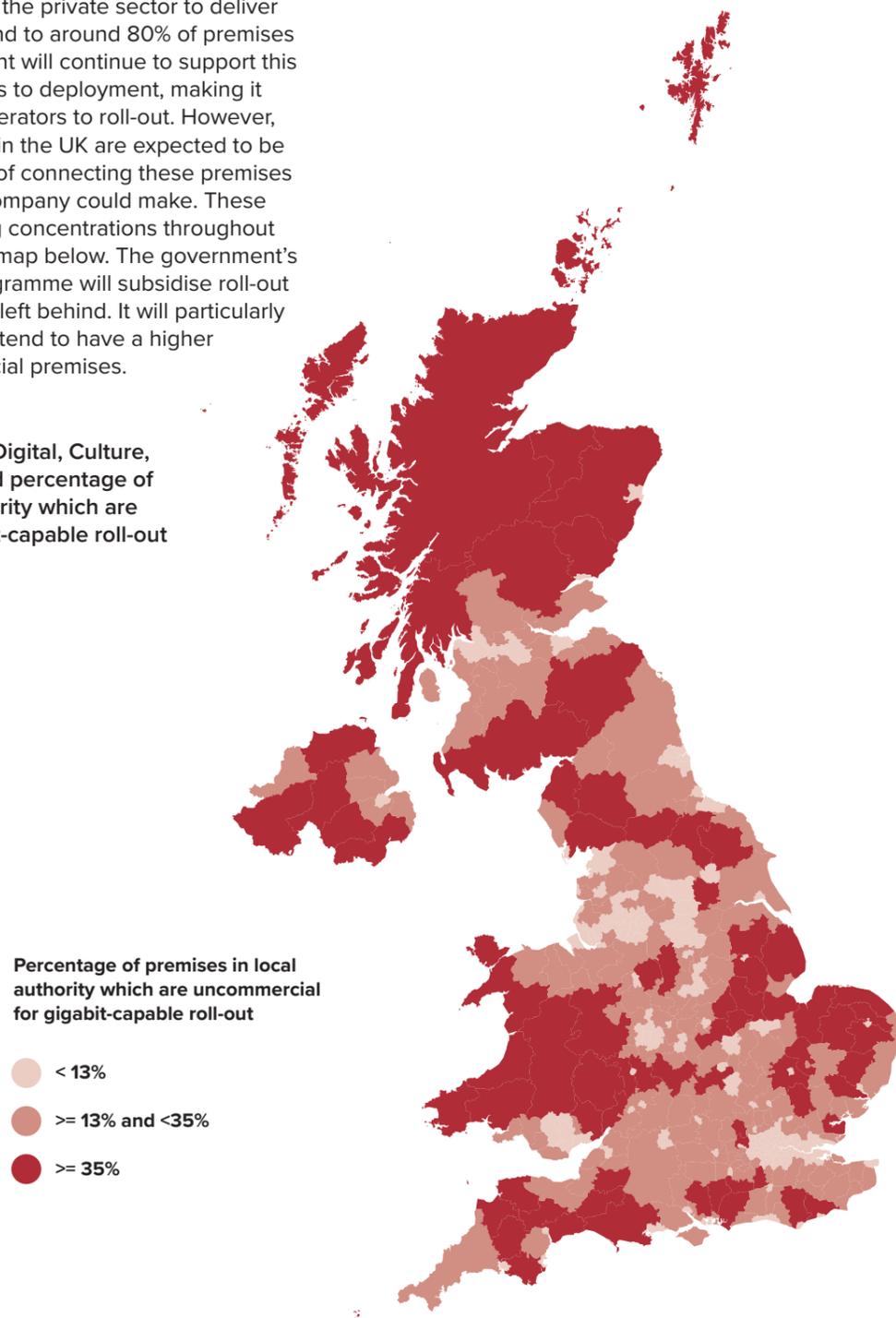
Source: Graph compiled using UK gigabit coverage data from thinkbroadband. UK gigabit coverage defined as percentage of UK premises with access to FTTP and/or DOCSIS 3.1. Data as of 10 November 2020.



**The strategy for UK-wide gigabit-capable broadband**

The government expects the private sector to deliver gigabit-capable broadband to around 80% of premises in the UK. The government will continue to support this through removing barriers to deployment, making it quicker and easier for operators to roll-out. However, around 20% of premises in the UK are expected to be uncommercial: the costs of connecting these premises outweigh the returns a company could make. These premises occur in varying concentrations throughout the UK, as shown by the map below. The government's £5 billion UK Gigabit Programme will subsidise roll-out to ensure no area will be left behind. It will particularly benefit rural areas which tend to have a higher proportion of uncommercial premises.

Source: Department for Digital, Culture, Media & Sport. Estimated percentage of premises in a local authority which are uncommercial for gigabit-capable roll-out



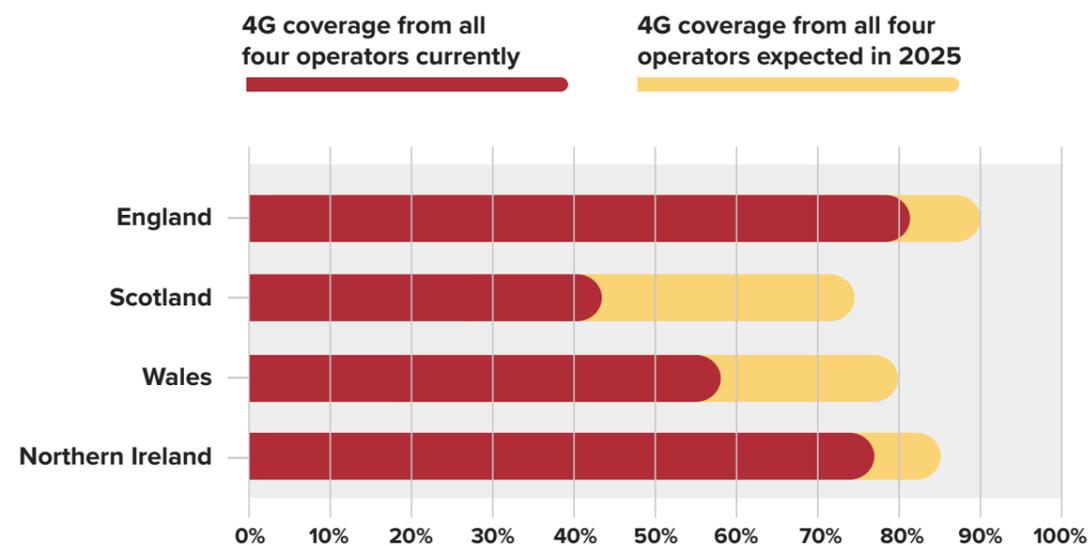
UK-wide roll-out is a major civil engineering project, requiring enough cabling to go around the Earth more than ten times.<sup>17</sup> The total level of investment required is in the region of £30 billion. Through the government's ambitious strategy, rapid increases in the rate of digital infrastructure deployment are already being seen and the UK is expected to see record speeds of deployment in the coming years. Current market data suggests that operators are on track to deliver new full fibre coverage to 2.5 million premises in 2020, up from around 750,000 in 2018.<sup>18</sup> The government expects this build rate to increase even further, creating thousands of new jobs.

Mobile connectivity is also crucial to allowing people to stay connected on the move. That is why the government is investing £500 million, matched by industry, to deliver high-quality 4G mobile coverage from at least one operator across 95% of the UK by 2025, through the Shared Rural Network. Through this ground-breaking partnership between government and industry, each operator has individually committed to reach 90% of the UK's landmass by 2026, and collectively the Shared Rural Network will provide additional coverage to 280,000 premises and 16,000 kilometres of roads by 2026. This will have major benefits in rural areas, and for Scotland, Wales and Northern Ireland nations in particular.

The Shared Rural Network will not only improve coverage, but also increase consumer choice. Currently, only 67% of the UK has good quality coverage from all four operators, and that will improve to 84% by the end of the programme.<sup>19</sup> This will mean far fewer people in rural areas will find themselves locked-in to the only mobile network with good coverage of their area.

The government will continue its pioneering 5G Testbeds and Trials Programme, with £50 million in 2021-22 to support demonstration projects across rural, urban and industrial settings. These projects show the exciting potential for 5G to transform the lives of consumers and businesses, and are a key part of ensuring the benefits of 5G can be felt in every nation of the UK by the mid-2020s.

It is also vital that digital infrastructure networks are secure and resilient. That is why the government is introducing the Telecommunications (Security) Bill which sets out a new regulatory regime for telecoms security. The government will also publish the 5G Supply Chain Diversification Strategy to ensure the UK's 5G networks are not over reliant on a single supplier, committing £250 million to start this journey. The strategy will set out a clear and ambitious plan to grow the telecoms supply chain and ensure it is resilient to future trends, to shape global standards, and to make significant investments in research and development to bring through new technology. The government will seek the advice of the Telecoms Diversification Task Force in developing specific programmes under this strategy.



Source: Ofcom 2020 Summer Update Connected Nations

### Flooding

Expanding economic opportunity means little for a place – and the people who live and work there – if the infrastructure supporting it is not resilient to potential hazards. Many rural communities and economies across the UK have experienced the devastating impacts of flooding, which can cause significant damage to homes and businesses lasting much longer than the floods themselves. The government is committed to harnessing the opportunities of rural landscapes to increase the resilience of rural communities to flooding. **The government will do this by maximising good land management and implementing nature-based solutions through the next £5.2 billion flood and coastal defence programme starting in 2021, a doubling of the current programme.** Further details are set out in Chapter 3.

## Boosting the UK’s cities and towns

The government recognises that different places across the UK have different challenges:

- **Regional cities** are not as productive or as connected, as they should be. The government’s long-term ambition is for UK cities to be globally competitive. The government will support them to improve their productivity through strengthened infrastructure; and
- **Many towns have lost out from structural changes** – facing economic and social deprivation. The government’s long-term ambition is for every town to be an excellent place to live and work – offering opportunity to those who live there. The government will drive the regeneration of towns, including through investing in infrastructure.

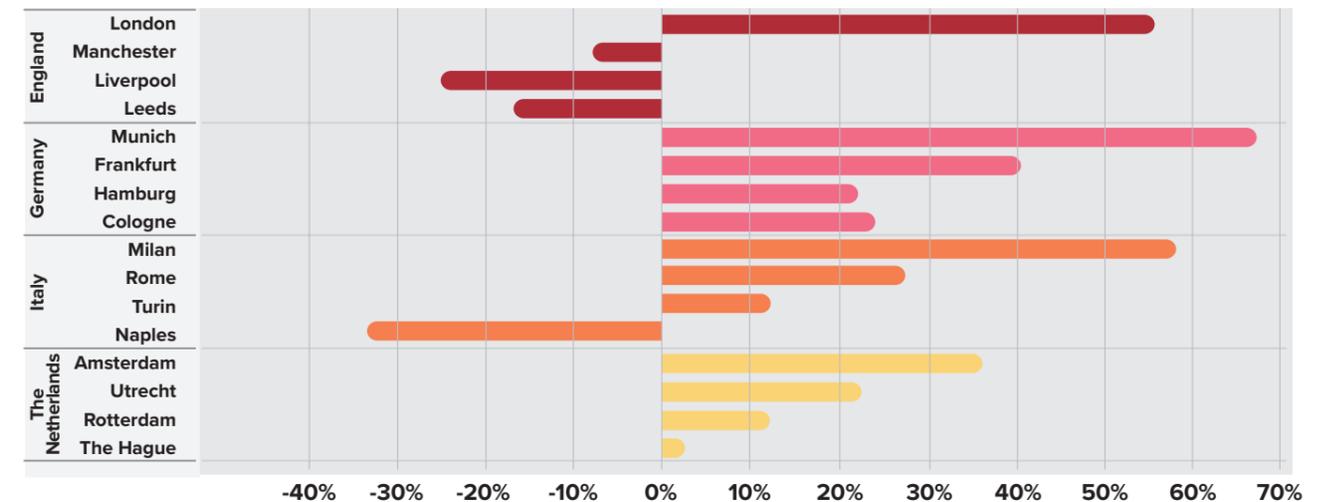
### Making cities the engines of future growth

The government shares the National Infrastructure Commission’s (NIC’s) view on the importance of strong regional cities; the vital organs of the UK economy. Cities drive economic growth through agglomeration effects; they encourage specialisation, drive competition and spread ideas and innovation faster than other places. London is one of the most productive cities in the world, and many other UK regional cities can also play a similarly important role in the UK economy.

However, the NIC noted that many of the UK’s largest cities have below average productivity relative to their size and population, in part due to high congestion and poor local transport links. They are not producing agglomeration economies to the degree that they could. This in turn has an impact on the success of nearby towns, as strong cities can act as an anchor for growth across a wider region.

A well-designed public-transport network is fundamental to the operation of any city. London is the only city in Europe where you can access more local services by public transport than by car.<sup>20</sup> But the story is different in regional cities, where access to those same services by public transport lags behind continental peers. **This is why the government will invest in the North, Midlands and South West to help rebalance the UK economy, and devolved administrations will receive funding to enable public transport investment in Scotland, Wales and Northern Ireland.** Levelling up the rest of the UK does not mean levelling London down. The government is continuing to address capacity issues in the capital, by financing the completion of Crossrail, but has agreed that Transport for London will stop development on Crossrail 2. This frees up investment to raise the performance of public transport networks in the regional cities towards London’s gold standard.

Productivity in selected major cities in England and comparable countries.  
Calculated using GDP per capita in the metropolitan area as share of the national value



Source: National Infrastructure Commission calculations using OECD Statistics. Functional Urban Areas and National level, 2018 (except France where latest urban productivity data is 2016). Productivity in English cities has been calculated as a percentage of the UK average

The government agrees with the NIC that long-term and locally led investment in large cities' transport networks is critical to driving future economic growth and competitiveness. This is central to the government's ambition of levelling up the UK.

The Transforming Cities Fund was launched at Autumn Budget 2017 to improve public transport, boost connectivity and reduce congestion through packages of interlinked schemes such as light rail, new bus corridors, cycling and walking infrastructure. The government has now allocated nine city regions a share of over £1.2 billion for a range of shovel-ready public and sustainable transport schemes – in addition to the over £1 billion already devolved to six Mayoral Combined Authorities. In line with the NIC recommendation, this will drive up productivity and spread prosperity through investment in public transport in MCAs.

Alongside the Transforming Cities Fund and a share of the £5 billion announced for buses and cycling over this Parliament, **eight City regions will also benefit from £4.2 billion government investment in five-year funding settlements for local transport starting in 2022-23**, and £50 million in 21/22 to support preparations for settlements. Following the approach that has worked for London, these settlements will be agreed with elected Mayors and published, providing transparency and accountability while giving Mayors the flexibility and certainty to deliver their plans. The city regions that will receive settlements, subject to appropriate governance, include Greater Manchester, Liverpool City Region, West Midlands, West Yorkshire, Sheffield City Region, Tyne and Wear, West of England and Tees Valley. This will deliver the NIC's recommendation to provide settlements that enable long-term and locally-led investment in large cities transport networks, devolving decisions on local transport to those that understand those systems best.

Transport needs to work hand in glove with skills, education, housing, culture and environment policies to deliver the step change in quality of life and economic performance the government wants to see. Alongside transport, the government is therefore taking steps to improve local infrastructure more broadly, working in conjunction with local areas to ensure investment is in line with local priorities. The government has agreed City and Growth Deals across the UK, to provide local areas with the powers and funding they need to drive forward local economic priorities. The government is investing in Scotland, Wales and Northern Ireland's cities, towns and rural areas through City and Growth Deals. There are 20 City and Growth Deals in Scotland, Wales and Northern Ireland either agreed or in negotiation, committing almost £3 billion of UK Government investment. This means every part of Scotland, Wales and Northern Ireland is supported by a City and Growth deal.

The government also continues to support pan-regional partnerships; the Northern Powerhouse, Midlands Engine, Western Gateway - and recognises the role they play in championing investment and opportunity in their geographies.

Spending Review 2020 also confirms that, in addition to the Brownfield Housing Fund announced at March Budget 2020 for Mayoral Combined Authorities to unlock up to 26,000 high quality homes, **the government will provide an additional £100 million in 21/22 to support housing delivery and regeneration**, including unlocking brownfield sites, regenerating estates and releasing serviced plots on public sector land.

These plans form part of the £7.1 billion National Home Building Fund which will help deliver up to 860,000 homes across the country, in large part through investment in infrastructure to unlock housing – including roads, community facilities and utilities. This will ensure that more homes mean better, not more stretched, local infrastructure and community facilities.



### **Regenerating towns and communities**

Towns in the UK are hubs of economic activity and provide homes to the majority of the population in the UK. While some towns have prospered, either in their own right or through their links to growing cities, many struggling towns do not always have the fundamental building blocks for a strong local economy in place.

Some towns face specific disadvantages that reduce growth and productivity. This can be a mix of economic deprivation, characterised by high concentrations of low-skilled workers, social deprivation, poor employment and low health outcomes. This can be exacerbated by poor transport and digital connectivity. Places that face these challenges need targeted support to help boost their local economies, support local leadership and maximise their potential.

**The government will, therefore, invest in infrastructure to support economic regeneration and create new employment opportunities in the towns across the UK** which are most in need, to make them excellent places to live and work.

Through the Towns Fund, the government is galvanising the local economies of over 100 struggling towns across England to support their long-term economic and social regeneration as well as their immediate recovery from the impacts of COVID-19. The first seven Town Deals were agreed in October 2020. Further successful towns will be announced over the coming months.

The government is taking steps through national programmes to support local economies, in towns across the UK. **Through its ambitious Freeports programme the UK government will bring jobs, investment and prosperity to some of the most deprived communities across the four nations of the UK.** Freeports will enjoy a combination of tariff benefits, tax incentives, and regeneration funding. The programme aims to establish Freeports as national hubs for global trade and investment across the UK, promote regeneration and job creation, and create hotbeds for innovation. A minimum of 10 Freeports will be delivered. Successful bidders will be announced in Spring 2021 and the first Freeports will be designated in late 2021.

Supporting jobs and growth across the UK, in particular in post-industrial and coastal towns, the government's decarbonisation agenda will build the UK's capability in new green industries. Infrastructure investment in offshore wind capacity (40GW by 2030) and port infrastructure will create jobs in coastal communities. Further investment in Carbon Capture and Storage and in low carbon hydrogen will drive economic activity in post-industrial towns.

# Infrastructure investment across the UK

Where policy is reserved for the UK government – for example digital infrastructure – it is taking action to improve infrastructure across the whole of the UK. Where policy is devolved – for example substantial areas of transport – the UK government allocates funding to the devolved administrations through the Barnett formula.

The map shows how investment by the UK government in a number of local infrastructure programmes will benefit different regions.

In addition, the government is making key transport investments in England, including:

## 1 North East

- **Tyne and Wear** and **Tees Valley** will benefit from intra-city transport settlements starting from 22/23.
- Providing £209m to the North East including £16m to redevelop **Sunderland Central Station**.

## 2 North West

- **Greater Manchester** and **Liverpool City Region** will benefit from intra-city transport settlements starting from 22/23.
- Providing £40m to **Preston City Region** including funding for a next generation Urban Traffic Management and Control system.
- Providing an additional £146m to halve the construction time of dualling the A66 across the Pennines.

## 3 Yorkshire and Humber

- **Sheffield** and **Leeds City Regions** will benefit from intra-city transport settlements starting from 22/23.
- Providing £319m to **West Yorkshire Combined Authority** including £30m for active and sustainable travel across **Bradford**, and £171m to **Sheffield City Region** including for a new bus rapid transit link.

- Developing schemes including the A1 from **Doncaster to Darrington**.

## 4 West Midlands

- **West Midlands Combined Authority** will benefit from intra-city transport settlements starting from 22/23.
- The Transforming Cities Fund provides £321m to **West Midlands Combined Authority** to invest in public transport schemes.

## 5 East Midlands

- Upgrading the A46 Coventry Junctions.
- Providing £169m to **Derby & Nottingham** including £25m for bus rapid transit in Derby, and £40m to **Leicester**.
- Progressing the North Hykeham Relief Road in Lincolnshire.

## 6 East of England

- Providing £39m to **Norwich** including a mobility hub at Norwich station, and £95m to **Cambridgeshire** and **Peterborough** to invest in public transport schemes.
- Building the Great Yarmouth Third River Crossing in **Norfolk** and Lake Lothing Third Crossing in **Suffolk**.

## 7 London & South East

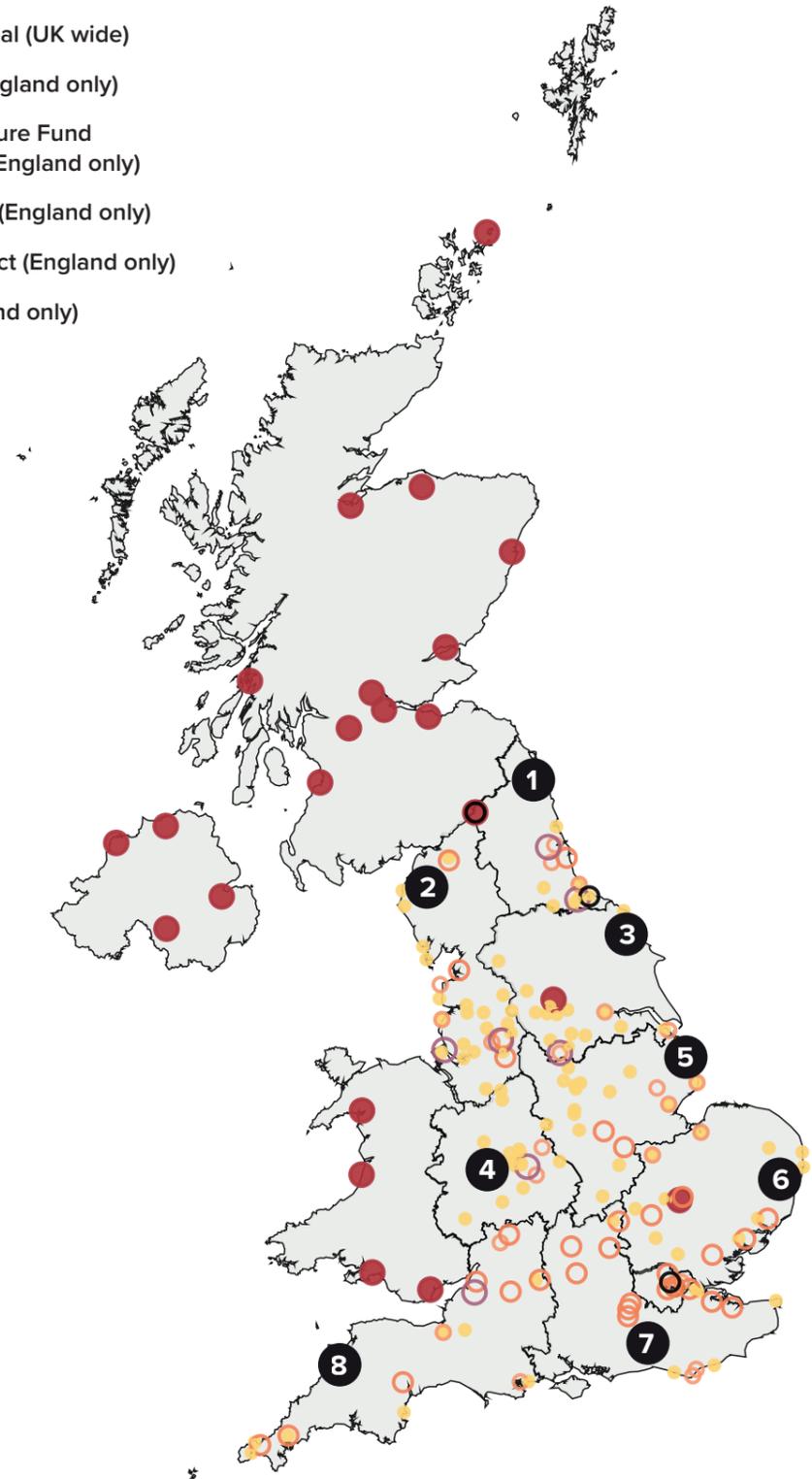
- Providing £60m to **Portsmouth** and **South East Hampshire** including the relocation of Gosport bus station and taxi rank, and £63m to **Southampton** including new rapid bus links.
- Investing in the Lower Thames Crossing and financing the completion of Crossrail.

## 8 South West

- The **West of England Combined Authority** will benefit from intra-city transport settlements starting from 22/23.
- Providing £59m to **Plymouth** including £12m to improve walking and cycling, and £79m to **Bournemouth, Christchurch & Poole**.
- Investing in the A303 Stonehenge scheme, and in MetroWest to improve rail services across **Bristol** and the surrounding region.

### Local infrastructure schemes

- City and Growth Deal (UK wide)
- Flood Defences (England only)
- Housing Infrastructure Fund - Forward funding (England only)
- Mayoral Gainshare (England only)
- Regeneration Project (England only)
- Towns Fund (England only)



# Connecting nations and regions

HS2 is this government's flagship national transport project, forming the spine of the UK's transport network by delivering essential North-South connectivity between some of the UK's biggest and most productive cities. High-speed rail does not just affect those who ride it, but also releases capacity on the classic rail network, meaning better local train connections into the UK's great cities. Construction for Phase 1 from London to the West Midlands started earlier in 2020, and the Hybrid Bill for Phase 2a from the West Midlands to Crewe is expected to receive Royal Assent later this year.

This government is committed to building back better. In line with the recommendations of Douglas Oakervee's review, **the government has strengthened HS2 governance, including through a new ministerial taskforce.** This is providing greater oversight and control of delivery performance, ensuring that HS2 will be delivered on time and on budget, and supporting realisation of the benefits of the scheme.

**Through the Union Connectivity Review announced by the Prime Minister the government will bring its four great nations closer together by assessing options to improve transport links.** The review will be chaired by Sir Peter Hendy and report by summer 2021. It will involve extensive consultation with the devolved administrations and consider the quality and reliability of existing connections; long-term trends in demand and technological developments; the environmental impact of both the existing and proposed transport links; and how connectivity can support economic growth as the UK recovers from COVID-19. The report will provide recommendations on whether and how best to improve connections, and whether that should include additional infrastructure investment by the UK government.

The government will also revitalise the arteries as well as the spine of the country's transport network, recognising that regional, as well as national, connectivity is vital to uniting the UK. **The government will make the largest ever investment in England's strategic roads - £27.5 billion over this Parliament, a 60% increase on spending in the last five years.** This major investment will ensure that these national traffic corridors are well designed, delivered, maintained, and continue to serve all road users into the future.

New upgrades will include: dualling the A66 between Penrith and Scotch Corner and halving the construction time as part of Project Speed; upgrading the A46 Newark bypass in the East Midlands; building a new Lower Thames Crossing; and building a two-mile tunnel on the A303 at Stonehenge to speed up journeys and enhance the World Heritage Site. The second Road Investment Strategy is focussed not just on road users, but on fulfilling the government's obligations to communities living close to major routes and towards the natural, built and historic environments. All of this money will generate Barnett payments to the Scottish Government, Welsh Government and Northern Ireland Executive, so that they can follow suit.

The railways helped to build modern Britain, so as well as building HS2, the government is also boosting the classic rail network. **Over the remainder of Network Rail's 5 year settlement – Control Period 6 – the government will invest £17.5 billion to renew and upgrade the railway system, improving passenger journeys across the UK.** This will deliver on the NIC's recommendations by progressing the East West Railway.

In 2017, the National Infrastructure Commission outlined the transformational economic potential of the Oxford-Cambridge Arc in its report 'Partnering for Prosperity'. At Spending Review 2020 the government has reaffirmed its commitment to the area, including additional funding to support the Budget 2020 commitments to develop a Spatial Framework to plan for long-term economic and housing growth and to explore the case for up to four Development Corporations along the route of East West Rail. This will help to deliver sustainable economic and housing growth, supported by infrastructure, that meets the needs of local people.

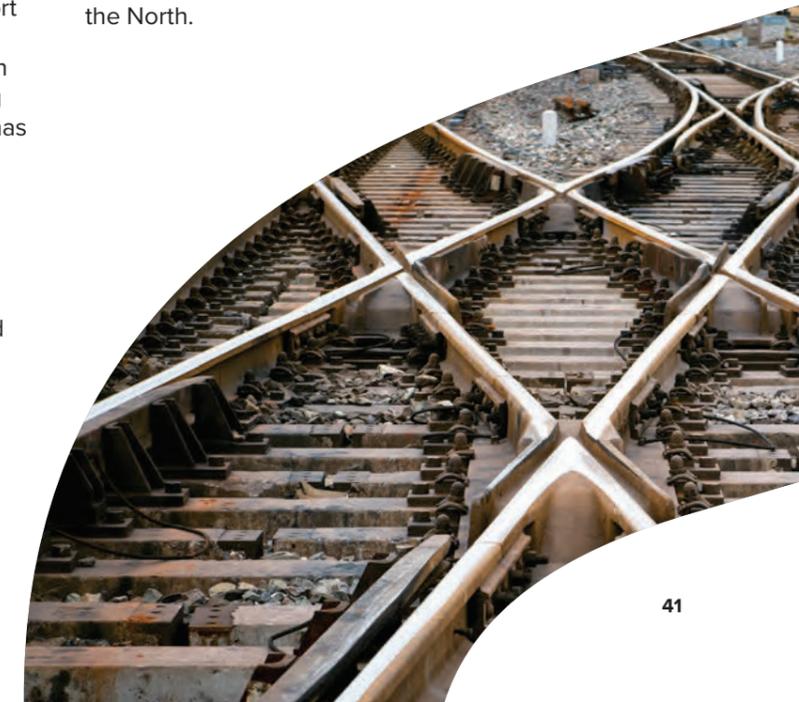
The government will also deliver on its manifesto commitment to spend £500 million to restore transport services previously lost in the Beeching cuts of the 1960s, including reopening the Ashington-Blyth line in Northumberland to passenger services, and restoring rail links to Okehampton in Devon. The government has also launched a New Ideas Fund to pay for feasibility work on proposals for new lines and stations.

Feasibility funding for the first ten schemes has been announced, which will provide a basis for decisions on further development: re-opening Meir Station in Stoke-on-Trent; the Barrow Hill line between Sheffield and Chesterfield; the Ivanhoe line between Leicester and Burton on Trent; branch lines on the Isle of Wight (Shanklin-Ventnor and Wootton-Newport); the Abbey line between St Albans Abbey and Watford Junction;

Reopening Wellington and Cullompton railway stations; Bury-Heywood-Rochdale lines; Clitheroe to Hellfield railway line; reinstatement of rail access to Devizes via a new railway station at Lydeaway; and the Waterside line (Hythe-Totton). The government will provide further feasibility funding for an additional fifteen proposals to inform decisions on further development: reopening Beeston Castle and Tarporley station in Cheshire, St. Anne's Park station in Bristol, and Ferryhill station in County Durham; reinstating links between Bolton, Radcliffe, and Bury; the Stratford-upon-Avon to Honeybourne/Worcester/Oxford line; new stations at Waverley in South Yorkshire and a station in the Langport/Somerton area of Somerset; improved services from Melton Mowbray and Falmouth; upgrading the South Fylde Line; the Maid Marian line between Nottinghamshire and Derbyshire; reinstating rail access to Cirencester; restoring services between Swanage and Wareham; the South Humber rail link; and a new link between Consett and Newcastle.

The government is also expanding the third round of the New Stations Fund to £32 million. This will fund the opening of railway stations at Edginswell and Thanet Parkway in Kent; and St Clears in Carmarthenshire. It will also provide funding to further develop proposals for stations at Haxby in York and Deeside in Flintshire.

The government is fully committed to improving connectivity between northern cities. Over the course of this year, the government has been drawing up an Integrated Rail Plan for the Midlands and the North of England, which will be published shortly. In line with the terms of reference, the Plan will ensure that Phase 2b of HS2, Northern Powerhouse Rail and other planned rail investments in the North and Midlands are scoped and delivered in an integrated way. This will bring transformational rail improvements more quickly and to more places, and will be informed by the NIC's assessment of the rail needs of the Midlands and the North.



# Connectivity for a trading nation

International connectivity is important for linking businesses to valuable markets, and to support trade and investment.<sup>21</sup> The UK has the third largest aviation network in the world. Flights into UK hub airports connect the regions and nations of the UK to the world, enabling a more global Britain. Air connectivity also brings together the nations of the UK, and in 2019 over 19 million passengers flew on routes between England, Scotland, Wales and Northern Ireland.<sup>22</sup>

The government last month launched the **Global Travel Taskforce** to consider how the international travel sector could be supported through the specific challenges caused by the COVID-19 pandemic. It has since considered what steps we can take to facilitate business and tourist travel on a bilateral and global basis, through innovative testing models and other non-testing means, and more broadly what steps we can take to increase consumer confidence and reduce the barriers to a safe and sustainable recovery of international travel. This is alongside the already unprecedented package of measures announced by the Chancellor and available to the travel sector, including schemes to raise capital, flexibilities with tax bills and the extended furlough scheme.

The UK's freight system is one of the most efficient in the world, providing seamless transportation of goods into, out of and across the country, boosting economic growth. The government has announced that it will provide a full response to the NIC's *Better Delivery: The Challenge for Freight* report through the publication of a comprehensive cross-modal freight strategy in 2021. This will also consider the impacts on the freight system of the end of the transition period and the COVID-19 pandemic.

In preparation for the end of the transition period, the government has provided critical support to key ports around the UK through their surrounding Local Resilience Forums to mitigate any potential disruption and ensure continued seamless transit of freight in and out of the country. This has included development and implementation of essential traffic management plans, particularly around the Port of Dover and the Channel Tunnel, as well as upstream intervention to support and improve haulier preparedness ahead of the end of the Transition Period. The government has also allocated £200 million towards the Port Infrastructure Fund to ensure that ports across the UK have the necessary infrastructure in place for freight to continue to flow smoothly in and out of the UK.

## Doing things differently

The government is taking steps to reform how it invests in places, as well as what it invests in, to embed long-term change in policy making to level up and unleash the potential of the Union.

**Major policy interventions will be considered UK-wide.** The UK Internal Market (UKIM) Bill changes the government's powers to act in Scotland, Wales, and Northern Ireland. If passed, the UK Government will have concurrent powers to invest in infrastructure and economic development.

The government supports English devolution to strengthen local institutional structures and bring decision-making closer to the places impacted by those decisions. Nearly 40% of people in England now live in an area where devolution has transferred powers and funding from Whitehall to a directly-elected city region mayor.<sup>23</sup> The government will set out expanded devolution arrangements in the English Devolution and Local Recovery White Paper, building on the success of the directly-elected mayors who are driving economic growth across their functional economic areas, by ensuring mayors have the powers and responsibilities they need to shape their local area.

**The government is also taking steps to ensure national policy making is sensitive to local needs.**

Through the government's Places for Growth programme, 22,000 civil service roles will be relocated from Whitehall by 2030 to address the regional imbalance in the civil service. The new National Infrastructure Bank will also be based in the north of England. In addition, the UK government will invest £210 million in 2021-22 in the Places for Growth and Government Property Agency hubs programmes, establishing more UK government hubs around the UK, enabling departments to further relocate out of London. The government will deliver on its commitment at *Budget 2020* for an economic campus in the North of England.

To ensure the impact of policies on places is taken into account when choices are made, the government conducted a review into its guidance on appraising proposals regarding government spending, taxation and regulations (*the Green Book*). This will better link policies to government objectives, including levelling up.

# The Green Book Review

As announced at Budget 2020, the government has undertaken a review of the Green Book, to ensure that investment spreads opportunity across the UK. The Green Book is the government's guidance on best-practice appraisal and is therefore a vital tool for ensuring value for money for taxpayers.

A central finding of the review is that the appraisal process often fails to properly consider how a proposal will deliver the government's policy ambitions, including levelling up. This leads to appraisals being focused on a benefit cost ratio (BCR) that does not reflect social policy objectives or give ministers the information they need about where costs and benefits fall.

HM Treasury has therefore updated the Green Book to end the dominance of the BCR in decision making, starting with this Spending Review. Appraisals must give a comprehensive picture of cost and benefits, including non-monetisable, non-economic impacts. In particular, options will be assessed first and foremost on whether they deliver relevant policy objectives (for instance, the regeneration of a particular place). Any option which fails to do so cannot be considered value for money and will not progress to shortlisting stage.

The government is also changing the guidance so it will no longer be acceptable for proposals to be 'place blind'. Business cases should be developed to align with relevant local strategies and major interventions in the area. And for the first time, business cases for all proposals will have to set out how they will impact different places on a comply or explain basis.

These changes will be crucial to levelling up. They will mean that appraisals and advice to ministers should include much better analysis on how options deliver their policy goals, as well as which parts of the country look to gain most from them, supporting better-informed decisions.

These updates will feed into future Spending Reviews and HM Treasury will also roll out a tailored programme of training across Whitehall and beyond to ensure that the new Green Book guidance is fully embedded in future appraisals.



# Decarbonising the economy and adapting to climate change

## At a glance

As set out in the Prime Minister's *Ten Point Plan for a Green Industrial Revolution*, infrastructure investment is fundamental to delivering net zero emissions by 2050. The government will unlock private sector investment to accelerate the deployment of existing technology, such as retrofitting the UK's building stock and electrification of vehicles, while advancing newer technologies such as carbon capture and low-carbon hydrogen. The government's approach will create jobs to support the recovery from COVID-19, and support the government's levelling up agenda by ensuring key industrial areas are at the heart of the transition to net zero. The UK is already decarbonising faster than any other G20 country.<sup>24</sup> As hosts of the UN Climate Change Conference COP 26 next year, the UK will go even further to promote the importance of low-carbon infrastructure and support its commitment to the Paris Agreement.

### Key measures include:

- Making significant investment in offshore wind and modern ports and manufacturing infrastructure to expand the share of generation from renewables;
- Providing up to £525 million to bring forward both large-scale nuclear and invest in the development of advanced nuclear technologies;
- £1 billion to support the establishment of carbon capture and storage in four industrial clusters;
- Investing £1.3 billion in charging infrastructure to accelerate the mass adoption of electric vehicles (EVs) ahead of ending the sale of new petrol and diesel cars by 2030;
- Promoting private investment and setting an enduring regulatory environment to promote energy efficiency;
- Enabling heat decarbonisation by supporting the roll-out of existing technologies like heat pumps and development of emerging technologies like hydrogen;
- Funding to help England to meet its share of the Climate Change Committee's recommendations to plant 30,000 hectares of trees a year in the UK; and
- Investing £5.2 billion by 2027 to better protect 336,000 properties and boost resilience of communities to the increased risk of flooding and coastal erosion resulting from climate change

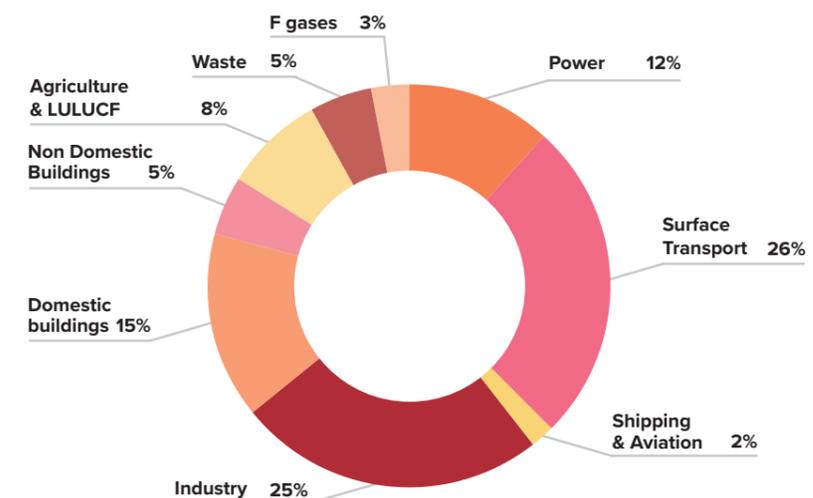
In June 2019 the UK became the first major economy in the world to legislate to end its contribution to global warming by 2050, in line with the UK's commitment to global climate action under the Paris Agreement.

**The UK's commitment to achieving net zero emissions by 2050 will require profound changes that will provide huge opportunities for the UK to build back better from COVID-19.** The UK will need strong, consistent and deliberate policy action to support the technologies that will reduce emissions.<sup>25</sup>

These changes will be economy-wide, and HM Treasury is currently undertaking a review into how the transition could be funded and where the costs could fall. An interim report will be published shortly and the final report in spring 2021.

The majority (over 80%) of the UK's emissions come from infrastructure sectors, and so action on infrastructure will be crucial for meeting the UK's Carbon Budgets and continuing progress towards the net zero target.<sup>26</sup>

### UK production emissions by sector (2019)



Source: Department for Business, Energy & Industrial Strategy provisional UK emissions 2019, on a by source basis - mapped to Climate Change Committee sectors

The UK has already made considerable progress, reducing emissions by 45% since 1990 while growing the economy by almost 80% (as of 2019).<sup>27</sup> This has been achieved while minimising costs, causing a net reduction in household bills.<sup>28</sup>

The majority of contributions and investment so far has come from the power sector, where emissions have fallen almost 70% since 2008.<sup>29</sup> This has been driven through coordinated action by the private sector working closely with the government: regulated efficiency measures have reduced electricity consumption by 14%;<sup>30</sup> coal power generation has fallen from 30% to below 1% since 2014,<sup>31</sup> and the price of off-shore wind has fallen by 55%.<sup>32</sup>

To go further, the UK will need to improve other aspects of its infrastructure in a way that more visibly alters people's lives, including how people heat their homes and travel around the country. **This Strategy sets out early actions that the government will take to build the infrastructure needed to achieve net zero, improve air quality, create a greener urban environment, and minimise the impact of flooding.** This includes significant progress on: carbon capture and storage, low-carbon hydrogen production, charging infrastructure for electric vehicles, offshore wind, and energy performance improvements in buildings.

In many cases the solutions needed are known and action needs to be taken immediately. Further progress will be made by accelerating the deployment of existing technology in the near-term, such as increasing wind generation or driving retrofit in the UK's building stock. These tasks will enable rapidly growing industries, creating jobs across the economy and boosting productivity.

For other areas, **new technologies and skills will need to be developed to continue decarbonising.** Since 2016, the government has made historic increases to public support for science. The UK's world-class institutions are already amplifying this scientific progress through curiosity-driven research and support for technologies. Looking ahead, the government will need to build on these strengths to drive both the development and deployment of new technologies, including:

- Low carbon hydrogen as a potential alternative to fossil fuel heating in industry and buildings, to store energy, a source of power, and for some modes of transport;
- Carbon Capture and Storage to remove up to 90% of the carbon dioxide emissions from gas-fired power stations and industrial factories, including those making hydrogen, as well as to support greenhouse gas removal technologies to offset some emissions from the hardest to decarbonise sectors;
- Technologies to remove carbon dioxide from the air, using 'direct air capture' or biomass, so that it can be used as an input to other processes, or stored; and
- Floating offshore wind to allow the harnessing of wind power across a greater proportion of the seabed.

Investment in these areas, where the UK has competitive advantage, can create the knowledge and skills needed for a green industrial revolution, driving leadership in the industries of the future, reducing national and global emissions, as well as providing the platform for significant economic growth. Where these investments are brought together to create place-based industrial clusters they can transform local economies, creating productive jobs, developing specialist skillsets, and attracting private investment. For example, the North East of England could become a home of choice for companies delivering carbon capture and storage; making hydrogen power a part of daily life; and designing, building and maintaining offshore wind turbines.

At the same time, **the country must adapt to the risks posed by climate change.** National infrastructure will be made resilient to future climate change by ensuring that its expected effects are fully considered at the design stage. This means addressing the likely impacts of higher temperatures, more extreme weather, and increased incidence of droughts, floods, and disease, and building in cost-effective mitigations over the whole life cycle of the asset now

## The government's approach

**Reducing emissions across whole sectors of the economy must be done in a sustainable way that minimises cost.** The benefits, opportunities and costs need to be shared across society and the economy must grow to enable the transition to be sustained, particularly as it recovers from the COVID-19 pandemic. **In November 2020, the Prime Minister laid out his Ten Point Plan for a Green Industrial Revolution. This strategy sets out how it will be delivered.**

The government cannot tackle this challenge alone. **Instead, the government will look to work closely with investors, industry and households.** This strategy sets out clear objectives and ambitions, to provide policy and regulatory certainty for project sponsors and investors to harness the transformational benefits that can be delivered by long-term private capital investment. The energy transition will be underpinned by harnessing private investment and innovation as new technologies become available, new markets are established and opportunities are created across the economy.

However, the full suite of policy levers will need to be deployed to encourage this private sector investment and create the appropriate market incentives to encourage competition and drive down costs, and to ensure that decarbonisation is achieved at the best possible value for money, with the right distributional balance of costs across consumers, taxpayers and the private sector.

**In the short-term, public financing will help to overcome barriers to investment in new technologies and ensure the costs are borne fairly across society, for example:**

- By using the government's unique position to support those risks where the private sector simply cannot, including in the development of financing and delivery models for complex and novel major infrastructure;
- By supporting trade exposed industries at risk of offshoring due to higher operational costs associated with decarbonisation technologies;
- By investing in fuel poor households and social housing to reduce bills for the poorest in society and protect the less able to pay; and
- By supporting the transition from R&D to deployment, driving forward innovation and encouraging UK companies to stay at the cutting edge.

**Now and in the longer term, creating the right regulation and tax measures will be imperative in driving competition and opening up new markets.** This will influence behaviour to address market failures, with a view to any government subsidies reducing over time as risks which once could not be borne by the private sector are mitigated. The Net Zero Review will analyse the range of choices for how households, businesses and the taxpayer could contribute towards the transition and evaluate the trade-offs between cost, competitiveness, effects on consumers and impacts on the taxpayer.

This chapter sets out the government's progress on this vision to date, across low carbon energy, industry, transport, buildings, resilience to climate change, and developing new and innovative technologies, as well as the strategy for moving forward.

# Power

The decarbonisation of the power sector is a major success story from the past decade. It accounted for just 12% of emissions in 2019, down from 27% in 2008, mainly due to the growth of renewables and reductions in the use of coal in power stations.<sup>33</sup> Throughout this period, private investment has also underpinned substantial progress in reducing the cost of clean electricity and maintaining secure supplies.

The steady increase in renewable investments has been driven through a number of successful subsidy schemes and market reforms. Competitive auctions through the Contracts for Difference scheme have led to a dramatic reduction in the costs of offshore wind from £120/MWh in the first auction in 2015 to just £40/MWh in 2019.

While the total cost to consumers from low carbon levies has been significant, rising to around £10 billion a year in 2020, these have secured significant reductions in the cost of clean electricity and also put downward pressure on wholesale prices. Further deployment of renewables can be done in a more sustainable fashion without significantly higher costs to consumers.

Progress on decarbonisation in the power sector has also been driven by a consistent carbon price signal that has reduced the UK's reliance on coal generation from 30% to below 1% since 2014.<sup>34</sup> **The UK has committed to ending coal electricity generation no later than 2025** and is encouraging other countries to follow suit. The carbon price remains one of several efficient tools in driving decarbonisation.

The government has also ensured that security of electricity supplies remains paramount as the country decarbonises. Since it was established in 2014, the Capacity Market has helped maintain sufficient supply of electricity generation, providing generators with competitively auctioned contracts to be available at periods of peak demand. The UK is also building the first nuclear power station in a generation, at Hinkley Point, which will provide reliable low carbon electricity to power the equivalent of around six million homes a year once it is operational later this decade.

The 2050 net zero goal provides the trajectory within which the government will continue to decarbonise the power sector, while ensuring that the right balance is struck between reducing power sector emissions, maintaining the security of the system and ensuring electricity remains affordable for households and businesses.

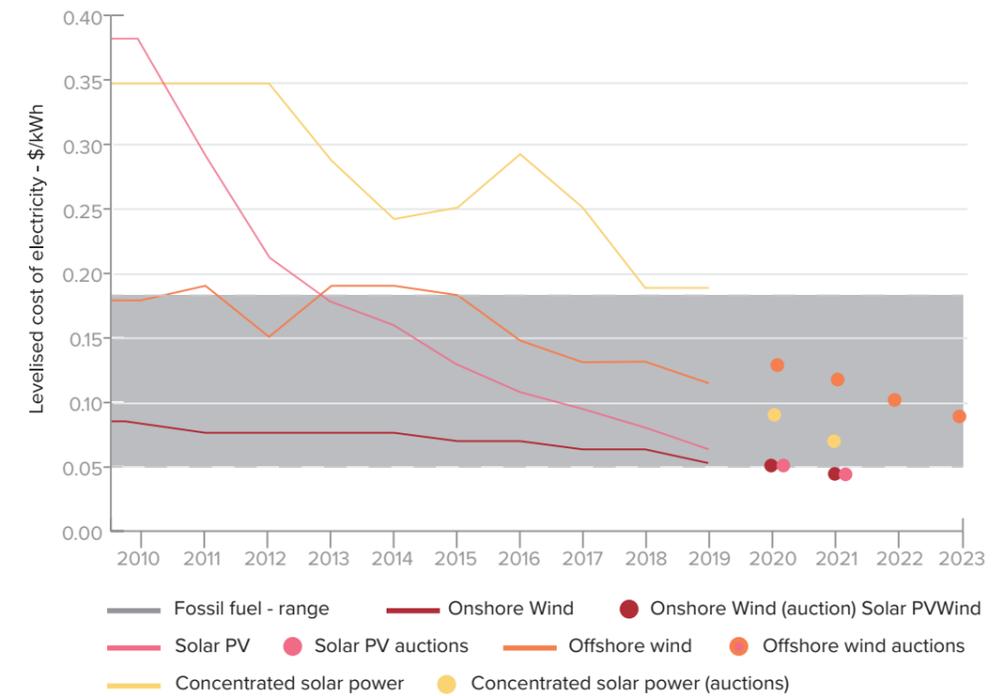
To achieve net zero by 2050, the power system will need to be virtually carbon free and significantly larger to cope with the additional demand from electrification in transport, heating and some industrial processes. This expanded system will require increased investments in network infrastructure, sources of flexibility, such as interconnection, demand response and storage and enough low carbon generation capacity to provide the vast majority of the UK's electricity needs.<sup>35</sup>

The bulk of this generation needed by 2050 will likely be provided by low cost renewables. However, given their intermittent nature there will also be a requirement for more reliable sources of power in the future energy provision of the UK. In particular, power generated from nuclear or power stations that burn hydrogen, or gas with carbon capture and storage. The government will therefore ensure private capital investment is able to continue to finance the energy transition and allow these technologies and network investments to come forward.

There will be decisions on how quickly capital-intensive energy infrastructure is deployed, where the government will ensure costs are minimised and distributed fairly across different groups. The Net Zero Review will look at these questions in more detail, and in spring 2021 will set out how the government will approach such distributional issues and ensure the UK benefits from the opportunities, as well as who bears the costs of the transition.

## Price of renewables globally

Source: Climate Change Committee Progress Report 2020



Around £20 billion a year is invested in the energy sector,<sup>36</sup> and there continues to be strong appetite for investment in sustainable energy projects with good environmental, social and governance credentials. The government has played a critical role in bringing technologies to market and reducing the cost of capital through the Contracts for Difference scheme. This competitive support mechanism is now well established and will help support the deployment of renewables as well as other forms of low carbon power.

Other financing models will also be vital to power sector decarbonisation. The Regulated Asset Base (RAB) model has played an important role in encouraging investment into complex infrastructure projects and the government is considering its replicability for energy projects such as nuclear power and carbon dioxide transport and storage.

## Renewables

To deliver net zero, the share of generation from renewables needs to dramatically increase. While the UK leads the world in the deployment of offshore wind, greater generation capacity will need to come from onshore wind and solar as well. As recommended by the National Infrastructure Commission (NIC), the next auction round for Contracts for Difference in

## 2021 will include technologies such as onshore wind and solar PV.

The government has also set out an increased ambition to achieve 40GW of offshore wind by 2030. To begin on this path and to increase the amount of renewable capacity needed to further decarbonise power, the government has announced an ambition for the 2021 Contracts for Difference Auction to support up to double the renewable capacity procured in the 2019 round, subject to maintaining competitive tension in the auction.

**The government will continue to support the deployment of renewables through competitive Contracts for Difference auctions every two years, with the next due in 2021.** Contracts for Difference have proven successful in reducing the cost of capital for renewable technologies, but this has insulated generators from price signals, potentially failing to incorporate the total system costs of intermittent renewables. As the NIC recommended, **the government will ensure that total system costs are considered in designing future Contracts for Difference rounds as far as possible and will publish a call for evidence on the evolution of the Contracts for Difference regime to explore these issues further.**

As renewables deploy at greater volumes it is likely that investors will look to the post-contract market revenues available and will wish to understand what the power market could look like with increasing zero marginal costs generation on the system. The government will continue to ensure that support mechanisms evolve to consider the total system benefits provided by competing generation technologies and flexibility solutions.

Building the sector has required considerable consumer-funded subsidies, which are forecast to reach over £10 billion annually by the end of the year. Following the 2019 auction, however, the latest offshore wind contracts are expected to deliver clean electricity at very low costs, and could even begin generating at below market prices when they start operating in the mid-2020s, meaning a better deal for consumers.

Consistent with the target of 40GW offshore wind by 2030, the government expects around 65% of electricity generated in Great Britain to come from renewable sources by 2030. However, the need to ensure that generation can be brought forward sustainably and at least cost to consumers, and that the sector contributes appropriately to the UK's overall climate goals, means that this is not a strict renewables target.

In partnership with industry, the government will enable the UK to harness more of the economic benefit from the accelerated deployment of renewables technologies, alongside the clean electricity it produces. The Offshore Wind Sector Deal with the renewables sector continues to support these efforts.

As a greater number of offshore wind farms are deployed off the British Isles, there will be many jobs created across the UK. To harness the potential of this new industry **the government has announced £160 million to upgrade UK ports and manufacturing facilities.** This infrastructure funding could help the sector support up to 60,000 direct and indirect jobs by 2030. The offshore wind industry has set a target in its Sector Deal, to secure 60% UK content for the offshore wind supply chain. The government will consult on the introduction of more stringent supply chain plan requirements in future Contract for Difference, including consequences for non-delivery.

**The government has also committed to support the development of floating offshore wind,** setting a target of 1GW deployment by 2030 to ensure the UK establishes a leadership position in the next generation of offshore wind technology.

### Nuclear

Nuclear power has long played an important role in UK power generation and will continue to do so provided it can be delivered to time and budget. Hinkley Point C will be the UK's first new nuclear plant in a generation, and has continued construction throughout the pandemic by adapting to new working environments.

Nuclear is a proven, value-for-money source of reliable low carbon power which can complement renewables. **The government is pursuing large-scale nuclear projects,** subject to clear value for money for both consumers and taxpayers and all relevant approvals, with further details to follow in the *Energy White Paper*.

As outlined in the *Ten Point Plan for a Green Industrial Revolution*, **the government will provide up to £525 million to bring forward large-scale nuclear and invest in the development of advanced nuclear research and development (R&D),** including up to £385 million in an Advanced Nuclear Fund for small modular reactors and advanced modular reactors. This is alongside £220 million for nuclear fusion.

Last year, the government consulted on a nuclear Regulated Asset Base (RAB). The government is considering the responses to this consultation and expects to publish a response in due course. Alongside considering the RAB model the government will also continue to consider the potential role of government finance during construction, provided there is clear value for money for consumers and taxpayers.

### Carbon capture and storage

Carbon capture and storage (CCS) will be essential for net zero. Power stations with CCS technologies could provide valuable low carbon electricity when renewables are not generating by capturing the emissions from biomass or gas-powered power generation. CCS will also be essential to decarbonising large parts of industry, producing low emissions hydrogen and in delivering greenhouse gas removal technologies, permanently locking away carbon dioxide.

However, the technology has not been delivered at scale and significant risks remain. Therefore, the government will play a central role in bringing forward this complex infrastructure in partnership with industry over the next decade. The CCS Action Plan sets out the ambition to deploy CCS at scale in the 2030s.<sup>37</sup>

To help deliver on the government's ambitions, Budget 2020 announced that the government will establish CCS in at least two UK sites, along with at least one CCS power station, using consumer subsidies.

The government is now increasing that ambition, and will:

- **Invest £1 billion to bring forward four CCS clusters by the end of the decade, with two to begin construction by the mid 2020s;**
- **Set an ambition to capture 10 megatons of carbon dioxide per year by 2030;** and
- **Outline further details in 2021 on a revenue mechanism to bring through private sector investment** into transport and storage, power and industry CCS and hydrogen projects via new business models to support these projects.

## Hydrogen

Hydrogen is a flexible energy carrier that can be burnt as a gas or used in a fuel cell to generate heat or power. It is a leading technology option for decarbonising heavy industry, and could be used to reduce emissions in hard-to-abate modes of transportation, such as heavy goods vehicles or shipping. Almost none of the hydrogen used in the UK today is low carbon, and it is mostly used in the petrochemical sector.

In order to realise the potential of hydrogen the government is establishing a **£240 million Net Zero Hydrogen Fund**. This will provide capital funding to support deployment of low-carbon hydrogen production in the UK, and will support both methane reformation with CCS ('blue' hydrogen), and electrolysis using renewable electricity ('green' hydrogen). Working alongside partners in industry, the government's aim is for the UK to develop 5GW of low carbon hydrogen production capacity by 2030, with a mixture of 'blue' and 'green' hydrogen.

Next year, the government will set out its approach to growing the hydrogen economy, through a **UK Hydrogen Strategy**. The strategy will consider how to continue support for the scale up of low carbon hydrogen production, as well as the interaction with storage, distribution and potential end use demand. It will set out how the UK can capture economic benefits from building a resilient domestic supply chain.

This will include details of hydrogen business models and a revenue mechanism for bringing through private sector investment, to ensure low carbon hydrogen can play a key role in the UK's economic recovery and achieving net zero. It will also set out how the government will support the hydrogen and CCS industries side by side, in conjunction with support for the demand side such as heating trials and support for hydrogen in shipping.

## Network reform

As the 2017 Cost of Energy Review and the NIC have pointed out, there is scope for greater competition in delivering the onshore network infrastructure upgrades the UK will require as the energy system decarbonises. Network operators will therefore be required to make investment decisions that are best for the operation of the whole system rather than their own network. The government will outline plans on onshore networks in the forthcoming *Energy White Paper*, including plans to legislate to introduce competition.

The government has already worked with National Grid and Ofgem to give more independence to the transmission system operator for electricity, and expects to see distribution networks take a more active role in system operation. **The government will review the right long-term role and organisational structure for the Electricity System Operator**, in light of the reforms to the System Operator instituted in April 2019. It is possible that there will need to be greater independence from the current ownership structure, should it be appropriate to confer additional roles on the System Operator.

As the power system evolves, the government will need to consider how its own role, as well as the roles of the regulator, the Electricity System Operator, network operators and other energy market participants will change over time. **The Energy White Paper will set out the government's approach on the overall governance of the system.**

The evolution of the power system will also require the evolution of the networks to deliver power to people's homes and businesses and to ensure this infrastructure does not hold back the transition to electric vehicles, cleaner sources of heat or greater renewables on the grid. To enable this, government and the regulator will continue to ensure there is a common understanding of the future strategic direction to align policy objectives while maintaining the regulators' independence. If achieved, this approach could provide investors with greater certainty over longer-term investment decisions and support the transition of the energy network.

## Industry

Industry accounted for 25% of emissions in 2019.<sup>38</sup> Since 1990, emissions have more than halved due to reductions across all parts of industry, including manufacturing, construction and fossil fuel supply.<sup>39</sup> In the manufacturing sector, greenhouse gas emissions fell by 25% between 2009 and 2017. Analysis from the Climate Change Committee (CCC) suggests this is due to the changing structure of the UK's manufacturing sector, as well as improved energy efficiency and a shift to low carbon fuels.<sup>40</sup>

A mix of technologies will be needed to fully decarbonise industry, because there is a wide variety of sources of emissions across sectors. Options include CCS, electrification of heating, and using hydrogen as a low carbon fuel. These will be considered in the context of changes in the energy sector.

Around half of manufacturing sector emissions in the UK come from major industrial clusters, and targeted public investment in shared infrastructure will help turn these areas into world-leading centres of low-carbon manufacturing, creating jobs and export opportunities.<sup>41</sup> Alongside this, firms will also need to make their processes more energy efficient. **The £315 million Industrial Energy Transformation Fund will support early adoption of energy efficiency and deep decarbonisation projects in energy intensive industries.**

Most energy intensive industries currently receive free allowances under the EU Emissions Trading System (ETS). When the UK leaves the EU, the UK will adopt a replacement carbon pricing system, which will include similar mechanisms to free allocation.

Many of the sectors that receive free allowances are particularly exposed to international trade, and bearing all the costs of decarbonising could be a risk to their competitiveness. As part of the *Industrial Decarbonisation Strategy*, to be published in spring 2021, the government will consider what demand-side policies can drive emissions reductions in industry. These could include developing the market for low carbon industrial products, for example through introducing new product standards to drive demand.

**The government will also consider what role fiscal measures should play in supporting industry.** As well as up-front capital support for CCS and low-carbon hydrogen production, **the government will set out new business models for industry carbon capture and hydrogen to enable private sector capital investment and support firms' longer-term operating costs.** The government's role will evolve over time, with subsidy reducing as technology matures, supported through an increasing carbon price. The government will consider what trade and diplomatic levers could be used to protect the competitiveness of UK industries as they decarbonise.

## Transport

Transport is the highest emitting sector of the UK economy, accounting for 28% of domestic emissions in 2019.<sup>42</sup> Reducing emissions from all modes of transport will therefore be key to achieving the UK's net zero target in 2050. The government is committed to going further and faster to tackle climate change, which is why **the Department for Transport is developing a bold and ambitious Transport Decarbonisation Plan to achieve net zero emissions across all modes of transport.** This Plan will be the biggest piece of work the government has ever done to tackle greenhouse gas emissions from transport. The holistic and cross-modal approach to decarbonising the entire transport system will set out a credible and ambitious pathway to deliver transport's contribution to carbon budgets and meet net zero by 2050.

Road transport is responsible for over 90% of domestic transport emissions and is also one of the biggest contributors to poor air quality in the UK's towns and cities.<sup>43</sup> Decarbonising road transport is therefore particularly important for meeting the interim carbon budgets, as well as cleaning up the UK's air.

To help achieve this, **the Prime Minister has announced that new petrol and diesel cars and vans will not be sold after 2030.** Between 2030 and 2035, any new cars and vans sold with tailpipe emissions should be capable of driving a significant distance with no carbon emissions from the tailpipe. All cars and vans sold after 2035 will be fully zero emissions at the tailpipe. The government will increase the uptake of zero emission vehicles with a package of regulation, incentives and investment in electric vehicle (EV) charging infrastructure, delivered in partnership with the auto sector, consumers and the growing chargepoint industry. As set out by the Prime Minister, in moving forward with this transition the tax system will need to encourage the uptake of EVs and that revenue from motoring taxes keeps pace with this change, to ensure the government can continue to fund first-class public services and infrastructure.

The EV charging ecosystem will be one of the UK's green industries of the future, and the government wants to maximise private sector investment in the delivery of charging infrastructure. However, recognising that it is a new market and that availability of charging infrastructure is a barrier for two thirds of drivers considering the switch to EVs, **the government will kickstart the delivery of a core rapid charging network across motorway and key A road service stations.** By 2023 the government expects to see a high-powered charging hub at every motorway service area, installed by the private sector.

To ensure the private sector can continue to expand the charging network at pace in the 2020s, **the government will invest £950 million in future proofing grid capacity along motorways and key A roads** to prepare for 100% uptake of zero emission cars and vans ahead of need.

**The government will also extend support for chargepoint installation at homes, workplaces and on-street locations,** but reform these schemes so that they target difficult parts of the market such as leaseholders and Small and Medium Enterprises (SMEs). **Finally, the government has committed £90 million to fund local EV charging infrastructure** to support the roll out of larger, on-street-charging schemes and rapid hubs in England.

Alongside this investment, the government will be consulting on regulations to improve the consumer experience at public chargepoints later in 2020. There are four core areas in the consultation, including payment methods and payment roaming, opening up chargepoint data, increasing the reliability of the charging infrastructure and ensuring pricing transparency. In 2019 the government consulted on proposals to require all newbuild residential properties with associated parking (including a block of flats with an associated car park) to have an EV chargepoint. The government also consulted on requiring all new non-residential properties, with more than 10 parking spaces, to have at least one chargepoint and cable routes for a further one in five spaces. The government will respond to the consultation soon, with regulations being laid in 2021.

At the start of this year, before the COVID-19 pandemic, EV market share had tripled compared to last year, and has held up through the course of the year. To further incentivise drivers to make the switch to an EV, the government uses the tax system to encourage the uptake of cars with low carbon dioxide emissions, which is why users of zero and ultra-low emission cars have beneficial Vehicle Excise Duty (VED) and company car tax rates (CCT) in comparison to conventionally fuelled vehicles. Following Budget, from April 2020, zero emission cars pay no VED at first registration or subsequently. **The Spending Review confirms the government will continue the Plug-in Car, Van, Taxi and Motorcycle Grants until 2022-23,** increasing funding by over £200 million compared to budget 2020, to £582 million in total.

As well as decarbonising private vehicles, the government wants to increase the share of journeys taken by public transport, cycling and walking, and decarbonise buses and trains. Supporting greener buses is another key part of the government's agenda for achieving net zero and tackling air pollution. London now has the largest fleet of electric buses in Europe,<sup>44</sup>

and the UK is one of the world's leading designers and exporters of buses. The Prime Minister announced in February that the government would deliver a further 4,000 zero emission buses. **The Spending Review confirms £120 million to deliver an additional 500 zero emission buses in 2021-22.** This builds on up to £50 million investment in the first All Electric Bus Town, which will be announced early next year and is expected to deliver around 300 zero emission buses, supporting greener and cleaner journeys.

Where it is less certain what technology will provide the most effective route to decarbonisation or where it is unclear how the technology can be scaled commercially, the government will fund R&D programmes to support innovation.

Innovation will play a crucial role in decarbonising domestic shipping, for which emissions are likely to be reduced mainly through the scale adoption of alternative fuel systems like hydrogen and ammonia. **The government will provide £20 million in 2021-22 to enable a UK network of technology demonstrations in alternative marine fuels and green shipbuilding,** including hydrogen vessels trials in Orkney and groundworks for a hydrogen port in Teesside. In parallel, the government will consider whether and how the Renewable Transport Fuel Obligation could be used to encourage the uptake of low carbon fuels in maritime, taking the availability of sustainable resources, competing uses and the international character of the maritime sector into consideration.



**£21 million will also be provided for the decarbonisation of aviation**, through supporting sustainable aviation fuels and zero emission flight infrastructure. This work will be overseen by the recently established Jet Zero Council, a partnership between government and industry to drive the delivery of new technologies and innovative ways to cut aviation emissions. This will fund a one-year competition to support the development of a Sustainable Aviation Fuel (SAF) Demonstration and first-of-a-kind commercial plants. This funding will also kickstart the establishment of a clearing house for SAF, the first of its kind in Europe, to certify new fuels and develop UK expertise. The government will also consult on introducing a SAF mandate. Funding for the Aerospace Technology Institute, which provides match-funding to stimulate the development of innovative and more efficient aircraft technologies, has also been extended.

The UK's airspace is an essential, but invisible, part of its national transport infrastructure. **The government is therefore committed to modernising UK airspace, which will deliver quicker, quieter and cleaner journeys and more capacity** for the benefit of those who use and are affected by UK airspace. The government will continue to co-sponsor the airspace modernisation programme with the Civil Aviation Authority. This will ensure that carbon savings for aviation can be realised through proven technology this decade.

Freight also contributes to pollution and congestion in the UK's urban areas which, left unchecked, will only get worse. The government supports the NIC's recommendations in this area, and believes that through the adoption of new technologies and better recognition of freight's needs in the planning system, it is possible to decarbonise freight by 2050 and manage its contribution to congestion.

Unlike lighter goods vehicles, such as passenger cars and vans, there is currently not a commercially viable path to decarbonise heavy goods vehicles (HGVs) which contribute 17% of UK transport emissions.<sup>45</sup> To support the sector to make the transition to zero emission vehicles, the government will invest £20 million in 2021-22 to establish zero emission road freight trials. These will assess the most effective and commercial path to decarbonising HGVs. The government will also consult on a phase out date for the sale of diesel HGVs.

The government has announced that it will provide a full response to the NIC's Better Delivery: *The Challenge for Freight report*, through the publication of a comprehensive cross-modal freight strategy. This strategy will be published in 2021 and will consider the impacts on the freight system of the end of the

transition period as the UK leaves the European Union and the COVID-19 pandemic. Since the publication of *Better Delivery* in April 2019, progress has been made against the recommendations in the report, including on:

- **Better land use planning:** through provision of guidance on how local authorities can assess need and allocate space for logistics in the *Housing and economic needs assessment*, July 2019; and
- **Data and analysis:** through the ongoing development of a freight mapping tool to enable the UK's freight networks to meet growing demands for faster deliveries while reducing its impact on congestion and the environment. The discovery phase of this project will conclude in December, with further work planned for 2021.

The government has also recently established a Freight Council to provide a forum for discussion with industry stakeholders from all parts of the freight sector. The forum met frequently in the first half of 2020 and will meet quarterly going forward, with a focus on long-term strategic issues for the freight sector.

## Buildings

Emissions from UK buildings have declined steadily over the past 20 years, falling 25% since their peak in 2001 due to a range of government interventions and actions by the private sector, many of which have also reduced energy bills.<sup>46</sup>

### These include:

- Improving the energy performance of homes through the Energy Company Obligation and public sector buildings through the Public Sector Energy Efficiency Scheme;
- Supporting the roll-out of low carbon heat through the Renewable Heat Incentive;
- Kickstarting the heat networks market through the £320 million Heat Networks Investment Project;
- Setting stretching efficiency standards for new gas boilers;
- Raising minimum standards for both new and existing buildings, and energy related products;
- Introducing minimum energy performance standards for domestic and non-domestic private rented properties and;

- Requiring large businesses to carry out audits every 4 years under the Energy Saving Opportunity Scheme (ESOS), covering buildings, industrial processes and transport, to identify cost-effective energy saving measures.

This year so far, the government has announced further measures to continue this progress, including:

- **Over £3 billion to make homes and buildings greener and more energy efficient** through the Green Homes Grant, Public Sector Decarbonisation Scheme and Social Housing Decarbonisation Fund demonstrator;
- **The introduction of a Future Homes Standard**, in the shortest possible timeframe before 2025, which will ensure new build homes are future proofed with low carbon heat and world leading levels of energy efficiency and consult shortly on increased standards for non-domestic buildings;
- **A new Green Gas Support Scheme** to support the production and injection of green gas (biomethane) into the grid, funded through a Green Gas Levy, and a £270 million Green Heat Networks Scheme, enabling new and existing heat networks to be low carbon and connect to waste heat that would otherwise be released into the atmosphere; and
- **Support for households and small businesses to invest in heat pumps** through a Clean Heat Grant scheme, backed by £100 million of funding.

These policies are driving growth in the energy efficient and low carbon heat sector, with the Office for National Statistics (ONS) estimating 114,000 were employed in the sector in 2018, an increase of 59% since 2015 with a turnover of £16.7 billion<sup>47</sup>

However, the UK continues to have some of the oldest and least energy efficient homes in Europe, and the sector continues to make up 23% of total UK emissions meaning that more ambitious and urgent action is required in this Parliament.<sup>48</sup>

To meet the UK's climate goals, the pace of heat decarbonisation and energy efficiency improvement needs to accelerate. 85% of homes are currently on the gas grid, but to get to net zero, the vast majority will need to stop burning natural gas.<sup>49</sup> This will require further improvements in the energy efficiency of buildings, repurposing the grid to green gases

(biomethane or hydrogen), moving to non-grid low carbon heat sources (primarily heat pumps), or to hybrid systems that combine the two. It is not yet clear which of these routes will be best, and it is possible that a variety of solutions will be required for different properties, or in different areas of the country. Making the decision too quickly may lead to inefficient investments and sub-optimal path dependency while uncertainty remains high.

However, with boilers lasting roughly 15 years on average, 2050 is only two heating system replacements away. **Therefore, by the early 2030s the UK needs to be in a position to ensure that the estimated 1.7 million new heating systems being installed each year are ready for net zero. Today, that number is nearer 30,000.** It is therefore necessary to take the steps now to inform decisions about what kind of installation must be made.

In relation to hydrogen, that means supporting activity to determine its safety and feasibility. This includes delivering hydrogen heating trials, where the government is investing £81 million with the goal of beginning a neighbourhood trial by 2023 and a large village trial by 2025. For heat pumps, it means taking large scale 'no regrets' actions which are necessary in all scenarios and can lead to lower consumer bills, reduced fuel poverty and a thriving industry. This includes ramping up the domestic heat pump market to 600,000 installations by 2028, growing heat networks, and improving the energy efficiency of the UK building stock. This will require strong regulation to drive behaviour change and investment from those able to pay, while ensuring that the government supports those who need it.

Action will also be required in the non-domestic sectors. Through the Public Sector Decarbonisation Fund, **the government will continue to take the necessary steps to improve schools, hospitals, prisons and other public buildings.** The government will consult on future building standards and in-use energy performance requirements for non-domestic buildings, and publish a response on non-domestic private rental sector buildings regulation.

More detail on how the government plans to use a combination of regulation and targeted spending to stimulate the energy efficiency market over the next decade, and encourage greater use of clean heat, will be set out in the forthcoming *Energy White Paper*, *Hydrogen Strategy*, and *Heat and Building Strategy*.

## Climate change adaptation

Infrastructure for energy, water, transport and communications underpins activities across society and the economy, yet may be directly or indirectly vulnerable to climate change risks. The second *Climate Change Risk Assessment (CCRA)*, published in 2017 identifies the key climate risks to infrastructure, including from groundwater flooding, coastal flooding and erosion, embankment failure, high winds, lightning as well as cascading failures from infrastructure interdependencies.

In the second National Adaptation Programme, the government set out a vision to develop an infrastructure network that is resilient to today's natural hazards and prepared for the future changing climate. The government engages with the Infrastructure Operators Adaptation Forum, a network coordinated by the Environment Agency, Climate Change Committee and National Infrastructure Commission. The Forum enables learning and the sharing of best practice on actions to reduce vulnerability and realise opportunities around interdependencies between infrastructure systems. In addition the government supports and builds capability of organisations reporting under the third cycle of the Adaptation Reporting Power, which opened in January 2019 and runs until Jan 2021. Over 90 organisations have confirmed their participation in this reporting round, including infrastructure operators responsible for energy, water, telecoms, road, rail and ports.

In the 25 Year Environment Plan, the government committed to ensure that all policies, programmes and investment decisions consider the possible extent of climate change this century. As part of ensuring this approach is embedded in policy and programme decisions, the government has revised the *Green Book Supplementary Guidance on Accounting for the Effects of Climate Change* to include updated information on climate evidence and assessments.<sup>50</sup> This guidance is an important tool in supporting departments to meet the Green Book requirement to consider climate risks in policy, programme and investment decisions where appropriate.

The increasingly interdependent nature of the UK's critical infrastructure means that the need to identify and limit cascading risks is only becoming more important. Climate change impacts may result in risks within and between critical national infrastructure sectors.

## Nature-based solutions and waste

Climate change has severe implications for natural habitats and biodiversity loss, and it is essential that these twin threats are tackled in parallel. The Review into the Economics of Biodiversity is considering the question of how economic prosperity can go hand in hand with addressing biodiversity loss in a global context. Domestically, nature-based solutions have an essential role to play both in climate mitigation and adaptation. Healthy and restored ecosystems lock away more carbon in plants and soils than degraded ones, while also supporting a more diverse and abundant range of flora and fauna.

**The government's Nature for Climate Fund (NCF) will help England to meet its share of the CCC's recommendations to plant 30,000 hectares of trees a year in the UK.** Woodlands and urban trees are vital green infrastructure which offer carbon capture as well as a wide range of natural capital and public amenity benefits such as clean water, natural flood alleviation, biodiversity, and urban cooling. **The government will**

**extend the Urban Trees Challenge Fund and invest in Community Forests.** The NCF will also help to restore more peatlands, locking in carbon while providing wider benefits for biodiversity and water. Further detail will be set out in the England Tree Strategy and England Peat Strategy next year.

The UK also needs to go further in increasing its resource-use efficiency, to reduce the burden placed on the natural world through the supply of raw materials and absorbing waste. **The Environment Bill is legislating wide-reaching waste reforms** – including extended producer responsibility (EPR), a deposit return scheme, and consistent collection of food waste and recycling - which will increase resource-use efficiency and cut greenhouse gas emissions from their implementation in 2024. EPR will ensure that the costs of processing packaging waste are transferred from local authorities to manufacturers and sellers. This will encourage innovation in packaging design, leading to a more sustainable use of resources.

In order to prevent the build-up of waste, it is important to be able to follow its journey through supply chains. New waste tracking technology in the UK is the future of a high-tech circular economy underpinned by world class digital infrastructure, and will ensure that all waste movements across the economy can be tracked, supporting resource efficiency as well as informing sustainable future infrastructure investment.



## Water and flood risk management

Climate change will continue to increase the risk that there is too much or too little water in the environment – leading to a higher frequency of flooding and drought. Both extremes in weather can cause significant damage and disruption to communities, homes, land and infrastructure.

While it will never be possible to prevent all flooding, taking clear action now to boost nationwide resilience will ensure the impacts from flood events can be minimised and communities can recover more quickly when they do happen. In July 2020, the Secretary of State for the Environment published the government's long-term Policy Statement on flood and coastal erosion risk management.<sup>51</sup> The Policy Statement outlines five ambitious policies and over 40 supporting actions to better protect and prepare the country against flooding and coastal erosion. Alongside the government's policy statement, the Environment Agency published their updated National Flood and Coastal Erosion Risk Management Strategy for England.

At the heart of the government's strategy is its flood and coastal defence investment programme, which provides longer-term certainty of funding, unlocking even greater efficiency in infrastructure investment. Devolved administrations receive funding in-line with the investment. **The March 2020 Budget announced that, from 2021, the amount invested in the flood and coastal defence programme in England will double to £5.2 billion, delivering 2,000 new defence schemes to better protect 336,000 properties over six years.**

This investment will reduce national flood risk by up to 11% by 2027 helping to avoid £32 billion of wider economic damages – benefitting every region of the country. This exceeds the level of investment recommended by the NIC, underlining this government's commitment to ensuring homes and businesses across the country are better protected from the devastating impacts of flooding.

Alongside this commitment, **the government announced a transformative £200 million Flood and Coastal Resilience Innovation Programme.** Through this new programme, managed by the Environment Agency, over 25 local areas in England – urban, rural and coastal, from the North, the Midlands and the South – will be selected to take forward wider innovative actions that improve their resilience to flooding and coastal erosion.

The government agrees with the NIC that there must be a twin track approach to delivering additional water supply and demand reduction to increase the resilience of water supplies. Water companies are responsible for planning to meet future supply requirements through the production of water resource management plans. For the next round of plans due in 2024, **the government will require the water industry to plan to deliver resilience to a one in 500-year drought.**

The Environment Agency published a National Framework for water resources in March 2020, and will support water companies to plan regionally and with other sectors to achieve the right balance of measures to increase resilience. At Price Review 2019, Ofwat agreed up to £469 million of funding for water companies between 2020 and 2025 to progress work on new strategic water resource and transfer infrastructure, as identified in company Water Resources Management Plans. Ofwat has established the Regulators' Alliance for Progressing Infrastructure Development (RAPID) to support this process and overcome barriers which might hamper the development of these strategic schemes.

As well as new infrastructure, the government recognises that demand on water supply must be tackled through reducing the amount of water lost through leaks and reducing the volume consumed by customers. **The government is exploring the possibility of a statutory target to reduce water demand using powers in the Environment Bill.** This would be on the volume of water distributed or abstracted by water companies, encompassing household use, non-household use and leakage. In line with the NIC's recommendations, the water industry has also committed to reduce leaks by 50% by 2050.

## Innovative technologies

Since 2016 the government has increased public investment in science and innovation to historic levels. These investments have enhanced understanding of the social, environmental and economic implications of future energy options, helping to create a whole system approach to net zero. This support is helping to bring

new innovations to the market. For example, cheaper and more efficient fuel cells and new sustainable biofuels, underpinning the net zero transformation.

**At the Spring Budget, the government committed to at least doubling the size of the Energy Innovation Programme.** The Energy Innovation Portfolio (now the Net Zero Innovation Portfolio) is designed to reduce the costs of decarbonisation by developing and accelerating near-to market low-carbon energy technologies that will be necessary to achieve net zero emissions by 2050. The portfolio is targeted at the development and demonstration end of the R&D spectrum to bolster technologies such as floating offshore wind, hydrogen and advanced modular nuclear reactors and stimulate private sector investment.

**The government is making £200 million of this funding available in 2020-21.** Through this programme the government expects to bring down the costs of deploying innovative near-to-market technologies, such as hydrogen. It will also support the commercialisation of new types of firm low carbon power to become available in the 2030s and 2040s, such as inter-seasonal storage, and less intermittent forms of renewables, such as floating offshore wind.

This investment will support leading researchers and innovators from all four nations to discover and create the industries of the future. This funding will boost R&D activity from discovery research to demonstration. Supporting the UK to seize the opportunity of scientific progress to deliver new transformative technologies, enhance the efficiency of existing approaches and support the adoption of emerging technologies across the country.

**At the Summer Economic Update the government dedicated £100 million towards Direct Air Capture technologies** – as a type of Greenhouse Gas Removal technologies – in order to help achieve net zero by 2050. In October, the Prime Minister also committed to support the development of floating offshore wind, setting a deployment target of 1GW by 2030.

**The government is also commissioning the NIC to undertake a new study looking at Greenhouse Gas Removal technologies.** This study will report in summer 2021, and the Terms of Reference have been published alongside this Strategy.

## Looking to the future

The government will continue to report reductions in the UK's carbon emissions in line with carbon budgets. The government will also monitor air quality, efforts to reduce the impact of climate change (including drought and flooding), progress against statutory fuel poverty targets, progress against the ambition for two million green jobs by 2030 across the UK, and steps to deliver an average building EPC rating of C. And, as the key pathways towards net zero become more well established, the government will track and use real time data, such as EV uptake and heat pump installation, to ensure the fundamental changes in the economy needed to deliver net zero are being delivered.

**This Strategy is central to the UK's efforts to achieve net zero emissions by 2050 and delivering the Prime Minister's *Ten Point Plan for a Green Industrial Revolution*.** By unlocking private sector investment, the government will accelerate the deployment of existing technologies, and advance innovation in new ones. In doing so, the government will lead the UK through a just transition to net zero, that supports the short-term recovery from COVID-19, and levels up and unites the nations, by providing long-term sustainable jobs in the future net zero economy.



# Supporting private investment

## At a glance

Private investment has delivered major benefits for UK infrastructure and will be vital over the coming decades as the UK moves towards meeting net zero in 2050. The government is committed to supporting private investment and is taking action across the following areas:

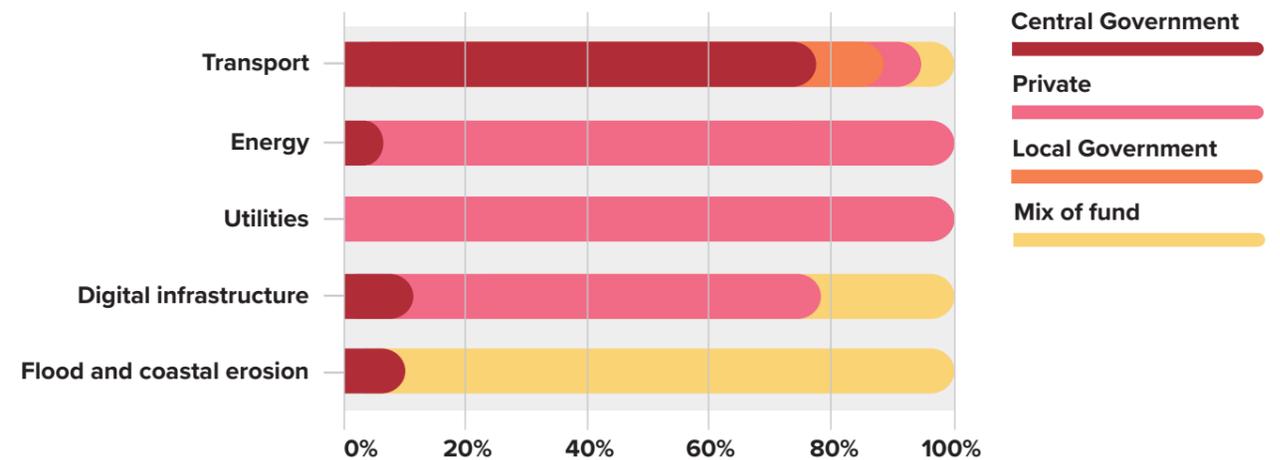
- **The government is setting up a UK infrastructure bank**, to co-invest alongside the private sector in infrastructure projects;
- The bank will operate UK-wide, be based in the north of England, and support the government's ambitions on levelling up and net zero;
- The bank will also be able to lend to local and mayoral authorities for key infrastructure projects, and provide them with advice on developing and financing infrastructure;
- **The government is committed to the model of independent economic regulation**, but will refine it to ensure it provides a clear and enduring framework for investors and businesses and delivers the major investment needed in decades to come, while continuing to deliver fair outcomes for consumers;

- **The government will produce an overarching policy paper on economic regulation in 2021**, which will consider regulator duties, injecting more competition into strategic investments, and the benefits of a cross-sectoral Strategic Policy statement; and
- **The government will continue to develop new revenue support models and consider how existing models - such as the Regulated Asset Base model and Contracts for Difference - can be applied in new areas and remains open to new ideas from the market. The government will not reintroduce the private finance initiative model (PFI/PF2).**

The private sector plays a vital role in achieving the UK's infrastructure ambitions. Much of UK's economic infrastructure is privately owned, with almost half of the UK's future infrastructure pipeline forecast to be privately financed.<sup>53</sup>

The UK has long been an attractive destination for private investment, underpinned by a sophisticated system of independent regulation, strong legal framework and expertise, and leading professional and financial services sectors. This has drawn investment from both UK and international investors across various sectors including transport, digital infrastructure, and utilities.

Funding mix of UK investment between 2018/19 and 2020/21 by sector



Source: 2018 National Infrastructure and Construction Pipeline

Private investment has delivered major benefits for UK infrastructure. Over the past decade alone, over £200 billion has been invested in the water and energy sectors.<sup>53</sup>

Over the past three decades, this investment has delivered significantly higher service quality for consumers. The number and length of power cuts has more than halved since 2002.<sup>54</sup> From 1990 to 2019, emissions fell 41% while the economy grew 78%,<sup>55</sup> water leaks are down by a third since the mid-1990s<sup>56</sup> and over 96% of premises in the UK have access to superfast broadband (speeds of 24Mbps or more).<sup>57</sup>

Historic levels of investment will be required in UK infrastructure in the coming years, to maintain and upgrade networks to meet the government's objectives for economic growth and decarbonisation. For example:

- Water companies in England and Wales will be investing at least £51 billion between 2020 and 2025;<sup>58</sup>
- The total level of investment required to upgrade the nation's broadband networks to be gigabit-capable speeds is in the region of £30 billion; the vast majority of this is expected to come from the private sector;<sup>59</sup>
- Total annual investment in the energy sector was £19 billion in 2019 and this is expected to increase in the years to come in order to transform energy networks to achieve net zero;<sup>60</sup>
- The Prime Minister's '10 Point Plan for a Green Industrial Revolution' will mobilise £12 billion of public investment and potentially three times more from the private sector.

The government remains strongly committed to supporting private investment and maintaining the UK's status as a leading global destination for private investment. That is why the government conducted an in-depth review – the 'Infrastructure Finance Review' (IFR) – of private investment in infrastructure and asked the National Infrastructure Commission (NIC) to undertake a review of UK's system of economic regulation. **This Strategy marks the government's conclusion to the IFR and response to the NIC study.**

The IFR was launched in Spring 2019, and consulted a broad range of financial and infrastructure experts on: the current state of the UK's infrastructure finance market and the role of the European Investment Bank; the ways in which the government and independent regulators can help facilitate investment; the potential future challenges for infrastructure financing; and the performance and possible improvements to the UK's institutional framework to support infrastructure finance. Further information on the IFR is set out in the government's formal response to the consultation, published alongside this strategy.

The government has heard from the market on the challenges facing UK infrastructure in the coming decades. The IFR found that the UK continues to have fundamental strengths, and the market appetite for investing in UK infrastructure is strong, especially for long-term investments with well-understood risk profiles. But the UK will face new challenges as it seeks to decarbonise the economy and ensure access to high-quality infrastructure across the country. The government needs to do more to attract private investment to deliver the investment needed in this period.

Following the IFR, the government's approach to private investment is built on three key principles:

- **The government will provide investors with long term policy certainty** including where appropriate, directly coinvesting alongside the private sector and acting as a cornerstone investor on key projects through a national infrastructure bank;
- **The government will maintain a strong and enduring system of independent economic regulation**, helping deliver the investment levels the country needs and fair outcomes for consumers of today and the future; and
- **The government will continue to use a range of policy tools and innovative funding mechanisms to embrace opportunities** from new technologies and decarbonise and level up the economy.



## A new infrastructure bank for the UK

To underpin this infrastructure revolution and catalyse the private investment the UK needs, **the government is setting up a new infrastructure bank for the UK.** The bank will play a leadership role in supporting private infrastructure projects to help meet the government's objectives on economic growth, levelling up, and transitioning to net zero.

**The bank will be headquartered in the north of England,** and will operate UK-wide, supporting investment in projects and programmes across the whole of the UK.

In line with the NIC's recommendation, the new bank will operate within a mandate set by government and have a high degree of operational independence. It will be a world-class, expert institution. The bank will play an important role in supporting new infrastructure technologies.

**The bank will co-invest alongside private sector investors** including banks, institutional investors, sovereign wealth funds, pension funds and global infrastructure investors. It will use a range of tools to support private projects: as well as offering guarantees through the existing UK Guarantees scheme, it will be able to offer debt, equity, and hybrid products.

**The bank will be able to lend to local and mayoral authorities for key regional infrastructure projects.** It will also be able to provide advice and support to these authorities on developing and financing projects.

The new bank will replace some of the activities of the European Investment Bank (EIB), following the UK's departure from the European Union. However, the bank will provide more targeted support than the EIB, and will be better aligned with the UK government's objectives.

**At Budget 2021, the Chancellor will set out comprehensive details regarding the operations, mandate and scale of the bank.** The government intends for the bank to be operational in an interim form, from spring 2021, so it can play a role in supporting the UK's economic recovery from the COVID-19 pandemic. The government will legislate for the bank at the earliest opportunity, to put it on a statutory footing.

## The role of pension funds

**There is a huge opportunity for pension funds to support the UK's infrastructure investment ambitions.** The industry anticipates that pension funds and insurers will be able to invest between £150 billion and £190 billion in infrastructure over the next ten years.<sup>61</sup>

Pension funds invest for the long-term and their objectives and investment profiles are well matched to infrastructure investment, particularly in regulated sectors.

The government wants the National Infrastructure Bank to work closely with pension fund and institutional investor market to explore opportunities for a further expansion of pension fund investment in UK infrastructure.

Already this year the government has made changes to make it easier for pension funds to invest in infrastructure. In March this year the Financial Conduct Authority (FCA) made changes to their 'permitted links' rules to allow unit linked pension funds, which are widely used for contract-based pensions investments, to invest in a wider range of illiquid assets.<sup>62</sup>

Furthermore, the recently published Solvency II Review Call for Evidence seeks views from stakeholders on potential areas in which Solvency II could be reformed to better incentivise insurers, who run contract-based schemes, to invest in infrastructure and other long-term productive assets.

The Department for Work and Pensions are considering a number of changes to remove barriers to infrastructure investment including:

- A consultation on changes to the calculation of the default fund charge cap for automatic enrolment schemes to allow greater flexibility for performance-based fee structures and thereby remove a barrier to investment in longer term assets like infrastructure.
- Changes to allow consolidation of smaller pension funds so they may more easily invest in infrastructure.

# Economic regulation

The economic regulatory framework is central to the provision of infrastructure, with Ofcom, Ofgem and Ofwat monitoring and refereeing how infrastructure is funded, delivered and operated within their respective sectors.

The UK's framework of strong, independent economic regulation has delivered significant benefits in the utilities sectors. The regulatory model has been integral to attracting over £200 billion of private sector investment in the UK's infrastructure networks and driving higher standards for consumers. The system has also played an important role during the COVID-19 pandemic, helping to ensure that financial assistance has been provided to vulnerable customers and enabling the continuity of vital services.

The government is committed to maintaining this system of independent economic regulation. But it is vital the system can rise challenges of the 21st century, notably the need to decarbonise infrastructure across all networks, adapt to climate change, capitalise on new innovative technologies and take advantage of opportunities arising from leaving the EU.

That is why, in 2018, the government asked the NIC to carry out a study on the regulatory model for water, energy and telecoms sectors. The aim of this study was to assess what changes might be necessary to the existing regulatory framework to facilitate future investment needs, promote greater competition and increase innovation, and meet the needs of both current and future consumers.

The NIC published their report – *'Strategic Investment and public confidence'* – in October 2019, setting recommendations for updating the regulatory model to incentivise long term investment and rebuild public confidence. The government thanks the NIC for their work, and at Budget 2020 the Government announced that it agrees with the NIC's primary finding that the UK's system of economic regulation is working well but needs updating in some areas to address 21<sup>st</sup> century challenges.

The government is committed to taking a long-term approach to investment to provide predictability and the required stability, as well as appropriate incentives to investors. This should also balance the needs of current consumers with those of future consumers. A detailed response to each of the NIC recommendations on economic regulation is set out in *'Response to the Regulation Study - Strategic investment and public confidence'*. The government's position will be expanded further in an overarching policy statement in 2021.

## Clear strategic direction

The government is mindful of the uncertainties currently faced by investors in a rapidly changing domestic and international context, and recognises the importance of integrity and consistency within the system to help provide certainty to investors and build consumer confidence.

The NIC stressed the importance of a more transparent strategic framework to help regulators support investments, balancing the long-term priorities with the current needs of consumers.

The government uses strategic policy statements as a formal mechanism to set long-term priorities for the regulated sectors, such as those already issued for Ofwat and Ofcom.

At Budget 2018 HM Treasury and the Department for Business, Energy and Industrial Strategy (BEIS) launched a review of strategic policy statements, concluding in 2019. The government considers that strategic statements have been successful in setting long-term priorities, but also recognises the benefits of having an additional overarching set of strategic priorities to complement and bring focus to sectoral specific strategic policy statements and reflect common challenges faced by regulators, such as data sharing and protection, as well as broader investment priorities such as the net zero and levelling up agendas.

The government supports the NIC's recommendation to create a more transparent strategic framework and commits to producing an overarching policy paper in 2021. This will set out further details on key areas, including commitments to consider regulator duties, inject more competition into strategic investments, and explore the benefits of cross-sectoral strategic policy statements in order to provide greater clarity for regulators, investors and consumers.

## Coherent duties to reflect new challenges

Regulators currently have a number of additional duties, beyond their primary duties, which they must consider in carrying out their core functions. For instance, Ofwat has a duty to contribute to the achievement of sustainable development, whilst Ofcom has a duty to consider innovation.

While existing duties vary between regulators, and further consideration should be given to how these are prioritised, the government supports the adoption of a coherent approach to price, quality, resilience and environment in order to meet 21st century challenges and promote innovation and growth. In particular, the government supports the NIC's recommendation that, where relevant, regulators should have duties to support net zero targets. **The government will continue to review the most appropriate measures, including a net zero duty, to ensure that regulators make the necessary contributions to achieve these targets.**

The government also recognises the opportunity for greater collaboration between regulators approaching similar challenges, building on the work of recent years. **The government supports the NIC's recommendation for the UK Regulators Network to have a stronger role, and commits to increasing collaboration, including by reviewing data sharing powers between regulators, with a view to considering how best to encourage regulators to develop joint data sets for 'whole customer' analysis.**

### Greater use of competition

To ensure that new infrastructure is delivered in the most efficient and appropriate way, the government supports the NIC's assessment that the use of competition should be harnessed as the most reliable means of supporting innovation and providing enhancements to economic infrastructure.

Competition in investment is already used successfully in economic infrastructure to drive transformational change. For example, competition has driven rapid innovation in mobile networks, seeing mobile data per connection being over six times higher than five years ago. The government will outline plans on electricity onshore networks, including introducing competition, in the forthcoming *Energy White Paper*. The government will also review whether regulators need further powers to promote competition as part of the forthcoming policy paper.

### Building public confidence

**The government recognises the importance of building public confidence in companies, regulators and investors, to the long-term success of utility provision.**

This includes ensuring companies take the needs of the communities they serve into account. To this end, the regulatory framework should be updated to reflect the government's priorities for levelling up and devolution of powers within the UK. **The government agrees with the NIC's proposals for regulators to ensure that devolved administrations, local authorities and metro mayors have sufficient opportunity to contribute to consultations as part of the price control process.**

The government also agrees with the NIC that regulators should be proactive in ensuring that rewards for investors reflect performance. Above all, customers must be confident that companies are well run and governed. Regulators need to deliver this confidence whilst also enabling sectors to be adequately financed so they may perform well for present and future generations. Regulators currently have a range of powers and tools to ensure that the rewards for investors reflect performance, and the government supports their role in driving improvements in this area.

Overall, as the NIC's report demonstrates, updating the UK's regulatory model to further long-term investment and build public confidence will be a vital task over the next few years. These efforts take on even greater significance in the context of the COVID-19 pandemic, where an effective and updated system of independent economic regulation will be crucial to efforts to build back better.

## Funding support mechanisms

The UK has a long history of harnessing the innovation and capacity of the private sector to help deliver infrastructure. Meeting the challenge of net zero will require a host of new technologies and a partnership in different forms between the private sector and government to pull them through into commercialisation.

The government has already developed a range of tools to attract investment and will continue to apply these in new areas and develop further innovative models to meet specific challenges. This includes setting revenues and prices on a competitive basis, for example through Contracts for Difference (CfD) in renewable energy; subsidising delivery in uncommercial areas like gigabit broadband rollout; or bespoke mechanisms for new investments such as the Regulated Asset Base (RAB) model for Thames Tideway Tunnel.

The government continues to consider new models and how existing models can be applied in new areas and is open to ideas from the market. Examples include:

- **New support mechanisms:** In 2019, the government consulted on using the RAB model for new nuclear power stations and other energy sources. It has also published a response on business models for carbon capture, and storage (CCS), where it is developing new support mechanisms and markets for industrial emissions technologies, hydrogen production and power plants with CCS technology in order to create innovative solutions to a complex set of incentives. These business models will require careful design to ensure new markets can be established and private investment can be sustained;
- **Opening up existing mechanisms to new areas:** In March 2020, the Government announced that onshore wind and solar PV would be included in the next round of CfD auctions. Since 2009, awarding the ownership and operation of offshore wind network connections through a competitive tender process is estimated to have saved consumers in excess of £700 million.<sup>63</sup> The government will outline onshore network in the forthcoming *Energy White Paper*, including plans to legislate to introduce competition; and

- **Incubating new ideas:** Since 2016, the Government has made the largest increases to public support for research and development (R&D) on record. This investment will support a range of sectors including new opportunities and emerging technologies for infrastructure, construction and manufacture, for example digital manufacturing, robotics and modular methods of construction.

In 2018, the government retired PFI/PF2 for new schemes because of their fiscal risk, inflexibility and complexity. As part of the IFR, alternatives to the PFI and PF2 model were explored and assessed against the government's test for any new private finance model: its benefits must outweigh the additional costs of private finance. No new models were found through this process, and so **the government** will not reintroduce PFI, PF2 or similar models of private finance.

The government still makes payments of nearly £10 billion a year on existing PFI, PF2 and other associated contracts which were entered into by previous administrations. **The government is funding a programme of work to review PFI contracts, to ensure they are well managed.** This includes providing support for authorities taking back PFI assets as contracts expire and delivering extensive contract management training across the public sector.



# Accelerating and improving delivery

## At a glance

The government wants to deliver infrastructure projects better, greener and faster. That means addressing longstanding challenges such as complex planning processes, slow decision-making, and low productivity in the construction sector. It also means learning lessons from the COVID-19 pandemic, for instance from the approaches that built Nightingale Hospitals in record time, and saw the UK move swiftly to secure access to a range of promising vaccines. Further, there is a clear opportunity with EU exit to change how this government delivers projects, using the flexibility the UK has as a sovereign country to do things differently.

The government set up Project Speed in the summer, to review every part of the infrastructure project life cycle and identify where improvements could be made. Project Speed has developed a comprehensive package of reforms, including:

- **Reform of environmental regulations** to deliver a quicker and simpler framework for assessing environmental impacts and secure better outcomes for the environment;
- **Landmark reform of the planning system** including consulting on amending permitted development rights, to let schools and hospitals be expanded quickly;
- **Transforming the construction sector** to enable it to become more productive, more sustainable and more internationally competitive, with better use of data and modern methods of construction;
- **Ensuring more effective decision making** with streamlined approval processes, more emphasis on quality design, and better monitoring and evaluation;

- **Embedding good design in all infrastructure projects** through planning reforms; and
- **Bringing about a step change in capability and leadership**, accelerating investment in major project expertise and delivery skills and improving the skills base across the country to ensure every area can deliver the infrastructure it needs.

These reforms have already driven substantial progress, and in future mean the UK's vital infrastructure like schools, hospitals, transport and other networks will be delivered better, greener and faster:

- **Better**, because the process of assessing infrastructure projects under the revised methodology will ensure the government is valuing the wider economic, social and environmental benefits of a project. The government will set projects up to succeed by strengthening the assurance and decision-making regime;
- **Greener**, because the requirements of the net zero commitment will be embedded in every stage of the project life cycle and underpin decisions on the technical solutions chosen to achieve the required outcomes; and
- **Faster**, by simplifying and shortening the processes through which projects secure the consents they need to proceed, procure contracts and deliver; while using modern methods of construction, new skills and a strategic relationship with industry which will improve productivity.

**The effective delivery of infrastructure is critical to the success of this Strategy.** The government and industry must work together in new ways to accelerate the delivery of the government's ambitious infrastructure portfolio, whilst delivering better environmental and biodiversity outcomes in line with the UK's 25 year Environmental Plan.

The UK has proved that it can deliver safe, world-class and innovative infrastructure, such as the A14 upgrade which was delivered eight months early and on budget using innovative procurement and construction methods. However, the project took years to enter construction, and illustrates the well-known and longstanding challenges that government and industry face. The end-to-end delivery process is complex and takes a long time, with some of the most critical projects taking over a decade to move from conception to reality.

Government decision making can be slow and duplicative, as can planning and development regimes. Productivity growth in the UK construction sector remains one of the lowest of all sectors of the economy, in part because the industry has lacked the confidence to invest in innovation and developing capability. The government has too few project delivery professionals equipped with the right skills, and projects are often not set up and managed well enough to anticipate and prevent delays and cost increases.

The COVID-19 pandemic has shown that this does not need to be the case. The government has assembled Nightingale hospitals in lightning quick time. Through the ventilator challenge, government and industry worked together to design, build and procure ventilators at record time and scale. It is time to take these learnings and apply them to infrastructure.

Combined with EU exit, **this provides opportunities to build back better by designing planning and procurement regimes that are tailored to the UK, putting outcomes ahead of process whilst protecting the environment and the nation's biodiversity.** It will also allow the UK to prioritise its own interests when procuring and working with industry, ensuring

money spent on infrastructure projects delivers transformational economic, social and environmental outcomes for citizens.

**The Prime Minister launched the Project Speed taskforce in summer 2020, which aims to accelerate and improve the delivery of the government's infrastructure portfolio.** Project Speed has reviewed the end-to-end delivery process working closely with experts - applying learnings across a number of case study projects to test and iterate a comprehensive package of reforms. On some of these projects, the taskforce has already found potentially significant time savings through more efficient and focused decision making, and will be accelerated further over the course of this Parliament.

## A66

The A66 is a critical freight and regional transport route, connecting the North East and North West. This major upgrade programme will dual the six remaining sections of single carriageway between Scotch Corner and Penrith.

The project was programmed to take over fifteen years, including four more years of development and ten years of construction.

The Project Speed review identified ways to save up to 50% of time in the planned construction process, cutting this down from 10 to 5 years through innovative solutions such as standardised, modular and offsite design and construction, alongside more intensive and concurrent delivery.

In aggregate, these interventions could accelerate delivery by around one third, enabling users to benefit from the improved road over five years earlier. Through reviewing the end-to-end delivery schedule of the A66, Project Speed was able to identify, test and iterate reform options to the decision making, planning and construction processes. These reforms will now be rolled out across the government's portfolio, dramatically cutting delivery times and providing benefits to users earlier.



**Project Speed represents a revolution in the government's approach to delivering infrastructure projects better, greener, and faster.** Embedding these reforms will require strong drive from government, legislative reform and strengthening working relationships with industry.

This package of reforms cuts across four areas:

- **Reforming infrastructure planning and better environmental regulations:** accelerating planning permission by removing blockers and inefficiencies in current planning regimes, allowing more dynamic project development whilst ensuring better environmental outcomes after EU exit;
- **Simplifying procurement regulations and modernising the construction sector:** designing more streamlined procurement regulations after EU exit, enabling government to use its weight as a customer to support the construction industry in adopting modern, highly productive practices;
- **More effective decision making:** front-loading decision making – stopping or progressing schemes earlier; streamlining and condensing governance, with assurance and approval milestones planned upfront and bringing in functional expertise earlier; and monitoring and evaluating projects using better data to support continuous improvement and policy reform; and
- **A step change in capability and leadership:** accelerating investment in major project expertise and delivery skills; and recruiting expert leadership and improving the skills base across the country to ensure every area can deliver the infrastructure it needs.

This is a major reform package and the prize is substantial - in aggregate, these reforms could accelerate delivery of infrastructure projects by up to a third. Much of the reform package relates to reserved policy and will apply to England. The UK government will work in partnership with the devolved administrations to ensure learnings and benefits are shared across the four nations.

## Reforming planning and environmental regulations

The planning system governs the regulation of land use and development. It is central to addressing the UK's infrastructure priorities, unlocking land to deliver new infrastructure whilst ensuring citizens are empowered to shape their local communities and achieving the best environmental outcomes.

Part of the current planning system can be complex and burdensome, slowing project development and adding costs to construction. They need to be refreshed to address 21<sup>st</sup> century challenges, as the UK builds back better, greener and faster.

Combined with EU exit, this is a historic opportunity to design more nimble frameworks that speed up the delivery of critical infrastructure while protecting and enhancing England's unique ecosystems. Reforming the planning system is not a task this government undertakes lightly, but it is both an overdue and a necessary reform.

### Planning regime for infrastructure

Whilst planning for the UK's largest schemes such as HS2 might require an Act of Parliament, or a special consent under the Transport and Works Act, the majority of infrastructure projects that require consents will use one of two main routes. The Town and Country Planning Act 1947 (TCPA), supported by the National Planning Policy Framework, allows local authorities to make planning decisions for development and infrastructure within their local areas. The Nationally Significant Infrastructure Projects (NSIP) regime is used for projects such as large strategic road schemes and power stations. The NSIP regime is well-respected but is currently not being implemented as effectively as possible, leading to slower delivery times and more uncertainty.

**In August 2020, the government published its *Planning for the Future***, which closed for consultation on 29 October 2020, proposing a wide range of reforms to bring England's planning system under the TCPA into the 21<sup>st</sup> century.<sup>64</sup> The reforms seek to support the redevelopment of town and city centres for housing and local infrastructure through a simpler and more certain system and unlock the growth potential of areas across the country.

In addition to these reforms, **the government is making it easier and faster to build social infrastructure**, responding to the needs of local communities, such as for schools and hospitals, by consulting on:

- **Amending Permitted Development Rights (PDRs)** through secondary legislation, which will allow for the easier expansion of schools, hospitals and prisons. PDRs accelerate specified types of development through the planning system by allowing development to take place without requiring full planning permission from the local planning authority. This change will enable the extension of the footprint of facilities by 25% or 250 square metres, whichever is larger; and
- **Introducing a faster planning application process** for more substantial school, further education college, hospital and prison developments, through secondary legislation to encourage greater prioritisation of applications by local planning authorities, including a shorter timescale of 10 weeks for determination.

## School Rebuilding Programme

The School Rebuilding Programme commits to a 10-year pipeline of 50 schools a year. This long-term pipeline will enable industry to invest in itself, building the capacity to deliver high quality, greener buildings that support the government's 2050 net zero target faster through application of modern methods of construction.

The proposed planning reforms in this Strategy will help to increase the use of permitted development rights to replace buildings on existing school sites, where the development is not on playing field land and does not exceed six metres in height. Many schemes are expected to be eligible for the enhanced PDR, potentially taking months off the planning permissions process for each of those projects.

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Major energy, transport, water, waste and commercial projects are consented through the NSIP regime. The regime has a strong track record for delivering robust consents. However, Project Speed has identified risks to the timeliness of ministerial decision making, inefficiencies in the ways in which different public bodies interact with the regime, and scope for improvement including through adoption of digital working practices. Therefore, **the government is establishing a National Infrastructure Planning Reform Programme** to refresh how the NSIP regime operates, making it more effective and bringing government departments together to deliver more certainty in the process and better and faster outcomes. This will:

- Set an ambition to cut timescales by up to 50% for some projects entering the system from September 2023;
- Establish a project “acceleration team” of planning experts to accelerate infrastructure projects through the system, identifying innovative ways to deliver faster planning consents; and
- Monitor the performance of the NSIP regime, coordinate with relevant departments on the need for a review of their National Policy Statements and ensure effective engagement with infrastructure departments, statutory consultees and the Planning Inspectorate and industry.

### Environmental regulations

**Delivering vital infrastructure whilst protecting and improving the environment is a top government priority.** EU exit provides a historic opportunity to design a quicker, simpler framework for assessing environmental impacts and enhancement opportunities, that speeds up the process while protecting and enhancing England’s unique ecosystems. This new system for environmental assessment will be tailored to the country’s needs, outcomes rather than process-focused, respectful of local democratic processes, and support net gains for biodiversity wherever possible. These reforms include:

- **A new system of environmental assessment (including Strategic Environmental Assessments and Environmental Impacts Assessments)** – to deliver a new framework that provides clarity, removes duplication, and ensures environmental considerations are embedded effectively in decision making at an early stage; and
- **Strategic approaches to the protection of habitats and species**, allowing more dynamic and pragmatic planning, including placing schemes like district level licensing on a statutory footing and developing strategic habitat mitigation and compensation schemes like the Solent nitrate trading platform.<sup>65</sup> This will help unlock development and reduce delays now, while respecting and improving the environment, without requiring wider reforms of the planning system to be in place.

### Designing high-performing and beautiful infrastructure

The government wants the planning process to stimulate proposals that are well-designed and will enhance the environment, health and character of local areas. As outlined in *Planning for the Future*, the government wants to better incentivise good design and high-quality homes and infrastructure, which should be a central tenet of the planning system and planning decisions.

**Good design is also an essential element in securing high performance of infrastructure from the start.**

In line with the design principles set out by the National Infrastructure Commission (NIC), **the government is committed to embedding good design in all infrastructure projects through:**

- Local plans which set clear rules rather than general policies for development, so that quality cannot be negotiated away nor can the lived experience of the consumer be ignored too readily;
- A reformed planning system which brings forward a new focus on design and sustainability in national policy and practice, building on the *National Design Guide* published in October last year, with a consultation on the proposed *National Model Design Code* later in 2020; and
- Requiring all infrastructure projects to have a board level design champion in place by the end of 2021 at either the project, programme or organisational level, supported where appropriate by design panels.

# Simplifying procurement and modernising construction

Up to £37 billion of contracts across economic and social infrastructure will be brought to market over the next year.<sup>66</sup> But current procurement regulations are burdensome, slow and do not do enough to ensure public money delivers high-quality, innovative outcomes.

The COVID-19 pandemic has required a step change in the scale of public procurement, whether it be designing and manufacturing ventilators or building Nightingale hospitals in record time. Combined with EU exit, this is a historic opportunity to improve the UK’s regulatory model, building on the lessons from COVID-19 and ensuring greater transparency, fair and open competition. **With a more effective procurement regime in place, government can use its weight as a major buyer to modernise the construction industry and drive better outcomes across the country.**

### A simplified procurement regime

Exiting the EU provides the opportunity to streamline regulations, reduce waste and create a simpler, fairer, more flexible and innovative regime for public procurers and for suppliers to government. The government will publish a green paper in due course which will propose radical reform of the procurement rules. These reforms include:

- **Reducing and simplifying the current procurement procedures** which cause unnecessary bureaucracy and confusion for suppliers;
- **Embedding transparency** by default throughout the commercial life cycle so that procurement and contract data can be more easily scrutinised; and
- **Improving the way commercial tools operate**, such as framework agreements, to improve open competition and avoid a situation where potential suppliers are locked out of government business; and

- **Improving the way in which procurement challenges operate** to reduce costs for both the public and private sectors, deterring spurious challenges whilst ensuring that genuine grievances are dealt with efficiently.

With a simpler, fairer and more effective regime in place, the government can use public procurement to drive better economic outcomes across the country – including supporting a more productive, modern construction industry.



### Transforming the construction sector

Currently, the UK's construction industry is not living up to its full potential. It contributed £117 billion to the UK economy in 2018 and supports over two million jobs, but is one of the nation's least productive industries, and the built environment is a major contributor to greenhouse gas emissions.<sup>67 68</sup>

The government can use its weight as a major construction client to transform and modernise the industry. The publication of The *Construction Playbook* in winter 2020 will improve how government assesses, procures and delivers public works. The *Construction Playbook* will set out policies and principles developed with the private sector and drawing on best practice across the public sector. A multi-year implementation programme will embed The *Construction Playbook* to:

- **Incentivise industry to innovate** by setting clear and appropriate outcome-based contract specifications, rather than defining upfront how infrastructure should be delivered;
- **Support industry to invest in itself** by providing greater certainty of demand with longer term contracting across portfolios. This includes continuing to publish a comprehensive National Infrastructure and Construction Pipeline with the next update in Spring 2021;
- **Facilitate the adoption of Modern Methods of Construction (MMC)**, off-site manufacturing by standardising components, designs and interfaces;
- **Further embed digital technologies** to standardise the approach to generating and classifying data, data security and data exchange, and to support the adoption of the Information Management Framework and the creation of the National Digital Twin; and
- **Develop a consistent and mutually beneficial relationship with industry** to move away from a confrontational approach, towards stronger relationship and contract management which will deliver continuous improvement over time.

The Infrastructure and Projects Authority (IPA) will publish *Transforming Infrastructure Performance 2021* next year, providing more detail to industry and partners on the government's shared vision for the future of infrastructure and the roadmap for delivering it, building upon the measures outlined in this Strategy and the *Construction Playbook*.

# Health Infrastructure Plan

The Health Infrastructure Plan sets out the Department of Health and Social Care's strategy for investment in NHS Infrastructure, and was taken further in the manifesto commitment to have 40 hospitals built by 2030. Application of the Construction Playbook principles, including a pipeline approach and commercial and procurement strategy which generates market appetite, will incentivise performance improvements over the life of the programme. This will involve the application of MMC and new technologies to facilitate, drive and enable the delivery of this investment in capital infrastructure within the challenging timeframe.

Building a stronger, more diverse and sustainable construction industry will require long-term investment in skills to increase recruitment, improve retention rates and support the industry to adopt new technologies and techniques – particularly in green and digital construction. The government has recognised the importance of investing in skills and training as part of its economic response to COVID-19, and the Prime Minister recently set out his commitment to skills and lifelong learning. Government is taking forward reforms to:

- **Support industry through sustained public investment**, by bringing forward £8.6 billion of decarbonisation, infrastructure and maintenance projects in the summer, and by increasing capital spending next year;
- **Leverage public contracts to boost opportunities** for construction apprentices, traineeships and T levels in the construction sector, and to recruit a more diverse workforce;
- **Improve apprenticeships for employers** across the economy, which the construction industry will especially benefit from, allowing them to transfer more of their unspent levy funds before they expire and use more intensive apprenticeships training options;
- **Introduce construction sector traineeships** to bridge the gap between further education courses and entry to employment; and
- **Allocate funding for adult learners** to access short training modules (4-16 weeks) for upskilling and reskilling via the National Skills Fund investment.

## More effective decision making

The government has a long-standing and robust decision-making process in place, supported by the frameworks of the *Green Book* and *Managing Public Money* guidance, HM Treasury and Cabinet Office approvals processes, and internal departmental investment committees. The UK is a world leader in its frameworks for decision making, and models such as the Green Book are followed by many other countries.

However, UK decision making could be faster and more effective. Low investment in regional infrastructure projects has left some parts of the UK behind, and decisions do not always fully capture the government's priority outcomes. Decision making is not always driven by the best data and the process can often be slow and duplicative. Finally, projects don't focus enough on monitoring and evaluation processes that would identify best practice for future decision making.

### Reflecting priority outcomes

If the government is to deliver on its ambitions to level up and decarbonise the economy, decision making will need to be more focused on supporting the government's priority outcomes. This means that, for example, projects which significantly reduce regional disparities and carbon emissions should be given greater consideration. **The government is taking forward work in a number of areas to ensure that decision making reflects priority outcomes**, including:

- **The 2020 Spending Review has already started the process**, introducing the new Public Value Framework which establishes a clear link between departments' spending proposals and intended outcomes, thereby supporting the selection of the most effective and impactful projects;
- **The government has launched the trial of a new Project Scorecard** to identify from the outset how projects will contribute to government's priority outcomes. This will give decision-makers better information about the extent to which different investment options deliver their objectives; and
- **The government has also published an updated *Green Book*** following a comprehensive review process. This seeks to rebalance an appraisal process that has frequently relied too heavily on the benefit-cost ratio, to the exclusion of the development of a robust and well-evidenced strategic case. It will also introduce new guidance on analysing place-based and transformational impacts. Together this will support and enable the levelling up agenda.
- **Developing a National Underground Assets Register**. The UK does not have an efficient process for utility asset owners to share their data. This means in order to plan or carry out infrastructure works, planners and excavators must contact all asset-owning organisations in the area, wait for each to respond, then compile information so it can be read and understood by workers. This process is slow, inefficient and limits the speed at which works can be carried out; a comprehensive register of underground assets would help address this. It will also help prevent accidental damage to underground pipes and cables which currently costs the UK economy £1.2 billion per annum and will improve worker safety.<sup>69</sup>

### Streamlining processes

The government can further improve the quality and the speed of those decisions, making them well and only once, rather than regularly re-opening and prolonging the process. Project Speed has developed the following reforms to do this:

### Better use of data

Good decision making is underpinned by clear and accessible data – both on the nature of the problems that infrastructure is trying to solve, and on the performance of existing infrastructure systems. The NIC's 2018 study *Data for the Public Good* identified that there is currently limited understanding of how the UK's infrastructure works as a system and that use of new technology like sensors, digitalisation, digital twins, the internet of things, big data, and artificial intelligence is piecemeal and not done in a coordinated way. The government will address this by:

- **Launching a new cost benchmarking hub and data platform**, supported by cost estimating best practice guidance to ensure project assumptions are realistic and achievable at the outset, enabling more robust decisions at an earlier stage;
- **Developing a "national digital twin" of the UK's infrastructure systems and built environment**. Smart infrastructure is capable of collecting data about itself as it operates, which can then be used to inform real-world decisions. This is known as a "digital twin". Although many infrastructure owners across energy, waste, transport and water have "digital twins" of their assets, the exchange of data between these systems is often ineffective, making it harder to tackle cross-cutting infrastructure issues such as climate change; and
- **Streamlining and condensing governance** – seeking to remove duplication and speeding up investment approvals at the centre of government by combining HM Treasury and Cabinet Office approvals processes for priority projects;
- **Bringing in specialists and ministers into the process earlier** – to offer expertise, support and provide key decisions early on - progressing or stopping projects at the right time; and
- **Front-end loading planning and decision making** – ensuring all major projects that are complex or novel use the Routemap methodology, a project initiation tool developed by industry and the IPA. A new Project Delivery Framework will be introduced in early 2021, including setting clear standards that must be met at each stage for a project to proceed.

### Monitoring and evaluation

**Good decision making does not stop with project approval.** To ensure the UK is getting the maximum value out of reforms and taxpayer money, the government needs to robustly monitor and evaluate projects during and after delivery. Changes to how the government monitors and evaluates project outcomes will improve how institutions like the NIC and National Audit Office (NAO) hold the government to account.

At the heart of the government's monitoring and evaluation framework is the IPA's oversight of the Government Major Projects Portfolio (GMPP). This ensures robust oversight of government's most complex and strategically significant projects and programmes. **The government is taking action by updating the GMPP to ensure the most critical and complex projects receive robust scrutiny and oversight.** The portfolio has recently been updated, increasing in size by 50% to reflect the full range of major projects delivering government priorities. Further, from April 2021 government departments will be required to collect and report improved project performance data including on; productivity, sustainability, levelling up and innovation to the IPA.

**From April 2021, all major infrastructure projects on the GMPP will be required to publish a summary business case following final approval, a close out report following completion and a long-term evaluation five to ten years into operation.** Over time this will create an evidence base to support continuous improvement and further policy reform.

## A step change in capability and leadership

Strong and accountable leadership is vital to the success of the government's infrastructure agenda and essential for successful delivery across every stage of the infrastructure lifecycle. The government is already investing in building the capability of its leaders through the Major Projects Leadership Academy and associated programmes.

**But to build better, greener and faster, the government needs to drive a step change in capability, culture and behaviour.** The government needs to equip those accountable for the success of projects – Senior Responsible Owners (SROs), Accounting Officers and Ministers – with the skills and tools they need, and ensure clear accountability, both for project delivery and successful outcomes.

The government is accelerating investment in major project expertise and leadership skills by:

- **Recruiting a pool of major projects experts,** deployed directly into departments, to boost leadership capacity and capability in government major projects, and filling critical gaps in professional delivery roles across the government's major project portfolio;
- **Creating a better deal for major project SROs** to boost capability and capacity across government, by taking forward work to reform selection, remuneration arrangements, grade structures and support, which will attract and retain top talent; and
- **Setting a requirement for projects to demonstrate SRO capability and capacity** through approvals gates, to ensure projects are resourced with leaders with the right level of experience and time to focus on effective delivery.

To complement these reforms, the government is putting in place a new rigorous approach to standards and professional accreditation to build a sustainable skills base by:

- **Establishing a new Government Projects Academy** to set professional standards and equip people across government with the expert skills needed to deliver major projects successfully, putting world class delivery, modern methods and sustainable practices at the heart of training practices. This would be open to project leaders from across the public sector and local government including **making new scholarships available to project leaders in local government;**

- Introducing a rigorous new approach to developing and accrediting project professionals at all levels, from foundation to mastery, starting in 2021, with standards set by the new Government Projects Academy; and
- Establishing training on major project delivery as a core expectation for Ministers and senior officials as senior sponsors of infrastructure projects, to build understanding of how best to support and challenge major projects to help them succeed.

## Looking to the future

This package of reforms will revolutionise the way government operates and transform the way infrastructure projects are delivered, leading to a step-change in delivery speed and quality.

**Project Speed has been an effective tool for galvanising Whitehall and industry, challenging the status quo and driving change.** However, the job is not yet complete. The taskforce will continue to remove obstacles in the process of delivering infrastructure, challenge assumptions, and develop, test and iterate reforms on case study projects. The reforms will be rolled out across the breadth of the government's infrastructure portfolio through the settlements agreed at Spending Review 2020 and future events.

**The government will remain committed to effective infrastructure delivery, implementing reforms at pace, removing barriers to delivery and continuing to test current assumptions.** This will ensure that the government's ambitious infrastructure pipeline is delivered better, greener and faster.



# Conclusion and next steps

This Strategy sets out the government's plans to transform its approach to infrastructure policy and delivery, to meet both the short- and long-term challenges facing the UK. This Strategy:

- **Provides a long-term perspective without ignoring shorter-term imperatives:** the Strategy puts recent spending announcements in context, emphasises the value of infrastructure investment to support the economic recovery, but also looks beyond the Spending Review to the government's longer-term ambitions.
- **Sets out clear goals and plans to achieve them:** the government has set out clear ambitions across all economic infrastructure sectors, focused on recovery, levelling up and decarbonisation. These ambitions are underpinned by clear actions, with more detail to come in some areas over the coming weeks and months, with more detail to come in some areas over the coming weeks and months.
- **Announces, multi-year funding commitments for key infrastructure programmes** to back up its ambitions, with more details to come at the next Spending Review in 2021. It makes clear that where policy is devolved, the devolved administrations benefit from funding, through the Barnett formula, enabling their investment to support people and business in Scotland, Wales and Northern Ireland. The Strategy also sets out the government's plans to review the National Infrastructure Commission's (NIC's) fiscal remit.
- **Confirms the government's commitment to fundamentally change the way it considers and delivers infrastructure** across the whole of the UK. It matches the spirit and ambition of the NIC's *National Infrastructure Assessment*, in many places exceeding their recommendations.

However, this Strategy isn't the final word on the government's infrastructure plans – it instead represents the first step of a multi-year process to transform the UK's infrastructure networks. The ambitions set out here will be further strengthened by the next Spending Review in 2021. This Strategy will also be enhanced by a series of related publications over the next 12 months, setting out further details on key areas of infrastructure policy, including:

#### In the next three months:

- *The Union Connectivity Review*
- *The Construction Playbook*
- *The Integrated Rail Plan*
- *The Energy White Paper*

#### In the next six months:

- *The Net Zero Review* final report
- *The National Infrastructure and Construction Pipeline*
- *Transforming Infrastructure Performance 2021*
- A transport decarbonisation plan

#### In the next twelve months:

- *The English Devolution and Local Recovery White Paper*
- An electric vehicle charging infrastructure strategy
- A heat and buildings strategy
- A hydrogen strategy
- An industrial decarbonisation strategy
- A refreshed *Industrial Strategy*

Taken together, these documents will set out the full scope and scale of the government's ambitions to level up and unite the country, decarbonise the economy, and revolutionise how the UK funds and delivers infrastructure.

#### Inclusive infrastructure

Much of the UK's infrastructure was built at a time when the needs of disabled people were not sufficiently prioritised. The consequence has been decades of retrofitted solutions – often expensive, unattractive, and achieving only 'accessibility'. It is vital that the UK's future infrastructure is fully inclusive of everyone, including Britain's 14.1 million disabled people.

The government is determined to transform the lives of disabled people, who for far too long have encountered barriers to enjoying the day to day activities and opportunities that others can take for granted. Infrastructure is a key part of this, and **in Spring 2021 the government will publish a *National Strategy for Disabled People***, expanding on the ways that the government will pursue inclusion and extend opportunities for disabled people across all aspects of life.

# The future of the National Infrastructure Commission

The NIC's exceptional analysis underpins many of the measures announced in this Strategy, and their National Infrastructure Assessment has influenced government decision making since its publication in 2018.

Looking forward, the NIC will now begin preparations for the second 'National Infrastructure Assessment' due for publication in 2023. This new, comprehensive review of the UK's evolving infrastructure priorities will have to take the ambitions and plans set out in this Strategy into account. It will also have to assess the longer-term impact of COVID-19 on economic infrastructure sectors, including any behaviour and technological changes catalysed by the pandemic.

In the meantime, the government has identified new priorities for the NIC for 2021, and is commissioning a new study on greenhouse gas removal technologies which will report next summer. The NIC will provide recommendations to government on:

- the technologies that should be deployed to deliver negative emissions;
- the policies needed to incentivise the rollout of these technologies; and
- the timeline of decisions needed by government to enable the UK to use negative emission technologies to achieve net zero.

The term of reference for this work have been published alongside this Strategy.

The government is also committed to ensuring the NIC maintains its reputation as an impartial, expert body. Building on the new and re-appointments announced earlier this year,<sup>70</sup> the government will shortly launch a competition to appoint several additional Commissioners. This will help strengthen the NIC's expertise in key areas – including local government and environmental issues – and increase the diversity of the Commission.

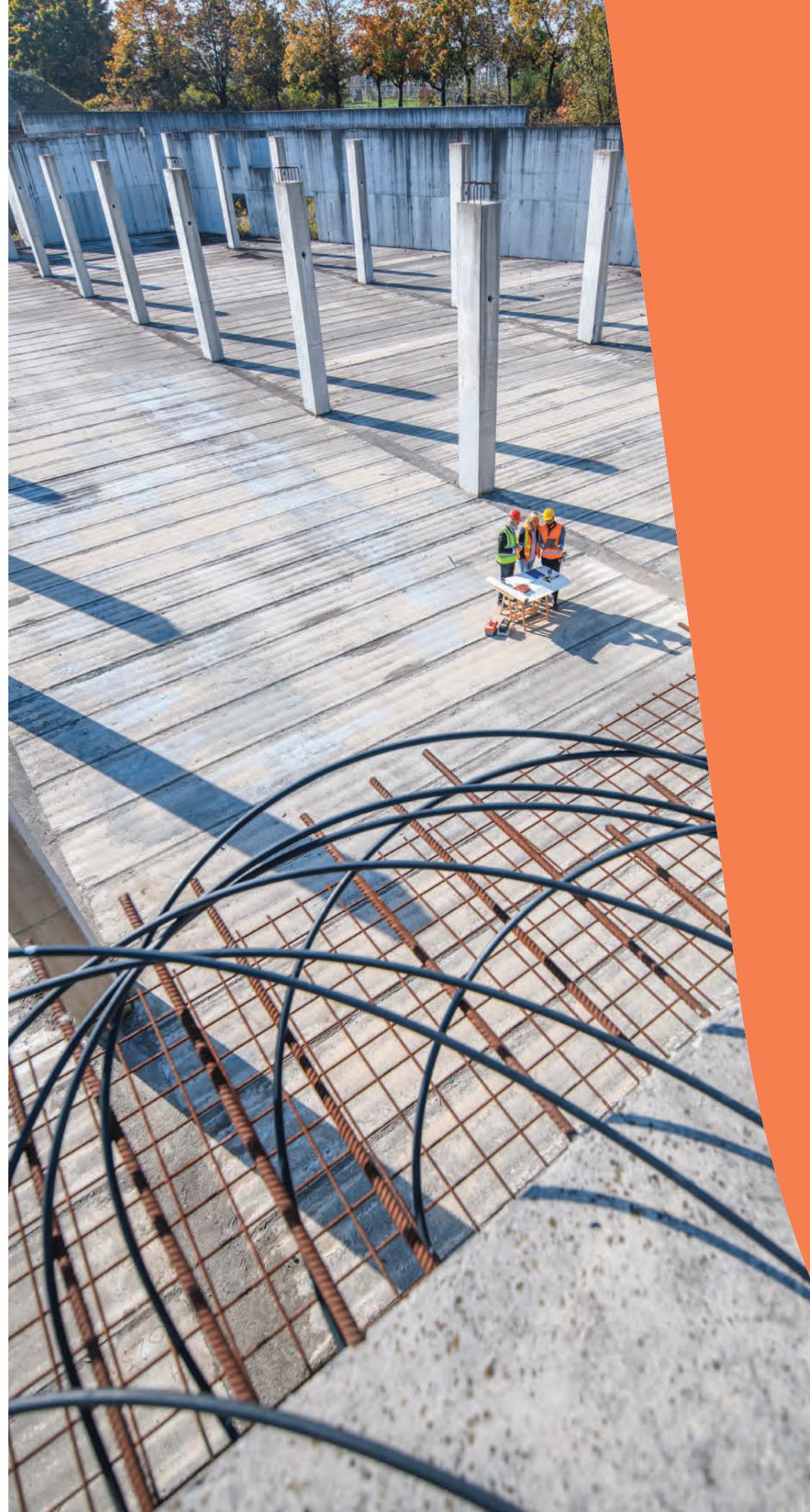
The government will also review the NIC's role and responsibilities in 2021, including updating their Charter and Framework documents if necessary, to ensure the Commission can continue to shape and support this government's infrastructure ambitions. This work will be carried out alongside a review of the NIC's fiscal remit.

## Responding to NIC studies

Since the National Infrastructure Assessment was published in 2018, the NIC has also produced three separate studies: on freight, economic regulation and resilience. The response to the NIC's regulation recommendations has been provided in 'Government response to NIC regulation study – Strategic investment and public confidence.' The Department for Transport will also provide a formal response to the Freight Study in 2021.

The NIC resilience report, 'Anticipate, React, Recover: Resilient infrastructure systems', published in May 2020, proposes a new framework for resilience and makes a series of recommendations to government to help ensure infrastructure operators can deliver and maintain truly resilient infrastructure. The current public health situation has shown that unpredictable 'black swan' events can and do happen, and that preparedness for these shocks is vital.

In light of COVID-19, and given the ever-present threat of climate change, there is a stronger case to talk about resilience of infrastructure – both in the context of the current pandemic and also the increasing risks from climate change and other threats. The government will therefore respond in full to the NIC report in early 2021.



- <sup>1</sup> Provisional Emissions, on a source basis, mapped to CCC sectors, Department for Business, Energy & Industrial Strategy, 2019
- <sup>2</sup> 'Experimental comparisons of infrastructure across Europe', ONS, May 2019. 'The effect of the size and the mix of public spending on growth and inequality', J Fournier and Å. Johansson, OECD Economics Department Working Papers No.1344, November 2016.
- <sup>3</sup> 'The Global Competitiveness Report 2019', World Economic Forum, October 2019
- <sup>4</sup> 'Hours spent in road congestion annually', JRC using TomTom data, 2017
- <sup>5</sup> 'Digital Economy and Society Index 2020 (DESI)', European Commission, October 2020
- <sup>6</sup> See 1, J Fournier and Å Johansson
- <sup>7</sup> 'National Infrastructure Assessment', National Infrastructure Commission, July 2018.
- <sup>8</sup> Excluding Barnett consequentials
- <sup>9</sup> 'Why does birthplace matter so much?', Journal of Urban Economics, March 2019
- <sup>10</sup> 'Action for Roads: A network for the 21st Century', Department for Transport, July 2013
- <sup>11</sup> 'Statistics on transport use during the coronavirus pandemic', Department for Transport, November 2020
- <sup>12</sup> 'Gear Change: a bold vision for cycling and walking', Department for Transport, July 2020
- <sup>13</sup> 'Annual bus statistics: England 2018/19', Department for Transport, December 2019
- <sup>14</sup> 'Transport Statistics Great Britain 2019: Moving Britain Ahead', Department for Transport, 2019<sup>15</sup> ICE State of the Nation 2020, Infrastructure-and-the-net-zero-target
- <sup>15</sup> 'Five largest OECD fixed and mobile broadband markets', OECD, December 2019.
- <sup>16</sup> 'Online shopping continues to grow', European Commission: Eurostat, April 2020
- <sup>17</sup> HM Treasury calculations based on 'Improving Broadband', National Audit Office, October 2020
- <sup>18</sup> HM Treasury calculations based on data from 'Connected Nations', Ofcom, and data from thinkbroadband, www.thinkbroadband.com
- <sup>19</sup> 'Connected Nations Update: Summer 2020', Ofcom, September 2020
- <sup>20</sup> 'Measuring the Impact of Proximity and Transport Performance', International Transport Forum, 2019
- <sup>21</sup> 'Aviation 2050: The Future of UK Aviation', HM Government, December 2018
- <sup>22</sup> Department for Transport analysis of UK Civil Aviation Authority data, 2019
- <sup>23</sup> 'Population estimates for the UK, England and Wales, Scotland and Northern Ireland: mid-2019', Office for National Statistics, June 2020.
- <sup>24</sup> 'The Low Carbon Economy Index', PWC, 2019
- <sup>25</sup> 'The Economics of Climate Change: The Stern Review', Cambridge University, 2007
- <sup>26</sup> 'State of the Nation 2020: Infrastructure and the Net Zero target', Institute of Civil Engineers, July 2020
- <sup>27</sup> 'Reducing UK emissions: 2020 Progress Report', Committee on Climate Change, June 2020.
- <sup>28</sup> 'Energy Prices and Bills: 2017', Committee on Climate Change, March 2017
- <sup>29</sup> Provisional UK Emissions 2019 – mapped to Committee on Climate Change sectors, Department for Business, Energy & Industrial Strategy
- <sup>30</sup> 'Energy consumption in the UK', Department for Business, Energy & Industrial Strategy, October 2020
- <sup>31</sup> 'Digest of UK Energy Statistics (DUKES) 2019', Department for Business, Energy & Industrial Strategy, July 2019
- <sup>32</sup> See 28
- <sup>33</sup> See 28
- <sup>34</sup> See 30
- <sup>35</sup> 'Net Zero Technical Report', Committee on Climate Change, May 2019
- <sup>36</sup> 'Energy in Brief', Department for Business, Energy & Industrial Strategy, July 2020
- <sup>37</sup> 'Clean Growth: the UK Carbon Capture Usage and Storage deployment pathway', Department for Business, Energy & Industrial Strategy, November 2018
- <sup>38</sup> See 29
- <sup>39</sup> See 29
- <sup>40</sup> See 27
- <sup>41</sup> Analysis of National Atmospheric Emissions Inventory 2017 Data, by Department for Business, Energy & Industrial Strategy
- <sup>42</sup> 'Provisional UK greenhouse gas emissions national statistics', Department for Business, Energy & Industrial Strategy, 2019
- <sup>43</sup> 'Transport statistics Great Britain', Department for Transport, December 2019
- <sup>44</sup> 'London's electric bus fleet becomes the largest in Europe', London Assembly, September 2019.
- <sup>45</sup> See 43
- <sup>46</sup> See 29
- <sup>47</sup> 'Low carbon and renewable energy economy, UK 2018', Office for National Statistics, January 2020
- <sup>48</sup> 'Green Deal and Energy Company Obligation', National Audit Office, April 2016
- <sup>49</sup> 'Sub-national Electricity and Gas Consumption', Department for Business, Energy & Industrial Strategy, December 2019
- <sup>50</sup> 'Green Book Supplementary Guidance on Accounting for the Effects of Climate Change', HM Treasury, February 2012
- <sup>51</sup> 'Floods and coastal erosion risk management – policy statement', Department for Environment, Food & Rural Affairs, July 2020
- <sup>52</sup> 'National Infrastructure and Construction Pipeline, 2018', Infrastructure and Projects Authority, November 2018
- <sup>53</sup> 'Strategic Investment and Public Confidence', National Infrastructure Commission, October 2019
- <sup>54</sup> 'What do energy networks do for you?', Ofgem, February 2017
- <sup>55</sup> 'Reducing UK emissions: 2020 Progress Report', Climate Change Committee, June 2020
- <sup>56</sup> 'Third years on, what has privatisation achieved?', Water UK, July 2019
- <sup>57</sup> 'Building Digital UK', Department for Culture, Media & Sport, November 2020
- <sup>58</sup> '2019 Price Review: Final determinations', Ofwat, December 2019
- <sup>59</sup> 'Future Telecoms Infrastructure Review', Department for Culture, Media & Sport, July 2018
- <sup>60</sup> 'UK Energy in Brief 2020', Office for National Statistics, July 2020
- <sup>61</sup> 'The Power of Pensions', Legal & General, June 2020
- <sup>62</sup> 'Amendment of COBS 21.3 permitted link rules – final rules and feedback to CP18/40', Financial Conduct Authority, March 2020
- <sup>63</sup> 'Offshore windfarm links tendering regime enters fifth round with projects worth £2 billion', Ofgem, September 2016
- <sup>64</sup> 'Planning for the Future', Ministry of Housing, Communities & Local Government, August 2020
- <sup>65</sup> 'Environment Bill resumes passage through Parliament', Department for Environment, Food & Rural Affairs, November 2020
- <sup>66</sup> 'Analysis of the National Infrastructure and Construction Procurement Pipeline 2020/21', Infrastructure and Projects Authority, June 2020
- <sup>67</sup> 'Briefing Paper 01432: Construction Industry: statistics and policy', Chris Rhodes, December 2019
- <sup>68</sup> Construction Statistics, Great Britain: 2018, Office for National Statistics, 18 October 2019
- <sup>69</sup> 'What do utility strikes really cost?', L. Makana, N. Metje, I. Jefferson, and C. Rogers, University of Birmingham, 2016; and 'Causes, impacts and costs of strikes on buried utility assets', N. Metje, A. Bilal, S. Crossland, Institute of Civil Engineers, 2015
- <sup>70</sup> 'National Infrastructure Commission boosted by new appointments', HM Treasury, September 2020



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# Net Zero Review: Interim report

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# Net Zero Review: Interim report

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# Executive summary

## Reaching net zero is essential for long term prosperity

Climate change is an existential threat to humanity. Without global action to limit greenhouse gas emissions, the climate will change catastrophically with almost unimaginable consequences for societies across the world. In recognition of the risks to the UK and other countries, the UK became, in 2019, the first major economy to implement a legally binding net zero target.

The UK has made significant progress in decarbonising its economy but needs to go much further to achieve net zero. This will be a collective effort, requiring changes from households, businesses and government. It will require substantial investment and significant changes to how people live their lives.

This transformation will also create opportunities for the UK economy. New industries and jobs will emerge as existing sectors decarbonise or give way to low-carbon equivalents. The Ten Point Plan for a Green Industrial Revolution and Energy White Paper start to set out how the UK can make the most of these opportunities, with new investment in sectors like offshore wind and hydrogen.<sup>1</sup> The transition will also have distributional and competitiveness impacts that the government will need to consider as it designs policy.

In recognition of these challenges, the Climate Change Committee (CCC), in its advice on the net zero target, noted that “if policies are not sufficiently funded or their costs are seen as unfair, then they will fail” and recommended that the Treasury undertake a review to consider:

“how the costs of achieving net zero emissions are distributed and the benefits returned... the fiscal impacts, risks of competitiveness effects and the impacts of decarbonisation across the whole economy”; and

“the full range of policy levers, including carbon pricing, taxes, financial incentives, public spending, regulation and information provision.”<sup>2</sup>

The Treasury accepted this recommendation and published the terms of reference for the Net Zero Review in November 2019. This interim report and the final report

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<sup>1</sup> ‘The Ten Point Plan for a Green Industrial Revolution’, HM Government, November 2020; ‘Energy White Paper: Powering our Net Zero Future’, HM Government, December 2020.

<sup>2</sup> ‘Net Zero: The UK’s contribution to stopping global warming’, Climate Change Committee, May 2019, p196.

that follows will sit alongside a comprehensive Net Zero Strategy next year, as well as sectoral decarbonisation strategies. They will form part of a government-wide effort to achieve net zero, address wider environmental issues and make the most of growth and employment opportunities.

## The interim report

This interim report sets out the analysis so far and seeks feedback ahead of the final report. This section presents a summary of the findings.

### **1. The combined effect of UK and global climate action on UK economic growth is likely to be relatively small. The scale, distribution and balance of new growth opportunities and challenges will depend on how the economy and policy respond to the changes required.**

The transition to net zero will create new opportunities for economic growth and job creation across the country. The demand for low-carbon goods and services will encourage new industries to emerge, with the potential to boost investment levels and productivity growth. Moving decisively in areas of comparative advantage could generate export opportunities and establish the UK as global leader across the low-carbon economy. Co-benefits from decarbonisation, such as improved air quality, can also be economically significant. However, reaching net zero will also involve costs and lead to significant structural change.

Overall, in the context of the rest of the world decarbonising, the net impact of the transition on growth to 2050 is likely to be small compared to total growth over that period, and it could be slightly positive or slightly negative. Policies like those in the government's Ten Point Plan have a role in ensuring the UK is able to make the most of the potential opportunities.

Regardless of the size or direction of the impact on the economy, the transition will lead to structural changes. Employment opportunities in green industries will emerge, while high-carbon sectors will have to adapt or decline. Some of these effects will be regionally concentrated. New green jobs are already appearing in sectors such as offshore wind, with growth and opportunities centred around regional clusters in the Humber and East Anglia. The net impact of the transition on local labour markets will depend on the costs of decarbonising for individual firms and the flexibility of the labour market to match vacancies with the necessary skills. This means that, though the macroeconomic impact might be small, there could be significant distributional implications. Government policy will need to continue to respond to this, ensuring levelling up across the country.

Structural changes in the economy will also have implications for fiscal policy. Revenues from taxes on the consumption of fossil fuels and from emissions-intensive industries will decline during the transition, for example, as petrol cars are replaced by electric vehicles. Over time the government will need to consider how to offset these lost tax revenues – whether through adjustments to other taxes or reductions in government spending – so that the UK can reach net zero while maintaining the long-term health of the public finances.

## **2. The costs of the transition to net zero are uncertain and depend on policy choices.**

The amount of investment required to reach net zero and the consequential impacts on operating costs are difficult to estimate. They are affected by a range of factors, including the precise path of the transition, changes in behaviour and the rate at which technology costs fall and efficiency gains are made, all of which are subject to significant uncertainty.

## **3. Government needs to use a mix of policy levers to address multiple market failures and support decarbonisation**

In choosing the best way to support the transition, government policy should seek to target market failures directly where possible, subject to distributional and international competitiveness impacts. The most important market failure to address is the negative externality associated with the emission of greenhouse gases, but there are many others holding back the transition to net zero, including inertia and lack of information. The market failures interact in complex ways within and across sectors.

Carbon pricing is an important lever in addressing the negative externality problem but should be supplemented by other policies in order to achieve an equitable balance of contributions from households, businesses and taxpayers. The government has announced it will introduce a domestic emissions trading scheme covering heavy industry, power generation and aviation after the UK leaves the EU.

## **4. Well-designed policy can reduce costs and risk for investors, support innovation and the deployment of new technologies.**

The development of technology will be important for meeting the net zero target, keeping costs down and maximising the potential economic benefits. Much of the finance required can come from the private sector, but the risks and uncertainties associated with novel technologies can hold this back. A clear policy framework setting out the government's approach at different levels of technological development can help address these uncertainties. Where uncertainty is at its greatest, government may need to provide more direct support.

The government's Ten Point Plan announced support for some of these emerging technologies, including an extra £200 million for two new carbon capture clusters by the mid-2020s, with another two for the 2030s and up to £500 million for trialling the use of hydrogen for domestic heating and cooking, starting with a Hydrogen Neighbourhood in 2023.

## **5. The risk of carbon leakage will increase with efforts to reduce emissions.**

The transition to net zero will have implications for the competitiveness of the UK economy. Some sectors will enjoy new export opportunities, but others could become less competitive if other countries follow different decarbonisation paths. These changes could lead to carbon leakage where policies achieve their goal of lowering emissions in one jurisdiction but inadvertently increase emissions

elsewhere. The size of the risk depends on each sector's costs of decarbonising, their trade exposure and international policies.

There is little evidence to suggest that carbon leakage has been a significant factor so far, but as the UK implements new policies to support this transition, the risk of carbon leakage may increase. The government has a number of ways to seek to mitigate this risk, including through its climate diplomacy and the design of policies to support the transition.

Additionally, the UK will host the COP26 climate negotiations next year and take over the G7 presidency. The UK is determined to use these opportunities to encourage ambitious international climate action and reduce global emissions. Collective action to reduce global emissions worldwide helps to reduce the risk of carbon leakage globally. The government is also using domestic policies like the £315 million Industrial Energy Transformation Fund to help sectors in the UK to decarbonise.

## **6. Households are exposed to the transition through their consumption, labour market participation and asset holdings. Government needs to consider these patterns of exposure in designing policies for the transition.**

Different types of household will have different levels of exposure to the transition. For example, higher-income households consume more carbon in absolute terms, but lower-income households tend to consume more carbon relative to their income, and households in Northern Ireland tend to have larger carbon footprints due to a higher prevalence of oil-heated housing.

Households are also exposed to the transition through the labour market, with people in certain occupations (skilled trade, and process plant and machine workers) more likely to work in more carbon-intensive industries. People in these occupations are also disproportionately likely to have a lower level of education and to be lower-income workers.

Analysis of households' exposure to the transition does not show where the costs will fall. This will depend on a range of factors, including the cost of decarbonising each sector, the availability of alternative low-carbon products and the distribution of new green jobs in the economy. However, government will need to be mindful of these issues as they consider the best way to design policy to support the transition. The government is already taking action with a £6.7 billion package of measures to help the lowest paid with their energy bills and by providing support for the creation of jobs in new green industries.

## **The final report**

The final report will be published in spring 2021. This will build on the analysis set out in the interim report, including by looking at:

- **Innovation and growth:** How the government can reduce policy uncertainty to encourage innovation, technological development and investment. It will

look at areas where the UK might have comparative advantage and consider how to maximise the economic benefits.

- **Competitiveness:** The scope for addressing the risks of carbon leakage and competitiveness that may arise from the transition to net zero.
- **Household impacts:** More detailed analysis of the implications for households from the decarbonisation of transport, buildings and power and options for managing any adverse impacts, as well as the trade-offs the government may face.
- **Embedding the findings:** How HM Treasury could incorporate climate considerations into spending reviews and fiscal events and how to embed the principles of the Net Zero Review into policy making across government.

# Chapter 1

## The net zero challenge

The UK has made significant progress towards decarbonising its economy over the last 30 years and was one of 195 countries to sign the Paris Agreement in 2015. Consistent with this and on the advice of the Climate Change Committee, the UK adopted a target of net zero greenhouse gas emissions by 2050.

The transition to net zero will lead to a more sustainable economy but implies significant changes for households, businesses and government. HM Treasury's Net Zero Review will consider how these changes can be managed. It will look at how to maximise the economic opportunities from the transition to net zero, how the costs associated with the transition should be met and how to ensure an equitable balance of costs and benefits across different parts of society.

The Review sits alongside other work by the UK government and the devolved administrations examining how best to decarbonise the economy and achieve net zero.

### Net zero is the “pro-growth strategy for the longer term”

1.1 In 2006, HM Treasury commissioned the Stern Review of the Economics of Climate Change. This estimated the overall costs and risks of global warming to be equivalent to losing between 5 and 20% of global GDP each year. Action to reduce greenhouse gas emissions reduces this risk, with the costs of action necessary to stabilise greenhouse gases concentrations in the atmosphere at 500 to 550 parts per million estimated to be between 1 and 2% of global GDP. Stern concluded that “tackling climate change is the pro-growth strategy for the longer term, and it can be done in a way that does not cap the aspirations for growth”.<sup>1</sup>

1.2 The Climate Change Act 2008 established the independent Climate Change Committee (CCC) to recommend emissions reduction targets for the UK (known as carbon budgets) and to evaluate progress towards meeting them. The initial goal set

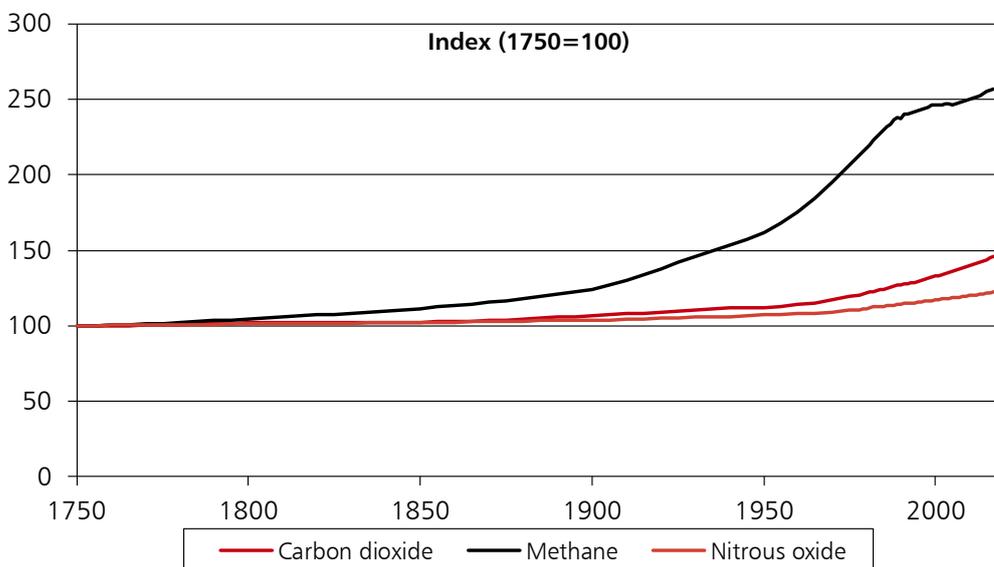
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<sup>1</sup> ‘Stern Review: The Economics of Climate Change’, HM Treasury, October 2006; the data for the cost of action was revised from 1% in the original report, to 2% in 2008.

in the Act was to reduce emissions by 80% compared to 1990 levels by 2050,<sup>2</sup> in line with advice at the time from the CCC.<sup>3</sup>

**1.3** Although the UK has made significant progress in reducing greenhouse gas emissions since 1990, global atmospheric concentrations of greenhouse gases have continued to rise (Chart 1.A) with consequential implications for the climate. The average temperature in the UK between 2008 and 2017 was 0.8°C higher than in the period from 1961 to 1990. The UK is seeing wetter winters and drier summers and has experienced several extreme weather events in recent decades. These include significant flood events in England in the winters of 2013 to 2014 and 2015 to 2016 and the joint hottest summer on record in 2018, with temperatures equalling the summers of 2006, 2003 and 1976. There are 240,000 homes and properties currently in high flood risk areas, and if shoreline management plans are not implemented, 5,000 properties could be affected by coastal erosion over the next 20 years as sea levels rise and more wave energy reaches the coast.<sup>4</sup>

**Chart 1.A: Atmospheric concentration of selected greenhouse gases**



Source: *European Environment Agency*.

**1.4** In recognition of the risks to the UK and globally, the UK was one of 195 countries to sign the Paris Agreement in 2015, committing to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C.<sup>5</sup> It is implicit in this target that global greenhouse gas emissions should reach net zero in the second half of this century.<sup>6</sup>

**1.5** Following the Paris Agreement, the UK, Scottish and Welsh governments asked the CCC for advice on when it would be feasible to reach net zero greenhouse

<sup>2</sup> Climate Change Act 2008 as enacted.

<sup>3</sup> 'Interim advice by the Climate Change Committee', Climate Change Committee (CCC), October 2008.

<sup>4</sup> 'Climate change impacts and adaptation report', Environment Agency, November 2018.

<sup>5</sup> 'Paris Agreement', United Nations, 2015, article 2.

<sup>6</sup> Ibid, article 4.1.

gas emissions.<sup>7</sup> In May 2019, the CCC published its recommendation that the UK should reach net zero by 2050, with individual targets for Scotland and Wales.<sup>8</sup> Later that year, the UK became the first major economy to implement a legally-binding net zero target.<sup>9</sup>

**1.6** The net zero target requires that by 2050 any greenhouse gas emissions produced within the UK must be reduced as far as possible and any residual emissions must be offset, for example by increasing natural carbon sinks such as forests or using technology like carbon capture and storage.<sup>10</sup>

**1.7** The target is focused on the flow of emissions into the atmosphere and applies to tonnes of CO<sub>2</sub>-equivalent (tCO<sub>2</sub>e). This measure aggregates emissions of different greenhouse gases based on their global warming potential relative to carbon dioxide.<sup>11</sup>

**1.8** The target covers emissions that take place on UK territory. It does not include the emissions embedded in goods and services that the UK imports: under internationally agreed frameworks for emissions accounting, established under the 1990 UN Framework Convention on Climate Change, these are the responsibility of the country of origin. The target therefore focuses decarbonisation efforts on the emissions over which the UK government and devolved administrations have most influence and which they are best able to measure.

## **The UK has made good progress since 1990, but has a long way to go to reach net zero**

**1.9** Between 1990 and 2019, the UK reduced its greenhouse gas emissions by 43%, compared to just 5% for the G7 as a whole (Chart 1.B). At the same time, the UK economy grew by almost 80%.<sup>12</sup> The rate of reduction in the carbon intensity of the UK economy since 2000 has also been the fastest in the G20.<sup>13</sup>

**1.10** This progress so far has been led by the power sector (Chart 1.C), where emissions have fallen by over 70% since 1990, largely through reducing the role of coal in electricity generation and increasing the role of renewables. Industrial emissions have also fallen significantly, by more than 50% over the same period. This represents emissions reductions across all parts of industry, manufacturing, construction and fossil fuel supply. In the manufacturing sector, CO<sub>2</sub> emissions fell by 25% between 2009 and 2017. These falls reflect a combination of reduced energy intensity, a shift to less carbon-intensive energy sources and changes in the structure of the manufacturing sector.

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<sup>7</sup> 'UK climate targets: letter to the Climate Change Committee (CCC) – 15 October 2018', Department for Business, Energy & Industrial Strategy (BEIS), Welsh Government and Scottish Government, October 2018. Northern Ireland does not currently have its own climate change legislation or emissions targets, but emissions from Northern Ireland are still covered by the wider UK target.

<sup>8</sup> 'Net Zero: The UK's contribution to stopping global warming', CCC, May 2019.

<sup>9</sup> 'UK becomes first major economy to pass net zero emissions law', BEIS, June 2019; Climate Change Act 2008 (2050 Target Amendment) Order 2019.

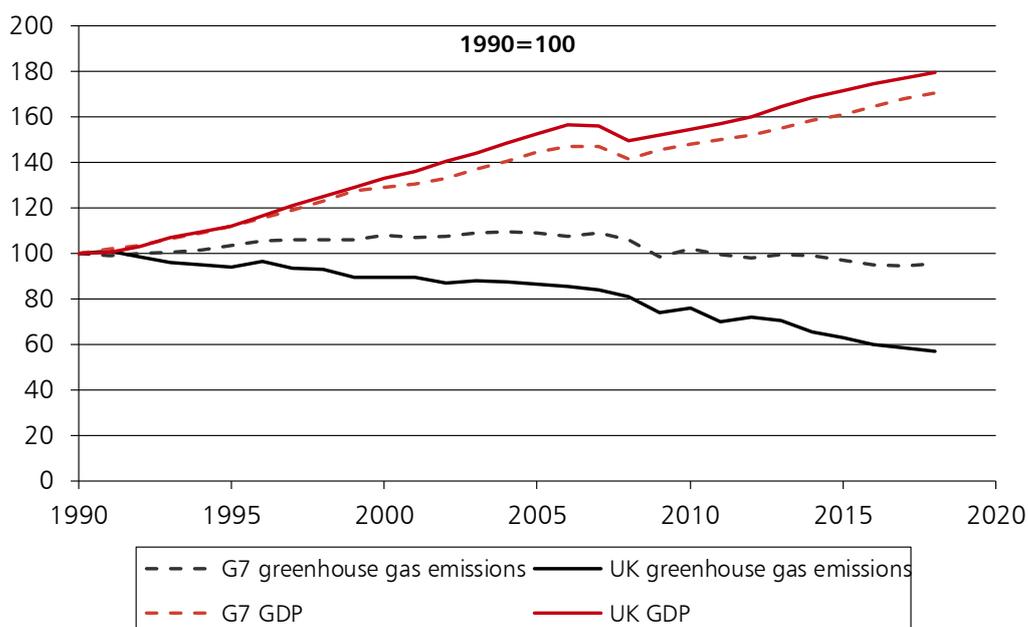
<sup>10</sup> Climate Change Act 2008; 'UK becomes first major economy to pass net zero emissions law', BEIS, June 2019.

<sup>11</sup> 'Annual statement of emissions for 2018', BEIS, 2020, p.5.

<sup>12</sup> 'Greenhouse gas emissions: Total emissions including LULUCF', OECD.Stat, 2020; GDP: 'World Economic Outlook Database' International Monetary Fund, April 2020.

<sup>13</sup> 'The Low Carbon Economy Index 2019', PwC, 2019.

**Chart 1.B: UK emissions reductions and economic growth since 1990**



Source: Organisation for Economic Cooperation and Development, International Monetary Fund.

**1.11** Other sectors have not decarbonised to the same extent, though there have been some successes. Waste policy reforms and emissions savings from fluorinated gases used in refrigeration and air conditioning equipment have driven down emissions in those sectors.<sup>14</sup> Elsewhere, emissions from agriculture, land use and land use change have been broadly flat since 2008. In the transport sector, emissions have remained relatively flat as increasingly efficient road vehicles have been offset by increased traffic levels. Emissions from international aviation and shipping have increased by nearly 90%, entirely due to aviation.

**1.12** Emissions associated with the UK's consumption are higher than territorial emissions. Chart 1.D shows that there has been a gap between UK emissions measured on a territorial basis and on a consumption basis since the mid-1980s. UK consumption-based CO<sub>2</sub> emissions peaked in 2007, at which point the UK's territorial CO<sub>2</sub> emissions were 37% lower than the consumption-based measure. Since 2008, both measures have declined.<sup>15</sup>

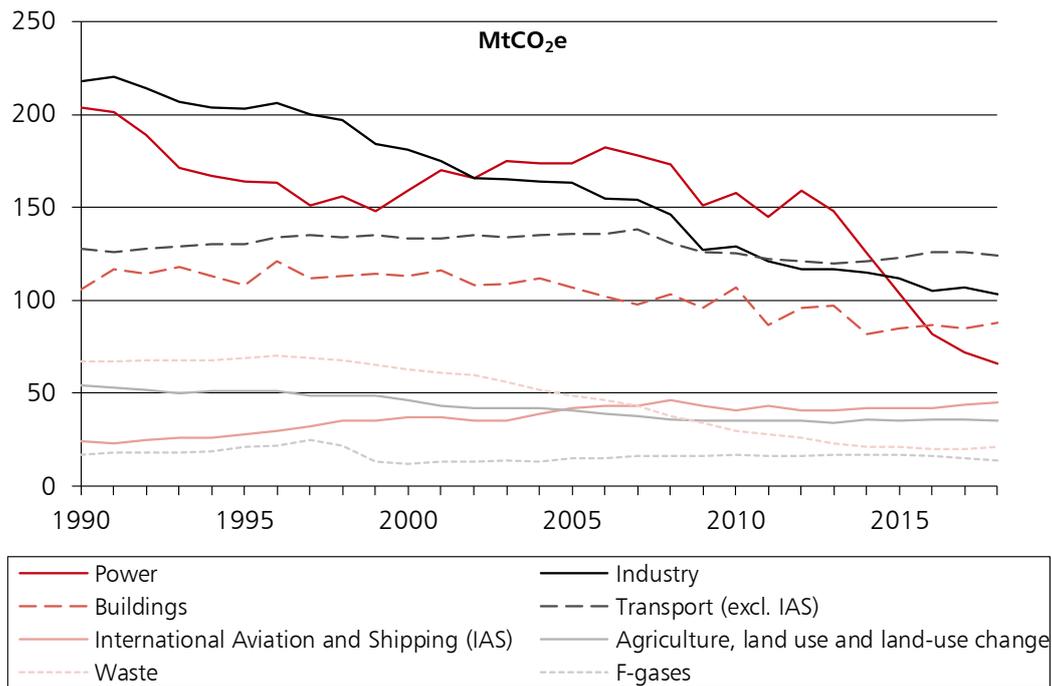
**1.13** For any country, the gap between consumption and territorial emissions will reflect the country's trade patterns and industrial structure. For some countries the gap will be positive, and for others it will be negative, in the same way that some countries run a trade deficit and others a surplus. Chart 1.E shows the balance of imported and exported emissions for a selection of large economies. Countries with a positive balance are net exporters of emissions and those with a negative balance, like the UK, are net importers of emissions.

<sup>14</sup> This report will predominately, though not exclusively, refer to 'sectors' as the groupings used by the CCC to sub-divide the economy. These sector groupings are more meaningful for understanding decarbonisation but are different and not comparable to the Standard Industrial Classifications (SIC code) that routinely used in other economic analysis.

<sup>15</sup> 'The decoupling of economic growth from carbon emissions: UK evidence', Office for National Statistics (ONS), October 2019.

1.14 In the UK, the services sector now represents around 79% of Gross Value Added,<sup>16</sup> and emissions-intensive industries around 2%.<sup>17</sup> This means that the UK exports relatively few emissions compared to other countries, explaining much of the gap between territorial and consumption-based emissions. It also means that the UK economy is relatively less exposed to the risk of losing competitiveness internationally as the government moves to decarbonise the economy. Nevertheless, some sectors will face a risk of losing competitiveness. This means that the UK's efforts to work with international partners to secure collective international agreement to reduce emissions globally are essential.

**Chart 1.C: UK emissions by sector**



Source: 'Reducing UK emissions: 2020 Progress Report to Parliament', CCC, May 2019; Final UK greenhouse gas emissions national statistics 1990-2018.

1.15 The effort to reach net zero will require innovation to reduce the costs of existing net zero-consistent technologies and to ensure that any new technologies are fully developed and commercially viable. While the innovation process needs to happen rapidly, such a transition is possible and advances in digital technology over the last 30 years highlight the potential for innovation over a similar time period.

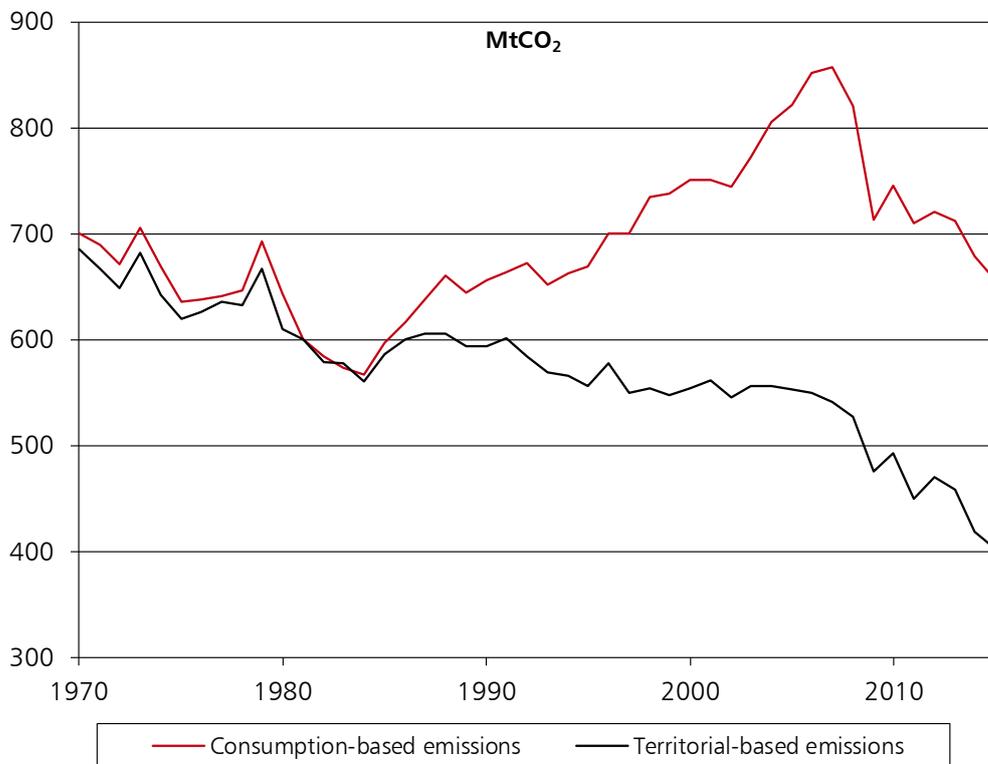
1.16 Increasing awareness and understanding of how the impacts and implications of the net zero target will affect the public is also crucial. In June 2020, 63% of the public said they were aware of net zero in some way but only 4% said they knew a lot about it. As the measures to reach net zero will require much greater public involvement and affect the public to a far greater extent than

<sup>16</sup> 'GDP output approach – low-level aggregates', ONS, November 2020.

<sup>17</sup> 'Electricity Intensive Industries: Relief from the Indirect Costs of Renewable Energy Schemes', BEIS, September 2018. This figure refers to industries covered by EU free allowances, the UK Carbon Price Support Mechanism, as well as the Renewable Obligation, Feed in Tariff and Contracts for Difference schemes. This differs from the official BEIS definition that covers all of manufacturing group C SIC, including mining and quarrying.

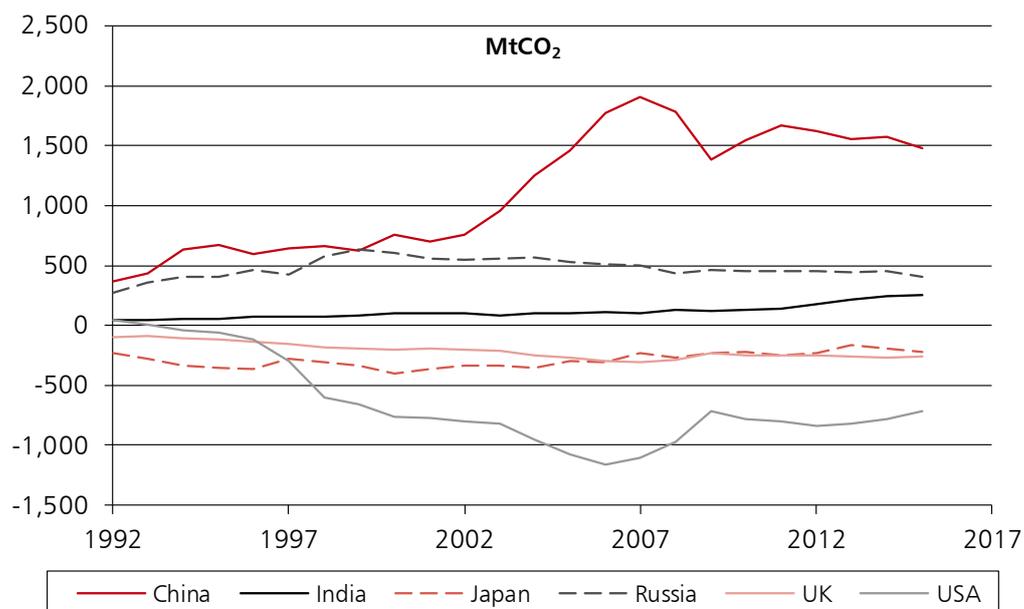
previous decarbonisation activities, ensuring greater access to information will be essential to reaching the target.<sup>18</sup>

**Chart 1.D: Different measures of UK CO<sub>2</sub> emissions**



Source: Office for National Statistics (ONS).

**Chart 1.E: UK imported emissions compared to other major economies<sup>a</sup>**



Source: ONS.

a A positive number indicates a net exporter of emissions: consumption emissions are less than territorial emissions. A negative number indicates a net importer of emissions: consumption emissions are greater than territorial emissions.

<sup>18</sup> 'BEIS Public Attitudes Tracker (June 2020, Wave 34, UK)', BEIS, August 2020.

## The Net Zero Review will support the transition to net zero

1.17 Alongside its recommendation that the UK adopt a net zero emissions target, the CCC recommended that HM Treasury do further work to examine how the costs of the transition should be funded and where the costs will fall, saying:

“If policies are not sufficiently funded or their costs are seen as unfair, then they will fail. HM Treasury should undertake a review of how the transition will be funded and where the costs will fall. The review should cover the use of fiscal levers and Exchequer revenue costs from carbon trading schemes, the impact on energy bill-payers and motorists, and the costs to industries especially where they are carbon-intensive and trade-exposed. It should cover costs from now through to 2050”.<sup>19</sup>

1.18 HM Treasury accepted the CCC’s recommendation to undertake this review. In doing so, HM Treasury intends to create additional clarity about how governments might approach decisions in the transition and seek to ensure an equitable balance of costs and benefits across different parts of society.

### Scope of the Review

1.19 HM Treasury published the Terms of Reference for the Review in November 2019 (see Annex A). It will look at how government policy can support technological development and deployment to maximise the potential growth opportunities from net zero. It will analyse the distributional and competitiveness impacts of the transition to net zero and considerations for determining the appropriate balance of policy levers.

1.20 Some of these levers are the responsibility of the devolved administrations, and net zero will only be achieved through a combination of reserved and devolved policies, building on initiatives already in place across the UK. The Review considers the role of the UK government, acknowledging the specific distributional challenges and opportunities across the UK.

1.21 This interim document sets out initial analysis and considerations:

- Chapter 2 sets out HM Treasury’s assessment of the macroeconomic impacts of the transition, the structural changes it entails and implications for fiscal policy;
- Chapter 3 considers the investment and costs that will be required in order to reach net zero;
- Chapter 4 looks at how different policy levers can best address the market failures causing climate change and holding back the transition;
- Chapter 5 considers the role of technology and innovation in maximising the benefits of move to net zero;

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<sup>19</sup> ‘Net Zero: The UK’s contribution to stopping global warming’, CCC, May 2019, p33.

- Chapter 6 sets out HM Treasury’s assessment of potential impacts on business from the transition and the potential impacts on carbon leakage; and
- Chapter 7 considers how these impacts could affect households.

## The report sits alongside action across the government

1.22 This review is just one part of the UK government’s work on the transition to net zero and to address wider environmental issues. This work includes the government’s Ten Point Plan for a Green Industrial Revolution,<sup>20</sup> the development of ambitious sectoral strategies such as the recent Energy White Paper<sup>21</sup> and the publication of a comprehensive Net Zero Strategy that will set out the government’s vision for the transition and how it intends to make the most of the growth and employment opportunities (see Box 1.A).

1.23 In addition, the UK will host the COP26<sup>22</sup> climate negotiations next year and take over the G7 presidency. The UK is determined to use these opportunities to encourage ambitious global action and achieve the transformational international change required by the Paris Agreement.

### Box 1.A: Activity across the UK government

**Green recovery:** The UK is looking to build back better and greener as it recovers from the economic impact of the COVID-19 pandemic. Budget 2020 announced:

- A £100 million scheme to help households and small businesses invest in low-carbon heating systems;
- A consultation on a Green Gas Levy to increase biomethane production for the gas grid;
- A Green Heat Networks scheme to encourage new and existing heat networks to adopt low-carbon heat sources, backed by £270 million funding.

July’s Plan for Jobs included a new £2 billion Green Homes Grant for homeowners and landlords to upgrade the energy and cost efficiency of their homes; a £1 billion Public Sector Decarbonisation Scheme to reduce greenhouse gas emissions from public sector buildings and £50 million for a demonstrator project to decarbonise social housing.

<sup>20</sup> ‘The Ten Point Plan for a Green Industrial Revolution’, HM Government, November 2020.

<sup>21</sup> ‘Energy White Paper: Powering our Net Zero Future’, HM Government, December 2020.

<sup>22</sup> 2021 United Nations Climate Change Conference, or 26<sup>th</sup> Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC).

The £191 million Sustainable Innovation Fund will help businesses across the UK drive forward cutting-edge new tech and recover from the impacts of coronavirus.

**Setting Carbon Budget 6:** Analytical work is on-going across government to set the next carbon budget. This will cover emissions between 2033 and 2037. The CCC published its advice earlier this month, and the government will respond by the end of June 2021.

**Energy:** Budget 2020 included a pledge to at least double funding for energy innovation, as well as to bring forward the phase-out date for unabated coal generation to 2025. The government has also committed to supporting the development of one power Carbon Capture and Storage (CCS) plant by 2030 to reduce emissions from gas-fired power stations; £1.03 billion for the CCS Infrastructure Fund to help establish four CCS clusters by 2030; and a £240 million Net Zero Hydrogen Fund to help develop up to 5GW of low-carbon hydrogen capacity by 2030. Finally, the Energy White Paper addresses the transformation of the entire energy system in the context of net zero, looking across the power generation, networks, buildings, industry, energy markets and oil and gas sectors.

**Buildings:** At Spending Review 2020 (SR20), the government allocated £1.13 billion in 2021/22 to decarbonise buildings in England and support the creation of clean heat networks. (£1 billion for building efficiency, £122 million for Heat Networks).

The government's Ten Point Plan also sets out an ambition to install 600,000 heat pumps by 2028 and included commitments to:

- implement the Future Home Standard in the shortest possible time;
- consult on non-domestic building standards;
- strengthen energy efficiency requirements for private sector landlords;
- create a market led incentive framework to drive growth; and
- bring forward regulations to support heat pump take up in off gas grid properties.

The government will shortly publish a Heat and Buildings Strategy, which will set out the immediate actions to reduce emissions from buildings, and the programme of work required to enable important strategic decisions in the first half of the 2020s on how to achieve mass transition to low-carbon heating.

**Industry:** The government is planning an Industrial Decarbonisation Strategy for spring 2021 and a Hydrogen Strategy to provide a framework for a hydrogen economy in the UK.

**Infrastructure:** SR20 announced £100 billion of capital expenditure next year, supported by a new National Infrastructure Strategy and the creation of a new infrastructure bank to catalyse private investment in projects across the UK, as well as a comprehensive set of reforms to the way infrastructure is delivered.

**Transport:** The Transport Decarbonisation Plan will set out for the first time how the government will accelerate a holistic, cross-modal shift to greener transport and drive more sustainable behaviours. The government has already announced significant investment in low and zero carbon transport. At SR20, the government confirmed almost £2.4 billion for transport decarbonisation, including £1.9 billion for electric vehicle charging infrastructure and grants for zero and ultra-low emission vehicles, and funding for active travel, zero emission buses and a range of R&D programmes to help decarbonise aviation, maritime and freight.

**Agriculture, land use and land use-change:** The upcoming England Tree Strategy and England Peat Strategy will set out the medium-long term strategy for securing greater carbon and wider natural capital benefits from woodlands and peatlands through public and private finance and non-spending measures. Budget 2020 announced £640 million for tree planting and peatland restoration.

**Greenhouse gas removal technologies:** At the Summer Economic Update the government announced £100 million for Direct Air Capture – a type of greenhouse gas removal (GGR) technology. The government has also published a call for evidence on GGR technologies in December 2020 and is commissioning the National Infrastructure Commission to undertake a new study on GGRs, to report in summer 2021.

**Green finance** can support the transition across all the sectors of the economy. The government continues to work closely with the financial services sector to implement the actions in the Green Finance Strategy. The government has announced plans to achieve mandatory climate-related financial disclosures and to implement a Green Taxonomy and its intention to issue a sovereign green bond and follow up with a series of further issuances.<sup>23</sup>

**Carbon pricing:** After the UK leaves the EU Emissions Trading System (ETS), the government will introduce a domestic UK ETS covering heavy industry, power generation and aviation, with a cap on emissions that decreases over time. Alongside this, the Carbon Price Support, an existing tax on fossil fuels used in electricity generation, provides a top-up to the UK ETS, incentivising investment in lower-carbon technology in the power sector.

1.24 Finally, alongside this work to address climate change, the 25-Year Environment Plan sets out the government's goals for improving the wider environment, in line with the commitment to ensure this is the first generation to

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<sup>23</sup> 'Green Finance Strategy', HM Treasury and BEIS, July 2019.

leave the environment in a better place than it found it.<sup>24</sup> The Dasgupta Review of the Economics of Biodiversity, an independent review commissioned by HM Treasury, looking at the interactions between the economy and nature and the causes and implications of biodiversity loss (Box 1.B), will also be published next year.

### **Box 1.B: Nature and climate change**

Alongside climate change, biodiversity is declining faster than at any time in history. This is severely eroding the natural world's resilience.

The two problems are inextricably linked. Loss and degradation of nature from human activity such as deforestation and poor soil management is contributing to greenhouse gas emissions and reducing the scope for natural sequestration of carbon from the atmosphere. Climate change in turn is damaging the natural world and is expected to become the biggest driver of biodiversity loss this century.

However, the ways to address climate change and biodiversity loss are also linked. The conservation and restoration of natural habitats such as peatlands, forests and coastal habitats can reduce greenhouse gas emissions, sequester carbon, build resilience in ecosystems (which protects biodiversity and provides benefits for society) and help people adapt to the impacts of unavoidable climate change.

Careful policy design to address both problems is required to ensure opportunities are maximised and to manage the trade-offs. For example, an increase in mining to extract materials required for renewable energy infrastructure could pose a significant threat to biodiversity, reducing the overall benefits of decarbonisation to society. The Dasgupta Review, an independent Review of the Economics of Biodiversity commissioned by HM Treasury, is exploring how society can sustainably engage with nature to support economic prosperity and wellbeing. It will propose solutions that both benefit biodiversity and contribute to climate change mitigation and adaptation.

## **Stakeholder feedback**

**1.25** To support the ongoing work of the review, HM Treasury would welcome feedback on the issues raised in this report. The Net Zero Review team may request more detail where appropriate. Please send responses by 23 January 2021 to: [NZRengagement@hmtreasury.gov.uk](mailto:NZRengagement@hmtreasury.gov.uk).

**1.26** The Net Zero Review will not publish the responses in full or in summary form. However, as explained in the notice below, HM Treasury may be required to disclose this information under the Freedom of Information Act 2000.

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<sup>24</sup> 'A Green Future: Our 25 Year Plan to Improve the Environment', Department for Environment, Food & Rural Affairs, January 2018.

1.27 Annex C sets out how your response will be treated and how any personal data you provide that identifies you or third parties will be handled.

## Chapter 2

# The economy and net zero

Global action to mitigate climate change is essential to long term prosperity. In the UK, the transition to net zero creates new opportunities for growth and employment. The investment and demand for low-carbon goods and services will encourage new industries to emerge, creating jobs across the country. Further opportunities could come from new areas of innovation and technology and changes in energy costs. Moving decisively in areas of comparative advantage could generate new jobs and export opportunities and establish the UK as a global leader across the low-carbon economy. The co-benefits from adopting low-carbon technologies, such as improved air quality, can also be economically significant.

Reaching net zero will also involve costs and lead to major structural changes in the economy, as existing industries may have to adjust how they operate or face decline. These impacts will be unevenly felt across different sectors, regions and households, and some industries may face greater challenges when adapting.

Policies like those in the government's Ten Point Plan for a Green Industrial Revolution help to ensure that the UK is able to make the most of the opportunities presented by decarbonisation.<sup>1</sup> An understanding of potential impacts and an awareness of the lessons from previous major transitions will also be vital when designing effective policies to ensure an equitable balance of costs and benefits arising from the transition.

## Global action to mitigate climate change is essential to long-term prosperity.

**2.1** Global action on decarbonisation is essential to avoid the effects of unmitigated climate change and to ensure that the global economy is sustainable in the long term.

**2.2** The assessment in this chapter suggests that, within the context of global action, the transition in the UK may have only a small effect on long-run economic growth, although the direction of the effect could be slightly positive or slightly negative. To some extent, the UK has already decoupled economic growth from

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<sup>1</sup> 'The Ten Point Plan for a Green Industrial Revolution', HM Government, November 2020.

growth in emissions: between 1990 and 2019, the UK reduced its greenhouse gas emissions by 43%, while the UK economy grew by almost 80%.<sup>2</sup>

**2.3** While in aggregate the effect of the transition on long-run UK economic growth may be relatively small, there could be significant structural changes to the economy: along with digitalisation, decarbonisation will probably be among the most important drivers of change in the UK economy to 2050. These structural changes will mean some sectors will expand and others will shrink.

**2.4** Low-carbon sectors could benefit from new domestic and global growth opportunities, whereas more carbon-intensive sectors may face greater constraints as a result of decarbonisation requirements across their global supply chains and markets. Differences in policies across countries may influence growth opportunities and the competitive pressures domestic firms face.

## **A qualitative approach allows macroeconomic assessments amid uncertainty about technology and policy**

**2.5** This chapter includes a qualitative assessment of the macroeconomic impacts resulting from the transition to net zero. It considers the most important channels through which the transition could affect the economy and the likely direction of those impacts, drawing on the existing literature. A qualitative approach allows an assessment of the impact of a generic set of policies. It also permits a rigorous discussion of the potential impacts where factors such as technological development and deployment are still uncertain.

**2.6** Impacts are compared to a counterfactual in which the rest of the world decarbonises, but the UK does not. This baseline enables an assessment of the impacts on competitiveness and productivity and an assessment of how the transition could alter the structure of the UK economy. This report does not seek to compare the costs and benefits of the net zero transition to the costs of unmitigated climate change, as UK action alone would be insufficient to address the problem.

**2.7** This counterfactual differs slightly from that used by the Climate Change Committee (CCC) in estimating the costs of the transition. The CCC assumes a hypothetical baseline of no additional climate action nor climate damage and does not take into account climate action taken by the rest of the world. Chapter 3 returns to this issue.

**2.8** Some organisations have attempted quantitative modelling of the transition to net zero, with a variety of baselines. Different models inevitably give slightly different results, but these estimates suggest that decarbonisation will have a modest overall macroeconomic impact. The European Commission analysis of a net zero-equivalent scenario (1.5°C global warming) indicates a small impact on European GDP out to 2050, ranging from slightly negative to slightly positive (-0.63%, +0.68% or +1.48% depending on the model choice).<sup>3</sup> The analysis the CCC commissioned to accompany their 2019 net zero recommendation similarly

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<sup>2</sup> Greenhouse gas emissions: Total emissions including LULUCF, OECD.Stat, 2020; GDP: 'World Economic Outlook Database' International Monetary Fund, April 2020.

<sup>3</sup> 'In-depth analysis in support on the COM(2018) 773: A Clean Planet for all – A European strategic long term vision for a prosperous, modern, competitive and climate neutral economy', European Commission, 2018.

suggested a moderate impact on the UK's GDP in 2050 (-0.8% or +3.4% according to model choice).<sup>4</sup> To put these effects into context, the CCC's advisory group on costs and benefits said that, should the UK maintain its normal level of growth, decarbonisation would simply mean "UK citizens would need to wait until half way through September 2051 to reach the level of income they would otherwise have achieved at the end of 2050."<sup>5</sup> Box 2.A sets out some of the challenges of quantitative modelling.

### **Box 2.A: Quantitative modelling approaches to net zero**

Quantitative models could theoretically be used to estimate macro or indirect effects of decarbonisation on the wider economy. There are three main categories of model that could be used, all of which have limitations.

Computable General Equilibrium (CGE) models, such as the one used by the Department for Business, Energy & Industrial Strategy (BEIS) during Carbon Budget 5 and in part by the European Commission, can capture the impact of carbon-cutting initiatives on firms and households. CGE models require assumptions about technological improvements to be imposed on the model. The outputs of any CGE modelling would reflect – and be highly sensitive to – these assumptions (although this is not a unique risk to CGE models).

Energy-systems models such as the one used by the CCC to estimate the costs of the transition discussed in Chapter 3 and BEIS's UK TIMES model fully depict the energy system and can estimate the costs needed to reach net zero under given constraints. These models are neutral about economic policy and have no direct link to wider economic variables. This makes them unsuitable for analysing the impacts of important policies such as carbon pricing.

Finally, there are macro-econometric models such as the model used by the Office for Budget Responsibility (OBR) in producing the UK's official economy forecasts. These models are best considered forecasting tools to enable forecast judgements to be applied consistently across a very wide range of macro-economic variables. The European Commission complemented its CGE climate modelling using such a model. This type of model could produce dynamic outputs over a long horizon, though the OBR's model (which is shared and co-developed with HM Treasury) currently only covers the immediate 5 to 6-year period needed for Budget forecasts. These models typically have no climate-specific variables and are unable to distinguish between low-carbon and high-carbon technology.

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<sup>4</sup> Report to the Climate Change Committee (CCC) of the Advisory Group on costs and benefits of net zero', CCC, 2019. More recent analysis is also mixed for example positive GDP effects see 'Economic impact of the sixth carbon budget', Cambridge Econometrics, 2020, while for more negative GDP effects see 'Macroeconomic responses consistent with the NGFS scenarios' National Institute of Social and Economic Research workshop, 2020.

<sup>5</sup> 'Costs and Benefits of Net-Zero Advisory Group – Chair Report', CCC, P. Elkins, May 2019, p. 13.

## Climate action will affect economic growth through multiple channels

2.9 The qualitative assessment of the macroeconomic impacts of the transition in this report considers each of the potential channels in turn, alongside evidence in the literature on the likely direction of any impact.

### Productivity

2.10 Productivity growth is essential for increasing household living standards and firm competitiveness in the long term. A well-designed transition that stimulates innovation and investment in low-carbon sectors with strong growth opportunities could improve long-term productivity growth in the UK. The government's Ten Point Plan outlines a programme of green growth and innovation to seek to achieve this.<sup>6</sup>

2.11 In contrast, a transition that discourages carbon-intensive activity without encouraging investment and production into low-carbon alternatives risks lower productivity growth.

2.12 In the short run, and at an industry level, several empirical studies suggest a link between environmental policies and negative productivity impacts, although some also find positive productivity effects.<sup>7</sup> The precise impact depends on the specific policy design and conditions in the sectors to which the policy applies. Where firms are currently not making the best use of their inputs, policy can encourage or compel them to improve efficiency.<sup>8</sup>

2.13 In the long run, the impact on productivity of policies to address climate change and environmental harm is less clear. The Porter Hypothesis suggests that environmental regulation can boost investment and innovation<sup>9</sup> because companies that innovate quickly may also experience first-mover advantages. The hypothesis suggests that these benefits more than offset the initial cost of regulation.<sup>10</sup>

2.14 There is sound empirical evidence to support a positive link between environmental regulation and innovation.<sup>11</sup> However, the limited number of studies undertaken do not provide clear evidence that this translates into improved productivity at the macroeconomic, firm or industry level.<sup>12</sup>

2.15 It is also worth noting that measures of productivity often only include labour and capital as inputs, ignoring the depletion of natural resources. GDP is the only output measured, with no accounting for the cost of damage from pollution associated with economic activity. The evidence cited above may therefore

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<sup>6</sup> 'The Ten Point Plan for a Green Industrial Revolution', HM Government, November 2020.

<sup>7</sup> 'Environmental policies and productivity growth: a critical review of empirical findings', T. Kozluk and V. Zipperer, Organisation for Economic and Social Development (OECD) Journal: Economic Studies, vol. 2014/1, 2014.

<sup>8</sup> 'Carbon policy and economy-wide productivity: A report for the Energy Systems Catapult', Frontier Economics, 2019.

<sup>9</sup> 'America's Green Strategy', Scientific American 264, M. Porter, 1991, p. 168; 'Toward a New Conception of the Environment-Competitiveness Relationship', Journal of Economic Perspectives 9 (4): 97–118, 1995.

<sup>10</sup> 'Climate Change Policy, Innovation and Growth', A. Dechezleprêtre, R. Martin and S. Bassi, LSE Grantham Institute, Jan 2016.

<sup>11</sup> 'Environmental policy, innovation and performance: New insights on the Porter Hypothesis', Journal of Economics and Management Strategy 20: 803–42, P. Lanoie, J. Lucchetti, N. Johnstone, and S. Ambec, 2011.

<sup>12</sup> 'Environmental policies and productivity growth: a critical review of empirical findings', OECD Journal: Economic Studies, vol. 2014/1, T. Kozluk and V. Zipperer, 2014.

overestimate the productivity of carbon-intensive industries compared to low-carbon alternatives.<sup>13</sup>

## Investment

**2.16** Investment is a vital component of economic growth, and significant investment will be necessary to achieve net zero. Many of the technological pathways to decarbonise the UK economy are currently uncertain, so the precise amount of investment required is still unclear. The government's Ten Point Plan outlines the ambition to mobilise £12 billion of government investment, and potentially up to three times as much private investment.<sup>14</sup>

**2.17** Some investment will move from carbon-intensive industries to low-carbon alternatives, but new investment is also likely to be necessary. Additional and productive investment in low-carbon growth areas could stimulate economic output in the near term and support productivity growth in the longer term.

**2.18** If decarbonisation leads to high additional investment, then this could reinvigorate overall investment levels in the UK and help support aggregate demand in the economy. UK investment levels have been below G7 and OECD<sup>15</sup> averages as a share of GDP in recent years, as shown in Chart 2.A. Higher total investment could increase the UK's economic growth rate. This would increase the size of the economy and so reduce the relative challenge of funding the required investment for decarbonisation.

**2.19** The investment in net zero could be from public or private sources. It is possible that a substantial increase in public investment for the transition would risk crowding out private investment or other targets for public investment. If the supply chain of low-carbon capital goods is constrained, for example due to skill shortages, then increases in public sector demand may simply out-bid and thus deter private investment.

**2.20** Public investment is less likely to crowd out private investment when economic growth is below trend and counter-cyclical public investment can be expansionary. Well-designed government investment may also crowd in private investment where it creates new markets, reduces technology costs or reduces risk for private investors.

**2.21** In summary, the technology and investment requirements for net zero are uncertain. The level of investment necessary for decarbonisation, and how much of that is additional, will determine whether total UK investment is higher,<sup>16</sup> lower<sup>17</sup> or

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<sup>13</sup> UK Environmental Accounts, ONS, 2020; Annual business survey, ONS, 2020.

<sup>14</sup> 'The Ten Point Plan for a Green Industrial Revolution', HM Government, November 2020.

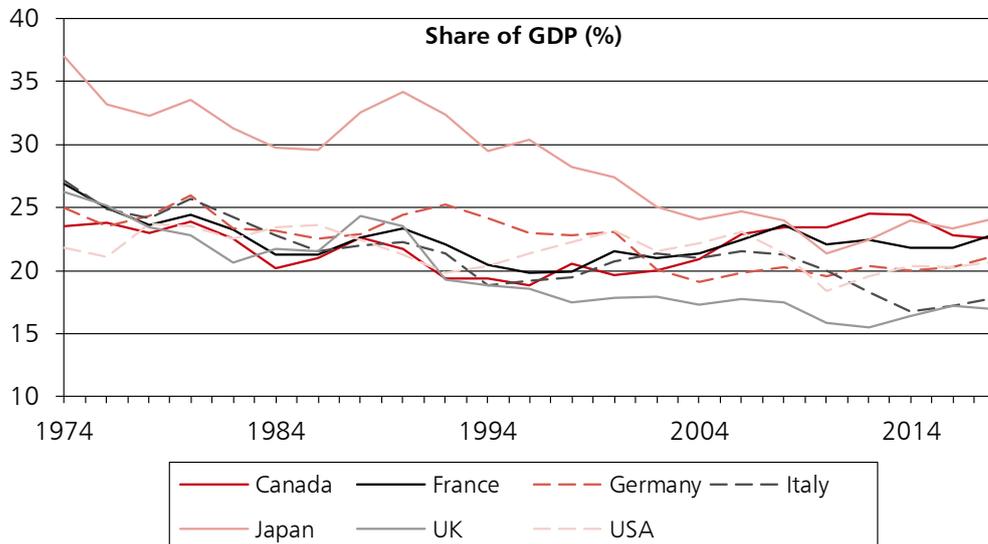
<sup>15</sup> Organisation for Economic Cooperation and Development.

<sup>16</sup> 'Investing in Climate, Investing in Growth: A synthesis', OECD, 2017; 'Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty', Intergovernmental Panel on Climate Change, 2018.

<sup>17</sup> 'When and Why Do Plants Comply? Paper Mills in the 1980s', U.S. Environmental Protection Agency National Center for Environmental Economics, W. Gray and R. Shadbeigan, June 2004. Gray and Shadbeigan, in an econometric model of American Paper Mills from 1979-1990, find a crowding out effect.

at the same level<sup>18</sup> than it otherwise would have been. Higher economic growth due to increased investment can reduce the relative funding challenge of decarbonisation.

### Chart 2.A: Total Gross Fixed Capital Formation



Source: World Bank, Organisation for Economic Cooperation and Development (OECD).

## Changes in energy prices for businesses and households

**2.22** Energy is a significant component of household consumption. It is also an input cost for production. The scale, direction and longevity of potential price changes will depend on the relative prices of energy produced by existing and new technologies. This in turn depends on the potential for technology, innovation and production at scale to lead to efficiencies in energy production and reduce the cost of clean energy over time.

**2.23** Costs of wind and solar energy have already seen significant falls, and some forms of renewable electricity generation in the UK, such as onshore wind, are expected to have lower estimated costs per unit than electricity derived from fossil fuels.<sup>19</sup> Lower long-run energy costs and greater energy efficiency could benefit both businesses and households. One of the priorities of the Energy White Paper is keeping energy bills affordable as the UK decarbonises, especially for the most vulnerable households.<sup>20</sup> Analysis by the National Infrastructure Commission further suggests that household energy bills could be potentially lower or equal to current levels after switching to clean energy.<sup>21</sup>

**2.24** Taxes that increase the price of energy, policies that add costs to bills, or regulations that constrain the use of the more cost-efficient but more heavily

<sup>18</sup> 'Environmental regulations and innovation activity in UK manufacturing industries', Resource and Energy Economics, vol. 34, issue 2, R. Kneller and E. Manderson, 2012. in their analysis of 25 UK manufacturing industries from 2000 to 2006, Kneller and Manderson do not find a positive impact of environmental compliance on total R&D or total capital investment. The study also finds evidence that more stringent environmental regulation directly lowers optimal expenditure on non-environmental innovation.

<sup>19</sup> 'Electricity Generation Costs 2020: Levelised Cost Estimates for Projects Commissioning in 2025, 2030, 2035, and 2040', Table 4.17, BEIS, 2020.

<sup>20</sup> 'Energy White Paper: Powering our Net Zero Future.', HM Government, December 2020.

<sup>21</sup> 'Technical annex: Energy and fuel bills today and in 2050', National Infrastructure Commission, 2018.

polluting technologies could therefore weigh on economic activity and productivity. The investment required for a widespread switch to low-carbon energy infrastructure may also add to energy prices.

## Competitiveness

**2.25** Where the level of ambition of UK climate change mitigation policies exceeds that of its trading partners, there is a risk of reduced UK competitiveness, particularly in highly traded sectors.<sup>22</sup> At the same time, the UK has areas of comparative advantage in a number of green and renewable sectors. Where the UK can capitalise on its leadership in decarbonisation, it may generate economic opportunities, including in technologies that are not yet established, such as carbon capture and floating offshore wind.

**2.26** One would expect the UK's opportunities to be aligned with its economic strengths as a world-leading knowledge economy, with a global financial services sector and advantages in renewable energies such as offshore wind engineering services.<sup>23</sup> The UK's ability to take advantage of these opportunities will be partly determined by the effective use of public policy, which can support the transition of important sectors and create an attractive environment for investment in innovation.

## Sectoral and structural impacts of the transition are likely to be significant regardless of the net impact

**2.27** Regardless of the magnitude and direction of aggregate economy-wide impacts, the transition will lead to significant changes in the structure of the economy. This will have knock-on impacts on sectors, jobs and regions.

**2.28** Some of these impacts will be locally concentrated, but precise impacts will depend on the ease with which the existing sectors can decarbonise, the rate at which new areas of economic activity emerge and on policies to manage the impacts or support the transition.

**2.29** It is not a given that the areas with currently high emissions will face the largest costs to decarbonise, and many of these regions could see new jobs as a result of policies such as those in the government's Ten Point Plan.<sup>24</sup> This included £12 billion of government investment to create and support up to 250,000 highly skilled green jobs, including an extra £200 million to create two carbon capture clusters by the mid-2020s, with another two set to be created by 2030. This increased the total invested to £1 billion, helping to support 50,000 jobs, potentially in areas such as the Humber, Teesside, Merseyside, Grangemouth and Port Talbot. Box 2.B further illustrates some of the potential economic opportunities that decarbonisation can bring across the country.

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<sup>22</sup> 'An Empirical Multi-Country Analysis of the Impact of Environmental Regulations on Foreign Trade Flows', *Kyklos*, vol. 50, C. Van Beers and J. Van den Bergh, 1997.

<sup>23</sup> The UK has an established comparative advantage in areas including offshore engineering (oil and gas), installation and maintenance of offshore drilling platforms, manufacture of platforms, cabling and substations, and development of offshore sites. 'Offshore Wind Energy Outlook', International Energy Agency (IEA), 2019.

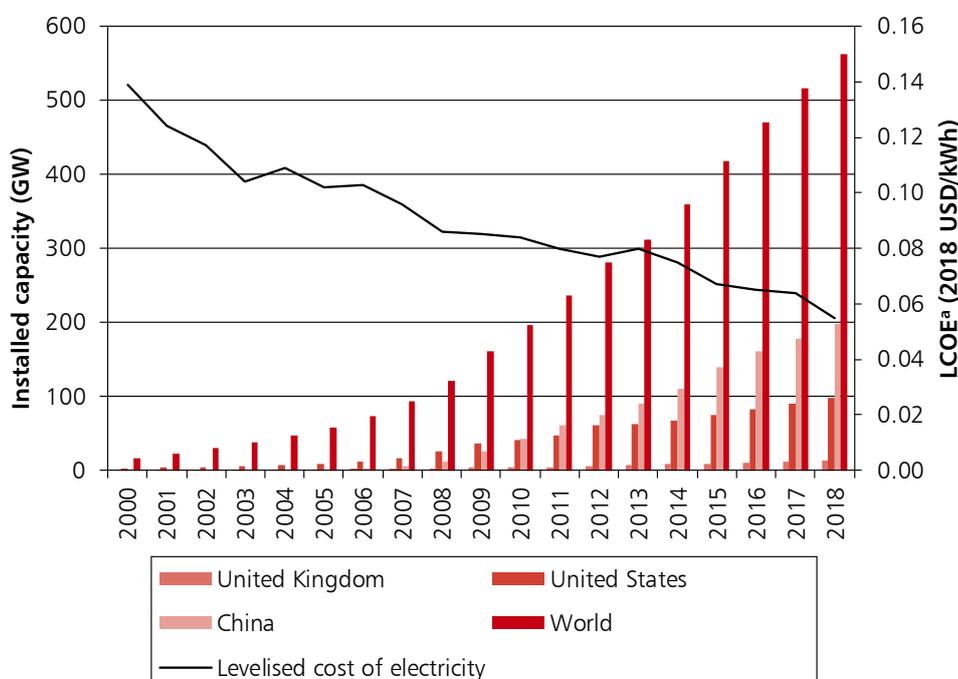
<sup>24</sup> 'The Ten Point Plan for a Green Industrial Revolution', HM Government, November 2020.

## Box 2.B: Onshore and offshore wind

Wind technology has developed rapidly over the past few decades. Since 2000, global onshore wind installations have seen a compound annual growth rate of 21%,<sup>25</sup> rising to nearly 30% annual growth since 2010<sup>26</sup> (Chart 2.B). Turbine prices have fallen on average by 38% since 2009.<sup>27</sup>

Offshore wind is also a rapidly developing technology of increasing importance for electricity generation. The UK has been a global leader in the promotion of offshore wind and has more installed capacity than any other country.<sup>28</sup> The UK's share of electricity generated by offshore wind has increased from 0.8% in 2010 to 6.2% in 2017 and is expected to reach 10% in 2020.<sup>29</sup> The average cost of electricity from offshore wind projects fell by over 25% between 2010 and 2019.<sup>30</sup>

Chart 2.B: Onshore wind installed capacity and average cost of electricity<sup>a</sup>



Source: 'Interactive Datasets, Wind Capacity', BloombergNEF, 2020; 'Renewable Power Generation Costs in 2019', International Renewable Energy Agency, 2020.

a The levelised cost of electricity (LCOE) is the average cost of the lifetime of the plant per MWh of electricity generated.

<sup>25</sup> 'Future of wind', International Renewable Energy Agency (IRENA), 2019.

<sup>26</sup> 'Offshore Wind Outlook 2019', IEA, 2019.

<sup>27</sup> 'Renewable Power: Sharply Falling Generation Costs', IRENA, 2017.

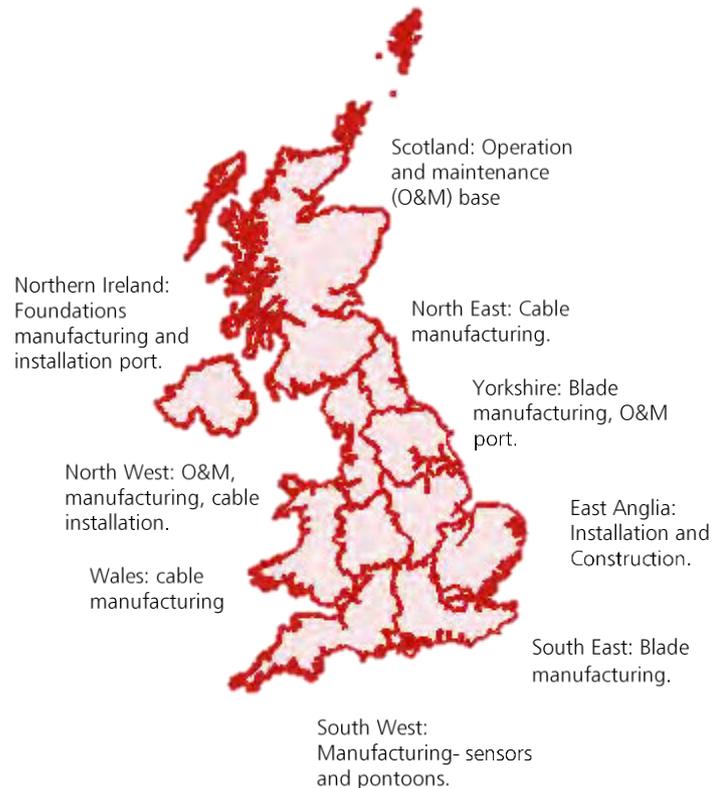
<sup>28</sup> 'Offshore Wind Outlook 2019', IEA, 2019.

<sup>29</sup> 'Offshore Wind Sector Deal Policy Paper', BEIS, 2020.

<sup>30</sup> 'Renewable Power Generation Costs in 2019', IRENA, 2020.

The UK has developed a successful offshore wind supply chain (Chart 2.C). In 2018, almost 50% UK projects' content was sourced in the UK,<sup>31</sup> with the sector aiming to increase this to 60% by 2030.<sup>32</sup> Offshore wind is associated with over 7,200 jobs, with regional clusters in the Humber and East Anglia.<sup>33</sup> Increasing offshore wind capacity to 40GW, from 10GW in 2020,<sup>34</sup> could support 27,000 jobs, including in manufacturing.<sup>35</sup> Some of these will replace jobs in high-carbon sectors; others will be additional.

**Chart 2.C: The wind supply chain has developed across the UK**



Source: 'Supply Chain Map', RenewableUK, 2020; 'NUTS Level 1 Fully Clipped Boundaries the UK', Office for National Statistics (ONS), 2018.

## Labour market

**2.30** Any structural changes to the economy will have knock-on impacts to the labour market and to demand for particular skills in the economy. The transition could generate a significant number of green or green-related employment opportunities across the UK across the skills and wage distributions as new industries emerge. However, employment losses concentrated in high-carbon sectors are possible if these sectors cannot adapt or absorb the costs of decarbonisation. The distribution of employment opportunities will depend on the flexibility in the

<sup>31</sup> 'Export Nation. A year in UK wind, wave and tidal exports', RenewableUK, 2018.

<sup>32</sup> 'Offshore Wind: Sector Deal Policy Paper', BEIS, 2020.

<sup>33</sup> 'Offshore Wind Sector Deal Policy Paper', BEIS, 2020.

<sup>34</sup> 'Wind Energy Statistics', RenewableUK, 2020.

<sup>35</sup> 'Offshore Wind: Sector Deal Policy Paper', BEIS, 2020.

labour market to match vacancies with the necessary skills, as well as government policy choices, and will not automatically match existing distributions of skills and labour. The potential labour market impacts are explored further in Chapter 7.

## The transition also has implications for financial stability

**2.31** A gradual and smooth transition can support (for example, by reducing the volume of stranded assets) and limit systemic risks to the financial system.<sup>36</sup> To this end, it is important that the government takes early and decisive action, providing clear signals on the direction of net zero policy to give certainty to investors and allow businesses to plan and adapt effectively.

**2.32** The Bank of England has identified a number of financial risks that could be realised if there were a disorderly transition to a low-carbon economy.<sup>37</sup> Credit risks can arise through stranded assets (fossil fuel assets and other carbon-intensive assets that become unusable) and losses from banks' and non-banks' loan exposure to companies vulnerable to transition risks. Insurers may be at risk if decarbonisation leads to a fall in value of the long-term assets held to support future pension benefits.<sup>38</sup> Market risk can arise from sharp re-pricing of fossil fuel and other carbon-intensive assets.

**2.33** The Bank also identifies operational risks, where shifting customer sentiment may pose reputational risks, for example through increasing pressure to divert capital flows away from carbon intensive companies towards sectors that contribute to the transition to a low-carbon economy. If such risks were to materialise at scale and pace, there could be significant implications for financial stability. These risks to the financial system could amplify the costs that climate change poses to the real economy.

**2.34** The Bank of England's proposed scenarios for modelling climate impacts on the financial system illustrate the difference that policy timescales to address climate change can have on financial stability.<sup>39</sup> A scenario where there is early and decisive action to address climate change would allow financial markets to price in the transition in an orderly fashion and take advantage of the opportunities it provides. In a late policy action scenario, where action to address climate change is delayed by ten years, a deeper adjustment is likely to be required. This may lead to significant shifts in global carbon prices, incurring risks to the financial system and the macroeconomy.

## The transition comes with co-benefits

**2.35** Co-benefits are ancillary benefits that result from greenhouse gas reduction. These include positive benefits such as improved public health outcomes (as a result of better air quality, better diets and more active travel), warmer, more comfortable

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<sup>36</sup> 'Too Little Too Late', European Systemic Risk Board, 2018. The Bank of England will also use the 2021 biennial exploratory scenario to explore the financial risks from climate change by looking at the difference in the costs between early and steady transition, and late transition with a sudden repricing shocks of assets.

<sup>37</sup> 'Transition in thinking: The impact of climate change on the UK banking sector', Bank of England, September 2018.

<sup>38</sup> Speech by Anna Sweeney (Bank of England), Moody's Insurance Summit Webinar, 9 September 2020.

<sup>39</sup> 'Discussion Paper: The 2021 biennial exploratory scenario on the financial risks from climate change', Bank of England, 2019.

homes, and wellbeing improvements from improved environmental amenities and green spaces.<sup>40</sup>

**2.36** Co-benefits have generally been excluded from macroeconomic modelling. However, they can be significant, realised in the near-term and largely benefit the country doing the emissions abatement. For example, the World Health Organization estimated the cost of premature deaths from air pollution in the UK as \$83 billion in 2010.<sup>41</sup> Therefore, co-benefits should not be excluded from final policy considerations.

## **The changes in the structure of the economy will also have fiscal implications**

**2.37** The transition to net zero and consequent structural changes in the economy will also have implications for the UK's public finances and fiscal sustainability. As some sectors grow and others shrink, the mix of tax revenues will change. Chart 2.D illustrates the cumulative relationship between employment and corporation taxes against emissions by industry. This shows that a small number of industries are responsible for a large share of emissions, but a much smaller share of tax. The top three sectors by greenhouse gas emissions account for 63% of UK industrial emissions but contribute just 14% of PAYE and Corporation Tax revenues.<sup>42</sup>

**2.38** Decarbonisation will mean significant changes for these high polluting sectors and industries, should decarbonisation lead to innovation and higher productivity in these sectors, the government might see associated tax revenues increasing. Alternatively if the costs of decarbonisation affect the near-term productivity of these firms, then the government might expect to collect less revenue from these industries. Nevertheless, these sectors' current small share of the tax-take suggests that the impact of the net zero transition on total tax revenues could be limited.

**2.39** Other taxes are more directly dependent on emissions. Chart 2.E shows the current tax revenues that are wholly dependent on individuals' and businesses' consumption of fossil fuels or emission of greenhouse gases. These sum to approximately £37 billion in the financial year 2019-20 or just over 4% of total revenues. While not all these taxes were designed solely to reduce carbon in the economy, much of this revenue is likely to be eroded during the transition to a net zero economy.

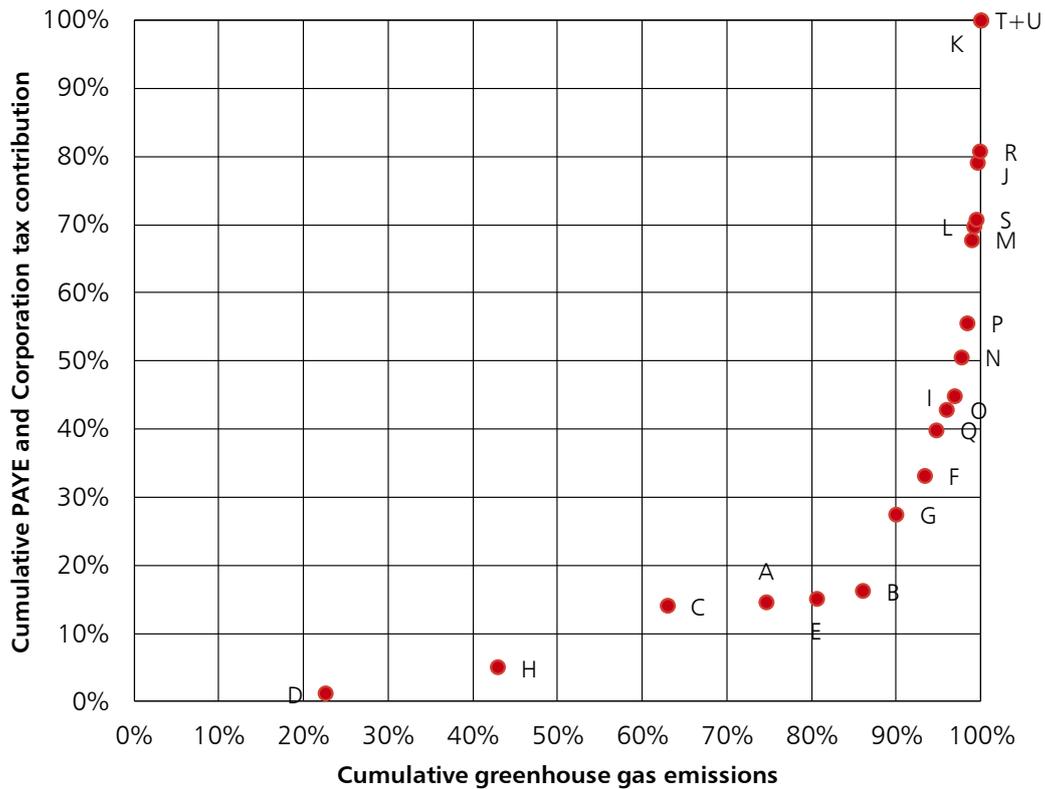
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<sup>40</sup> 'Multiple benefits from climate change mitigation: assessing the evidence', Grantham research Institute on Climate Change and the Environment, London School of Economics and Political Science (LSE), Kirk Hamilton, Milan Brahmabhatt, Jiemei Liu, November 2017.

<sup>41</sup> 'Economic cost of the health impact of air pollution in Europe', World Health Organization, 2015.

<sup>42</sup> 'Atmospheric emissions', Office of National Statistics (ONS), 2020; 'Income Tax deducted from pay by industry statistics', HM Revenue & Customs (HMRC), Pay As You Earn (PAYE) deducted from pay by industry, 2019; Corporation Tax Statistics, HMRC, 2020.

Chart 2.D: Industrial greenhouse gas emissions and revenue contributions by sector<sup>a</sup>



Code	Description	Code	Description
D	Electricity, Gas, Steam and Air Conditioning Supply	I	Accommodation and Food Service Activities
H	Transportation and Storage	N	Administrative and Support Service Activities
C	Manufacturing	P	Education
A	Agriculture, Forestry and Fishing	M	Professional, Scientific and Technical Activities
E	Water Supply; Sewerage, Waste Management and Remediation Activities	L	Real Estate Activities
B	Mining and Quarrying	S	Other Service Activities
G	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	J	Information and Communication
F	Construction	R	Arts, Entertainment and Recreation
Q	Human Health and Social Work Activities	K	Financial and Insurance Activities
O	Public Administration and Defence; Compulsory Social Security	T+U	Other

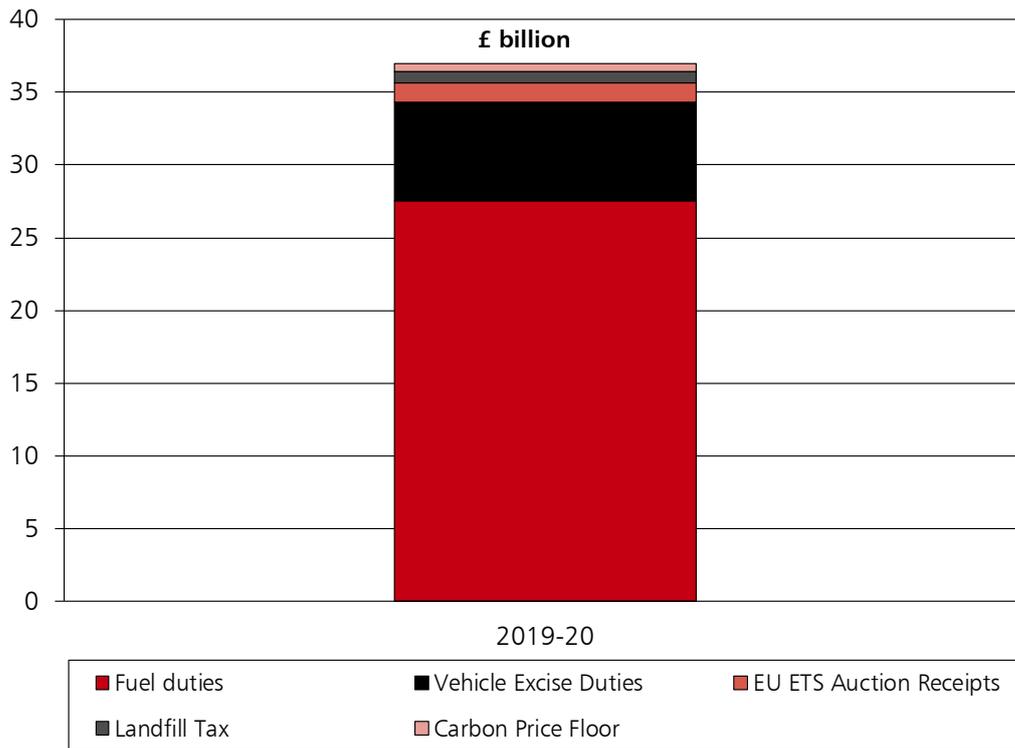
Source: 'Atmospheric emissions: greenhouse gases by industry and gas', ONS, 2020; 'PAYE tax deducted from pay, by industry', ONS, 2019; 'Tax receipts and NICs', HMRC, 2020; 'Corporation Tax liabilities', HMRC, 2019.

a Industrial emissions account for 74.1% of total GHG emissions. Revenue contributions by industry are calculated using PAYE + CT receipts. Sector refers to ONS Section level SIC code.

2.40 Taxes included in this analysis are wholly or partially at risk. For example, it is estimated that up to 90% of current Landfill Tax revenue could be at risk, as a significant proportion of the revenue is derived from biodegradable waste which releases methane and carbon dioxide.

2.41 Other tax revenues have mostly been excluded from this analysis where the net fiscal impact of the transition is uncertain. For example, the transition will have an ambiguous effect on revenues from the Climate Change Levy (CCL), a levy on business energy consumption. Consumption of electricity is expected to increase significantly, which would tend to increase CCL revenues, but this is to some extent offset by use of gas and solid fuels falling nearly to zero, reducing CCL revenues. Chart 2.E therefore only includes CCL revenues from the Carbon Price Support.

**Chart 2.E: Tax revenues from greenhouse gas consumption<sup>a</sup>**



Source: HMRC tax receipts and NIC contributions, 2020; PAYE deducted from pay, 2020), OBR economic and fiscal outlook, 2020.

a Current revenues from EU ETS receipts are at risk due to low greenhouse gases at the end of the transition.

2.42 On the expenditure side there is a potential fiscal benefit, with the spending on domestic decarbonisation expected to decline by 2050 as the economy decarbonises and markets and technologies mature. Some related spending pressures may remain, subject to decisions on how to fund capital and operating costs, and how to manage carbon leakage. In 2019-20 the government spent £1.5 billion<sup>43</sup> on domestic climate mitigation, with additional support of £11.4 billion through fiscally neutral spend, such as Contracts for Difference, where policy is funded through consumer bills.<sup>44</sup>

<sup>43</sup> This is the sum of all domestic climate mitigation spending from BEIS, the Department for Transport (DfT) and the Department for Environment, Food and Rural Affairs (DEFRA) and their arms-length bodies. This excludes international or climate adaptation spending. It also excludes spending on programmes where decarbonisation is one of multiple objectives, and it is difficult to isolate the decarbonisation spend.

<sup>44</sup> There are eight environmental levies that are added to energy bills, but are not included in this tax-at-risk assessment, as they are fiscally neutral. This means they do not represent a fiscal risk because, once decarbonisation has been completed, all revenue and spending pressures are fully offset. The removal of the levies will, however, reduce the overall size of the public sector. The ONS treats these levies in three different ways in the public sector finances. Four environmental levies (Renewables Obligation,

2.43 As set out above, global decarbonisation is necessary for sustainable economies in the long run, and therefore for the health of the public finances. Nevertheless, the UK still needs to act to maintain public finances' sustainability as it achieves net zero. This is to ensure that government can continue to fund other public service priorities and respond to future economic shocks. The importance of maintaining fiscal space to be able to respond to shocks has been underscored during recent months by the response to the COVID-19 pandemic. This has led to a significant rise in public debt that is both necessary and affordable and supported by historically low borrowing costs.

2.44 The transition to net zero will coincide with a period during which the OBR expects greater pressure on the public finances due to demographic trends.<sup>45</sup> Given the risks facing tax receipts over the transition period, the government will need to make decisions over time and in light of economic conditions about whether or not to adjust taxes in order to maintain revenue in a low-carbon economy, or to balance any loss of tax revenue with reductions in spending. Carefully considering impacts such as these is crucial for ensuring sustainable public finances into the future.

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Contracts for Difference, Capacity Markets and the Green Gas Levy) are included within the public sector finances, but for the Renewable Heat Incentive, only the spend aspect is included as annually managed expenditure. Three levy-obligations are not classified within the public sector but operate in a similar manner (Feed-in tariffs, Warm Home Discount and the Energy Company Obligation). The OBR discusses the classification of environmental levies in more detail in 'Restated March 2019 forecast', November 2019, paragraphs 1.20 to 1.22.

<sup>45</sup> 'Fiscal Sustainability Report', Office of Budget Responsibility (OBR), 2020.

# Chapter 3

## Estimating the costs of the transition

The transition to net zero requires new investment. Households, businesses and taxpayers will need to insulate homes and buildings, install low-carbon heating systems and replace internal combustion engine vehicles with low emission alternatives. These investments will lead to changes in households' and businesses' ongoing costs, particularly through their energy use.

The scale of the investment and changes to ongoing costs will vary from household to household and from business to business. The net impact will depend on the household's or business's current carbon exposure and their ability to change consumption patterns or business processes. It will also be affected by the timing of natural investment cycles, the rate at which technology costs fall, innovation and nationwide system-level decisions, such as the choice of energy mix over the next decade.

As a result, any cost estimate is highly complex, speculative and should be considered as a scenario based on assumptions rather than a projection. Nevertheless, such estimates can provide a sense of the scale of the challenge. To support its report on net zero last year, the Climate Change Committee (CCC) estimated that the transition would have a net cost of £50 billion across all economic sectors in 2050.<sup>1</sup> They have now updated this estimate to £16 billion.<sup>2</sup> This includes assumptions about changes to behaviour, falls in technology costs and efficiency gains, all of which are highly uncertain. These costs are partial and do not include the costs of policy interventions or broader supporting investment such as skills development, nor do the CCC cost estimates capture the wider economic effects, the fiscal impacts, the non-financial costs to households and businesses, or all the co-benefits of decarbonisation.

### What are the costs?

**3.1** The transition to net zero will require households and businesses to incur new costs. These costs are primarily capital expenditures, but also encompass changes to the long-term operating costs of the economy.

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<sup>1</sup> 2018 prices.

<sup>2</sup> 2019 prices

**3.2** The size of these costs is difficult to estimate. Technological development can bring costs down, but the rate is hard to predict. Government policy can also affect how quickly new technology is adopted, as well as adding to the total cost directly through expenditures on administering and enforcing policies to support the transition.

**3.3** Nevertheless, some organisations have attempted to estimate the cost of achieving net zero in order to give a sense of the scale of the challenge. The Climate Change Committee (CCC) last year put the cost at £50 billion in 2050, considering only the investment required and the impact on the running costs of technologies.<sup>3</sup> Their latest publication updates this estimate to £16 billion, as a result of changes in their modelling assumptions and lower costs forecasts for some important technologies.<sup>4</sup> The potential benefits from the transition, described in Chapter 2, could offset these costs to some extent.

## The nature of the costs

**3.4** The transition to net zero will be capital-intensive. This new capital equipment will have different – and in many cases lower – running costs to the high-carbon equipment it replaces.

**3.5** The capital and running costs will vary between sectors and between households, businesses and taxpayers depending on market structures and government policy. The impact of some costs will be small where new low-carbon products are more attractive than the current equivalent and the cost of changing is low. Others will prove more difficult. Table 3.A shows the types of changes in business practices and consumption patterns, investments and ongoing running costs that will be required over the next 30 years in different sectors of the economy.

## Factors affecting the total cost

**3.6** The final size of the cost is difficult to predict. This is because many of the details of how the transition will evolve are unknown. They will be determined by business decisions, consumer choices, trends in innovation and government policies over a 30-year period.

## Natural investment cycles

**3.7** The investments required to meet net zero will often mean replacing existing machinery or equipment with lower-carbon equivalents. Timely policy interventions with adequate lead times for households and businesses, can reduce the additional outlay required, for example by allowing a gas boiler to be replaced with a low-carbon alternative at the end of its natural life rather than having to scrap the boiler early. This is discussed in greater detail in Chapters 2 and 5.

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<sup>3</sup> 'Net Zero: The UK's contribution to stopping global warming', Climate Change Committee (CCC), 2019.

<sup>4</sup> 'Sixth Carbon Budget – Methodology Report', CCC, 2020.

**Table 3.A: Examples of decarbonisation investments, costs and savings for households and businesses**

Sector	Share of UK 2018 emissions (%) <sup>a</sup>	Example of decarbonisation change	Example of capital investment	Example of operating cost impact
Buildings	17.8	Improving home energy efficiency	Insulation	Energy bill savings
		Replacing oil or gas heating system	Heat pump or hydrogen boiler	Cost from clean fuel
Industry	20.8	Green cement	Carbon capture unit installation	Electricity cost of running a CCUS <sup>b</sup> unit
Power	13.3	Increase in green electricity generation	Wind farms	Low cost electricity
Agriculture, land use and land use-change	7.1	Woodland creation	Planting trees	Higher management and upkeep costs
Waste & fluorinated gases	7.0	Improved levels of recycling	New recycling infrastructure	Recycling plant running costs
Transport – surface	23.2	Replacing internal combustion engine car or van	Electric car or van	Fuel savings or increases
Transport – aviation and shipping: domestic (A); international (B)	1.6 (A)	Decarbonising aviation and shipping fuel	Airline fleet upgrades	Changes in fuel costs compared to current fossil fuels
	9.1 (B)			
Negative emission technologies	N/A	Capturing and removing carbon	Direct air capture plant	Energy cost of running plant

Source: 'Reducing UK emissions: 2020 Progress Report to Parliament', CCC, May 2019; Final UK greenhouse gas emissions national statistics 1990-2018.

a Where possible, this report uses the 2019 data. This table uses the 2018 data as international aviation and shipping emissions for 2019 will not be available until February 2021.

b Carbon capture, usage and storage

### Rate of innovation

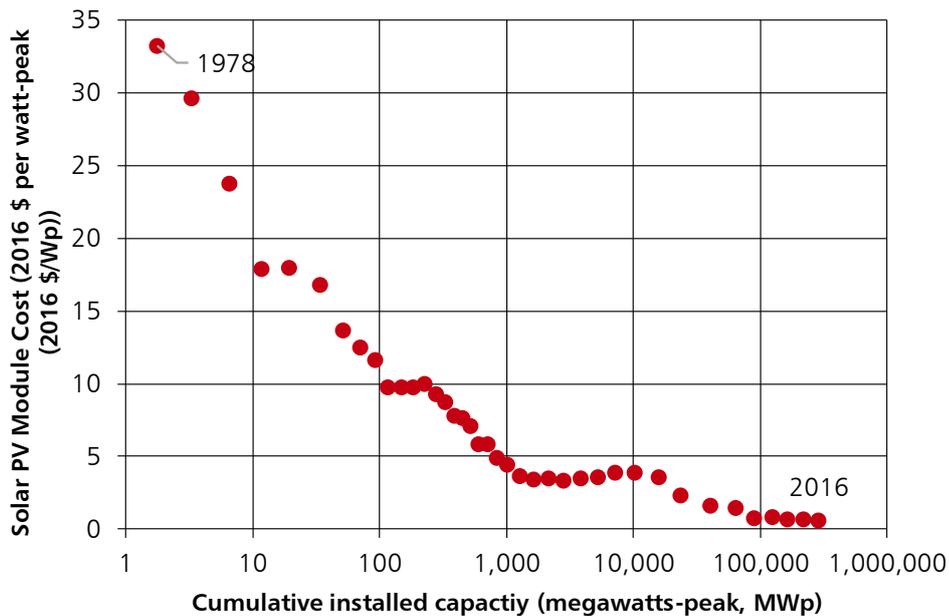
**3.8** The costs of new technologies tend to fall as they become more developed and are deployed more widely. Technology costs could be considerably lower in the 2030s and 2040s than in current forecasts, but the speed at which they will fall is unknown. Cost reductions can be driven by several factors including economies of

scale, research and development spillovers and the learning-by-doing process.<sup>5</sup> Box 3.A discusses how solar panel costs have fallen since their invention in 1954.

### Box 3.A: Innovation in solar energy has spurred global cost reductions

The cost of solar photovoltaic (PV) technology has fallen dramatically since it was invented in 1954. The cost of solar PV modules has fallen by 20-25% on average for each doubling of global solar PV capacity (Chart 3.A).<sup>6</sup>

#### Chart 3.A: Solar module cost and cumulative installed capacity



Source: Unit cost: 'How well do experience curves predict technological progress? A method for making distributional forecasts', F. Lafond, A.G. Bailey, J.D. Bakker, D. Rebois, R. Zadourian, P. McSharry & J.D. Farmer, March 2018; Cumulative capacity: Lanford et al. (2017) up to 2009 and International Renewable Energy Agency (IRENA) Global solar PV installed capacity and solar PV model price. Cited in Ritchie (2017) 'Renewable Energy'.

Innovation and scientific cooperation across the world have spurred these cost reductions.

First, the US government funded the commercial use of solar PV in 1956 in satellites.<sup>7</sup> Then, during the 1980s-90s, the Japanese government worked with Japanese corporations to find commercial uses for PV and created a rooftop subsidy scheme. This meant that by the mid-2000s Japan was producing roughly 50% of global PV modules.<sup>8</sup>

<sup>5</sup> 'Wright meets Markowitz: How standard portfolio theory changes when assets are technologies following experience curves', Journal of Economic Dynamics and Control, Volume 101, R. Way, F. Lafond, F. Lillo, V. Panchenko and J. D. Farmer, April 2019.

<sup>6</sup> 'Renewable Energy', Our World in Data, H. Ritchie and M. Roser, 2017; 'Photovoltaics report', Fraunhofer Institute for Solar Energy Systems, ISE, September 2020.

<sup>7</sup> Vanguard Satellite 1958, NASA 2017.

<sup>8</sup> 'How Solar Energy Became Cheap', G.F. Nemet, 2019.

In 2000, Germany introduced feed-in tariffs and prioritised grid access for renewables. This led to Germany accounting for over half of global installations of solar panels between 2004 and 2007.<sup>9</sup>

The rise in demand for PV as a result of policy in Germany transformed Chinese production. Between 2000 and 2007, the solar PV industry in China grew from just a few start-ups to being a world leader, with the success of a few pioneering companies encouraging more investors to move into the industry.<sup>10</sup>

Global installed capacity of solar PV rose from 808 MW to 570,000 MW between 2000 and 2019. Over a third of installed capacity in 2019 was in China,<sup>11</sup> which also manufactured approximately two-thirds of modules that year.<sup>12</sup>

Investment in solar PV is predicted to continue to rise, with a potential six-fold increase over the next decade. By 2050, installed capacity is predicted to be eighteen times higher than in 2018.<sup>13</sup>

The UK plays a role in research and development in the global solar supply chain, leading the development of next-generation PV technologies. Nippon Sheet Glass (NSG) and Oxford Photovoltaics (PV) are UK based companies leading the development of new technologies.<sup>14</sup>

**3.9** Forecasting falls in technology prices is difficult. Estimates can be conservative, thereby overstating the cost of achieving net zero.<sup>15</sup> Chart 3.B, for example, shows the difference between the predicted cost of onshore wind projects commissioned in a given year and actual levelised<sup>16</sup> cost of electricity for projects in the corresponding year.

**3.10** Underestimating falls in technology prices can also be seen at the economy-wide level. In 2008, the CCC estimated that the costs required to reduce carbon emissions by 80% by 2050 would be the equivalent of 1 to 2% of GDP in 2050. Technological progress in the subsequent decade meant that when the CCC gave their advice in 2019, they estimated that it would be possible to achieve the more

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<sup>9</sup> 'How Germany helped bring down the cost of PV', Energy Transition, C. Morris 2016.

<sup>10</sup> 'Unrelated diversification in latecomer contexts: Emergence of the Chinese solar photovoltaics industry', Environmental Innovation and Societal Transitions, Vol 28, C. Binz and L.D. Anadon, September 2018; 'Analysis on the development and policy of solar PV power in China', Renewable and Sustainable Energy Reviews, S. Zhang and Y. He, 2013.

<sup>11</sup> 'Renewable Capacity Statistics 2020', International Renewable Energy Agency (IRENA), March 2020.

<sup>12</sup> 'Photovoltaics report', Fraunhofer Institute for Solar Energy Systems, ISE, September 2020.

<sup>13</sup> 'Future of Solar Photovoltaics', IRENA, 2019.

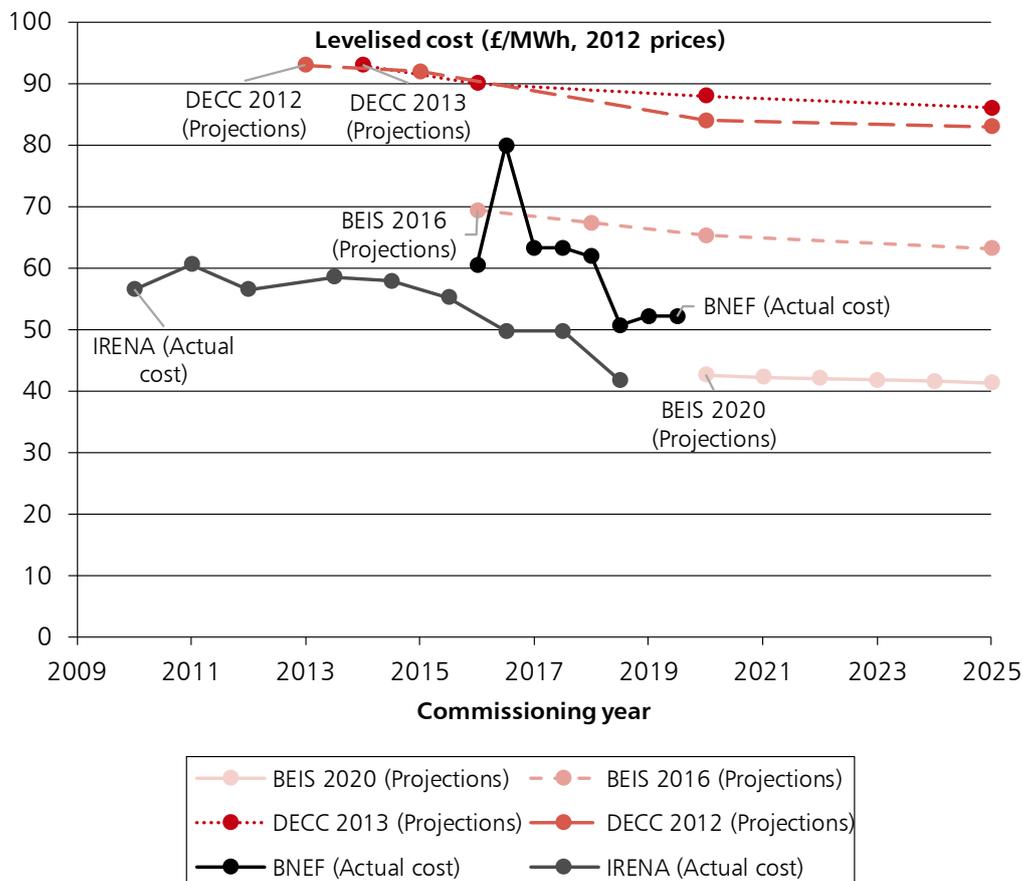
<sup>14</sup> 'The Solar Commission', Regen, July 2019; 'UK firm's solar power breakthrough could make world's most efficient panels by 2021', J. Ambrose, The Guardian, 15 August 2020.

<sup>15</sup> 'The Role of Modelling and Scenario Development in Long-term Strategies', Long-Term Climate Strategies, World Resources Institute, D. Zenghelis, 2018.

<sup>16</sup> Levelised costs is a measurement used to assess and compare alternative methods of energy production. It can be thought of as the average total cost of building and operating the asset per unit of total electricity generated over an assumed lifetime.

ambitious target of net zero emissions by 2050 for the same cost.<sup>17</sup> The latest CCC cost estimates show the cost could be lower than 1% of GDP.

**Chart 3.B: Projected onshore wind costs and average cost of past projects<sup>a</sup>**



Source: 'DECC Electricity Generation Costs', Department for Energy & Climate Change, 2012 and 2013; 'BEIS Electricity Generation Costs', Department for Business, Energy & Industrial Strategy, 2016; 'BEIS electricity generation cost report (2020)', BEIS, 2020; 'Renewable Power Generation Costs in 2018', IRENA, 2018; 'Historic LCOE', BNEF, 2020.

<sup>a</sup> The average, or 'levelised', cost of the lifetime of the plant per MWh of electricity generated.

**3.11** There may be limits to the falls in costs that could take place, and cost reductions may be limited to certain technologies. The learning-by-doing effect appears to be strongest with technologies that are built using highly repeatable activities, usually involving the manufacture of small unit pieces. For example, about 1 billion solar PV modules have been made globally since the invention of the product in 1954, allowing cumulative learning by doing to occur.<sup>18</sup>

**3.12** The effect is less visible for technologies where this does not apply. The cost of building nuclear power stations has not fallen in recent years as safety regulations in the sector have tightened in response to the 2011 Fukushima nuclear disaster.<sup>19</sup>

<sup>17</sup> 'Net Zero: The UK's contribution to stopping global warming', Climate Change Committee, 2019.

<sup>18</sup> 'Sunny Uplands: Alternative energy will no longer be alternative', The Economist, C. Stoescu, November 2012; BloombergNEF, 2020.

<sup>19</sup> 'High costs and renewables challenge the case for nuclear power', The Financial Times, Pfeifer, 2018.

**3.13** However, learning can, and does, occur for nuclear power station construction where nations are able to invest in fleet deployment, using the same design across multiple projects, as seen in the Republic of Korea and elsewhere.<sup>20</sup> There remains strong interest in developing new nuclear power plants as resource-poor countries seek to decarbonise their power systems. Therefore, while costs have not uniformly fallen as a result of the c. 500 nuclear power stations that have been built globally,<sup>21</sup> there is an understanding of the potential for learning in the future. This could be aided by international coordination and a degree of regulatory alignment. In the UK, the developer of Hinkley Point C is reporting evidence of a tangible learning benefit between reactors 1 and 2 with some milestones for reactor 2 being achieved with fewer man-hours of labour than were expended to reach equivalent milestones on reactor 1.<sup>22</sup>

**3.14** Nuclear project developers are also exploring ways to modularise construction where possible to mitigate delays caused by weather and therefore reduce overall project risk. Furthermore, pending global regulatory approval, small modular reactors (SMRs), could have the potential to go further by using repeat manufacture and on-site assembly techniques that accelerate learning and enable cost reductions. The Prime Minister announced in November 2020 up to £215 million from the Advanced Nuclear Fund would be made available for investment in this technology.

### **Pace of behavioural change**

**3.15** Changes in patterns of demand can also affect the cost of transitioning to net zero. This is especially true of difficult-to-decarbonise sectors like aviation and agriculture, where the abatement options needed for residual emissions will tend to be the most expensive. The pace at which behaviour change will take place is highly uncertain and may depend on societal changes and government policy.

### **Policy certainty**

**3.16** Certainty on policy direction is also a driver of costs for the private sector.<sup>23</sup> Uncertainty about how government policy will evolve across the transition can push up financing costs or deter investment entirely as the private sector awaits government decisions. This can increase costs if decisions are delayed sub-optimally.

**3.17** The beneficial effects of policy certainty can be seen through the greater fall in the cost of wind energy, which has had a more consistent policy direction, compared to nuclear energy. Chapter 5 discusses the role of signalling and stability in reducing uncertainty for economic actors.

### **System-level decisions**

**3.18** The transition to net zero includes a number of system-level decisions. These include decisions about the UK's overall approach to decarbonisation, infrastructure choices and the shape of the energy system. These decisions may affect the balance between investment and ongoing running costs.

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<sup>20</sup> 'The ETI Nuclear Cost Drivers Project: Summary Report', Energy Technologies Institute, 2018.

<sup>21</sup> 'Sunny Uplands: Alternative energy will no longer be alternative', The Economist, C. Stoenescu, November 2012; BloombergNEF, 2020.

<sup>22</sup> 'Building on experience - the route to unit 2 (Hinkley Point C), EDF Energy, 2020.

<sup>23</sup> 'Cost of Energy Review: independent report', Professor Dieter Helm, October 2017.

**3.19** For example, decisions about the final roles of hydrogen and electricity in the future UK economy will affect how households and businesses heat their buildings, fuel use in industry and long-haul transport. This will have consequential impacts on investments required to reach net zero and operating costs. The viability of hydrogen in turn partly depends on whether Carbon Capture, Use and Storage (CCUS) can be deployed at scale to produce clean hydrogen on a cost-competitive basis. Demonstrations are underway, with at least one hydrogen-CCUS cluster expected to be operational by the mid-2020s.

**3.20** Another system-level decision is the scale of negative emission technologies in a net-zero UK. The CCC's net zero scenario included a significant role for greenhouse gas removals, including those yet to be developed and deployed, over the next 30 years to balance residual emissions from some of the most difficult to decarbonise sectors, such as industry, agriculture and aviation.<sup>24</sup> How quickly and cheaply negative emissions technologies develop will determine the degree to which those emissions can be offset or more expensive sectoral abatement options will be needed.

## **Cost estimates are still useful, despite the uncertainty**

**3.21** Despite the challenges set out above, cost estimates are still useful in understanding the scale of costs required to achieve net zero. The CCC, and other groups such as the Energy Systems Catapult, have produced estimates for a UK net zero target. The European Commission has also estimated total costs for an EU-wide net zero target in 2050. These estimates vary in their baselines, scope and assumptions about technologies and behavioural change.

**3.22** Choosing a particular baseline or counterfactual is challenging and has a large impact on the final cost estimate. Consumer behaviour and preferences are constantly shifting. For example, the current trend in plant-based diets will lead to lower costs for the transition, but the degree to which this trend continues, and whether it should be counted in the counterfactual scenario is a matter of judgement. Given the 30-year time period, assumptions could compound to produce large differences in cost estimates by the end of the forecast period.

**3.23** Further variability comes in the scope and measurement of the greenhouse gas emissions to be abated. UK estimates are based on international best practice accounting standards as set out by the Intergovernmental Panel on Climate Change (IPCC),<sup>25</sup> but the methodology is subject to review and revision. For example, the IPCC has recently re-classified the greenhouse gas effect of peatland degradation.<sup>26</sup> This has increased estimated UK greenhouse gas emissions from all peatland sources by between 17.2 and 21.7 MtCO<sub>2</sub>e in 2017. Emissions from degraded peatlands are not currently included in the UK's Greenhouse Gas Emissions Inventory. Once they are, this will increase the UK's total emissions by 3 to 4%.<sup>27</sup>

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<sup>24</sup> 'Net Zero: The UK's contribution to stopping global warming', CCC, 2019.

<sup>25</sup> '2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories', IPCC, 2006.

<sup>26</sup> '2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands', IPCC, 2014.

<sup>27</sup> 'Net Zero: The UK's contribution to stopping global warming', CCC, 2019; 'Implementation of an Emissions Inventory for UK Peatlands', Centre for Ecology and Hydrology – Natural Environment Research Council, C. Evans et al, December 2017.

## The Climate Change Committee's cost estimate

**3.24** In December 2020, the CCC published its advice on the Sixth Carbon Budget. In this analysis they provided new estimates of the cost of achieving net zero by 2050.<sup>28</sup>

**3.25** In their 2019 report, the CCC advised that the annual cost in the final year of the net zero transition would be £50 billion.<sup>29</sup> In their Carbon Budget 6 advice, published earlier this month, this figure has been revised down to £16 billion. The reduction is due to lower cost forecasts for some important technologies and a change in the scenario they have modelled; they have assumed greater behavioural change over the next 15 years and less reliance on greenhouse gas removals in the final years of the transition.<sup>30</sup> Table 3.B sets out how the CCC's estimate breaks down across sectors.

**3.26** In the CCC's net zero scenario, buildings is the most costly sector to decarbonise, at around £7 billion a year on average. These are mainly capital investments, with some operating cost savings. The high cost for buildings (over 50% of the total cost for all sectors) compares with a 17.8% share of direct emissions in 2018 (88 MtCO<sub>2</sub>e). These investments mean that buildings will have relatively limited residual emissions of 1 MtCO<sub>2</sub>e in 2050, around 0.2% of total 2018 emissions.

**3.27** Transport was the largest emitting sector in 2018, but the CCC's net zero scenario has a net cost saving from decarbonising the sector due to savings from using electric vehicles relative to internal combustion engines. Savings are largely driven by an assumption of falling battery costs, and by lower running costs compared to petrol and diesel vehicles. Other forecasters predict less rapid declines in costs and lower savings. Transport remains the highest emitting sector in 2050, but most residual emissions are from aviation. Those residual emissions increase the need for the development of negative emission technologies to remove greenhouse gases from the atmosphere, with an average annual net cost for these removals of £2.3 billion.

**3.28** Agriculture also remains challenging to decarbonise fully in the CCC's scenario. It maintains a large proportion of its 2018 emissions level and will require significant offsets according to the CCC.

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<sup>28</sup> 'Sixth Carbon Budget – The path to Net Zero', CCC, 2020.

<sup>29</sup> Under the CCC's definition, costs are estimated by summing costs and cost savings from carbon abatement measures and comparing them to costs in an alternative scenario (a hypothetical world with no climate action or climate damages). For example, installing energy efficiency measures (e.g. loft insulations, cavity wall insulations) in homes has an upfront cost but reduces energy demand and emissions. There is an investment cost from installing the measures (e.g. labour costs, costs of building materials), followed by an ongoing stream of fuel and cost savings. The total cost of the measure will be the sum of its annualised costs and cost savings. This exercise is applied to all abatement measures in the economy to estimate total resource costs. See 'Net Zero: The UK's contribution to stopping global warming', CCC, 2019, p.227.

<sup>30</sup> 'Sixth Carbon Budget – Methodology Report', CCC, 2020.

**Table 3.B: CCC estimates of UK emissions and costs of decarbonisation by sector**

Sector	2050 residual emissions as a share of 2018 UK emissions (%)	Average annualised net cost (£bn) <sup>a</sup>	Average in-year operating cost (£bn)	Average in-year investment cost (£bn)	Peak in-year investment cost (£bn)	Peak year
Buildings	0.2	7.3	-2.7	11.7	19.0	2028
Industry	0.5	2.2	0.5	1.8	4.1	2036
Electricity production <sup>b</sup>	0.2	1.6	-4.8	15.5	22.6	2034
Fuel supply	0.1	1.0	-0.3	2.5	4.6	2048
Agriculture, land use and land use-change	3.0	0.3	0.0	1.3	1.9	2042
Waste & F-gases	1.9	0.6	0.0	0.3	1.2	2023
Transport <sup>c</sup>	4.7	-1.7	-21.8	11.4	14.1	2040
Negative emission technologies	-10.6	2.3	0.0	0.2	0.4	2040

Source: 'The Sixth Carbon Budget – The UK's path to Net Zero', CCC, 2020.

a Annualised costs spread the investment costs over the lifetime of an asset and include the cost of finance. Therefore, the sum of in-year operating and investment costs do not equal the annualised net cost.

b This row contains electricity production and network costs. The majority of network costs are related to electricity, though a small part relates to carbon capture and storage networks used in industry, greenhouse gas removals and hydrogen production.

c CCC estimates of residual emissions and costs include international aviation and shipping. All costs in 2019 prices.

### Understanding the CCC's net cost estimate

**3.29** Forecasts over a 30-year horizon are highly uncertain. For this reason, the CCC has produced several scenarios for how the UK might reach net zero. Their main scenario includes a number of assumptions relating to technologies used, technological development rates, technological adoption rates and resulting efficiencies, and behavioural change. For example, the CCC analysis assumes a 20% reduction in beef, lamb and dairy consumption by 2030 and a reduction up to 17% of total car miles by 2050.

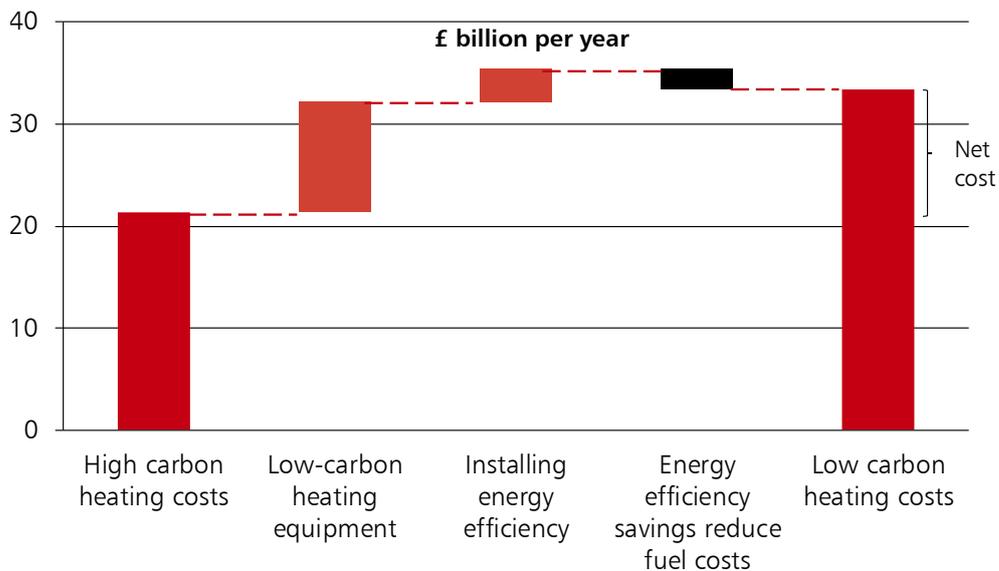
**3.30** On the basis of these assumptions, the CCC produced a 'net resource costs' estimate, which is the additional capital and operating costs required, offset by savings from efficiencies that may be realised. For example, if a household was to buy a new hydrogen boiler costing A, instead of a traditional boiler costing B, the

CCC would conclude that the net resource cost was A-B rather than A. The resource costs estimate also takes account of whether the running costs over the boiler's lifetime would be relatively higher or lower.

**3.31** The CCC's aggregate resource cost estimate is ultimately the net effect of a series of large costs outweighed by slightly smaller savings and varies significantly by sector. It is worth noting that, during the transition, operating cost changes mainly relate to energy consumption costs. In the CCC's net zero scenario, they estimate that there will be a 70% reduction in gas use and an 85% reduction in oil. These are replaced by low-carbon sources of energy such as renewable electricity, which in turn benefits from assumptions about efficiencies over time leading to lower cost electricity generation. This implies a significant operating cost saving for the economy as a whole and that the majority of the net cost relates to capital expenditure and the return on that capital.

**3.32** Chart 3.C illustrates the CCC's calculations for the heating sector. The first bar shows household spend of £21 billion on high-carbon sources of heating on average over the transition. The second and third bars show the additional capital cost of installing energy efficiency measures and low-carbon heating systems, such as heat pumps, which totals around £14 billion in additional costs. These costs may be borne by households, property owners or by the taxpayer, depending on policy choices. Installing energy efficiency measures has an upfront capital cost (e.g. costs of building materials, labour costs), but reduces operational costs as less energy is used to reach the same heat level. The fourth bar shows operating cost savings of around £2 billion in 2050 as a result of reduced energy usage. This leaves the position on the right, with net costs of around £12 billion.

**Chart 3.C: Impact of net-zero emissions scenario on household heating costs, 2020 to 2050**



Source: 'Sixth Carbon Budget – The path to Net Zero', CCC, 2020, Figure 6.5.

**3.33** Other technology options have both upfront capital costs and higher operating costs, like hydrogen heating for homes. For these technologies, costs will continue to be incurred after 2050. The final financial impact on households,

businesses and taxpayers depends on government policy choices, as well as the materialisation of costs and benefits from the rest of the transition.

### Limitations of the CCC's net cost estimate

**3.34** While the CCC's net cost estimate is a helpful guide, it remains a scenario based on assumptions.

**3.35** The CCC did not directly include all macroeconomic modelling of the wider effects of net zero on the economy in their cost estimate<sup>31</sup>. If decarbonisation causes the economy to grow at a slower (or faster) rate than it would have done, the compounding effect over several decades could lead to costs (or benefits) that may be significantly larger than the CCC's net cost estimate in 2050.

**3.36** The CCC's net cost estimates do not include the cost of designing, implementing and enforcing decarbonisation policies, nor the development of the supporting skills and knowledge to create, install and use low-carbon technologies. For example, the CCC assumes that there are no net costs associated with individuals choosing to walk and cycle rather than to drive. However, there will be costs (and benefits) to the individual as well as new costs to taxpayers from building new cycling infrastructure. If new skills are not acquired, such as those required for retrofitting buildings with energy efficiency measures, there will be supply-side constraints that will affect growth.

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<sup>31</sup> Cambridge Econometrics provided the CCC with supporting research on the macroeconomic context of decarbonisation. See 'Economic impact of the sixth carbon budget', Cambridge Econometrics, 2020.

# Chapter 4

## Market failures and policy choices

One way to approach the problem of climate change and the transition to net zero is by considering market failures. In this framework, climate change is caused by market failures in the form of externalities and public goods. Those who emit greenhouse gases do not always pay for the damage their emissions cause, nor can they be excluded from enjoying the benefits of the climate. Compounding the problem are market failures that hold back the adoption of low-carbon technologies and practices, including inertia and lack of information.

In designing policies to support decarbonisation, the government will need to consider how best to address these market failures. Carbon pricing can be a good way to address the negative externality and realign incentives but will not be sufficient to achieve net zero by itself. Further measures will be needed to address the other market failures and to manage the distributional impacts of the transition and its effects on business competitiveness.

### Decarbonisation means addressing a variety of market failures

4.1 Addressing global warming involves overcoming a series of market failures. Perhaps the most significant of these is the negative externality driving climate change: those who emit greenhouse gases generally do not face the full costs of their actions, leading to increasing concentrations of greenhouse gases in the atmosphere.<sup>1</sup> However, the path to a net zero economy is further impeded by other market failures that may need to be addressed to support the process of decarbonisation.

4.2 There are three broad types of market failure:

- **static price failures** where market prices of goods and services do not reflect their full cost or benefit to society. A change in prices, and a resulting change in patterns of consumption and production, could make society as a whole better-off. These market failures include negative externalities, positive externalities, public goods and natural monopolies.

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<sup>1</sup> 'The Economics of Climate Change: The Stern Review', Nicholas Stern, Cabinet Office – HM Treasury, 2006.

- **static non-price failures** where there are appropriate price incentives, but other constraints prevent a socially optimal outcome. This group of market failures includes static information failures, split-incentives, inertia or bounded rationality, property rights failures and liquidity constraints.
- **dynamic failures** where people make choices that appear to be economically sensible in the short-run but leave society worse off in the long-run. This is a particular feature of the development of new technologies. These market failures include uncertainty and multiple equilibria problems, relating both to coordination failures and technological development curves.

**4.3** Many sectors experience multiple market failures simultaneously. Even if a negative externality associated with greenhouse gas emissions is addressed, other market failures may need to be overcome to achieve net zero. For example, in the power sector, the primary market failure is the negative externality associated with the use of fossil fuels to generate electricity but there are also dynamic market failures associated with the development of new technologies, and liquidity constraints may hold back major infrastructure projects such as the construction of new nuclear power plants. Distortions in the power sector can also affect other sectors of the economy, potentially magnifying their impact. The Prime Minister’s Council for Science and Technology has advised on the importance of systems thinking in the government’s approach to decarbonisation. Annex B examines the types of market failure in more detail and considers how they apply in different sectors.

## **There are a variety of policy levers to address these various market failures**

**4.4** The government has a range of policy levers available to support the transition to net zero. The main policy levers can be broken down as follows:

- Levers that change the price of emitting greenhouse gases, including carbon pricing (through taxes or emissions trading schemes), subsidies and regulations, which affect prices by promoting or limiting certain activities;
- Facilitative levers that change market institutions – or the rules of the game – so that private actors are better able to decarbonise; and
- Broader public interventions, for example, through public spending or the design of regulatory frameworks to support the transition where the market will not.

**4.5** Some of the policy levers that drive decarbonisation are reserved to the UK government, but many are devolved to the Scottish and Welsh governments and Northern Ireland Executive. This means that, while this report considers the role of the UK government, some of the choices between policy levers will be for the devolved administrations, working in collaboration with the UK government.

**4.6** Some policy levers may be better suited to addressing particular types of market failure, but the most appropriate lever will also depend on issues of practicality and consideration of other government objectives. For example, in cases where it is not possible to measure or target emissions directly, policies may have to address the market failure indirectly, by targeting some proxy for emissions. Equally,

in cases where this is possible, it may be undesirable due to the impact certain businesses or groups of households. This means that there may be trade-offs between the efficiency and equity of decarbonisation policies. It may also be hard to fully identify the wider impacts of a policy at the outset. Markets will adjust in response to new incentives, and links between sectors may mean that policies can sometimes introduce new distortions or perverse incentives. This further complicates the decision-making.

## Emissions pricing

**4.7** Given its central role in driving climate change, addressing the negative externality associated with greenhouse gas emissions is likely to be an important part of any strategy to achieve net zero. One way of doing so is to attach a price to emissions. This creates an economic incentive for households and businesses to reduce their emissions. The government can create such a price through emissions taxes, ETS, subsidies or even regulation.

**4.8** Taxes, ETS and subsidies change the relative price of an activity but preserve the optionality for businesses and households to change their behaviour or pay the carbon price (or forgo the subsidy). This creates a market incentive for abatement and can encourage innovation. The IMF suggests that an economy-wide carbon price – implemented in the form of a carbon tax – could be more effective than other policy levers in mobilising capital investments.<sup>2</sup>

**4.9** Prohibitive regulations, in contrast to taxes, subsidies and trading schemes, compel households and businesses to change their behaviour. This gives the private sector less flexibility to innovate but provides more certainty that abatement will occur and can support the development of economies of scale.

**4.10** Each of these policy levers changes the cost of producing emissions, and to some extent they can be used interchangeably to achieve the same policy objectives (Box 4.A). However, different levers will have different distributional impacts and implications for competitiveness. Regulations impose costs on firms and households, but unlike taxes and subsidies, they do not result in a transfer of resources to or from government.

**4.11** The impacts of particular policies or packages of policies will depend on their detailed design, the behavioural response of households and businesses, and the characteristics of the market concerned, including the costs of abatement and the availability and affordability of alternative products. For example, where a market is competitive and trade-exposed, it is harder for firms to pass costs onto consumers, resulting in potentially bigger impacts through wages and profits. These effects will also evolve as technology develops and prices change over time. Chapters 6 and 7 discuss these issues in more detail.

**4.12** Finally, although emissions pricing is likely to be an important component of any policy package, it will not on its own be sufficient to achieve net zero given the presence of other non-price market failures which can act as a barrier to private investment.

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<sup>2</sup>Fiscal Monitor: How to Mitigate Climate Change', International Monetary Fund (IMF), October 2019.

#### Box 4.A: Pricing carbon emissions

Taxes, ETS, subsidies and regulations are all important policy tools to support decarbonisation. However, they have different functions and distributional implications.

**Emissions taxes** can increase the cost of greenhouse gas emissions directly or implicitly through relative rates of indirect taxes on carbon-intensive and low-carbon products or services. Taxes can apply to emissions, particular inputs or outputs and can be sector-specific or more broadly applied. As well as creating an incentive to reduce emissions, emissions taxes can spur innovation and greener investments to reduce future tax liabilities. For example, if the tax system allows carbon offsetting, it could help drive innovation in negative emissions technologies.

In an **emissions trading scheme** (ETS) an emitter must buy a quantity of permits equivalent to the amount of greenhouse gases they emit. The number of permits is fixed, and the price is determined by the market for permits.

ETS and taxes are conceptually similar levers. Both provide price signals to drive behaviour change, granting the private sector substantial flexibility on how best to decarbonise, while raising revenue, directly or from the sale of the permits. However, their deployment and technical specification is different. While a tax fixes a price for emissions, an ETS fixes the quantity through a system-wide cap. This cap on emissions can then be reduced over time to provide confidence that the UK will mitigate its emissions to meet its net zero target and to provide an effective, responsive price signal to drive decarbonisation.

An alternative to increasing the price of emitting greenhouse gases is to decrease the price of carbon abatement through a subsidy or tax relief. **Subsidies** may be effective at supporting new markets to develop, helping to manage high initial costs for producers or stimulating demand to encourage supply chains to develop. They tend to be linked to specific actions rather than general abatement. This may limit the incentive for firms to innovate in non-subsidised technologies that could prove more effective. Unlike regulation or tax, it is not possible to compel action through subsidies, as they rely on economically rational responses and awareness of the government offer. Additional market failures, such as inertia, may therefore affect uptake.

A subsidy is more likely to be inefficient when there is uncertainty about the technological pathway, while a tax can encourage decarbonisation in a technology neutral way. Subsidies may be more effective, however, where households or firms do not have access to the money required to adopt lower-carbon technologies or there is a risk of carbon leakage.

**Regulations** can ban use of certain technologies, require adoption of others or impose standards for efficiency, packaging or the allowable level of emissions. The feasibility depends on the complexity of the regulation, the characteristics

of the regulatory base, the frequency of reform and the efficiency of the enforcement authority. The implied carbon price of a regulation is the cost of adhering to it.

Regulations can allow government to directly drive the pace of decarbonisation in certain sectors and set direction for innovation and technological development by providing certainty and creating a level playing field. This can drive large scale adoption and allow firms to generate economies of scale. Regulations can also help ensure decarbonisation where firms and households are not responding in the expected way to price signals. As with subsidies, there is a risk that the government does not choose the optimal technology and limits the scope for the private sector to innovate, although this is less of a risk with technology neutral standards.

## Indirect taxes

**4.13** As well as pricing the consumption of emissions directly, the tax system, including tariffs on imports, can be used to set additional incentives or disincentives. For example, the Company Car Tax is designed to make it more attractive for employers and employees to choose cars with the lowest carbon dioxide emissions.

**4.14** Indirect taxes can also target activities with emissions as a by-product. For example, Landfill Tax aims to divert waste away from landfill, one of the main sources of emissions from waste, to more environmentally friendly alternatives. Since 2000, Local Authority waste going to landfill in England has fallen by 87%, with an associated reduction in emissions.

## Facilitative levers

**4.15** Facilitative levers seek to change the structure of the market or the way people make decisions in order to make it easier for households and firms to choose low-carbon options. These levers can complement carbon pricing by addressing the other market failures that hold back the process of decarbonisation. This can lower the overall costs of the transition, change who pays and who is able to cover the necessary costs.

- **Leadership:** Government leadership in decarbonisation can range from political commitments to environmental requirements for government procurement decisions. Such interventions can provide direction and certainty for the private sector, supporting innovation, driving cost reductions and creating opportunities for firms that have already adopted low-carbon methods. It can also help nudge public attitudes towards greener behaviours by setting greener default options in public buildings, for example. UK leadership in multilateral fora, including through our COP26 and G7 Presidencies, can encourage international action to reduce emissions. Government coordination domestically and internationally can reduce the cost to the UK of reaching net zero by spreading the cost and risk associated with innovation, driving economies of scale and by helping to facilitate collaboration.

- **Awareness:** Measures to improve information about low-carbon choices can help drive consumer and producers towards alternative products. Examples include information and educational campaigns; government advice centres and online support services; and mandating improved labelling to help drive consumer and producer choices towards low-carbon alternatives. They usually come at low fiscal costs and can increase businesses' accountability to consumers for their emissions. However, they can come with high compliance costs for businesses.
- **Capability:** New skills, technologies and ideas will be needed to reach net zero. This may require training programmes, development of new financial products to facilitate the investment required for net zero, and support for innovation to help the development of green products. This latter is discussed further in Chapter 5.

## Direct public interventions

**4.16** Further government intervention can be required where carbon pricing and the facilitative levers described above cannot resolve all the market failures holding back the transition. This is particularly likely in the case of public goods and infrastructure or where new markets are needed for net zero. These interventions can include:

- **support for innovation** and the development of new technologies;
- **regulation of utilities** and other sectors with risks of monopoly power;
- support for **development of new markets**. For example, the government is providing support for electric vehicle charging infrastructure to help develop a viable private market; and
- **delivery of large capital investment and infrastructure**. As set out in the National Infrastructure Commission's National Infrastructure Assessment,<sup>3</sup> government can absorb risks by providing a proportion of the initial capital funding, crowding in private investment.

**4.17** There are various risks associated with government intervening in this way, principally that it will misallocate resources. Actively developing new markets through public spending or regulation runs the risk of locking in technology that turns out to be less cost effective in the long run. However, such interventions may be necessary to guarantee an adequate pace to meet the 2050 target. The distributional impacts of these policies depend on the users of the infrastructure or innovation supported and the opportunity-cost of public funds.

## Adjustments to existing policies

**4.18** Existing policies may not be aligned to net zero, as government must balance multiple priorities. Small changes to existing schemes can improve incentives for decarbonisation across the economy with lower policy costs, though potentially at the cost of making existing schemes more complicated or compromising other policy aims.

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<sup>3</sup> 'National Infrastructure Assessment', National Infrastructure Commission, July 2018.

# Chapter 5

## Innovation and private finance

The majority of the technologies needed to meet net zero already exist, but many need further development to become cost competitive and be proven at scale. Developing and deploying these technologies requires investment, much of which will come from the private sector, but the uncertainties associated with novel technologies can make it difficult to raise finance. Government can help increase certainty and reduce the cost of capital but may also in some cases want to provide more direct support.

### Technological change will be an important factor in reaching net zero

**5.1** Many of the technologies required to meet net zero already exist, but it is not yet clear which will be the most appropriate or cost effective, or which will provide the biggest opportunities for economic growth. Several important technologies are not yet proven at scale or cost competitive. Further technological developments could also create cheaper, or more efficient, technologies than those that are currently available.

**5.2** This development process needs to happen rapidly. It can take many years for scientific discoveries to lead to the creation of a new product and even longer for the product to reach the point where it can be widely deployed. For example, as shown in Chart 5.A, it took over 50 years for solar photovoltaic (PV) technology to reach mass deployment following its invention. Any new technologies will need to be developed and deployed at a faster rate than solar PV if they are going to contribute to the UK reaching net zero by 2050.

**5.3** Such a transformation is possible. Advances in digital technology over the last 30 years illustrate the potential for innovation over a similar period. Net zero technology could make similarly rapid advances in the next 30 years, especially in an environment that supports innovation and investment.

**5.4** Government can play an important role in creating this environment and helping to accelerate the net zero transition. Policy certainty can increase the viability of private sector investment and speed up the deployment of net zero products. Government leadership can also help address dynamic market failures in the transition, particularly in guiding and creating new markets.

**5.5** As an early mover to decarbonisation, the UK is well-positioned to leverage innovation and generate export opportunities. Estimates suggest innovation

opportunities could drive £27 billion in Gross Value Added (GVA) through domestic economic activity and £26 billion through exports by 2050.<sup>1</sup> The largest export opportunities could be in road transport, carbon capture usage and storage (CCUS), smart systems and offshore wind,<sup>2</sup> with export opportunities for the UK at different stages of the supply chain. Box 5.A sets out in more detail some of the opportunities for innovation. Government policy and decisions on innovation could shape where these opportunities will occur over the next decade.

### Box 5.A: Innovation opportunities

**Offshore wind** has developed rapidly in the last decade and the UK has established itself as a world leader in its adoption. The large domestic market for offshore wind in the UK provides a strong platform for the UK to increase its share of the European and global market.

With innovation, the UK could gain first mover advantages in areas such as operations and maintenance (O&M) services and floating platforms. Analysis commissioned by BEIS estimates that by 2050 O&M and decommissioning services could become a £53 billion market. Offshore wind exports could support 21,000 jobs and £2.4 billion GVA per year,<sup>3</sup> including exports of specialised turbine parts to Europe worth over £0.4 billion per year.<sup>4</sup>

In recognition of these opportunities, the Prime Minister announced on 18 November 2020 the government's aim to quadruple the capacity of offshore wind in the UK to 40GW by 2030. The government has made available £160 million to upgrade ports and infrastructure in places like Teesside and the Humber in order to support the industry's growth, and advances in offshore wind such as these could support up to 60,000 jobs in 2030.

**Greenhouse gas removal technologies:** The CCC estimates that 58MtCO<sub>2</sub> per year will need to be captured and stored in 2050 by new greenhouse gas removal (GGR) technologies such as direct air capture and storage of CO<sub>2</sub> (DACCS).<sup>5</sup>

DACCS requires supporting infrastructure such as carbon capture, utilisation and storage (CCUS) which presents a potential growth and export opportunity for the UK. Analysis commissioned by BEIS estimates that the UK could capture £4.3 billion of GVA from exports by 2050 as the global CCUS market expands to an estimated 6,800 MtCO<sub>2</sub> captured annually.<sup>6</sup>

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<sup>1</sup> 'Energy Innovation Needs Assessment: Overview Report, Department for Business Energy and Industrial Strategy (BEIS), 2019, p25. This analysis was carried out before the UK's net zero target was agreed and is therefore based on an 80% emissions reduction target by 2050.

<sup>2</sup> Ibid, p21.

<sup>3</sup> 'Energy Innovation Needs Assessment: Offshore Wind', BEIS, 2019, p7.

<sup>4</sup> Ibid, p50.

<sup>5</sup> 'The Sixth Carbon Budget: The UK's path to Net Zero', The Climate Change Committee (CCC), 2020.

<sup>6</sup> 'Energy Innovation Needs Assessment: Carbon capture, utilisation and storage', BEIS, 2019.

As these technologies are in the early stages of development the costs are high and the cost trajectory is unclear, but they have the potential to fall with a supportive policy environment. The government's £100 million GGR innovation fund will support research and development of these technologies, alongside the Prime Minister's announcement on 18 November 2020 of up to £1 billion of investment to support the establishment of CCUS in four industrial clusters in the UK and an ambition to capture 10 Mt of CO<sub>2</sub> a year by 2030.

## Innovation will require significant investment

**5.6** Significant investment will be required to reach net zero. Estimates suggest that in order to deploy renewables at the speed required, annual global investments in renewable energy would need to increase from approximately \$330bn in 2018 to close to \$740bn in 2030.<sup>7</sup> In the UK, this investment has already started, with more than £92 billion invested in clean energy since 2010.<sup>8</sup> The UK's world-leading financial, legal and technical advisory services sector is well-placed to support further investment, particularly as new technologies emerge and create further opportunities.

**5.7** The financial services sector is increasingly recognising the investment opportunities associated with the transition to net zero. In 2020, 38% of assets managed in the UK integrated environmental, social and government factors into their investment selection process, up from 26% in 2019.<sup>9</sup> In response to this growing investor demand, the UK government announced that it will issue its first Sovereign Green Bond in 2021, subject to market conditions, and its intention to issue a series of such bonds to build out a green yield curve in the future. These bonds will help finance projects that will address climate change, finance much-needed infrastructure investment and create green jobs across the economy. UK Sovereign Green Bonds will also provide a benchmark for the finance sector, which will help stimulate the UK's domestic green bond market.

**5.8** Risk aversion, overvaluation of carbon-intensive activity and a failure to take account of the environmental impacts can still hold back the flow of private finance into net zero investments. This is in part because there is currently no consensus on the definition of net zero-aligned investments, differing data standards and various methods for evaluating climate-related risks. The Green Finance and Clean Growth Strategies set out the government's approach to overcoming these problems, and an objective of COP26 will be to ensure that climate change is factored into every financial decision.

**5.9** When firms market and leverage finance that is said to be green, it is important that it is clear to everyone what that means and exactly why they define it in this way. To improve understanding of the impact of firms' activities and investments on the environment and support the transition to a sustainable economy the UK is implementing a green taxonomy – a common framework for determining which activities can be defined as environmentally sustainable. The clear

<sup>7</sup> '10 Years Progress to Action', International Renewable Energy Agency (IRENA), 2020.

<sup>8</sup> 'The good, the bad and the ugly in the UK's green finance crusade', Solar Power Portal, J. R. Martin, 2019.

<sup>9</sup> 'Investment management in the UK 2019-2020', The Investment Association Annual Survey, September 2020

and transparent disclosure of climate change risk and the impacts of economic activities on the environment can further help financial institutions, policy makers and consumers to consider these factors in their decision-making. Box 5.B. explores climate risk disclosures in more detail while the rest of this chapter considers risk aversion.

### **Box 5.B: Climate risk disclosure**

Accurate disclosure is crucial to ensuring that financial markets can appropriately price risk to support informed and efficient capital allocation. Climate change presents material financial risks and opportunities to the financial system and real economy, making climate-related financial disclosures particularly important for a smooth transition to a lower-carbon economy.

The Task Force on Climate-related Financial Disclosures (TCFD) was established by the Financial Stability Board in 2015 and published recommendations forming a framework for disclosing the financial risks and opportunities posed by climate change in 2017.

The UK government is highly supportive of the TCFD's framework and, in November 2020, announced its intention to make TCFD-aligned disclosures mandatory in the UK across the economy by 2025, with a significant portion of mandatory requirements in place by 2023.

Climate risk extends beyond national borders, and internationally agreed standards are needed to achieve consistent and comparable reporting. The UK government has also welcomed the International Financial Reporting Standards (IFRS) Foundation Trustees' consultation on a global approach to sustainability reporting.

## **Risk and uncertainty can push up the cost of capital**

**5.10** Investing in new technology always carries risk, but lack of certainty about the future path of government policy can exacerbate these risks in the context of net zero. This in turn can push up the cost of capital, requiring higher returns in order to justify the investment.

**5.11** These risks are particularly acute at the early stages of development, where technologies have not been proven or widely tested. As technology reaches commercial maturity, traditional investors may feel more confident about likely returns and the cost of capital should fall.

**5.12** The UK is also affected by how other countries approach decarbonisation. Many countries have now adopted legally binding targets or policy ambitions for net zero emissions or carbon neutrality, including France, New Zealand and China. As decarbonisation progresses across the world, there will be a global effort to innovate, spreading risk more widely and reducing the cost.

## The government can help to reduce uncertainty

**5.13** Clear government policy signalling, and stability in decision-making, can help reduce risk for investors. This can make it easier for the private sector to justify investment in emerging technology. This section looks at technology policy and how the government can provide signals about the timetable for reaching net zero and wider decarbonisation policy.

### Signalling technology policy under uncertainty

**5.14** Chapter 4 considered the government's role in addressing the market failures that are driving climate change and holding back the transition to net zero. How government approaches these policy decisions affects the returns that investors in emerging technologies might see.

**5.15** Government decisions about infrastructure and the UK's future energy system are particularly important for emerging technology investors. Government can help to increase certainty for investors by sending clear and timely signals about how and when it will take these decisions. This can help reduce the cost of capital.

**5.16** Table 5.A sets out one way of thinking about the different levels of uncertainty involved in the development of technologies for net zero:

- Level 1 describes a situation where technology has been proven to work, market institutions are well established and the technology is usually commercially viable, such as solar or wind energy.
- Level 2 uncertainty exists where there are a small number of known possible pathways, such as the choice between hydrogen or electricity for heating buildings. Hydrogen heating would require repurposing the existing gas grid to carry hydrogen instead of natural gas and deployment of hydrogen boilers, which are currently in only early stages of development and yet to be proven at scale. Using electricity would mean the rollout of heat pumps or heat networks, with a high capital cost.
- Level 3 applies to technologies whose use is more uncertain and which are not currently commercially viable. For example, greenhouse gas removal (GGRs) technologies that are still being developed. The degree to which GGRs will be used in 2050 to meet net zero depends on how quickly these technologies develop and how far costs fall.
- Level 4 describes technologies that have not yet been invented and therefore true ambiguity exists.

**Table 5.A: Technology and innovation uncertainty framework**

Level of technological uncertainty	Level of market uncertainty	Example	Implications
Level 1: Clear-enough future	Are commercially viable	Solar, wind, electrification of cars and vans.	Proven technologies with some uncertainty in costs  Decisions can be taken now
Level 2: Alternative futures	Not necessarily commercially viable, but successful pilots	Hydrogen v mass electrification	Technologies unproven at scale, or options between alternatives  Action needed to prove technical feasibility and enable cost reduction before decisions can be taken
Level 3: Range of futures	Not yet commercially viable	Some greenhouse gas removal technologies	Unproven technologies that could affect decarbonisation choices in other sectors over the next 30 years  Action needed to support innovation before investment decisions can be taken
Level 4: True ambiguity	Pure uncertainty of what the market would look like	New game-changing technology	Unknown unknown  Certainty needed to provide a basis on which economic actors may invest and develop technology

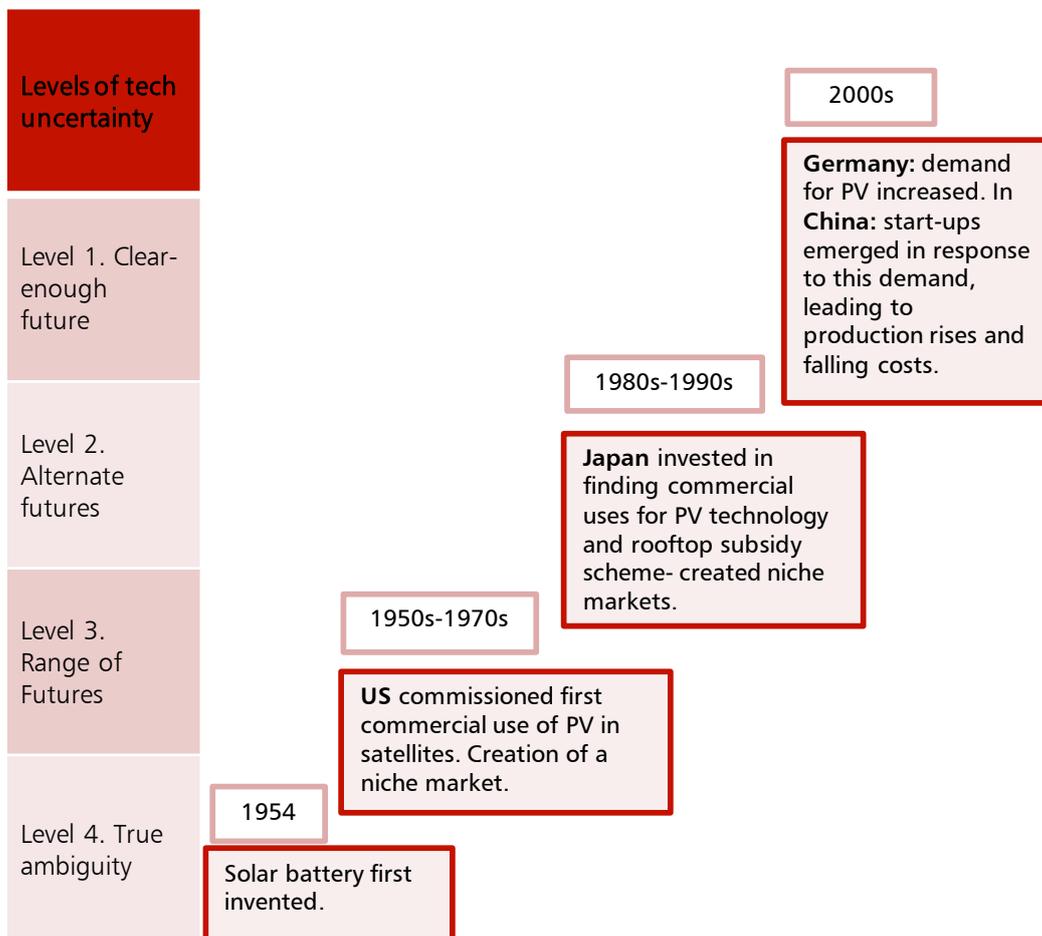
Source: 'Strategy Under Uncertainty', *Harvard Business Review*, H. Courtney, J. Kirkland, P. Viguerie, November-December, 1997.

**5.17** As technologies develop, certainty increases and they move away from level 4 towards level 1. Chart 5.A shows how the solar panels have moved through this process over the last 60 years.

**5.18** Grouping net zero technologies in this way and using this as an organising framework is one way for the government to explain its approach and provide information on how it will make future decisions. If used well, approaches such as these can help ensure signalling is consistent, transparent and timely, which in turn can help the private sector make investment decisions. This is consistent with the

general approach outlined in Technology Readiness Levels frameworks, which can be used in more specific, project-by-project innovation settings.<sup>10</sup>

**Chart 5.A: Solar's progression through uncertainty levels**



Source: 'How Solar Got Cheap', Nemet, 2019.

### Providing certainty over the timetable

**5.19** Government clarity on the pace and timetable for decarbonisation can also help businesses align their investment and planning decisions with the net zero target. This is particularly important given the rapid pace of change required compared to past energy transitions. However, identifying the appropriate moment to accelerate the transition and implement new technologies requires careful assessment and balancing of risk and opportunity.

**5.20** A transition that is left too late or is not sufficiently well communicated could see businesses continuing to invest in high-carbon technologies beyond when would be consistent with achieving net zero. This could lead to stranded assets as these technologies would have to be decommissioned before their natural end of life. It could also increase costs, as low-carbon technologies have to be deployed quickly near the end of the transition. This also increases delivery risk, as there may not always be sufficient numbers of people with the right skills to install the required equipment.

<sup>10</sup> 'Science and Technology Committee – Second Report: Technology and Innovation Centres', House of Commons, February 2011, Annex 1.

**5.21** Moving early may enable the UK to develop a first-mover advantage in important technologies, creating export and growth opportunities. On the other hand, deploying technology at an early stage, before there is sufficient learning-by-doing to bring costs down, may mean missing out on some of the benefits of falling costs and could lock in an inferior technology.

**5.22** The UK uses carbon budgets to set out the profile for its transition. These set legal limits on UK greenhouse gas emissions over 5-year periods and are set 12 years in advance in order to provide long-term guidance to investors. Stability in commitments has been highlighted as important for setting expectations of investors and supporting the effectiveness of decarbonisation efforts.<sup>11</sup> To achieve net zero by 2050, the government will need to consider how best to provide signals, in line with asset replacement cycles, to guide business decisions.

### **Stability in the regulatory and tax environment**

**5.23** A further way government can increase market confidence is through transparency and stability in energy network industry regulation and setting of wider decarbonisation policy.

**5.24** Stability in economic regulation of the electricity sector is a particularly important area given the importance of innovation in the power sector. The government is committed to the model of independent economic regulation, which supports the transparency and stability required to allow investment. The framework will continue to evolve to facilitate the investment required for net zero, and the National Infrastructure Commission's (NIC) 2019 report on regulation of the UK's energy, telecoms and water industries sets out how this might happen.<sup>12</sup> The government published its response to the NIC's recommendations alongside further detail on its plans to decarbonise the UK's infrastructure networks in the National Infrastructure Strategy.<sup>13</sup>

**5.25** How government sets medium to long term product regulation and creates tax certainty can also increase market confidence and provide stability for businesses to make investment decisions. Measures could include clear phase-out and phase-in dates for technologies, with long notice periods, and a clear regulatory framework for a market in negative emissions to support the commercialisation of these technologies. Some commentators indicate that medium-term certainty on carbon pricing and its trajectory, along with other tax policies further strengthen the policy signals for the private sector, helping to guide the timing of investment.<sup>14</sup> The final report will explore these issues further.

## **The government can manage and share risk**

**5.26** Greater certainty over sectoral and in some cases technology policy will provide investors with greater confidence at different stages of the innovation cycle, from research and development to deployment. However, this may not always be sufficient to overcome the barriers to private sector investment. In some limited

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<sup>11</sup> 'Four decades of multiyear targets in energy policy: aspirations or credible commitments?', Wires Energy and Environment, G. Nemet, P. Braden, E. Cubero and B. Rimal, March 2014.

<sup>12</sup> 'Strategic investment and public confidence', National Infrastructure Commission, October 2019.

<sup>13</sup> 'National Infrastructure Strategy', HM Treasury, 25 November 2020.

<sup>14</sup> 'Innovation: Government's Many Roles in Fostering Innovation', Price Waterhouse Coopers, January 2010.

cases, the government may need to provide greater support. This will particularly be the case for new and innovative technologies, where returns are unclear, pushing up risk and therefore financing costs. This could make projects unviable in some cases. Government intervention to share risks can help make the remainder of the project viable for the private sector.

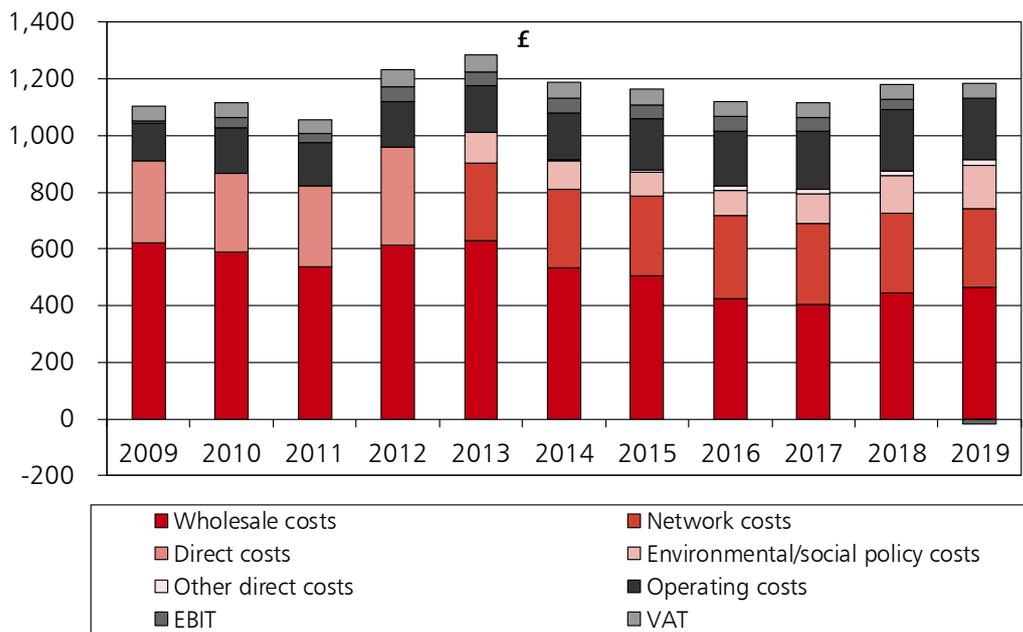
## Reducing revenue and financing risk

**5.27** One way the government can share risk is by guaranteeing loans. For example, the UK Guarantees Scheme (UKGS) supports private investment in nationally significant UK infrastructure projects. The UKGS works by offering a government-backed guarantee to help infrastructure projects access debt finance where they have been unable to raise finance in the financial markets. It has issued £1.8 billion of guarantees over 7 years (10 approved guarantees), averaging around £250 million per year since 2012 in benign market conditions.

**5.28** Government can also regulate to reduce the revenue risk for the private sector. This can be appropriate where the risk or high upfront costs associated with some projects cannot be financed by the private sector without intervention. Such interventions can help diversify risks and costs, both within and across generations. Two examples of this are the Contracts for Difference (CfD) schemes and the Regulated Asset Base (RAB) models, which create stable returns for investments through levies on consumer energy bills, as outlined in Box 5.C. A number of other social and environmental policies are also part-financed through electricity bills, including the Warm Home Discount to provide support to low income households and the Energy Company Obligation, which helps fund the installation of energy efficiency measures, particularly focused on fuel-poor households. Chart 5.B shows the changing make-up of a dual fuel (electricity and gas) bill.

**5.29** While the implementation of social and environment policies have placed additional costs on consumer bills, the overall domestic bill has fallen since 2013, largely due to improved energy efficiency and lower wholesale prices, while also ensuring security of supply. Over the long term the make-up of electricity bills is likely to continue to change, as the transition leads to an increasing proportion of renewables in the energy mix. These generally have higher up-front capital costs, but lower running costs than fossil fuel-based production. The next stages of the review will consider in more detail the implications of passing costs through energy bills; including distributional and behavioural implications.

**Chart 5.B: Domestic dual fuel energy bill breakdown**



Source: 'Large suppliers: Domestic dual fuel bill breakdown over time', Ofgem, 2020.

### Box 5.C: Business models for electricity decarbonisation

The UK has significantly decarbonised its electricity system, reducing emissions by over 50% since 2010.<sup>15</sup> Renewable electricity sources such as solar and wind generated 37% of the UK's electricity in 2019,<sup>16</sup> but these are relatively recent technologies, and volatile energy prices risked making private investment unviable when they remained unproven. The government has used two private finance models to overcome this.

#### Contracts for Difference

The Contracts for Difference (CfD) scheme has been the government's main mechanism for supporting low-carbon electricity generation. The scheme was introduced to protect developers of large-scale renewable projects from volatile market prices. Developers are paid a price agreed through a competitive auction for the electricity they produce over a 15-year period. By guaranteeing prices and providing revenue support for generators of renewable projects, CfDs aim to attract more affordable private finance into the sector. While this has not required any direct action from consumers, consumers have paid for the transition through their energy bills. When the agreed price exceeds the average market price, consumers pay the difference to the generator. The scheme is designed to keep total costs down for consumers. The Control for Low Carbon Levies (CLCL) sets the overall envelope

<sup>15</sup> 'Final UK greenhouse gas emissions national statistics: 1990 to 2018', Department for Business, Energy and Industrial Strategy (BEIS), 2020.

<sup>16</sup> 'UK Energy Statistics, 2019 & Q4 2019', BEIS, 2020.

for each auction, and CfD contracts do not require a difference payment to be made when electricity prices are negative for six consecutive hours or longer.

### **Regulated Asset Base**

The Regulated Asset Base (RAB) is a widely used economic regulation model typically applied for monopoly infrastructure assets such as water, gas and electricity networks. A company receives a licence from an independent economic regulator, which grants it the right to charge a regulated price to users through their bills in exchange for provision of the infrastructure in question. An independent regulator (such as Ofgem) sets the charge and holds the company to account to ensure expenditure is in the interests of consumers. The structure has facilitated significant investment from the private sector over the last 20-30 years, lowering the cost of services and increasing quality for customers.

Supporting private investment through these models has been successful in securing private finance and bringing down overall costs very rapidly. The price of offshore wind projects has fallen from £114.39/MWh in the 2015 CfD<sup>17</sup> auction to just £39.65/MWh in last year's auction (in 2012 prices).<sup>18</sup> However, in some countries financing the costs through energy bills has been highly regressive, as lower income households spend a higher proportion of their incomes on energy.

## **Direct support for early stage innovation efforts**

**5.30** Where uncertainty is at its highest and it is not possible to accurately assess risk, government action to reduce financing and revenue risk may still be insufficient to secure private investment. The government may need to support innovation directly, for example by funding research and development or by taking some of the equity risk directly onto the government's balance sheet. For early-stage technologies, particularly in the research and development stage, the government can provide capital funding to help the project get off the ground where financing constraints may be a barrier.

**5.31** This direct support can help overcome the initial risks, make the project more commercially viable and help to crowd in private investment. The European Investment Bank and UK Green Investment Bank acted in this role for offshore wind projects like the Galloper wind farm. The framework outlined in Table 5.A can be used as a tool by government to consider possible gaps in the innovation ecosystem which may require direct support.

However, government may not always be best placed to identify potentially successful projects. Careful governance around such schemes are required in order to maintain credibility of decision-making.

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<sup>17</sup> 'Breakdown Information on CfD Auctions', Department of Energy and Climate Change (DECC), 2015.

<sup>18</sup> 'Contracts for Difference Allocation Round 3 results', BEIS, 2019.

## Chapter 6

# International competitiveness and net zero

The transition to net zero will involve significant structural change in the UK economy. Sectors will be affected in different ways, depending on the cost of abatement and their exposure to international markets. Where trading partners do not pursue similar policies, some activities could become less competitive. Some businesses might choose to move to jurisdictions with less stringent climate change mitigation policies.

Evidence of carbon leakage to date is inconclusive, but as the UK adopts more ambitious initiatives to reduce its emissions, the risk of carbon leakage could increase without sufficient international and domestic mitigating action. Any action on competitiveness and carbon leakage risks needs to be balanced with the efficiency of policy at driving climate mitigation and that policy's distributional implications and feasibility.

## Climate policy can affect international competitiveness

**6.1** The competitiveness of any sector, and the economy more broadly, depends on a wide range of factors including: the ability of the labour market to match people and jobs effectively; the level of skills in the workforce; accumulation of capital; market size and openness to trade; access to finance; the quality of physical and technological infrastructure; and the effectiveness of the regulatory, public and legal institutions at creating a stable operating environment.

**6.2** Climate change mitigation policies could also affect a sector's competitiveness, for example by placing additional costs on certain activities through regulation. Even countries that have climate policies of a similar level of overall ambition might use different approaches to suit their local circumstances. This means that the profile of climate change mitigation policies and the requirements on different sectors at any given time will differ between countries, with potential implications for competitiveness.<sup>1</sup>

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<sup>1</sup> For the purposes of this review, we define competitiveness as, "the capacity and ability of a firm or sector to gain and maintain a profitable, sustainable market share relative to rivals in domestic and international markets." This firm or sector-specific definition of competitiveness is useful as it recognises the dynamics of competitiveness over time and defines it in terms of outcomes and follows 'UK Business Competitiveness and the Role of Carbon Pricing: An assessment of the determinants of business competitiveness and the role of carbon pricing policy in the UK', Department for Business, Energy and Industrial Strategy (BEIS), April 2020.

6.3 Nevertheless, climate policy is just one factor in determining business competitiveness, and it is challenging to assess whether and how far competitiveness might be affected as a result of climate policies alone. Different countries' economies have different structures and are constantly changing, with new companies and sectors emerging and others declining. Production can shift from one jurisdiction to another for a wide range of reasons. Disentangling these effects from the impact of differences in climate policies can be difficult.

## Losses in competitiveness can result in carbon leakage

6.4 Loss of competitiveness caused by climate mitigation policies can result in carbon leakage. This occurs when policies designed to reduce emissions in a given country affect the competitiveness of its businesses relative to international competitors that are subject to weaker climate change mitigation policies. This can undermine the effectiveness of mitigation policy if, for example, production moves to a country with a more carbon intensive energy because the net effect may be higher global emissions overall. There could also be economic costs for the country from which production moves including a loss of employment in affected sectors.<sup>2</sup>

## Channels

6.5 There are three main channels by which leakage can occur.<sup>3</sup> The first and second are the focus of this chapter:

- In the short run, competitiveness falls because businesses in the jurisdiction with more ambitious emission reduction policies face higher costs. These costs cannot be passed on entirely to consumers without a loss in demand causing a drop in output, either because of lower sales in the domestic market, or lower exports;
- Over the medium to long run, differences in the strength of emissions reduction policies could influence investment decisions, resulting in a shift in production to other jurisdictions relative to what would otherwise have been the case;
- A reduction in demand for fossil fuels due to mitigation policies in some countries could reduce international fossil fuel prices relative to where they would otherwise have been without those policies. This could incentivise businesses in other countries to increase their consumption of fossil fuels.

## Establishing carbon leakage

6.6 A loss of competitiveness from climate policy only results in carbon leakage if the following three conditions are met:

- Carbon mitigation policies, such as the carbon price or regulations, are not similar across countries;
- Emissions shift to a region with lower-carbon mitigation obligations. Carbon leakage occurs if emissions, along with production and

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<sup>2</sup> 'Carbon Leakage: Theory, Evidence and Policy Design', World Bank Group, October 2015.

<sup>3</sup> 'Business competitiveness in industrial sectors and the role of carbon pricing policy in the UK', BEIS, 2020.

employment, decrease in the region covered by mitigation policies and increase in the region with less stringent policy. For example, carbon leakage has not occurred if carbon pricing reduces a sector's output because its goods become more expensive, but the production is not replaced by international firms;

- Production shifts to a firm with higher emissions intensity. If production moves to a firm with lower emissions intensity and global emissions decrease as a result, it is not carbon leakage.

**6.7** Although trade can provide a conduit for carbon leakage, it plays an important positive economic role. Trade is central to developing and sustaining livelihoods in the UK and across the world, including in poorer countries, encouraging production where it is most efficient, giving consumers choice and lower prices.

**6.8** Shifts in trade patterns can be misconstrued as carbon leakage if not properly considered in context. For example, trade flows may be affected by short-term shocks. Under such circumstances, it is important that supply chains are as responsive as possible, whether the shock is an unexpected spike in demand for personal protective equipment as seen this year, or a hit to supply, for example, the impact of a drought on domestic cereal production, reducing exports or necessitating increased imports. Agricultural trade is particularly important for channelling food from areas of surplus supply to food-deficit countries. These food security benefits of trade are likely to grow as climate change generates increasingly frequent and significant supply shocks.<sup>4</sup>

**6.9** At the same time, international trade can exacerbate pressures on insufficiently protected areas that are critically important from an environmental perspective because of their roles as carbon sinks and biodiverse habitats. This is particularly true for agricultural trade. Apart from increasing the level of regulatory protection and enforcement for such sensitive areas, pressure on these areas can also be reduced through improvements in agricultural productivity internationally and changes in patterns of global aggregate demand, as illustrated by Box 6.A.

### **Box 6.A: Agriculture**

Aggregate global agricultural demand and its rate of growth affect the degree to which global production is incentivised to expand. Any such expansion is generally achieved by a combination of an intensification of production on existing agricultural land and bringing new land into production. Both are associated with increased emissions and impacts on biodiversity, whether due to increased applications of fertilisers associated with emissions of nitrous oxide (a potent greenhouse gas) or because of deforestation or other forms of land use change that turn important carbon sinks into sources of emissions.

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<sup>4</sup> A further point relates to the multiple uses to which agricultural land can be put, which can complicate assessments of carbon leakage. For example, changing production patterns may see a contraction in output in one arable crop, but also the expansion in the production of other crops. This raises a question about how those different impacts are traded-off in any assessment of carbon leakage.

As a result, emissions per unit of production at the margin may be substantially higher than the average.

This means that whether and how fast international demand for agricultural products expands, especially if it is quicker than the rate of global agricultural productivity growth on existing farmland, will affect the incentives for agricultural practices (such as land use change) that disproportionately affect the emissions intensity of agricultural production. This puts a premium on improving the rate of agricultural productivity growth on land that is already farmed. This can be achieved in part through technological developments and investment in human capital, but also by ensuring that agricultural land and credit markets function well, so that land is farmed and managed by those best placed to make most effective use of available land. Modest changes in consumption patterns internationally can also, in principle, yield disproportionately beneficial results.

For example, OECD modelling considers a scenario whereby a productivity improvement of 10% by 2030 is achieved globally across all agricultural production.<sup>5</sup> The benefits of such productivity improvements are partly offset because improvements in productivity increase output and reduce prices, stimulating increased consumption relative to the baseline. The overall result is a net reduction in direct global agricultural emissions of 340 MtCO<sub>2</sub>e in 2030.<sup>6</sup>

The same OECD modelling also considers a scenario whereby the global average per capita consumption internationally of ruminant products (specifically beef, sheep meat, butter, cheese, fresh milk and milk powders) gradually reduces so that in 2030 it is 10% lower than 2017 levels. The scenario also assumes that the consumption of non-ruminant products increases by the same proportion, with per capita consumption of calories left unchanged. Under this scenario, international direct greenhouse gas emission savings from agriculture (not counting any savings from avoided land use change) amount to 0.9 GtCO<sub>2</sub>e per year in 2030.

## The risks of carbon leakage vary by sector

**6.10** Some businesses could lose competitiveness as costs associated with the need to decarbonise in their sectors increase. Others could gain as new opportunities emerge to sell low-carbon products in the UK and internationally. The precise impact on businesses will be influenced by the extent to which policy is used to mitigate competitive impacts and enhance opportunities. This means that the net impact on UK businesses of transitioning to net zero is unclear.

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<sup>5</sup> 'Enhancing Climate Change Mitigation through Agriculture', Organisation for Economic Cooperation and Development (OECD), 2019.

<sup>6</sup> Over the period 2007-2016, agriculture directly resulted in approximately 12% of global anthropogenic GHG emissions (6.2 +/- 1.4 GtCO<sub>2</sub>eq) as well as a further 9% of GHG emissions globally each year (4.9 +/- 2.5 GtCO<sub>2</sub>eq). *ibid*.

## Some sectors will be less exposed

**6.11** In some sectors, the transition to net zero should have limited to negligible impacts on competitiveness, irrespective of the level of mitigation ambition overseas. This could be because the transition imposes limited obligations on those sectors. For example, wages make up the vast majority of costs in the business services sector and are not affected directly by mitigation requirements.

**6.12** Sectors that face high trade costs, or where additional costs for domestic producers can be passed through to consumers, will be less vulnerable to competitiveness effects than sectors that are subject to various trade pressures. For example, only 3% of cement produced globally is traded, largely between close neighbours, as its low value to weight ratio makes it uneconomic to transport large distances.<sup>7</sup> In most cases, mitigation costs affecting the cement industry as a whole are likely to be passed on to consumers of construction.

**6.13** Finally, sectors where international competitors face similar obligations to reduce emissions, or where increased costs due to mitigation are either low or temporary, could also expect little or no change in business competitiveness.

## Highly traded emissions-intensive goods

**6.14** As the UK moves to net zero, producers of emissions-intensive goods may face higher mitigation costs and therefore experience a loss of competitiveness if they are exposed to competition from foreign firms in domestic and international markets. Examples might include the metallurgical and mineralogical sectors.

**6.15** In these sectors, climate change mitigation policies could increase unit costs of production. In the short run, this will affect UK businesses' competitiveness negatively if these businesses' trading partners do not experience similar pressures.<sup>8</sup> The size of the impact will depend on the cost of the policy to the business relative to the size of the competitiveness advantages.

**6.16** Equally, policies that have an initial negative impact on competitiveness could spur innovation, increase productivity and create demand for low-carbon products. Where the UK moves first, this could create opportunities for UK businesses who are early adopters of low-carbon practices or who develop low-carbon technologies. The companies would need to be strong enough to withstand short-run pressures in order to see the medium to long-run benefits.

## Mitigating options

**6.17** There is limited evidence that climate change policies have caused significant carbon leakage to date, or whether, and to what extent, carbon pricing is associated with a loss of competitiveness.<sup>9</sup> This lack of evidence may be explained by, for example, subsidies that have mitigated any competitiveness impact that could have arisen from full exposure to carbon pricing.

**6.18** Historically, the UK's approach to addressing carbon leakage and competitiveness concerns has been to pay compensation to energy-intensive sectors

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<sup>7</sup> HM Treasury calculations based on UN COMTRADE and the US Geological Survey.

<sup>8</sup> 'Carbon leakage prospects under phase III of the EU ETS', Vivid Economics, June 2014.

<sup>9</sup> 'Competitiveness impacts of carbon policies on UK energy-intensive industrial sectors to 2030', Climate Change Committee (CCC), April 2017.

for the pass-through costs of the EU Emissions Trading System (EU ETS) and Carbon Price Support and to shield trade-exposed industries from the carbon price under the EU ETS through free allowances. This approach has targeted sectors most at risk of carbon leakage and limited the difference in carbon pricing levels internationally. Some sectors, such as domestic agriculture, have not been the subject of emission mitigation obligations to date.

**6.19** The government is committed to using its role hosting the UN Climate Change Conference and presidency of the G7 next year to catalyse ambitious global action to tackle climate change. The government is also providing targeted support to help key sectors transition. For example, the £315 million Industrial Energy Transformation Fund will help energy intensive industries invest in energy efficiency and decarbonisation measures. In addition, the £1 billion Carbon Capture and Storage Infrastructure Fund and the £240 million Net Zero Hydrogen Fund will play a key role in building shared infrastructure that will help key sectors to decarbonise. Next year, the government will set out details on the revenue mechanism to encourage private sector capital into these new technologies.

**6.20** The transition to net zero will require more ambitious climate policy. Whilst this creates a higher risk of carbon leakage, potential options for mitigating these risks include:

- **Climate diplomacy:** Sharing the burden of mitigating global emissions in a balanced way would reduce the risks of carbon leakage significantly. Furthermore, ongoing international climate diplomacy and efforts to secure collective action to reduce global emissions have a really important role in addressing carbon leakage.
- **Prioritisation across sectors:** Frontloading climate change mitigation policies in sectors at least risk of carbon leakage could help emission intensive sectors to adjust gradually over the next 30 years. However, businesses making new long-term investments would still need to take account of the future impact of the transition. Continuing to invest in carbon-intensive technology risks firms being left with stranded assets later in the transition.
- **Prioritisation within sectors:** Within emissions intensive sectors, even where they are trade exposed, acting quickly on mitigation is most sensible where the scope for carbon leakage is lowest relative to the potential for climate mitigation.
- **Improving productivity:** Policies to boost the competitiveness of tradable sectors in a sustainable way. If businesses improve their productivity, this will make them more resilient to potential competitiveness impacts and carbon leakage. More productive businesses are also likely to have lower emissions per unit of output than less productive businesses.
- **Subsidies and revenue recycling:** Building on the targeted support government has already provided, further use of subsidies (or revenue recycling) may help mitigate the risks of carbon leakage even as domestic policy initiatives force a process of domestic emission mitigation.
- **Treatment of imports:** Strong economic arguments can be made for treating imports in ways that seek to compensate for the competitiveness impacts of any asymmetry in domestic and internationally emissions

mitigation policies. There are a number of material practical issues that would need to be carefully considered, such as measurement difficulties, substitution and displacement effects, and the implications of international trade rules.

**6.21** Technological innovations that enable emissions mitigation at reduced cost will also reduce the risk of carbon leakage. In addition, changes in domestic consumption of tradable emissions-heavy products could enable climate change mitigation without increasing the risk of carbon leakage.

# Chapter 7

## Households and net zero

Structural changes during the transition to a net zero economy will have implications for households. They will be affected directly through the goods and services they buy, and indirectly through the impacts on the wages they earn and the value of the assets they hold. Higher-income households consume more carbon in absolute terms, but lower-income households tend to have more carbon embedded in their consumption relative to their income.

The analysis of exposures to the transition presented in this chapter does not seek to calculate the impact of the transition on any particular group. The transition is a dynamic process that will take place over several decades, and its impact on individual households will ultimately depend on a range of factors including: the development of new low-carbon sectors in the UK; the pace of transition and policy levers chosen; the price of low-carbon alternatives to households and businesses' current activities; and the dynamism of the labour and capital market. Nevertheless, the analysis does underline the importance of managing the transition in a way that minimises the risks of adverse impacts for certain groups.

### **The transition will bring costs and benefits to households across the UK over the next 30 years**

**7.1** The structural changes involved in the transition to net zero will have implications for households. New investment will create new economic opportunities, and the relative price of low-carbon goods and energy should fall. However, there will also be costs including new investment, and relative price increases for some higher-carbon goods. All households will be affected by these changes, though some will be affected more than others.

**7.2** The transition will be a dynamic process and one that will take place over 30 years. It is therefore very difficult to predict the impact of the transition on any particular household. However, analysis of exposures can give a sense of the scale of change faced by certain groups and help the government design policy to improve the affordability of low-carbon alternatives and to support green job creation. The Energy White Paper sets out a £6.7 billion package to save families in old inefficient homes up to £400, and the government's Ten Point Plan will mobilise £12 billion of

government investment to create and support up to 250,000 green jobs and spur over three times as much private sector investment by 2030.<sup>1</sup>

**7.3** The transition will also have intergenerational impacts, which will depend on the precise timing of the costs and benefits of the transition. For example, energy efficiency improvements have an upfront cost, but lead to lower ongoing running costs. Other technology choices, such as direct air carbon capture and storage or switches to more expensive, but clean, fuels may have a more enduring impact on costs. Policy design and financing mechanisms, both public and private, can affect the profile of costs and benefits, as well as their distribution across the population.

## **Different groups within the current population have different degrees of exposures to the coming changes**

**7.4** Within the current UK population, different groups will have different degrees of exposure to the transition. Considering the impact of the transition on these groups will be an important factor in determining how best to design policies to support the transition. The analysis in this chapter considers these exposures. It does not take account of the potential benefits to households from decarbonisation discussed in Chapter 2; these also need to be considered in policy design.

**7.5** Beyond taxation and public spending that directly apply to households, the transition to net zero will affect households directly through the goods and services they buy and indirectly through the costs on businesses discussed in the preceding chapter. This chapter focuses on:

- **Consumer prices:** Carbon is emitted in the production of products that households consume, both directly in the consumption of energy and fuel, and indirectly through embodied carbon in the supply chain. Regulation, taxation or abatement activity may increase the prices of these products. At the same time, lower costs in other areas will make some goods more affordable.
- **Labour market:** Individuals work at firms that emit carbon in their production processes. To the extent that decarbonisation reduces worker productivity, it may cause real wages and labour market opportunities in these firms to decline over time. On the other hand, the transition will also create new economic and employment opportunities as new sectors emerge, as set out in Chapter 2.

**7.6** A further channel through which the transition could affect households is business profits. Where businesses become less profitable, this will pass through to the households that own them. The transition will spur a reallocation of capital across the economy. New, low-carbon sectors will be new sources of profit. These profits pass through to households through dividends and through the value of their assets. This interim report does not include analysis of this channel. These channels are complex, and the final costs may pass through to households through all three channels.

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<sup>1</sup> 'The Ten Point Plan for a Green Industrial Revolution', HM Government, November 2020; 'Energy White Paper: Power our Net Zero Future', HM Government, December 2020.

## Household carbon consumption

**7.7** This section explores UK households' exposure to increases in consumer prices driven by decarbonisation by estimating the carbon footprints of households' consumption in the present day. The analysis does not show the actual impact on households: as prices change, households' consumption patterns will also change, and policy choices will affect how costs are passed through. The final impact will also depend on the distribution of the benefits of decarbonisation, the cost of the alternative low-carbon products and the extent to which costs are passed through via consumer prices as opposed to wages or profits.

### Box 7.A: Estimating households' carbon footprint methodology

The analysis combines spending data from the Living Costs and Food (LCF) survey<sup>2</sup> and Department for Environment, Food & Rural Affairs (Defra)'s Carbon Footprint data.<sup>3</sup> The Defra Carbon Footprint data trace emissions for goods and services through from source to final consumption goods. LCF data on the consumption of these goods is used to allocate this carbon to households (assuming constant CO<sub>2</sub>e per pound within each consumption category).<sup>4</sup> This then allows us to estimate households' carbon footprint and show this by income decile and other characteristics. This can begin to tell us how different households could be affected from the costs of reducing emissions. However, this is just an average and a variety of factors could mean certain households are more or less exposed.<sup>5</sup>

**7.8** Chart 7.A shows the estimated carbon footprint by household income decile. On average, households in the top income decile consume around 20 tCO<sub>2</sub>e per year, while the lowest income decile consume almost 9 tCO<sub>2</sub>e per year. Housing and utilities make up the largest proportion of all households' carbon footprints, but for lower-income households this makes up more than half of their carbon footprint. Transport carbon emissions, on the other hand, are disproportionately emitted by higher-income households. These footprints are on an average basis, so there is likely to be some significant variation within each group due to factors such as housing energy efficiency, employment status and family size.

**7.9** Although the highest-income households emit more than two times as much carbon as the lowest-income households, they have incomes that are more than eight times greater on average. This largely reflects a higher saving rate among higher-income households, reducing their total consumption relative to their income. It also reflects the fact that carbon intensive consumption of, for example, energy and heating makes up a higher proportion of lower-income households'

<sup>2</sup> 'Living Costs and Food Survey', Office of National Statistics (ONS), 2014/15-2016-17 - data is presented in the fiscal year 2020-21.

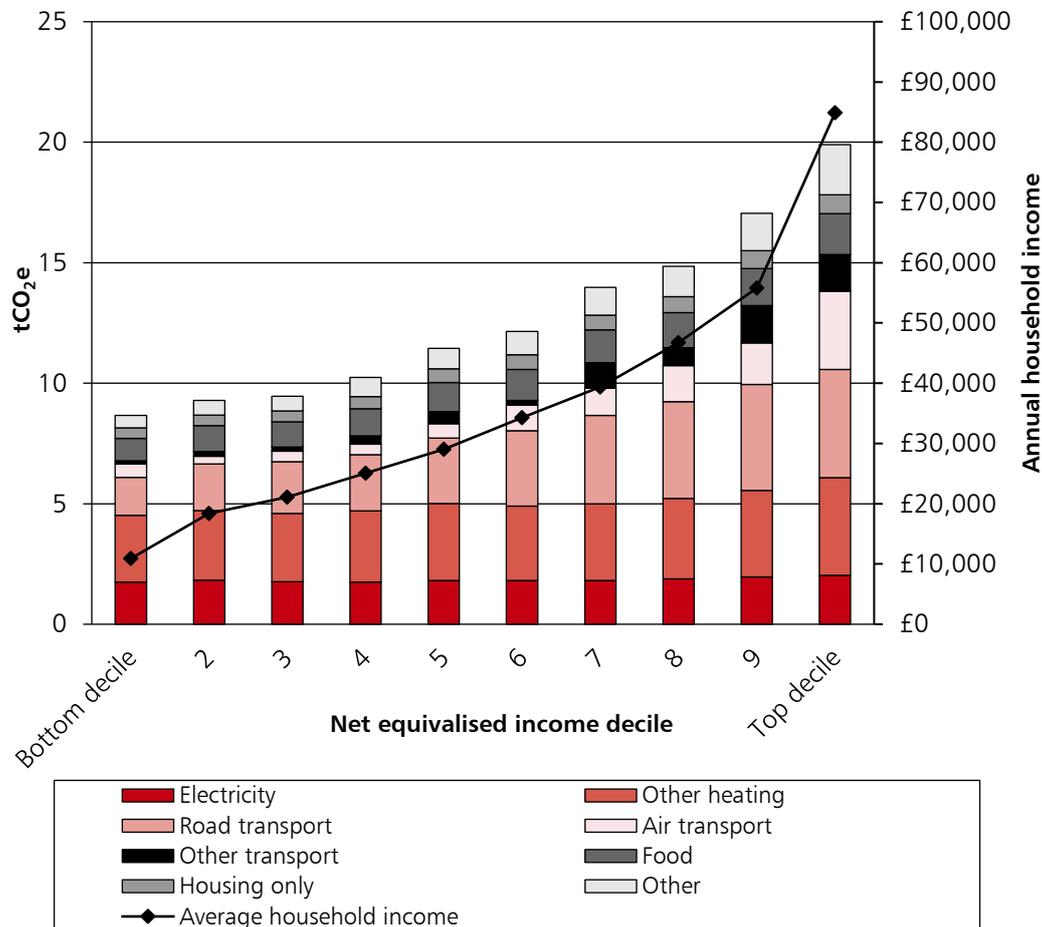
<sup>3</sup> 'UK's Carbon Footprint' (2016 data), Department for Environment, Food and Rural Affairs (DEFRA), 2020.

<sup>4</sup> The analysis uses territorial emissions from the Defra Carbon Footprint data (in line with the rest of this report). The household consumption data in the LCF does not distinguish between spending on domestic versus imported goods (or goods with part of their supply chain imported). Therefore, total spending is used to apportion domestic emissions. This implicitly assumes that all households are equally likely to consume domestic and imported goods. Or put another way, households' carbon footprints are not lower if they disproportionately consume imported products.

<sup>5</sup> This methodology follows a similar approach taken in 'Reducing inequality resulting from UK low-carbon policy', Climate Policy, Volume 20, A. Owen and J. Barrett, June 2020.

footprints. Overall, this means that higher-income households have more room within their budgets to absorb the costs of decarbonisation.

**Chart 7.A: Average household greenhouse gas footprint by net equivalised household income decile**



Source: HM Treasury calculations, LCF data, Defra Carbon Footprint.

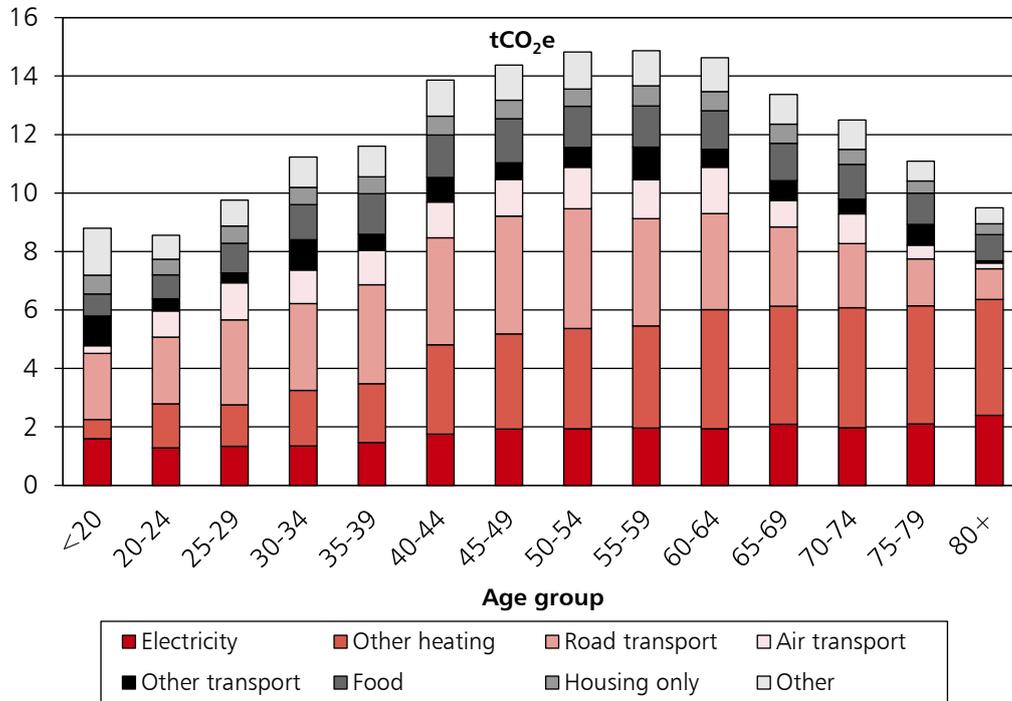
**7.10** Charts 7.B and 7.C consider differences in carbon footprints by age, defined by the age of the household reference person.<sup>6</sup> At the household level, shown in Chart 7.B, the carbon footprint peaks between the age of 40 and 65. However, this is purely the result of household size: households in this group are the most likely to have more members and hence have greater consumption. After adjusting for the number of people in the household, Chart 7.C shows that older age groups have a higher carbon footprint on a per-person basis, driven mainly by greater housing and energy use.

**7.11** Charts 7.D and 7.E look at emissions by household type. Chart 7.D shows that single households emit the least CO<sub>2</sub>e on average, while households with more than one adult emit the most, which is a result of the size of these households. Pensioner households tend to emit less in transport use, relative to other family

<sup>6</sup> The household reference person is the householder who: owns the household accommodation; or is legally responsible for the rent of the accommodation; or; has the household accommodation as an emolument or perquisite; or, has the household accommodation by virtue of some relationship to the owner who is not a member of the household. If there are joint householders, the household reference person will be the one with the higher income. If the income is the same, then the eldest householder is taken.

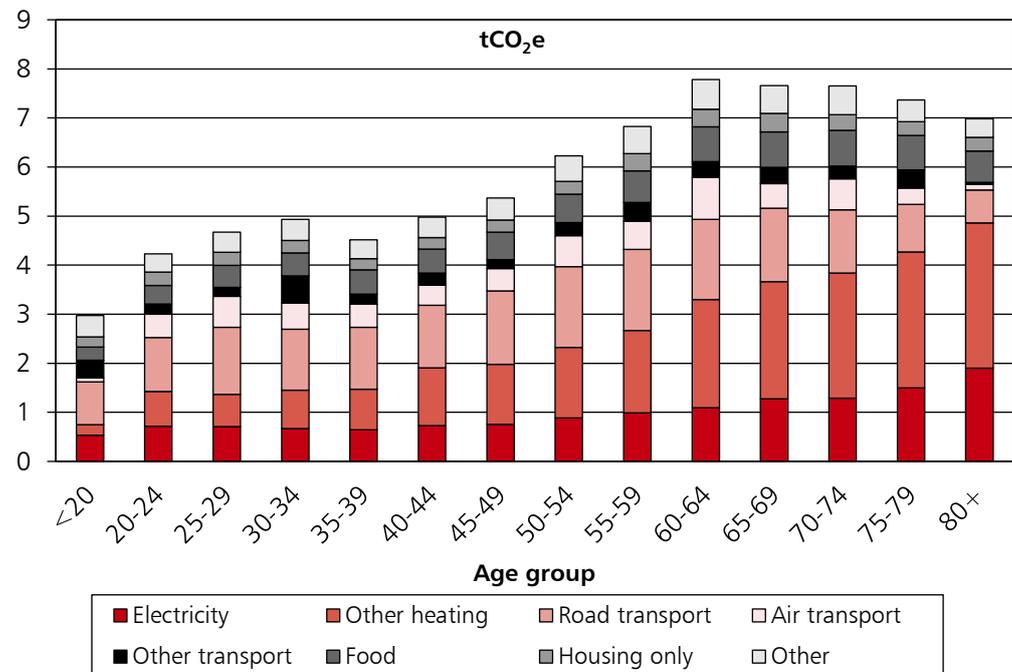
types. As shown in Chart 7.E, on a per-person basis electricity and heating make up a greater proportion of smaller households' carbon footprints, reflecting the economies of scale of living with more than one other person.

**Chart 7.B: Average household greenhouse gas footprint by age**



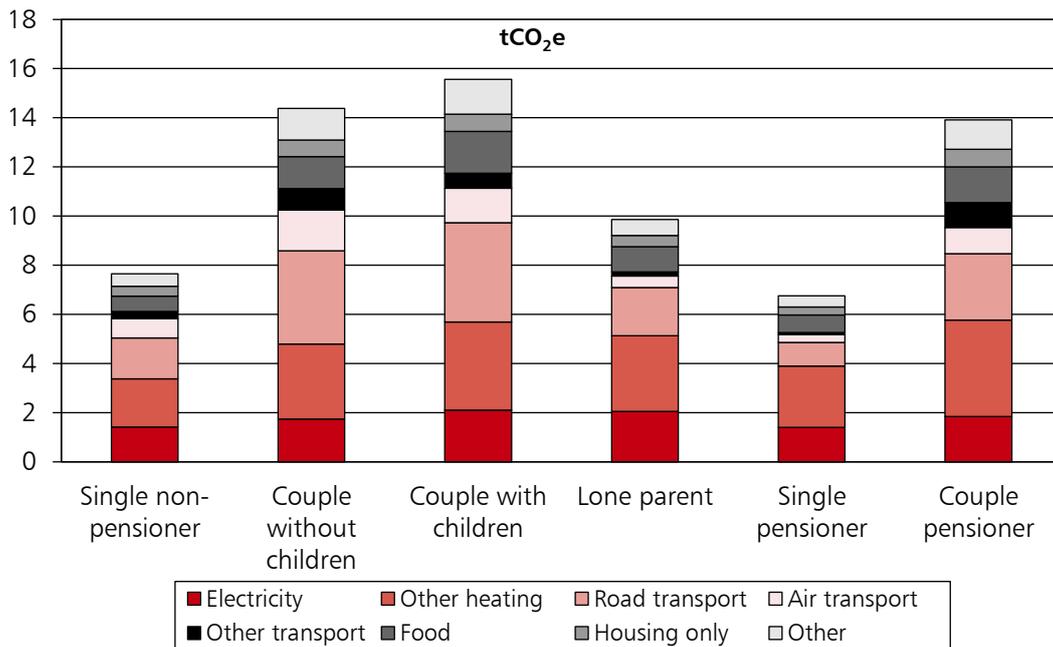
Source: HM Treasury calculations, LCF data, Defra Carbon Footprint.

**Chart 7.C: Average per-person greenhouse gas footprint by age**



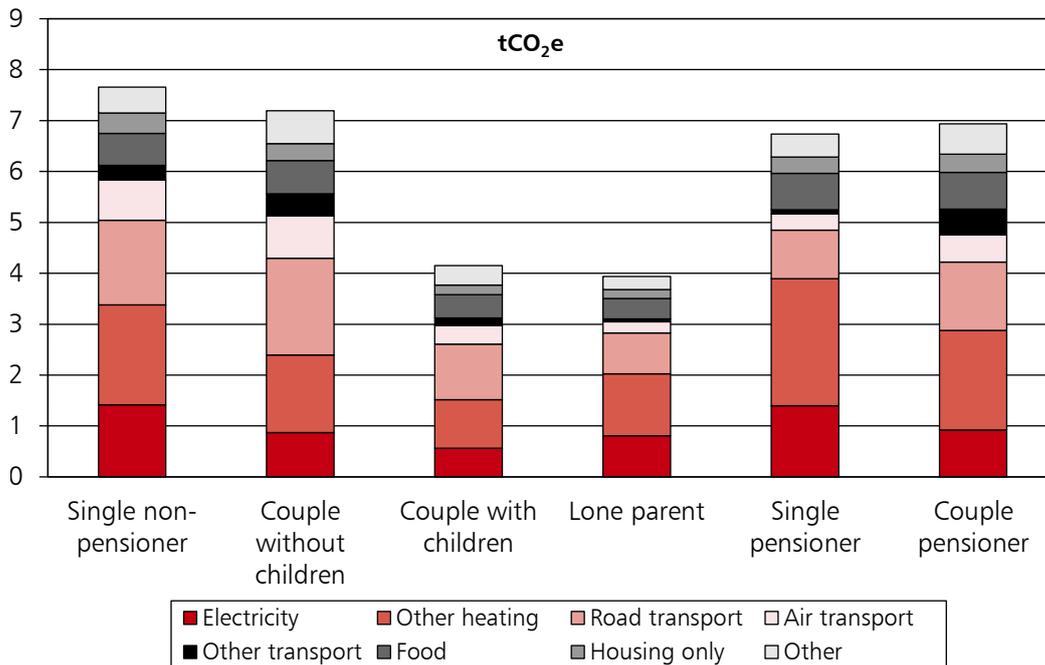
Source: HM Treasury calculations, LCF data, Defra Carbon Footprint.

Chart 7.D: Average household greenhouse gas footprint by family type



Source: HM Treasury calculations, LCF data, Defra Carbon Footprint.

Chart 7.E: Average per-person greenhouse gas footprint by family type



Source: HM Treasury calculations, LCF data, Defra Carbon Footprint.

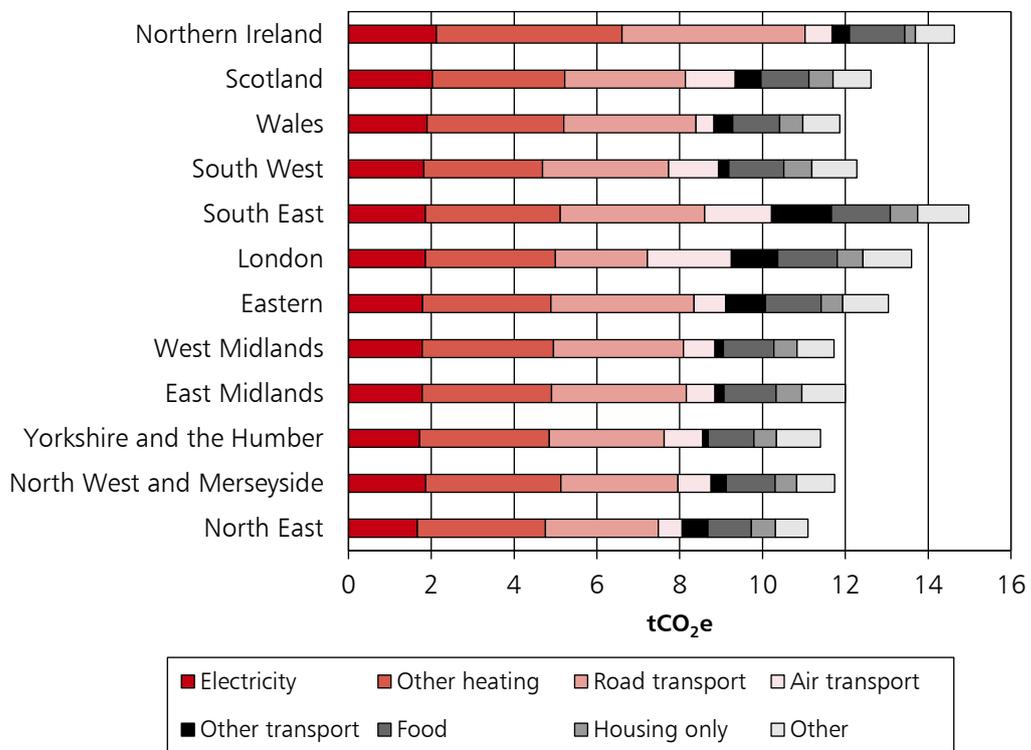
7.12 Chart 7.F then shows the breakdown by region. This shows a relatively similar carbon footprint across the nations and regions, although the South East and Northern Ireland is somewhat higher compared to households in Scotland, Wales and other regions in England.<sup>7</sup> In the South East, this is driven by higher than average use of transport. In Northern Ireland, this could be due to the high

<sup>7</sup> Note that, as elsewhere in the analysis, this uses UK wide carbon factors within each consumption category, so CO<sub>2</sub>(e) per pound spent on electricity in Scotland is the same as in England.

proportion of homes in Northern Ireland using heating oil as their primary heating source – 68% of homes overall and 82% in rural areas – the largest percentage of domestic homes using heating oil in Western Europe.<sup>8</sup>

7.13 Finally, Chart 7.G shows the difference between rural and urban districts in England. The most rural households’ carbon footprints in England are around 9% larger than the most urban households. This could be due to rural households’ consumption of electricity and heating: 14% of households in Great Britain do not have mains gas, or are off the grid,<sup>9</sup> and are therefore often reliant on carbon-intensive heating fuels such as oil. There will also be other factors at play, including income levels and property type.

**Chart 7.F: Average household greenhouse gas footprint by Government Office Region**

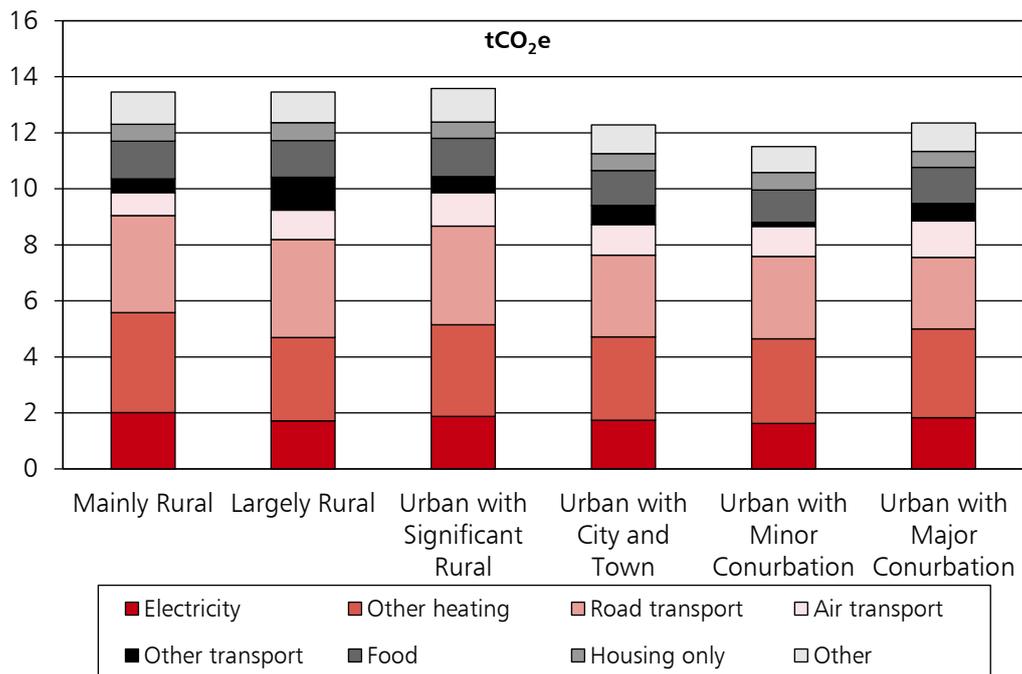


Source: HM Treasury calculations, LCF data, DEFRA Carbon Footprint.

<sup>8</sup> ‘Report on Fuel Poverty’, Committee for Social Development, Northern Ireland Assembly, May 2012.

<sup>9</sup> ‘Sub national estimates of households not connected to the gas network 2015-2018’, Department for Business, Energy and Industrial Strategy (BEIS), December 2018.

**Chart 7.G: Average household greenhouse gas footprint by rural urban classification (England only)<sup>a</sup>**



Source: HM Treasury calculations, LCF data, DEFRA Carbon Footprint, 2011 Rural Urban Classification in England.

- <sup>a</sup> Local authorities are categorised as rural or urban based on the percentage of their resident population in rural areas or 'rural-related' hub towns. Mainly Rural: At least 80% living in rural settlements and hub towns; Largely Rural: At least 50% but less than 80% living in rural settlements and hub towns; Urban with Significant Rural: At least 26% but less than 50% living in rural settlements and hub towns; Urban with City and Town, Urban with Minor Conurbation, Urban with Major Conurbation: Less than 26% living in rural settlements and hub towns.

## Households, emissions and the labour market

**7.14** This section considers how households might be affected by the transition through their employment and wages. The analysis shows sectors and types of jobs that are currently associated with high-carbon emissions. As with the consumption analysis, this should not be seen as reflecting the final impact of the transition on those sectors, jobs or employees. This will depend on the policy levers chosen to support the transition, how easily and cheaply these sectors can decarbonise and their international exposure and competitiveness. And for employees, it will depend on where and when new employment opportunities emerge in competing, low-carbon industries.

**7.15** Over the course of the transition, there will be significant changes in the UK labour market. Some of these changes will be directly associated with the transition to net zero, although other technology-driven changes are also likely to be important. Changes in the labour market in one sector may be offset by new employment opportunities elsewhere, including through the expansion of low-carbon industries.

**7.16** The International Labour Organization (ILO) expects 24 million new jobs and 6 million job losses by 2030 as a result of collective action to meet the goals of the 2015 Paris Agreement. This net job creation is primarily driven by growth in

renewable energy, which is expected to be 11% higher than the business-as-usual scenario.<sup>10</sup> The ILO has found that renewable energy growth leads to higher job creation than expanding other energy sources, while reducing emissions.<sup>11</sup> Jobs would also be created in manufacturing and construction, and the economic linkages between sectors mean that employment in services, waste management and agriculture will also grow. For example, over two million jobs will be created worldwide in the manufacture of the electrical machinery required to produce electric vehicles and the generation of electricity from renewables.<sup>12</sup>

### Box 7.B: Labour market exposure methodology

The analysis combines ONS data on atmospheric emission by industry<sup>13</sup> and Living Costs and Food Survey<sup>14</sup> employment data to calculate carbon intensity per worker. Carbon intensity is assigned to workers in the Living Costs and Food Survey based on the industry in which they work.<sup>15</sup>

This is then used to calculate the average carbon intensity for specific occupations and education levels based on the industries in which workers of each occupation and education level work. Charts 7.K and 7.L then show the distribution of education levels and occupations across the income distribution.<sup>16</sup>

## Employment by sectoral emissions

**7.17** Chart 7.H shows the average carbon intensity per worker by industry. Unsurprisingly, the emissions intensity is highest in the electricity and gas sector – with more than three times the emissions per worker than any other industry. In total, the five industries with the highest carbon intensity contribute more than two-thirds of industrial greenhouse gases, but only employ a fifth of all workers.

**7.18** As these sectors decarbonise, the wages and employment opportunities they offer will change, depending on the costs of decarbonising and the policy framework. However, at the same time, there will be growth in lower-carbon sectors. This will create new, competing employment opportunities for people with the skills currently employed in more carbon-intensive sectors.

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<sup>10</sup> 'World Employment Social Outlook 2018 – Greening with Jobs', International Labour Organization (ILO), 2018, p. 42.

<sup>11</sup> 'The transition in play: Worldwide employment trends in the electricity sector', Geneva, International Labour Organization, Research Department Working Paper No. 28, G. Montt, N. Maitre, S. Amo-Agyei, 2018.

<sup>12</sup> 'World Employment Social Outlook 2018 – Greening with Jobs', ILO, 2018, p. 42.

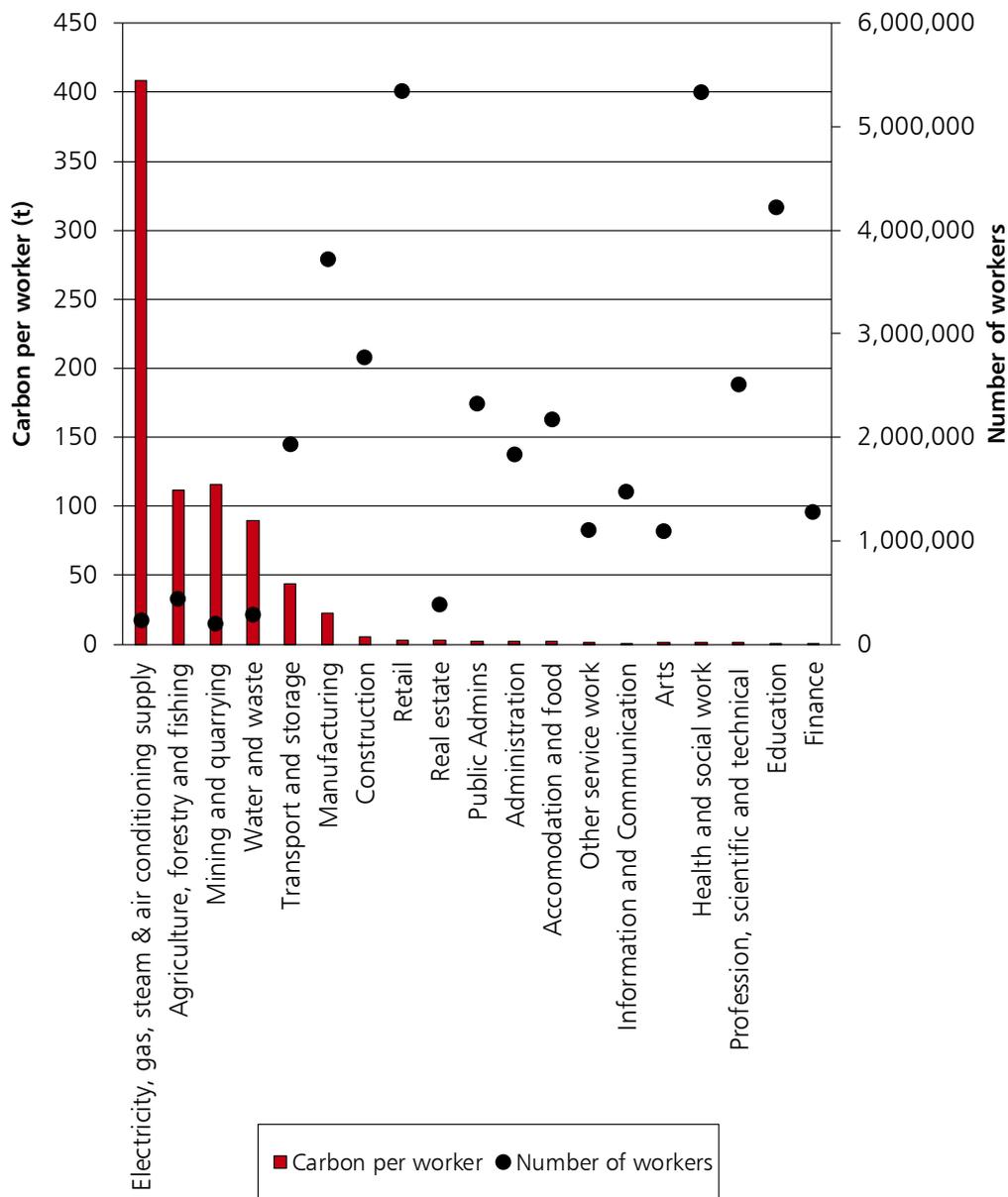
<sup>13</sup> 'Atmospheric emissions: greenhouse gas emissions intensity by industry', 2018 data, ONS, 2020.

<sup>14</sup> 'Living Costs and Food Survey', ONS, 2014/15-2016/17.

<sup>15</sup> These greenhouse gas emissions data record emissions where they occur. They do not account for interdependencies between sectors using outputs that are carbon intensive. For example, many other sector use electricity produced in the electricity and gas sector; however, the carbon associated with the production of electricity is captured in the oil and gas sector rather than passed on to the users of the electricity.

<sup>16</sup> Income deciles are defined based on net household income projected in 2020-21.

Chart 7.H: Average carbon per employee by industry



Source: HM Treasury calculations, LCF household survey, ONS atmospheric emission by industry.

### Employment, skill types and emissions

7.19 Many workers can perform similar jobs in a number of different industries with very different carbon exposures. To more accurately identify which workers might be more exposed to current carbon use in a dynamic labour market Charts 7.I and 7.J show an average carbon intensity for people in different occupations and skill types. This is calculated based on the sector in which workers from each education level or occupation are currently employed. This assumes that all types of roles within each sector are equally affected by the exposure to carbon.

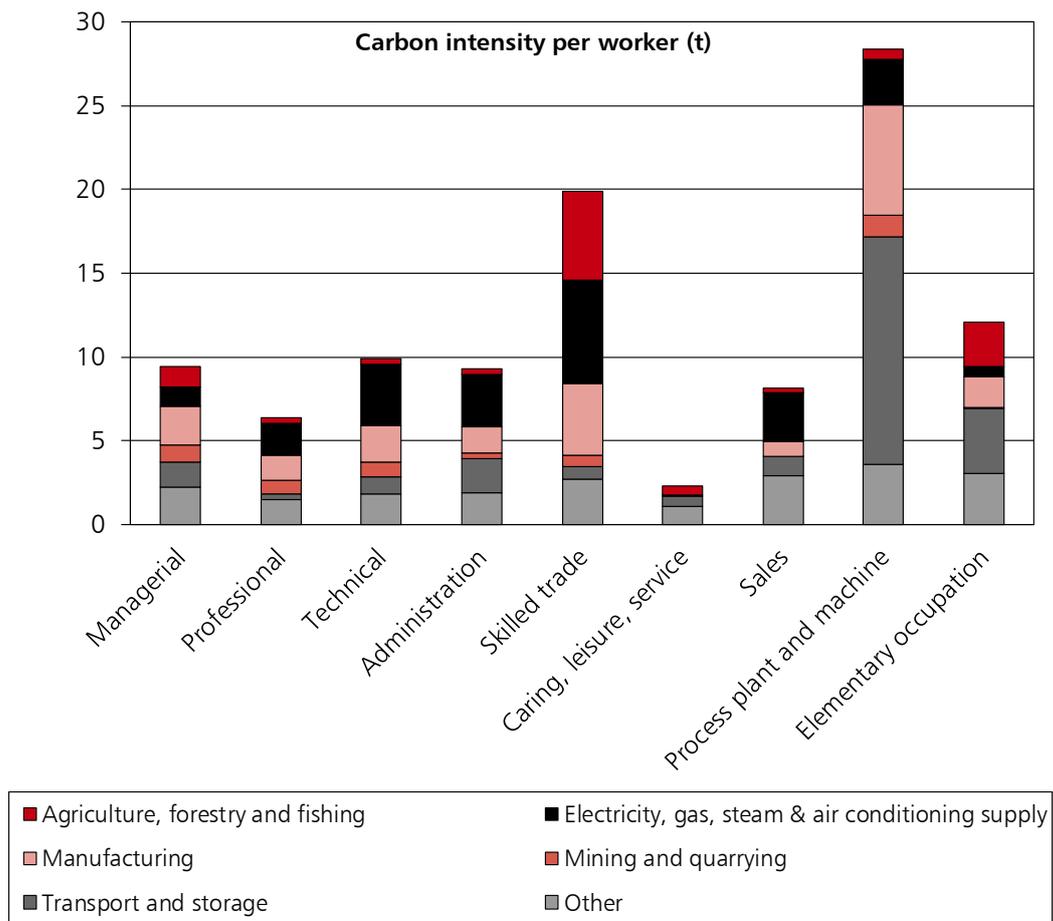
7.20 Skilled trade, and process plant and machine workers tend to be employed in the most carbon-intensive jobs, reflecting higher employment rates in the agriculture and electric and gas sectors. Process plant and machine workers have a higher carbon intensity due to a higher propensity to work in the transport and

storage industry, while skilled trade workers are disproportionately likely to work in the agriculture sector.

**7.21** Similarly, people with low and middle levels of education (those with education up to A-levels) tend to be employed in jobs with an average carbon intensity over 20% more than highly educated employees (degree and above).

**7.22** During the transition, new, lower-carbon industries and jobs will emerge. The UK’s low-carbon industries already support over 460,000 jobs,<sup>17</sup> from electric vehicle manufacturing in the Midlands and the North East to the offshore wind industry in the Humber and the Tees. As discussed in Chapter 2, increasing offshore wind could support 60,000 jobs. Some of these jobs will replace jobs in high-carbon sectors, and some will be additional. However, the transition will still require employers to change their practices to reduce their carbon emissions, which may disproportionately affect these occupations and skills levels. The £315 million Industrial Energy Transformation Fund helps such sectors in the UK to decarbonise. The eventual impact on households will depend on the match between the skills in the jobs lost and the jobs created.

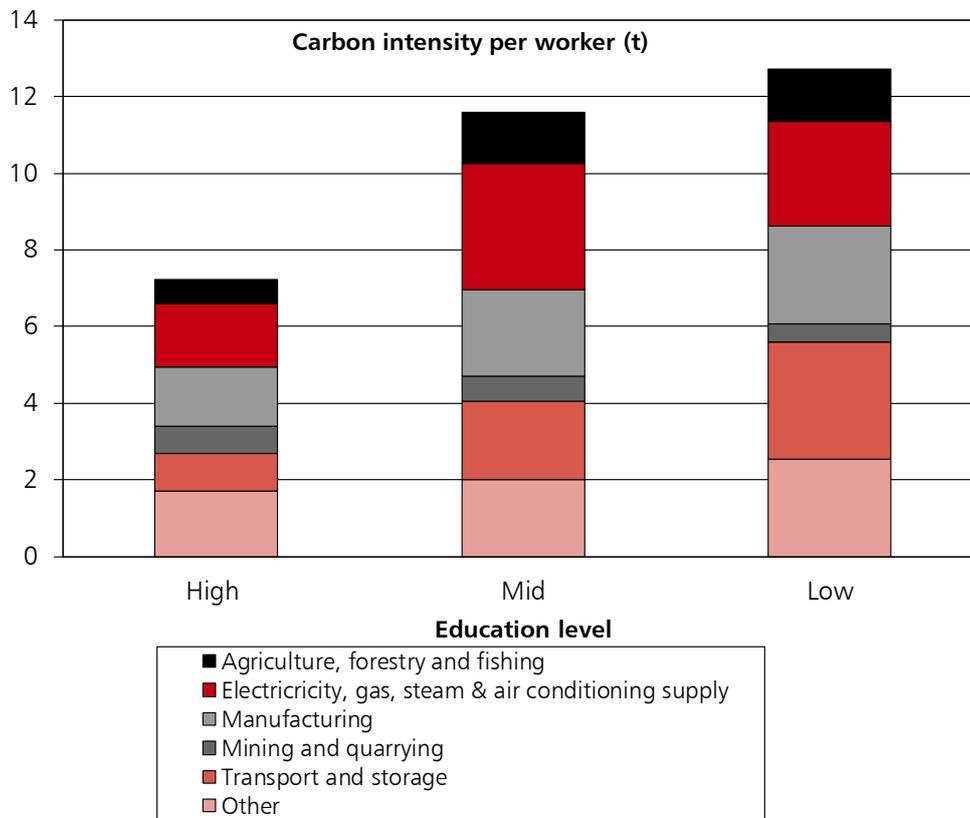
**Chart 7.1: Average carbon per worker by occupation (based on industry of employment)**



Source: HM Treasury calculations, LCF household survey, ONS atmospheric emission by industry.

<sup>17</sup> 'Low Carbon and Renewable Energy Economy (LCREE) Survey QMI', ONS, October 2019

**Chart 7.J: Average carbon per worker by education (based on industry of employment)<sup>a</sup>**



Source: HM Treasury calculations, LCF household survey, ONS atmospheric emission by industry.

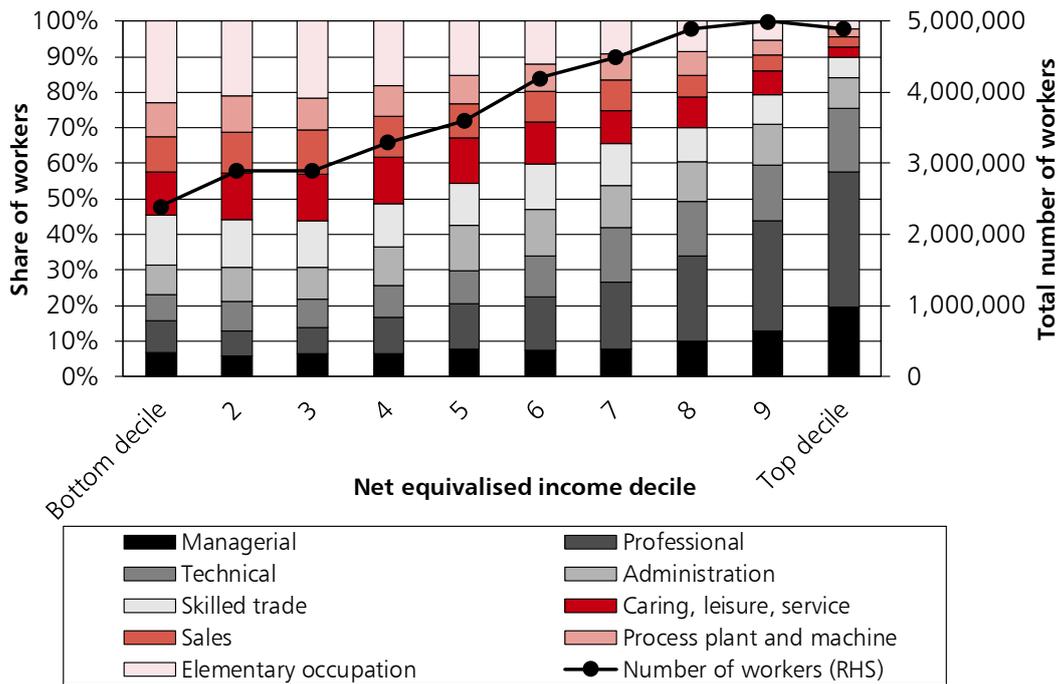
a 'High' education refers to degree level and above, 'Mid' refers to A levels or equivalent, 'Low' refers to GCSE and below.

## Employment, income and emissions

**7.23** The final step is to explore the types of households in these employment groups with higher carbon intensity. Chart 7.K shows occupations of employees broken down by net household income decile (lower income households tend to have fewer or no workers and so fewer workers make up the lower deciles). The high-carbon intensity occupations, skilled trade, and process plant and machine workers are skewed towards lower-income households: almost a quarter of workers in the lowest income quintile of households work in these occupations compared to one in ten of those from the richest quintile. Similarly, Chart 7.L shows low- and mid-education employees are disproportionately drawn from low-income households.

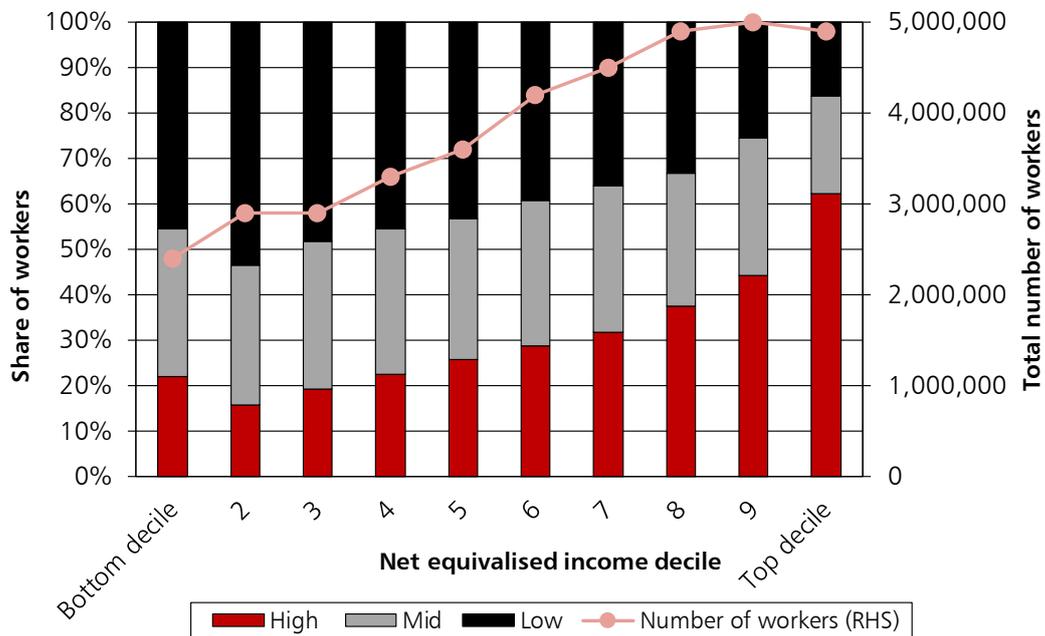
**7.24** However, this does not mean the labour market adjustment would have an overall regressive pattern. Higher-income households receive a significantly greater share of income from earnings, whereas lower-income households receive a greater share of income from welfare. This means that higher-income households are more exposed to any labour market shock. The carbon-specific trends highlighted here are not enough to outweigh this. It is also possible that the carbon intensity of the labour market is geographically concentrated.

Chart 7.K: Distribution of occupations of employees across income deciles



Source: HM Treasury calculations, LCF household survey, ONS atmospheric emission by industry.

Chart 7.L: Distribution of education levels of employees across income deciles<sup>a</sup>



Source: HM Treasury calculations, LCF household survey, ONS atmospheric emission by industry.

<sup>a</sup> 'High' education refers to degree level and above, 'Mid' refers to A levels or equivalent, 'Low' refers to GCSE and below.

## Managing the distributional impacts of the transition

7.25 In designing policies to support the transition, the government will need to take account of the distributional consequences. The design of decarbonisation policies will have implications for distributional outcomes as will decisions on whether to mitigate the impact of the transition through other policy tools, for example:

- a policy can explicitly target distributional impacts alongside other objectives (e.g. progressive interest rates on loans or support for fuel poor homes such as the £6.7 billion package set out in the Energy White Paper<sup>18</sup> that could save families in old inefficient homes up to £400, including the extension of the Energy Company Obligation and Warm Home Discount);
- the ongoing burden of the policy can be increased or reduced for different groups, or some can be excluded from paying altogether (e.g. surcharges, exemptions or targeted reliefs);
- targeted support can be provided to cover the capital and/or running costs caused by a policy (e.g. targeted scrappage schemes coupled with low-emission zones);
- the funds raised by a levy or tax can be redistributed to a particular group to offset the primary impact (e.g. levies with recycling);
- the general tax and welfare system can be used to compensate those who are affected (e.g. targeted tax cuts or higher welfare payments); and
- progressive redistribution can also be a co-product of policies with other explicit aims (e.g. taxes on air travel).

7.26 As with the costs of emission abatement, where there is a need for public financing, funding can be raised through general taxation or through borrowing. They can also be raised through specific taxes or levies, with the revenue raised earmarked to fund these policies. The trade-offs between managing these impacts, effectiveness of policy at driving the transition, and the impact on competitiveness, are discussed in Chapter 6.

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<sup>18</sup> 'Energy White Paper: Powering our Net Zero Future' CP 337, HM Government, 2020

# Annex A

## Net Zero Review terms of reference

The text below sets out the terms of reference for the Net Zero Review as published. Although the Review was initially planned to report in autumn 2020, the COVID-19 pandemic has meant the final report has been delayed to spring 2021.

### Context

The UK has a proud record of global leadership in tackling climate change and supporting clean growth.

In 2006, the UK published the first global review into the economics of climate change. This led to the Climate Change Act 2008, which established a comprehensive legal framework for delivering emission reductions in the UK, including a 2050 carbon reduction target and interim carbon budgets.

Between 1990 and 2017, we reduced our emissions by 42% while growing the economy by more than two thirds.

The UK legislated in June 2019 to reach net zero greenhouse gas emissions by 2050, becoming the first major economy to do so.

The government also accepted the Climate Change Committee's recommendation that HM Treasury should undertake a review of how the transition to net zero would be funded and where the costs would fall. This review will take this forward, examining the key choices to transform to a green economy and achieve net zero by 2050.

In parallel, the government will continue its efforts to reduce greenhouse gas emissions and deliver on its carbon budget commitments, while keeping costs down for consumers, supporting the creation of good jobs and growing the economy.

### Objectives

To consider how the transition to net zero will be funded and assess options for where the costs will fall. This will involve:

- 1 Analysing the range of choices for how households, businesses and the taxpayer could contribute towards different elements of the transition to net zero.
- 2 Identifying mechanisms to create an equitable balance of contributions.
- 3 Maximising opportunities for economic growth as we transition to a green economy.
- 4 Evaluating the trade-offs between cost, competitiveness, effects on consumers and impacts on the taxpayer.

## Scope

The review will consider the full range of government levers, including tax. It will not duplicate existing or ongoing work elsewhere, such as:

- detailed policy to decarbonise specific sectors
- the costs of adapting to the impacts of climate change
- the social and global co-benefits of decarbonisation

## Governance, engagement and timetable

The review will be conducted by Her Majesty's Treasury, with close engagement across Whitehall and with the devolved administrations.

The review will consult widely, as well as draw on evidence from experts and insights from those who will have a role in and be impacted by the transition. Further details will be set out in due course.

The review will report to the Chancellor of the Exchequer. Her Majesty's Treasury will publish a report in autumn 2020 setting out principles to guide decision-making during the transition to net zero.

# Annex B

## Market failures and climate change

### Market failures: the theory

This annex sets out further detail on the theory of market failures and the main market failures in each sector.

**Table 7.A: Static price failures**

Market failure	Description
Negative externalities	Arise when the production or consumption of a good or service imposes a cost on a third party that is uninvolved in the initial transaction, imposing a larger cost on society as a whole than on the private actors. Stern judged the lack of a price on emitting greenhouse gases to be the largest market failure driving climate change and pervasive across all sectors of the economy. <sup>1</sup>
Positive externalities	Exist when production or consumption of a good or service benefits a third party uninvolved in the initial transaction. As a result, benefits to society as a whole are greater than benefits experienced by private actors and the goods and services are consequently under-produced or consumed. Positive externalities commonly occur in innovation processes. Early adopters of green technology generate positive externalities for others by supporting supply chain development and bringing down costs over time.
Public goods	Exist when a good or service is non-excludable and has no rival in consumption. Once a public good is supplied, no one can be stopped from consuming it, and its consumption by one person does not reduce the amount available to another person. Consequently, these goods suffer from a free-rider problem, where those accessing the service do not have to pay for it. Greenhouse gas removals, for example by forests that sequester carbon from the atmosphere, are public goods since no one can be excluded from the benefit of lower carbon in the atmosphere. Quasi-public goods partially exhibit these features – being non-rival or non-excludable – up to a point, often in cases where there is a capacity limit. Some of the infrastructure required to achieve a net zero economy can be thought of as quasi-public goods – for example cycle lanes and pedestrian areas which can help encourage a modal shift away from petrol and diesel vehicles.

<sup>1</sup> 'The Economics of Climate Change: The Stern Review, Nicholas Stern', Cabinet Office – HM Treasury, 2006.

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Natural monopolies	<p>Occur where there are high upfront fixed costs associated with providing a good or service and low marginal costs. These high costs (common in infrastructure) may mean that a market with one producer to supply most of the market is most efficient. However, the lack of competition that results can, if unaddressed, result in inflated prices and poor quality of service.</p> <p>In the UK, economic regulators oversee the network operators that carry risks of natural monopoly. Many of these networks will be important for the transition to net zero. For example, the capacity of the electricity grid will be important for the electrification of large parts of the economy and the gas grid will play a central role if hydrogen is used on a large scale.</p>
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**Table 7.B: Static non-price failures**

Market failure	Description
Information failures	<p>Occur when a lack of information means that economic actors cannot make the decision that provides the most benefit to them. Information failure is an issue for net zero where the choices being asked of people may be complex and the information that exists is hard to interpret or there are too many options. A lack of knowledge about the benefits of making energy efficiency improvements to buildings, in production or in personal consumption may also hold back decarbonisation even where there is the will to do so.</p>
Inertia and bounded rationality	<p>Occur where people are satisfied with a sub-optimal outcome. The necessary incentives and information exist but these do not translate into change, because people are biased towards the status quo. It can also be the case that people apply different weights to costs and benefits in different time periods, or of different natures – for instance cost savings versus inconvenience. This could help explain the low rate of adoption of energy efficiency measures in buildings, which would normally pay for themselves without the need for government intervention.</p>
Split incentives	<p>Occur where one party bears the cost of purchasing a good while another party benefits, or the party that bears the cost cannot guarantee it will reap the full benefit over time. This occurs in the rented sector both for homes and for industry, where tenants would experience the benefits of reduced bills from energy efficiency measures but cannot guarantee that they will continue to rent the property for enough time to recoup the costs of their installation. Split incentives also occur in the shipping sector where charterers may be deterred from investment in abatement as they will only receive the benefits when leasing the ship – similarly ship owners can have lower incentives to invest themselves as they may not receive all of the savings from the efficiency improvements.</p>

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Liquidity constraints	Occur where people are willing to make an investment that is cost saving but do not have access to the capital to pay for it. If they could borrow money to fund the investment, they would do so. This may be an issue throughout the transition due to the large amount of new capital investment required, for both households and businesses.
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**Table 7.C: Dynamic failures**

Market failure	Description
Uncertainty and risk bearing	Uncertainty about the future increases risk. Combined with risk aversion, this can lead to disproportionate increases in financing costs for investment and sub-optimal levels of investment. This is a particular problem for new and developing technologies which will be crucial for the transition, or in circumstances where future policy is unclear.
Multiple equilibria: coordination failures	Occur where a lack of communication between actors in the market, or an inability to coordinate action across time, leads to an outcome that leaves everyone worse off. For example, one possible barrier to increased uptake of electric vehicles may be that drivers are concerned that there are not enough charging points to be able to pursue the journeys they want to. However, it may also only be profitable for firms to roll out sufficient charging points when there is enough demand for them. If these actors were able to coordinate their supply and demand, the market would produce a better outcome.
Multiple equilibria: technology development curves	As new technology is deployed the costs of that technology falls. New, low-carbon technology is often more expensive as it has not yet been deployed at scale – whereas markets dominated by fossil fuel dependent technologies are fully developed. As a result, low-carbon goods and services are often initially not price competitive and demand is lower. There may be tipping points with new technologies: a point when the cost of the technology falls far enough to secure a significant switch in consumer and business demand for the new product. In the power sector, solar panels and wind turbines were initially very costly but have fallen in price substantially over time as they have been taken up at scale.

## Market failures by sector

This section considers how the market failures set out above apply to the various sectors of the economy important to the net zero transition. The list of market failures here is not exhaustive, and many sectors will experience multiple market failures simultaneously.

## Power

Market failures in the power sector are particularly important as the distortions created in this market can affect other sectors of the economy, potentially magnifying the impact. This is particularly relevant in the case of buildings, surface transport and industry.

The primary market failure is the negative externality associated with the use of fossil fuels to generate electricity. In the absence of government intervention, the cost of climate change caused by the emissions is not reflected in the cost of producing or using the electricity. This means that the price of fossil fuel-generated electricity can be lower than for low-carbon power sources such as nuclear and renewables. The existing Emissions Trading System (ETS) and top-up from the Carbon Price Support have been effective in making emissions-intensive power less competitive than some of these alternatives but may not have completely internalised the externality. The Climate Change Levy increases the cost of electricity usage with the aim of encouraging efficiency improvements and reducing emissions.

Dynamic market failures such as uncertainty and multiple equilibria relating to technological development curves exist in the renewable sector. There are a number of existing mechanisms to overcome these, including the price signals given by the ETS and UK government schemes to improve revenue certainty for investors, such as Contracts for Difference. Hydrogen power and carbon capture technologies face similar dynamic market failures.

Liquidity constraints may hold back deployment of nuclear power. Large upfront capital investment is required, and the costs are incurred over a long timeframe, creating a barrier to adoption.

Risks of natural monopoly appear in the electricity and gas grids and in a potential CO<sub>2</sub> network to support carbon capture and storage. For this reason, Ofgem regulates the electricity and gas network companies' revenue, investment and performance standards.

## Buildings

Fossil fuel-powered heating is the primary source of emissions from buildings. The climate cost of these emissions is not fully included in the price of heating, creating a negative externality. Decarbonising buildings therefore requires efficiency improvements to reduce energy use such as double glazing and loft insulation, as well as finding new ways to heat our homes, workplaces and other buildings.

Low-carbon heating systems are currently more expensive than systems to support fossil fuel heating.<sup>2</sup> This should change over time as the technologies are rolled out at scale, but this process is held back by multiple equilibria problems relating to coordination and technological development curves, which keep costs high. As discussed above, electricity and hydrogen grids that would power low-carbon heating systems could also represent natural monopolies.

Split incentives may further hold back investment in energy efficiency as the tenants who would benefit from bill savings cannot guarantee that they will rent the

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<sup>2</sup> 'Cost of installing heating measures in domestic properties – a study providing cost data for different heating appliances', Department for Business, Energy and Industrial Strategy (BEIS), September 2020.

property for long enough or have high enough energy use to recoup the costs of their installation. Similarly, landlords have little incentive to improve the energy efficiency of their property if it does not increase its rentable value, since they will not benefit from lower bill costs themselves.

Households may wish to avoid the disruption involved in installing energy efficiency measures, and upfront costs can be high with long payback times. People may not value the benefits, given they will only occur over a long time period, and affordability and liquidity constraints could prevent households from making up-front investments, even when these reduce costs overall. Finally, people may not have access to information on the benefits they could experience from taking up these measures.

## Transport

### Surface transport

Emissions from internal combustion engines represent a negative externality as their costs is not fully captured in the relative price of the vehicles or their operating costs. To date there has been limited progress in decarbonising road transport. This is largely because fuel efficiency gains have been offset by increases in miles driven and sales of larger vehicles. Shifts towards public transport and active travel, like walking or cycling, can decrease the size of this negative externality, but the infrastructure needed may be a quasi-public good.

The sector will rely on new markets and developing technologies for producing zero-emission vehicles (ZEVs) to reach net zero. However, electric cars, vans and motorcycles are not yet price competitive with internal combustion engine alternatives, even with government subsidies, both in terms of upfront cost and total cost of ownership. The Climate Change Committee (CCC) estimates that upfront cost will reach parity with conventional vehicles in the second half of the 2020s.<sup>3</sup> This assumes that battery technologies continue to scale-up production and price reduction forecasts materialise.

There is an additional dynamic market failure whereby a lack of adequate charging infrastructure may present a barrier to uptake of ZEVs, but the fact that enough ZEVs are required to be in use to make charging infrastructure profitable may prevent the infrastructure being delivered. There are other static non-price market failures that also present a barrier to adoption of these vehicles: misinformation about range and environmental impact of batteries; inertia; and liquidity (up-front affordability) constraints.

There are still several different technological options in play for zero emission heavy duty vehicles, including lorries, buses and coaches. Where these rely on common infrastructure, such as a network of hydrogen refuelling stations, a super-fast charging network or overhead catenaries, there are limited incentives for firms to make changes to their fleet. At the same time, a limited HDV fleet does not provide the necessary incentives to private actors to start building the infrastructure. Further coordination is required across countries, given that heavy goods vehicles make long journeys across borders. Failure to do so will result in vehicles either needing to be

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<sup>3</sup> 'Net Zero – Technical Report', Climate Change Committee (CCC), May 2019.

compatible with multiple systems, or goods having to change vehicle at borders, adding to costs.

Rail makes up a small proportion of total emissions from surface transport. The difference in emissions between low-carbon and fossil fuel powered trains is not reflected in the ticket prices or in the cost to train companies of using rail infrastructure. However, railways contribute to decarbonisation by enabling a shift from other more polluting forms of transport. Developing new technologies such as hydrogen trains may provide a lower-cost option for lowering rail emissions in some parts of the network but may come with dynamic market failures around uncertainty and multiple equilibria.

## Air travel

The cost to third parties from the emissions of air travel is a negative externality in the absence of intervention, as it is not reflected in the market price. Decarbonisation of the sector in the short term is largely reliant on fuel-efficiency improvements and reduced demand. There are currently no truly zero-emission solutions for long-haul flights. However, small hydrogen and electric planes are being developed, which could be viable on short and medium-haul flights before 2050.

Given that significant technological development is required in this sector, dynamic market failures will play a significant role. Sustainable aviation fuels present a way to reduce emissions from aviation and production could be scaled over the next ten years to achieve meaningful carbon savings in the decade from 2030. However, these fuels are currently more costly than existing aviation fuels. As fuel costs make up a significant proportion of airlines' costs and the sector is highly competitive, there is currently little incentive to move away from conventional fuels until there is price parity with sustainable fuel cost. International cooperation is also necessary to overcome potential coordination failures.

## Shipping

The cost of using a vessel powered by fossil fuels does not reflect the cost to third parties of emissions and pollution created as a by-product. A range of options exist to reduce shipping emissions, some of which may allow shipping to get to near-zero emissions. These include more fuel-efficient ships, logistical improvements and the use of alternative fuels like ammonia and hydrogen.

Some fuel efficiency and logistical improvements can be price competitive mitigation measures. This implies that static non-price market failures, like inertia, or liquidity constraints faced by smaller ship operators are significant barriers to adoption.

Additionally, the maritime sector is highly fragmented, with a combination of ship owners, operators and charter companies. There is an asymmetry of information between these agents, which may result in sub-optimal outcomes.

There are also split incentives between the owners of the ships and the charter companies that rent them. These mean that necessary net zero investments to these vessels may not be undertaken by the charter companies, as it can be unclear whether they will recoup their investments if the ship owner were to terminate their contract.

Alternative low-carbon maritime fuels still require technological development to become price competitive with existing fuel sources. However, without considerable

roll-out and an internalisation of the negative externality, these fuels may not become price competitive. This is a multiple equilibrium market failure.

## Industry

Emissions from industry are a negative externality problem, insofar as the price set by the current EU Emissions Trading Scheme does not fully internalise those emissions. Non-price market failures such as liquidity constraints, information failures and inertia will all contribute to varying degrees to holding back decarbonisation depending on the sub-sector in question.

Where possible, switching from fossil fuel-based inputs to alternatives like hydrogen, electric heat or biomass will mitigate the negative externality problem. There are also a range of energy efficiency and circular economy measures – industrial symbiosis, reuse, repair, remanufacture of products and recycling of materials – that are currently cost saving and would reduce pollution.

Keeping options open is critical to optimizing the most efficient technological choice. However, this creates a trade off with the long capital lifecycles typical in industry: some industries have action point cut offs within the next five years to achieve net zero by 2050.

Emissions from non-combustion processes, such as in the production of ammonia, cement, iron and steel, can represent a negative externality in the absence of policy intervention. These emissions are an unavoidable consequence of production of what are generally raw materials with only imperfect substitutes. Instead of reducing output, the CCC's modelling assumes the emissions are captured at the point of production and stored underground using a network of carbon dioxide pipes. This new network could represent a natural monopoly, as there are large initial fixed costs to the deployment of the infrastructure that continually fall as the network is expanded. A competing network of pipes might not be feasible, nor economically efficient. However, having only a single provider does create risks of monopoly power that could result in poor quality and overpricing of services if left unaddressed.

## Fluorinated gases

Fluorinated gases (F-gases) are used in a variety of equipment, including refrigeration systems, air-conditioning units, heat pumps, medical inhalers, fire extinguishers and in a variety of other industrial and specialist applications. F-gases can have a global warming potential up to 23,000 times more powerful than CO<sub>2</sub>. If left unaddressed by policy, they would incur a significant negative externality if released to the atmosphere.

For several of these uses, alternatives to F-gases and F-gases that have a lower intensity greenhouse gas effect are becoming available and cost effective. This would mitigate the negative externality. There may also have been an imperfect information failure, but the regulatory approach has been largely effective at reducing F-gas use and developing the market in use of alternatives.

## Waste

When consuming a product, the price paid may not always capture the full costs of disposing of that product after use, including any associated emissions. Charges for

landfill use have internalised some of these costs and indirectly increased the price of emissions. Information failures and inertia in households and businesses may also hold back effective sorting of waste and, consequently, carbon-efficient waste management.

Waste collection and waste-water management can show features of a natural monopolies in the absence of policy intervention. There are high initial fixed costs that fall as the network is expanded and a competing service may be economically inefficient, depending on the precise geography of the area.

Finally, informal or illegal waste disposal such as flytipping and littering create further negative externalities, such as reduced or detrimental visual amenity and pollution of the natural environment. Split incentives across public authorities can also hold back carbon-efficient waste policy.

## Agriculture

A variety of market failures are present in this sector. Many are static, rather than dynamic failures.

The primary source of emissions from the sector is from ruminant livestock production. This is a significant source of methane, a greenhouse gas around 28 times more powerful than carbon dioxide.<sup>4</sup> High or inefficient use of resources such as fertiliser can increase emissions principally through their breakdown in soil which releases nitrous oxide, a greenhouse gas around 298 times more powerful than carbon dioxide.<sup>5</sup> The use of fossil fuels in agricultural machinery and heating emits carbon dioxide, but this is a relatively small proportion (10%) of total emissions from the sector.<sup>6</sup> These all represent negative externalities as the costs they impose on others are not consistently captured in farms' production costs.

The size of the negative externalities can potentially be mitigated through improved farm management practices: improved resource efficiency through best practice management, the adoption of innovative technologies and changes in patterns of land use can mitigate these emissions. This includes adopting different feeding practices for livestock, selective breeding, improving animal health, adopting more fuel-efficient machinery, more efficient fertiliser applications and restoring peatlands. These could create trade-offs with other competing policy objectives.

Many of these measures are consistent with improvements in agricultural productivity. This can bring down resource use per unit of output, as well as the associated emissions.

Inertia is cited regularly in the literature as a barrier to change in this sector. However, it is difficult to distinguish between this and other non-price market failures such as imperfect information, issues around tenure and the impacts of government subsidies.

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<sup>4</sup> 'Fifth assessment report', Intergovernmental Panel on Climate Change (IPCC), September 2014.

<sup>5</sup> 'Fifth assessment report', IPCC, September 2014.

<sup>6</sup> 'Net Zero – Technical Report', CCC, May 2019.

## Land use and land-use change

When making decisions about land use, farmers' and land managers' incentives do not reflect all the costs to third parties that can arise from different types of land use. As discussed in the section above on agriculture, certain land use choices are more emissions-intensive than others. The market value of land and the market prices of goods produced on that land do not reflect the variance in emissions.

Increasing the resource efficiency or productivity of the land lessens this trade-off, allowing other marginal land to be made available for alternative uses, while maintaining total output.

For example, marginal agricultural land can be freed up for afforestation, peatland restoration or flower meadows, all of which provide third party ecosystem services such as carbon abatement and sequestration. Land prices do not reflect the positive externalities that can come from these alternative uses of land. Aspects of afforestation can also be considered a public good, since the benefits of carbon sequestration don't fall with number of people experiencing them, and no one can be excluded from experiencing those benefits.

In addition, there are non-price market failures that prevent land managers from making the most efficient use of their assets. For example, farming subsidy rules and tenancy law may discourage land managers from changing land use. A transition in land uses will require new skills and knowledge which may be an additional barrier.

## Greenhouse gas removals

The CCC is clear that greenhouse gas removal technologies (GGRs) are likely to have a role in offsetting residual emissions, especially in hard to abate sectors such as air travel. These removals can therefore be viewed as the cost of reducing the negative externality in a given sector, or as positive externality in their own right.

The government has issued a call for evidence on GGRs, as there are a variety of options to be considered. Beyond the measures captured in the land use section above, the CCC identify bioenergy and carbon capture and storage (BECCS) and wood in construction (WIC) as the most currently feasible ways to remove greenhouse gases. However, there are non-price static market failures that must be overcome for the market to work effectively. For example, imperfect and asymmetric information about where the biomass being used for BECCS or WIC is from, the sustainability impacts and the amount of carbon that is sequestered in each unit may prevent the market from working efficiently. This risk becomes greater if biomass is traded overseas, with a need for international transparency and cooperation.

A CO<sub>2</sub> Transport and Storage (T&S) network is required for BECCS, as with all CCUS processes. This new network may present natural monopoly market failures, as there are large initial fixed costs to the deployment of the infrastructure that continually fall as the network is expanded. A competing network of pipes might not be feasible, nor economically efficient. However, having only a single initial provider does create risks of monopoly power that could result in poor quality and/or overpricing of services, if left unaddressed.

There are also other less developed GGRs being considered in the UK such as enhanced weathering and Biochar. Current analysis suggests direct air carbon

capture and storage (DACCS) is likely to have the greatest deployment potential of these approaches in the UK by 2050. These will require further research and development to reduce their costs, to understand their effectiveness and their trade-offs. The knowledge gained from this research and development is a quasi-public good as it is difficult to exclude people from accessing research findings, and information is not depleted by use. In addition, DACCS would require an existing CCS network, as discussed above. Finally, the high levels of uncertainty about the viability in the early stages of development of these technologies may lead to underinvestment by the market.

# Annex C

## Processing of personal data

This notice sets out how HM Treasury as the data controller will use your personal data for the purposes of gathering stakeholder feedback for the Net Zero Review Interim Report and explains your rights under the General Data Protection Regulation (GDPR) and the Data Protection Act 2018 (DPA).

### Your data (Data Subject Categories)

The personal information relates to you as either a member of the public, parliamentarian or representative of an organisation or organisations or company or companies.

### The data we collect (Data Categories)

Information may include your name, address, email address, job title and employer, as well as your opinions. It is possible that you will volunteer additional identifying information about themselves or third parties.

### Legal basis of processing

The processing is necessary for the performance of a task carried out in the public interest. For the purpose of this Interim Report the task is requesting evidence or obtaining opinion data in order to develop to develop good effective proposals and recommendations to government.

HM Treasury may use the contact details provided to contact respondents in the period between the Net Zero Review Interim Report publication to when the Final Report is expected to be published in order to request clarification or further information regarding the response provided where this is deemed necessary.

### Special categories data

We do not expect that any special category data will be processed.

### Legal basis for processing special category data

Where special category data is volunteered by you (the data subject), the legal basis relied upon for processing it is: the processing is necessary for reasons of substantial public interest for the exercise of a function of the Crown, a Minister of the Crown, or a government department.

This function is consulting on departmental policies or proposals, or obtaining opinion data, to develop good effective policies.

### Purpose

The personal information is processed for the purpose of obtaining the opinions of members of the public and representatives of organisations and companies, about

departmental policies, proposals, or generally to obtain public opinion data on an issue of public interest.

### Whom we share your responses with

Information provided in response to this Interim Report may be published or disclosed in accordance with the access to information regimes. These are primarily the Freedom of Information Act 2000 (FOIA), the Data Protection Act 2018 (DPA) and the Environmental Information Regulations 2004 (EIR).

If you want the information that you provide to be treated as confidential, please be aware that, under the FOIA, there is a statutory Code of Practice with which public authorities must comply and which deals with, amongst other things, obligations of confidence.

In view of this it would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information, we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded as binding on HM Treasury.

Where someone submits special category personal data or personal data about third parties, we will endeavour to delete that data before publication takes place.

Where information about respondents is not published, it may be shared with officials within other public bodies involved in this Interim Report to assist us in developing the policies to which it relates. Examples of these public bodies appear at: <https://www.gov.uk/government/organisations>.

As the personal information is stored on our IT infrastructure, it will be accessible to our IT contractor, NTT. NTT will only process this data for our purposes and in fulfilment with the contractual obligations they have with us.

### How long we will hold your data (Retention)

Personal information in responses to this Interim Report will generally be published and therefore retained indefinitely as a historic record under the Public Records Act 1958.

Personal information in responses that is not published will be retained for three calendar years after the Net Zero Review has concluded.

### Your rights

You have the right to request information about how your personal data are processed and to request a copy of that personal data.

You have the right to request that any inaccuracies in your personal data are rectified without delay.

You have the right to request that your personal data are erased if there is no longer a justification for them to be processed.

You have the right, in certain circumstances (for example, where accuracy is contested), to request that the processing of your personal data is restricted.

You have the right to object to the processing of your personal data where it is processed for direct marketing purposes.

You have the right to data portability, which allows your data to be copied or transferred from one IT environment to another.

### **How to submit a Data Subject Access Request (DSAR)**

To request access to personal data that HM Treasury holds about you, contact:

HM Treasury Data Protection Unit  
G11 Orange  
1 Horse Guards Road  
London  
SW1A 2HQ

[dsar@hmtreasury.gov.uk](mailto:dsar@hmtreasury.gov.uk)

### **Complaints**

If you have any concerns about the use of your personal data, please contact us via this mailbox: [privacy@hmtreasury.gov.uk](mailto:privacy@hmtreasury.gov.uk).

If we are unable to address your concerns to your satisfaction, you can make a complaint to the Information Commissioner, the UK's independent regulator for data protection.

The Information Commissioner can be contacted at:

Information Commissioner's Office  
Wycliffe House  
Water Lane  
Wilmslow  
Cheshire  
SK9 5AF

0303 123 1113

[casework@ico.org.uk](mailto:casework@ico.org.uk)

Any complaint to the Information Commissioner is without prejudice to your right to seek redress through the courts.

### **Contact details**

The data controller for any personal data collected as part of this Interim Report is HM Treasury, the contact details for which are:

HM Treasury  
1 Horse Guards Road  
London  
SW1A 2HQ

020 7270 5000

[public.enquiries@hmtreasury.gov.uk](mailto:public.enquiries@hmtreasury.gov.uk)

The contact details for HM Treasury's Data Protection Officer (DPO) are:

The Data Protection Officer  
Corporate Governance and Risk Assurance Team  
Area 2/15  
1 Horse Guards Road  
London  
SW1A 2HQ

[privacy@hmtreasury.gov.uk](mailto:privacy@hmtreasury.gov.uk)





## HM Treasury contacts

This document can be downloaded from [www.gov.uk](http://www.gov.uk)

If you require this information in an alternative format or have general enquiries about HM Treasury and its work, contact:

Correspondence Team  
HM Treasury  
1 Horse Guards Road  
London  
SW1A 2HQ

Tel: 020 7270 5000

Email: [public.enquiries@hmtreasury.gov.uk](mailto:public.enquiries@hmtreasury.gov.uk)

