June 2021

Progress in reducing emissions

2021 Report to Parliament

Climate Change Committee

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Contents

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Joint Foreword

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.

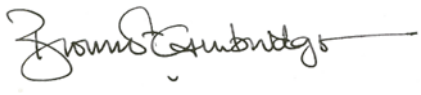
We commend Ministers for accepting our advice on the future path for UK emissions. The setting of the UK's 2030 NDC, the passing into law of the Sixth Carbon Budget, the decision to bring international aviation and shipping emissions within the UK carbon budgets; all were made on the Committee's recommendation. 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 $MtCO_2e$ 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.

Adaptation policy needs a step change in ambition and action.

- **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.

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_2 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.

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Rebecca Heaton is responsible for Drax Group's efforts to mitigate climate change, ensuring that sound science underpins climate change polices 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).

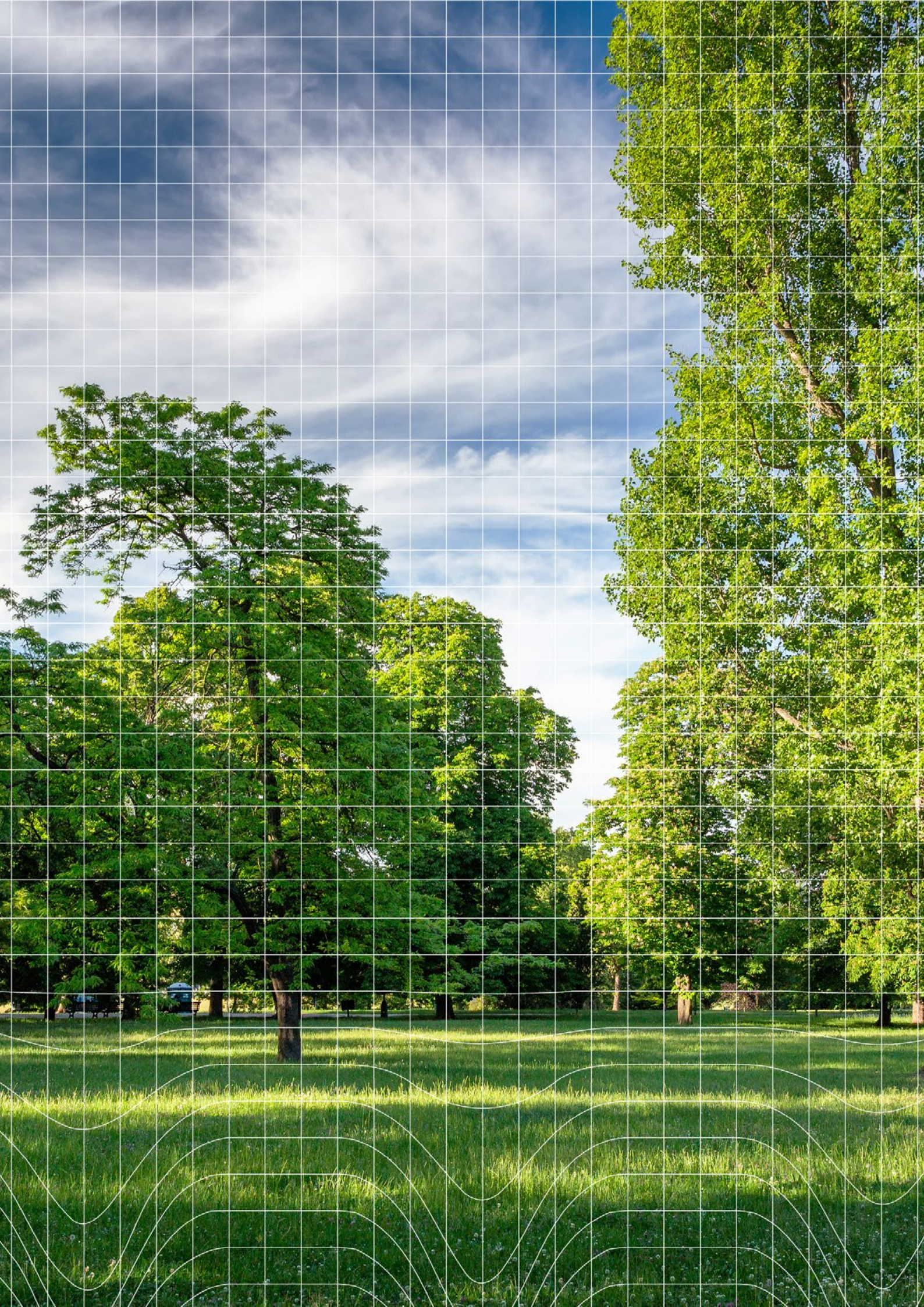
Professor Corinne Le Quéré FRS

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



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 Net Zero Strategy must set out a coherent vision of how Net Zero and the Sixth Carbon Budget will be met.

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.

The Government should introduce a Net Zero Test to ensure that all policy decisions are compatible with the legislated targets.

- **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 $MtCO_2e$, 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.

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 $MtCO_2e$, 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.

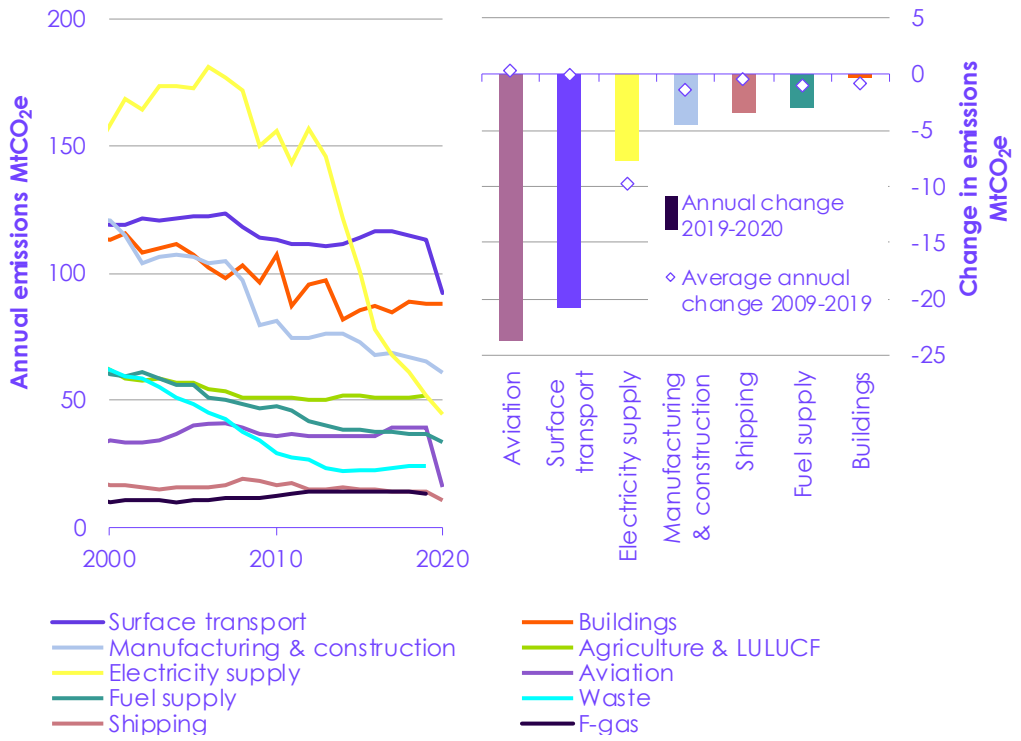
- Sales of **electric vehicles** and the deployment of supporting charging infrastructure have increased considerably in recent years. Policies will be required to drive the accelerated uptake required throughout the 2020s (e.g. a zero-emission vehicle mandate). There are also concerning trends, notably 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.

Figure 1 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_2 emissions are not shown on the right-hand chart. Final estimates of 2020 emissions in these sectors will be published in early 2022. The sectoral emissions for aviation and shipping include the UK's share of international aviation and shipping emissions, and are CCC estimates.

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:

- 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 in many areas is in line with, or close to, the necessary level.

- 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, there has been a tendency for ambition to fall short of our recommended pathway to meet the Sixth Carbon Budget.

- 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).

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:

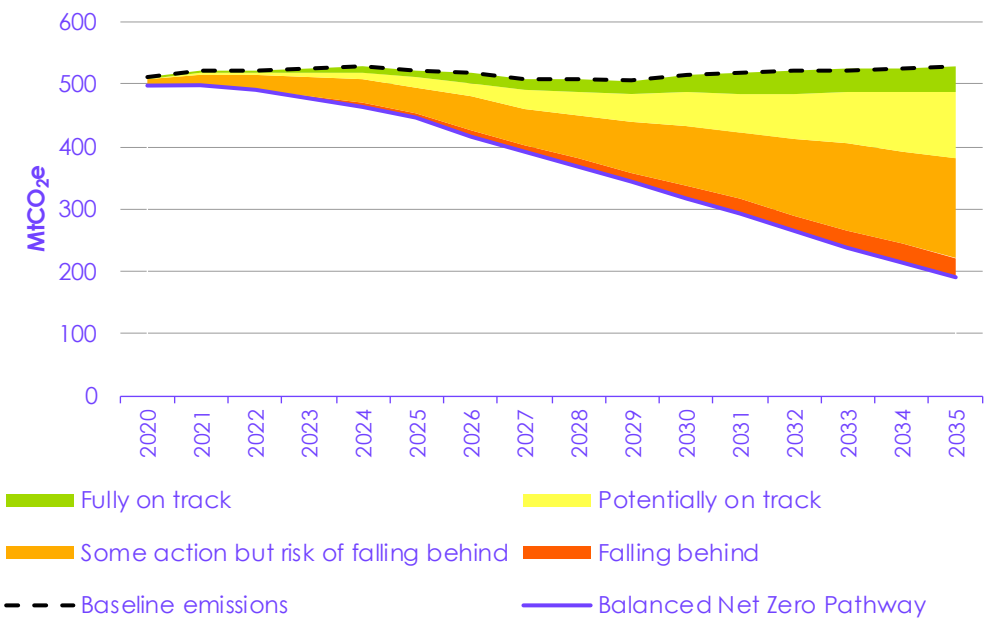
- **Consumer choices.** So far, the Government's announcements have focused on technologies and largely ignored the potential for changes in consumer choices to reduce emissions. These are particularly important to limit emissions in 'hard to abate' sectors, such as aviation and agriculture. We note 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?



Source: CCC analysis; CCC (2020) *The Sixth Carbon budget – The UK's path to Net Zero*

Table 1
Government commitments compared to the CCC Pathway between 2025-2035

Headline actions	Government commitment [1]	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) [2]	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 [3]	10 $MtCO_2$ captured and stored annually by 2030, across four industrial clusters, including at least one power project	22 $MtCO_2$/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 [4]	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 $MtCO_2$/year by 2030
Nuclear power [5]	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:

[1] 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.

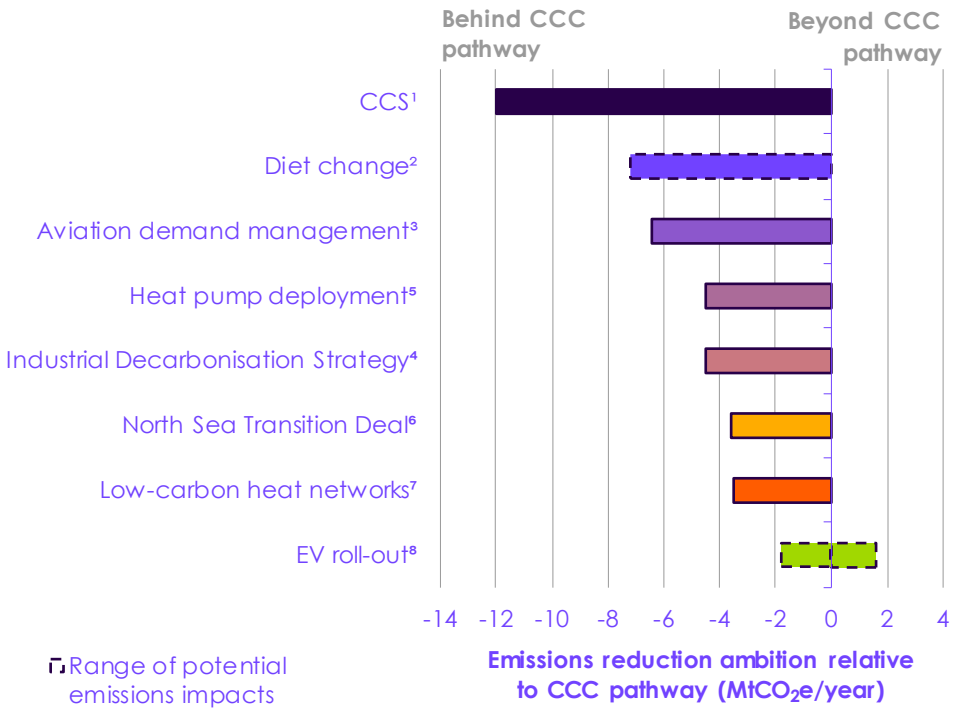
[2] Government commitment on low-carbon heat network deployment is illustrative, and has been inferred from Government spending commitments, using assumptions around expected leveraged investment and the proportion of funding targeted at low-carbon networks.

[3] 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.

[4] Government peatland restoration commitments include Scotland, Wales and England. CCC peatland restoration numbers in 2025 are UK-wide.

[5] 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.
[1] Government CCS ambition for is 10 $MtCO_2$/year in 2030, compared to 22 $MtCO_2$/year in the CCC pathway.
[2] The level of diet change without explicit policy to support it is uncertain. Emissions could be up to 7.2 $MtCO_2e$/year higher than the CCC pathway in 2030.
[3] Lack of ambition for aviation demand management would result in higher emissions of 6.4 $MtCO_2e$/year in 2030 relative to the CCC pathway for aviation emissions.
[4] The Industrial Decarbonisation Strategy aims for a 67% reduction by 2035, compared to 73% in the CCC pathway.
[5] 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.
[6] The North Sea Transition deal commits to a reduction that falls short of the CCC pathway by 3.7 $MtCO_2e$/year in 2030.
[7] 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).
[8] 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).

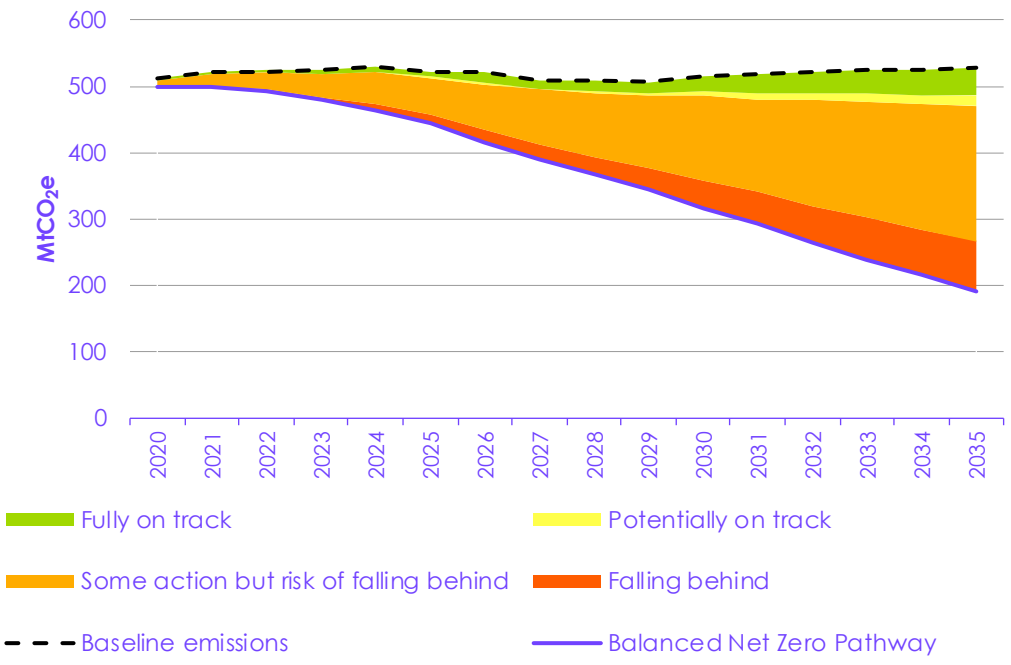
We have also seen, through the failure of the Green Homes Grant, the challenges of real-world implementation and the need for well-designed and well-executed schemes that properly address the barriers to decarbonisation. Failures cannot be avoided completely, but it is critical that effective replacement 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 $MtCO_2$ 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.

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.

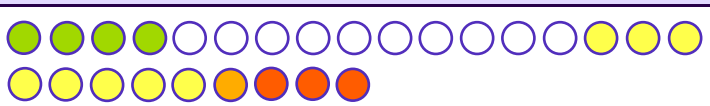
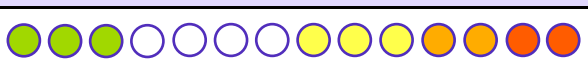
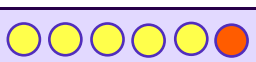
- Even within departments that are performing better overall there are pockets of poor or slow performance. For example, **BEIS's** Heat and Buildings Strategy has been delayed by almost a year, while the **Department for Transport** has not set out any plans for limiting growth in aviation demand.

- 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.

Table 2
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.

Cross-cutting priorities

Cross-cutting issues must be addressed to enable sector-specific strategies and plans to be rolled out effectively.

Several cross-cutting issues must be addressed to enable sectoral 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 carbon budgets. The inclusion of international aviation and shipping in the Sixth Carbon Budget 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, 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_2/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

The global context

Introduction

This chapter summarises global developments in tackling climate change ahead of COP26.

The 26th 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' 2ºC, 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

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 1.2ºC 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 0.25ºC per decade.‡ At this present rate of increase, human-induced warming would exceed 1.5ºC above preindustrial levels (the lowest level referred to in the Paris Agreement long-term temperature goal) by the early 2030s.

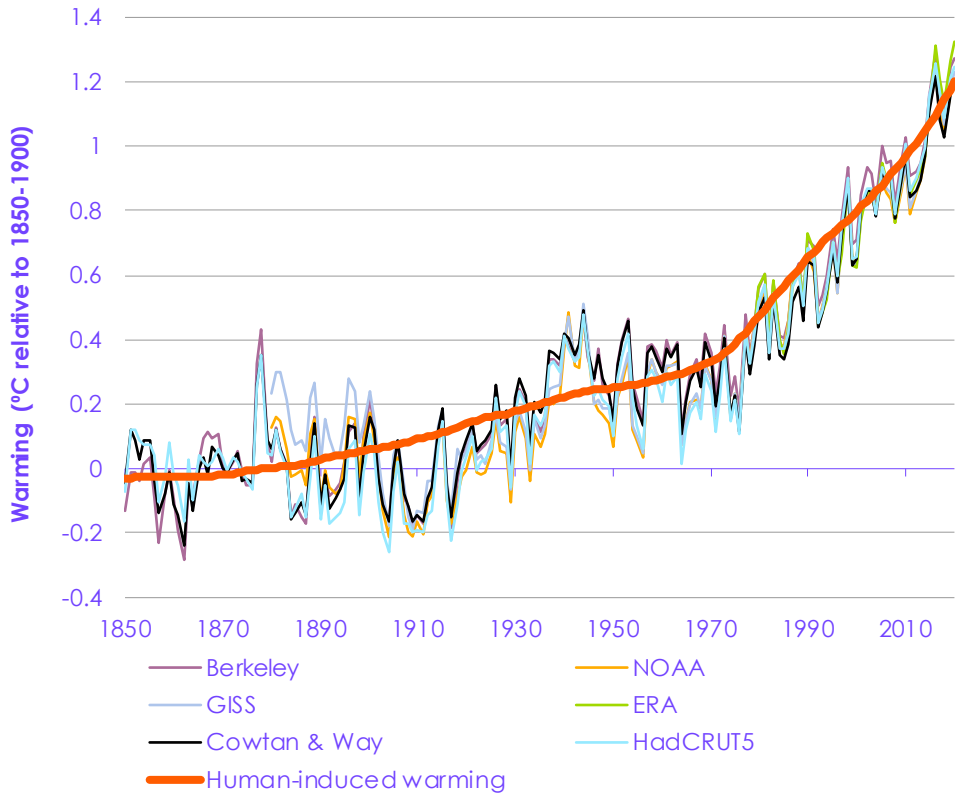
The temporary falls in global CO_2 emissions in 2020 associated with measures to address COVID-19 (section b) did not significantly affect the evolution of atmospheric carbon dioxide concentrations, global temperature or climate hazards, all of which continued to increase as they are primarily determined by cumulative global CO_2 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.

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_2 emissions from energy fell by around 6% in 2020 (relative to 2019 levels), largely resulting from the effects of measures to address COVID-19.[1] 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_2 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.

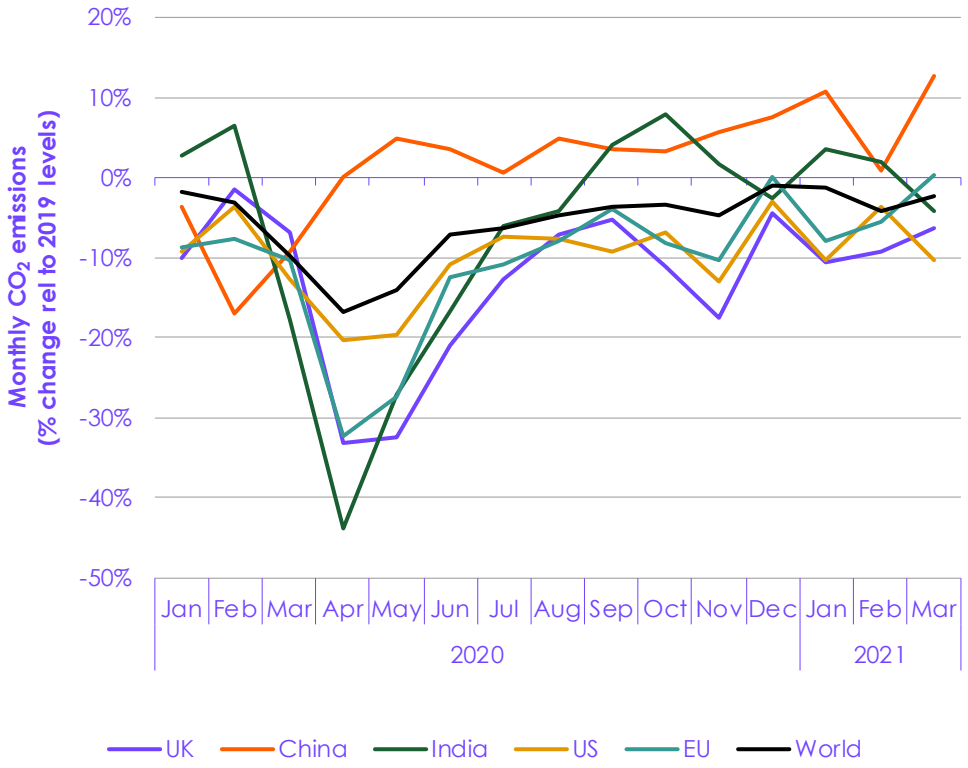
- **Greenhouse gases.** Accurate global data on GHG emissions from non-energy sectors and for other GHGs is not yet available. It is expected that there would be much more limited COVID-19-related impacts on these

emissions than energy related CO_2 emissions as the industries responsible for non-CO_2 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 supressed below 2019 levels (Figure 1.2).

Figure 1.2 Monthly CO_2 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.[2] 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: [3]

- **Global energy use** fell by 4% in 2020, with the largest and most sustained reductions occurring in advanced economies.

Fossil fuel use was more affected than energy use overall and global electricity use only declined slightly.

- **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,

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_2 emissions (~5% above 2020 levels, 1% below 2019 levels).[3] This would see annual global CO_2 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.[4] 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.[5] 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.[6]

- **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.[7]

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_2 emissions fell by around 2.5 $GtCO_2$ in 2020, with falls of around 1 – 2 $GtCO_2$ 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_2 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.[8] 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.[9] 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.[10]

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_2 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_2 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 goal 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.[11] 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.[12] Most operating facilities are in North America, supported through tax incentives and in most cases income from use of the captured CO_2 for enhanced oil

recovery. In Europe, a handful of projects based around using CO_2 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_2 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. 1.5ºC) 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_2 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_2 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_2 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).[13] Around 10-15% of global deforestation is driven by demand for agricultural and food products (e.g. beef) for export to developed countries.[14]
- **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.

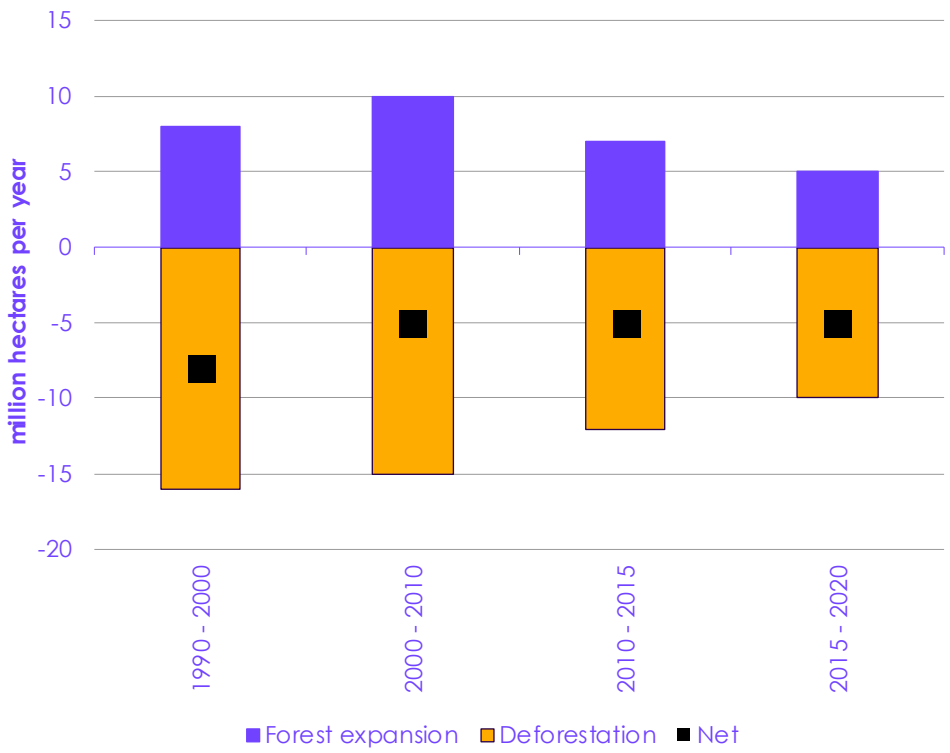
Reducing global emissions from land-use change requires a focus on ending tropical deforestation. This is because deforestation in this part of the world is primarily removing very high-carbon stock primary forest that has never been cut

* 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.[15*] 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).[16] It remains unclear whether a significant increase in ambition from China (~25% of global emissions) will be seen ahead of COP26.

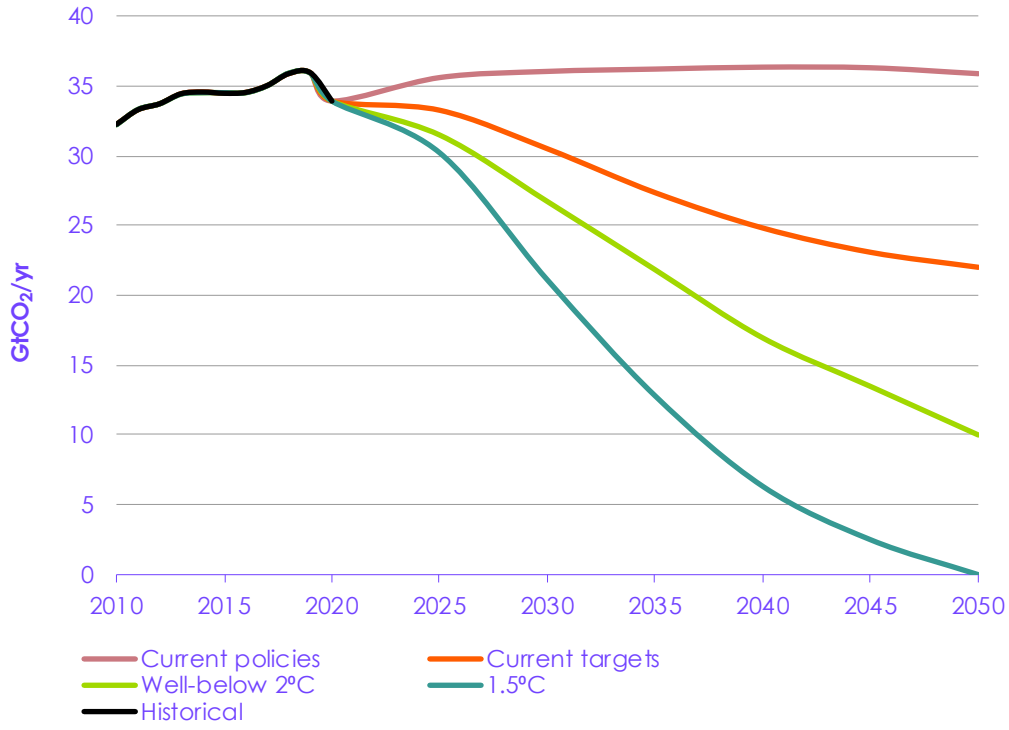
Current trajectories indicate a plateau for global emissions over the coming decade, with a significant gap to Paris Agreement consistent pathways.

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.[17]

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_2 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.[18] 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.

Better evidence bases – particularly in developing countries – will be key to improving resilience to climate risks.

- **Improving the evidence base for effective adaption.** 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.[19] 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.

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 UNFCC 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.[20] 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.

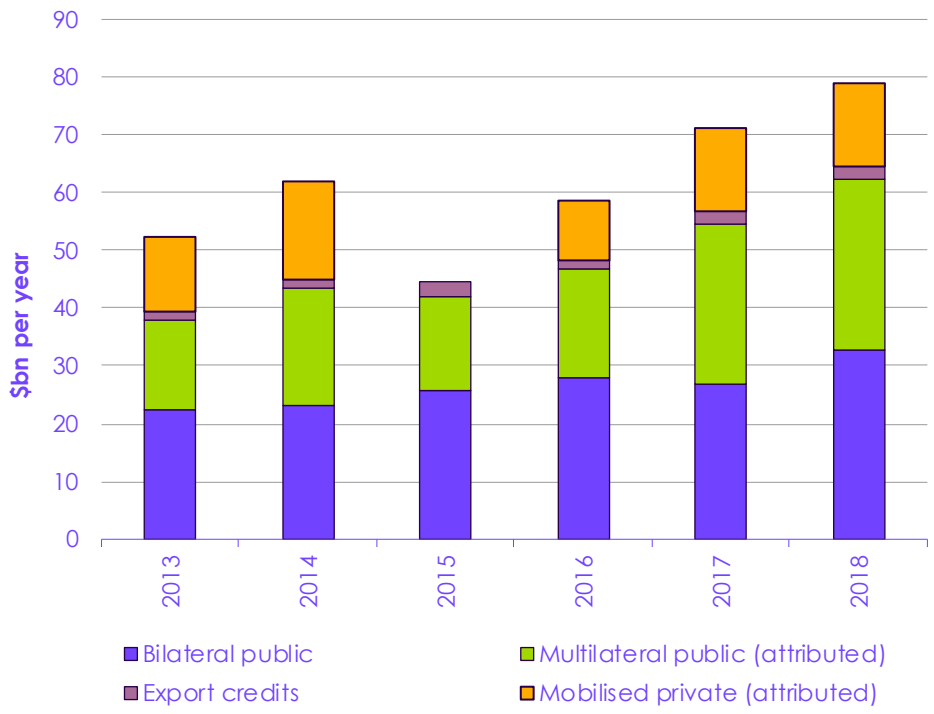
A more equal split between mitigation and adaptation climate finance is needed.

- 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.[21] 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.*

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



Source: OECD (2020) *Climate Finance Provided and Mobilised by Developed Countries in 2013-18.*
Notes: In 2015 there was no data available for mobilised private finance.

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.[22] 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

[1] IEA (2021) *Global Energy Review: CO_2 Emissions in 2020*.

[2] International Monetary Fund (2021) *World Economic Outlook (April 2021)*

[3] IEA (2021) *Global Energy Review 2021*.

[4] IRENA (2020) *10 years: Progress to Action*.

[5] IRENA (2020) *Renewable Power Generation Costs in 2019*.

[6] IEA (2020) *World Energy Outlook 2020*; Lazard (2020) *Levelized Cost of Energy and Levelized Cost of Storage*.

[7] Bloomberg New Energy Finance (2021) *Hitting the EV inflection point*.

[8] Princeton (2021) *Net Zero America*.

[9] IRENA (2021) *Renewable Capacity Statistics 2021*.

[10] IEA (2021) *Renewable Energy Market Update 2021*.

[11] Manych, N. et al. (2021) Finance-based accounting of coal emissions. *Environmental Research Letters*, 16, 044028.

[12] Global CCS Institute (2020) *Global Status of CCS Report 2020*.

[13] United Nations Food and Agriculture Organisation (2020) *Forest Resources Assessment 2020*.

[14] 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

[15] ECIU & Oxford Smith School (2021) *Taking stock: A global assessment of net zero targets*.

[16] Climate Action Tracker Initiative (2021) *Global Update: Climate Summit Momentum*.

[17] 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*.

[18] UNEP (2020) *Adaptation Gap Report*.

[19] Harrington, L. & Otto, F. (2020) Reconciling theory with the reality of African heatwaves. *Nature Climate Change*, 10, 796–798.

[20] UN Independent Expert Group on Climate Finance (2020) *Delivering on the $100 billion climate finance commitment and transforming climate finance*.

[21] IFRC, World Disasters Report 2020, 2020

[22] 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

UK emissions and drivers


1981

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 $MtCO_2e$ 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 $MtCO_2e$ in 2019.** This includes the UK's share of international aviation and shipping emissions.
- **Our greenhouse gas consumption footprint was 703 $MtCO_2e$ 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 $MtCO_2e$**, 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.

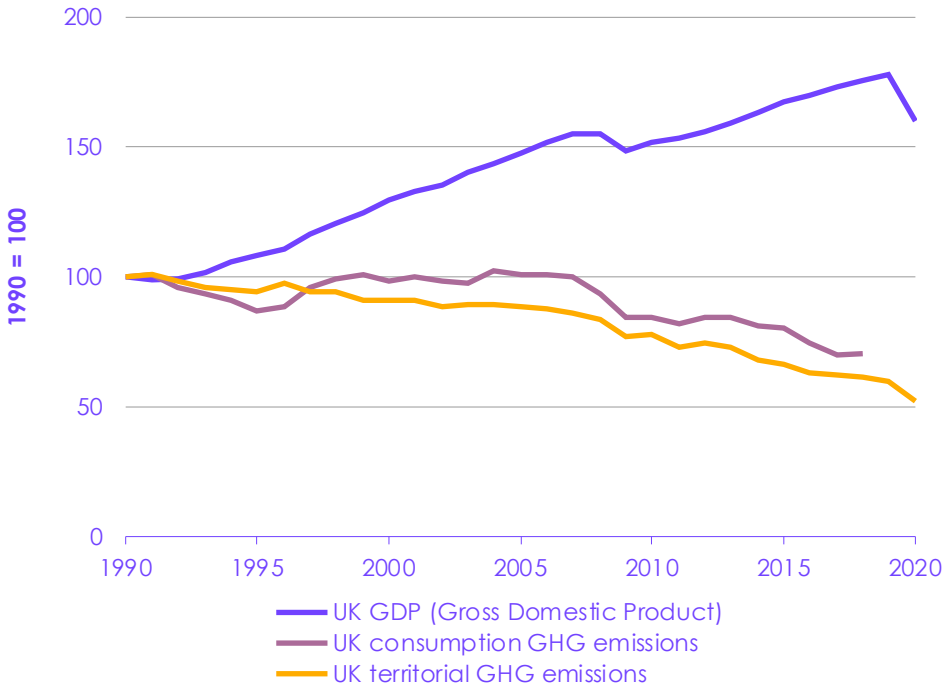
We set out our analysis in the following three sections:

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.

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 $MtCO_2e$ over the next fifteen years – compared to an average fall of just 5 $MtCO_2e$ 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_2/kWh in 2009 to 200 gCO_2/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_2 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 $MtCO_2e$ 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.

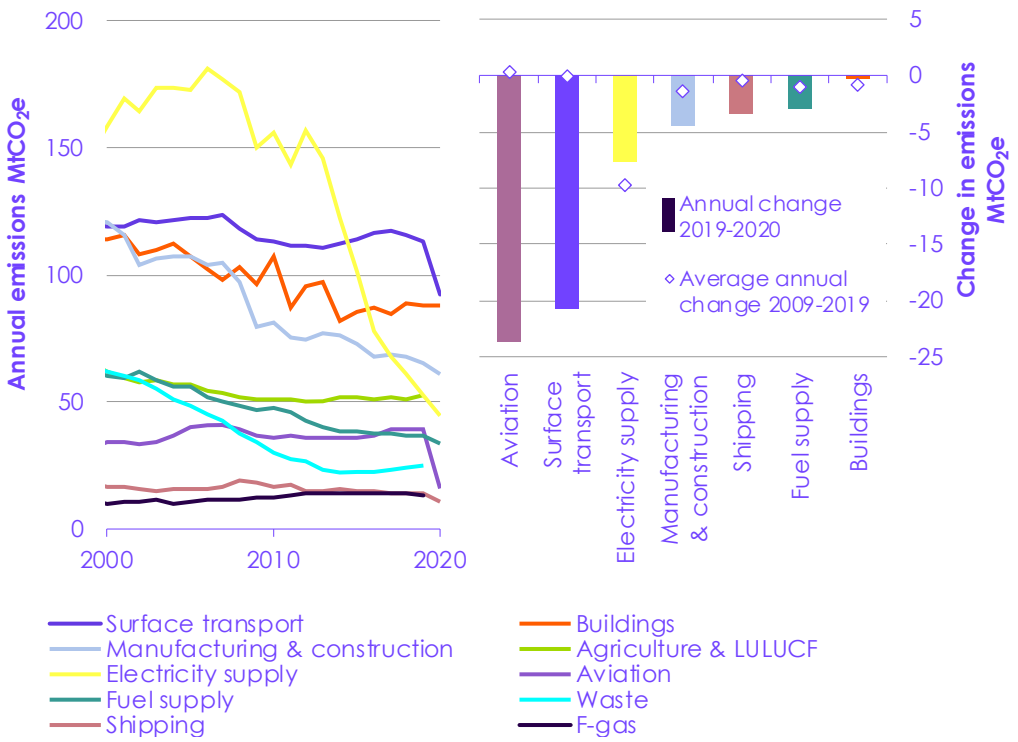
- **F-gas emissions increased, but began to fall towards the end of the 2010s** as new regulations restricting the use of the most harmful gases took effect. Emissions increased by 20% from 2009 to 2017, but fell by 7% in two years to 13.4 $MtCO_2e$ in 2019.

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.

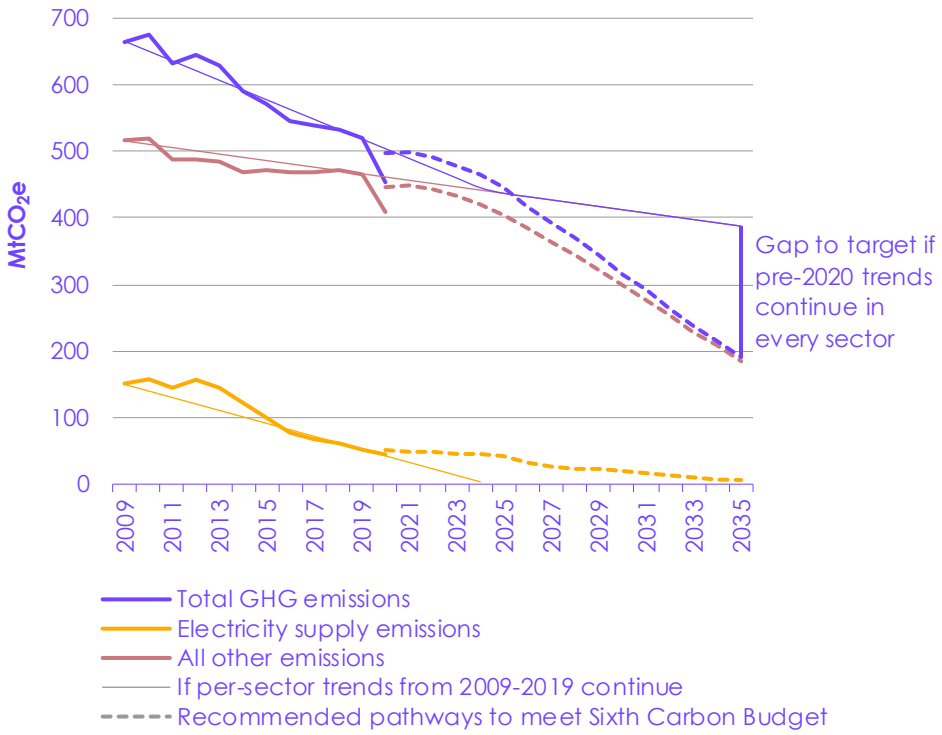
Figure 2.2 Changes in UK emissions by sector



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_2 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_2 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.

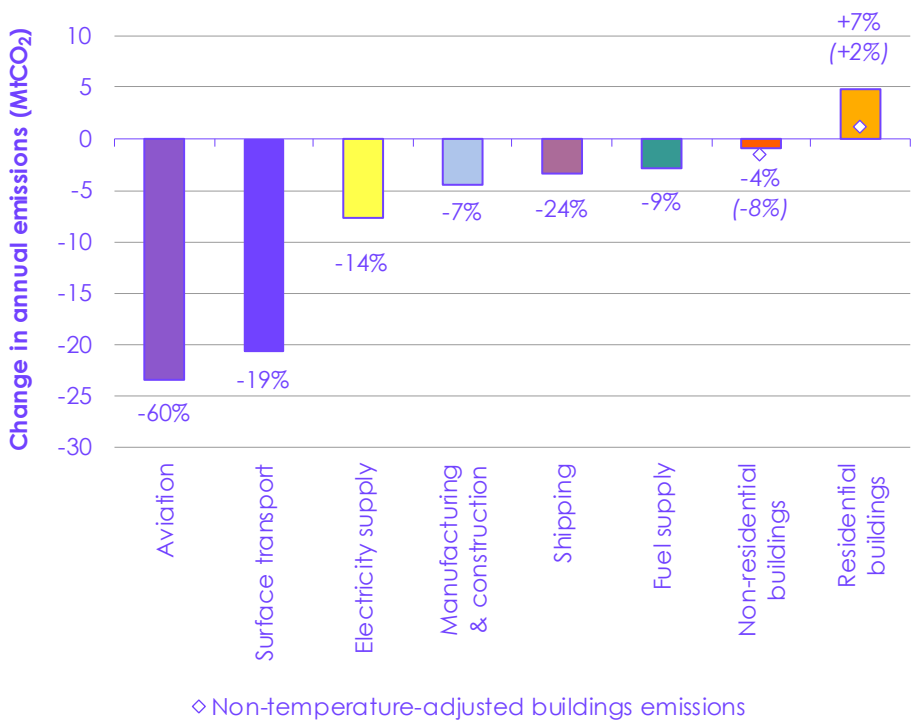
Emissions fell by 13% in 2020, almost entirely due to the impacts of lockdown measures.

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.

Figure 2.4 Change in UK CO_2 emissions 2019-2020



Source: BEIS (2021) *2020 UK Greenhouse Gas Emissions, Provisional Figures*; CCC analysis.
Notes: The bar for change in emissions from residential and non-residential buildings shows the temperature-adjusted data, which adjusts emissions for warmer average temperatures in 2020. The change in actual buildings emissions in 2020 is shown in brackets.

Estimates of all sources of emissions in 2020 are available, but some (particularly non-CO_2) 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_2 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_2 emissions from other sectors** – particularly CO_2 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_2 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.

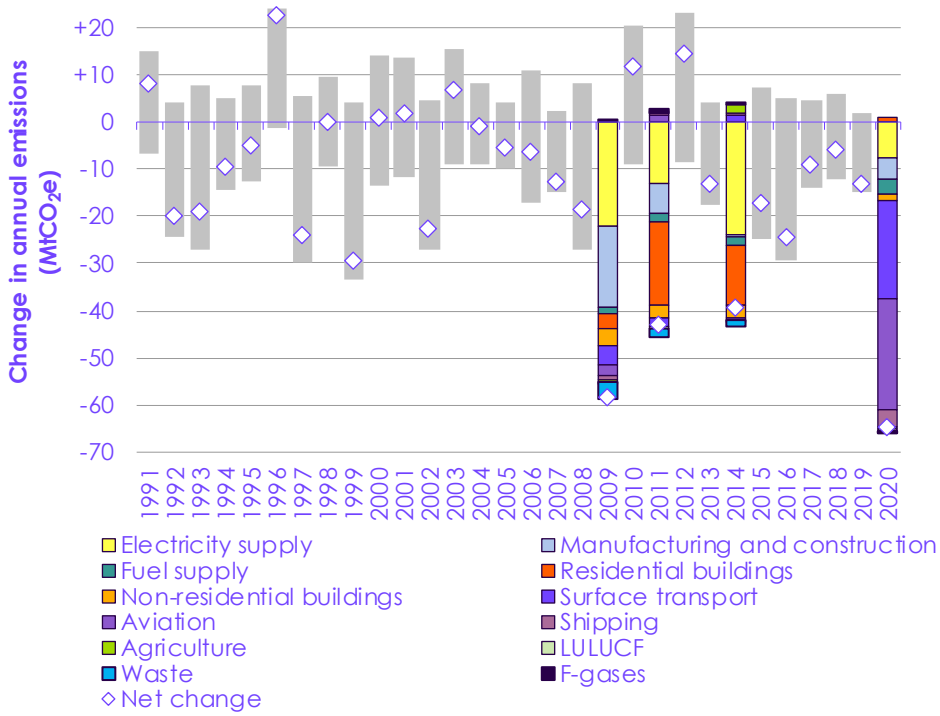
† This is a change from our approach in previous reports, where IAS emissions were held constant at the previous year's level. The pandemic means that this approach would not have produced a valid estimate of IAS emissions in 2020.

- 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.[1] There were also revisions of around -1.5 $MtCO_2e$ 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 $MtCO_2e$ 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 $MtCO_2e$ to the UK inventory in 2018 (Figure 2.6) and has turned the LULUCF sector from a net sink (of around 10 $MtCO_2e$) to a net source of GHG emissions of almost 6 $MtCO_2e$ 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_2-equivalent, or tCO_2e), and are agreed internationally. There have been multiple changes to the GWP estimates used for CH_4, N_2O and F-gases since the inception of the inventory.

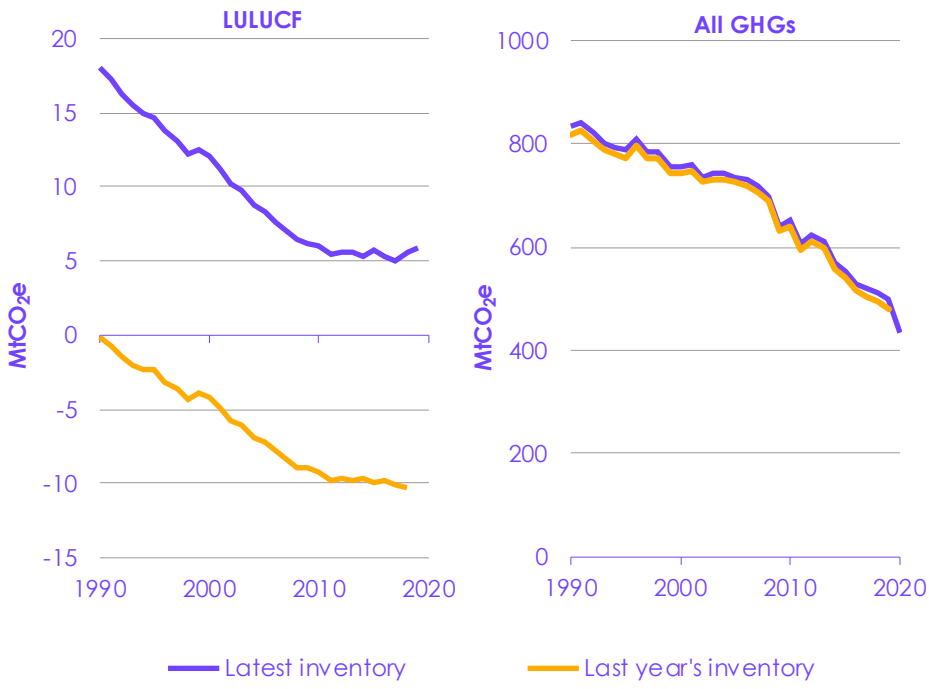
The UK inventory will update its GWPs before 2024, adding between 3 and 20 $MtCO_2e$ to the latest estimate of UK emissions, depending on the methodology that is used.* We expect further updates when available when the IPCC AR6 (Working Group 1) report is published in August 2021.

- **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 $MtCO_2e$ of annual emissions from UK peatlands have now been included in the scope of the inventory. This change was expected.

Figure 2.6 Changes to the UK greenhouse gas inventory



Source: BEIS (2021) *Provisional UK greenhouse gas emissions national statistics 2020*; CCC analysis.
Notes: LULUCF = Land use, land-use change and forestry.

* 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.

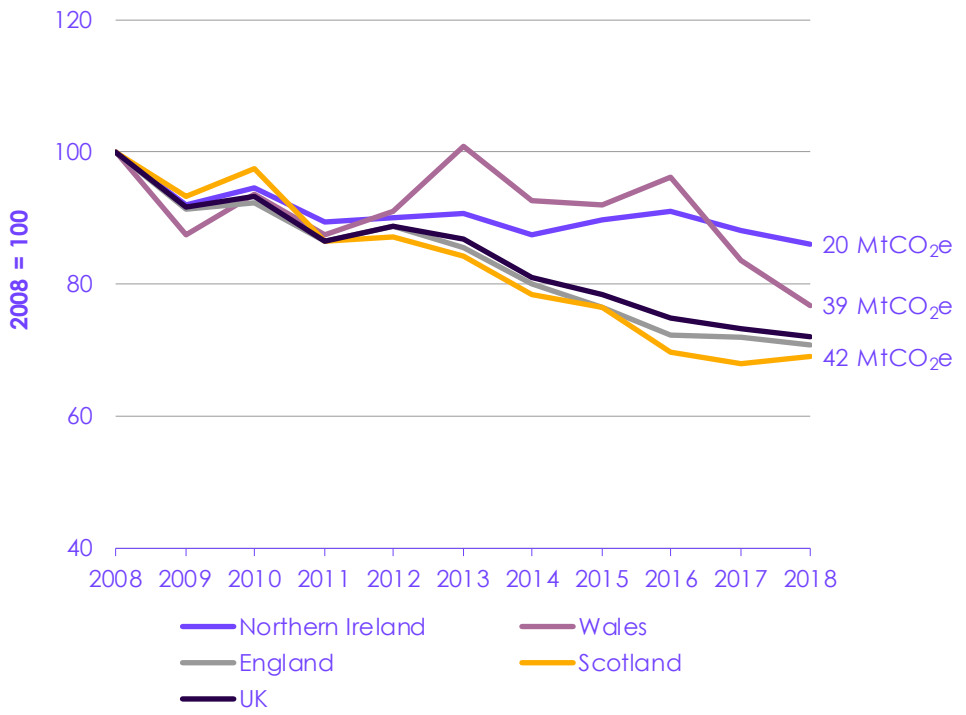
Emissions data for Scotland, Wales and Northern Ireland lags the UK data by more than a year.

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.

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,[2] many can continue to do so effectively[3] and many employers are already adapting to this new reality.[4]
  - **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.[5]
  - **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,[6] 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 supressed 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.[7] 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.[8] 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.[9] 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%	Passenger numbers 78% lower in August 2020 compared to 2019.[9] Travel restrictions and concerns around safety likely to result in lower passenger numbers compared to pre-pandemic levels over the next year.[10]	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.[11,12] Leisure travel may also be impacted – survey data suggest some people intend to fly less than they did before the pandemic.[13] The size of the aviation sector that will emerge post-pandemic is still unclear.
Shipping	0%	-2%	-24%	9% drop in global maritime trade in 2020 and comparable fall in tonnes of goods traded in the UK.[14,15] Lower trade than pre-pandemic levels expected in 2021.[16]	Rebound likely – though economic scarring could have permanent reduction in shipping volume in some sectors.

Surface transport	-5%	-2%	-18%	Demand for travel dropped considerably across all transport modes except walking and cycling during periods of national lockdown. Demand rebounded during the period between lockdowns, but the extent of this varied across modes, with car demand recovering more quickly. Public transport use remains far below pre-pandemic levels, with safety concerns remaining for many.[17] Record falls in new car purchases.	Substantial uncertainty around how the impact of COVID-19 will influence the transport system in the longer term. 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.[18] Increases in walking and cycling could last, especially if support for necessary infrastructure is maintained and enhanced. Reduced use of public transport may endure – 32% of people said they will reduce use compared to before the pandemic.[19]
Residential buildings	-3%	-1%*	+7%*	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.[20]	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.
Non-residential buildings	-3%	-1%*	-4%*		
Electricity supply	-6%	-14%	-15%	Reduction in non-domestic electricity use resulting in a 4.7% drop in total consumption in 2020, with domestic energy consumption up by 2%.[21]	Possible changes in profile of electricity demand, depending on extent of structural shifts such as more flexible working patterns.
Fuel supply	-5%	-1%	-8%	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. Global oil and gas demand partially recovered since the beginning of the pandemic. Prices are close to pre-pandemic levels.[22]	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[23] and others suggesting peak oil will be reached earlier than previously expected.[24]
Manufacturing & construction	-5%	-3%	-7%	Short-term fall due to national lockdowns, manufacturing revenues temporarily fell to 65-70% of pre-COVID level, and largely recovered.	Rebound likely – though economic scarring could have permanent reduction on emissions in some sectors.

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 $MtCO_2e$.

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 $MtCO_2e$.

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.[25] 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.[26] 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,[27] 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.[28]

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 $MtCO_2e$. 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.[29]

Provisional 2020 data show that total freight shipped through the UK's major ports fell by 10% in 2020,[30] largely due to the impacts of the COVID-19 pandemic:

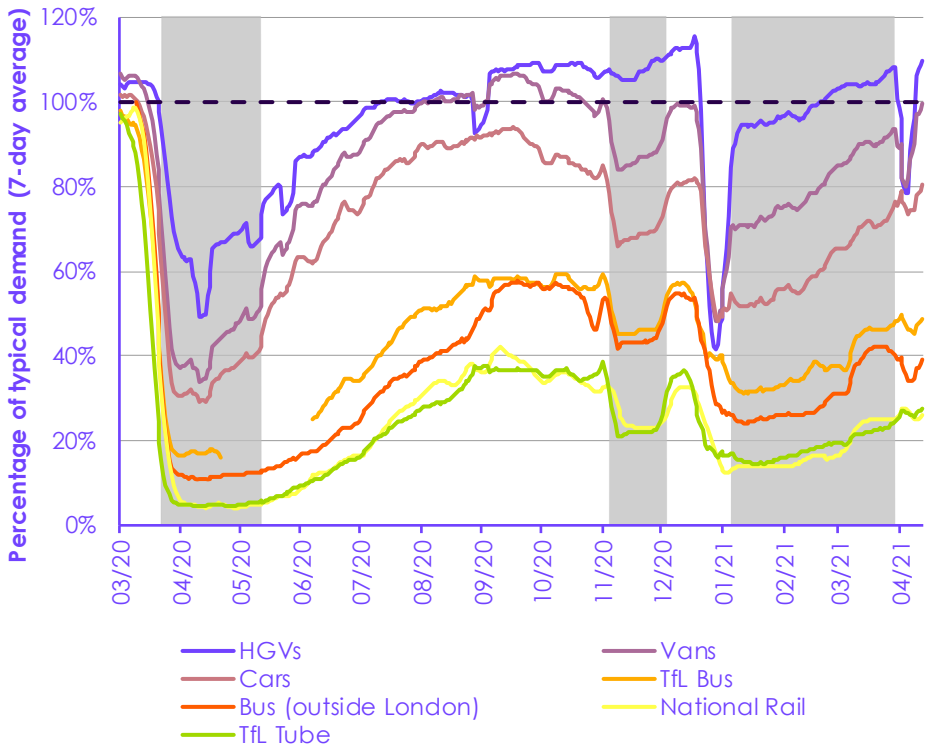
- This effect was particularly pronounced in Quarter 2 of 2020, when freight volumes were 18% lower than normal.
- We expect the impacts to continue to be felt in 2021 as the UK comes out of lockdown, but volumes are expected to return to normal levels of demand by 2022. However, the long-term impacts 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.[31]

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.

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.

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.

- **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 remains much lower than pre-pandemic levels.

- **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,[32] 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.

New car sales have fallen to the lowest level since 1992.

- Total **new car sales** in 2020 fell by 30% in 2020 to 1.6 million, the lowest level since 1992.[33] Sales in the second-hand market fell by 15%.[34] However, the car market began to rebound during late-2020 and evidence[35] 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).

- Overall, recent research[36] 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 COVD-19 pandemic.

- Before the pandemic, around 5% of people in employment worked mainly from home, while a further 12% did so occasionally.[37] 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.[38]
    - 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.[39,40]
    - 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%.[41]
- A recent study[42] 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 $MtCO_2e$ 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 $MtCO_2e$/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 [43] 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 [44] 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 $MtCO_2e$ – 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, [45] 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. [46] 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. [47, 48]

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.[49] 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%.[50] This was a driving force for lower production of petroleum products in the UK, which was down by 17%.[51]

  - 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.[52]

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.

  - Assessments of the long-term impacts of COVID-19 on oil and gas markets vary,[53] but it is expected that demand could potentially return to 2019 levels as early as 2021-22.[54] 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).

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.

The electricity system was tested under large changes in demand and high levels of variable renewables on the grid.

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.[55]

Support for climate action remains high.

- **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.[56]

There is a renewed focus on inequalities. The need for a just transition is arguably greater than ever.

- **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[57] and were higher in both Black and South Asian ethnic groups than the national average.[58] 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.[59] 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 that 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.[60] The most pronounced changes in UK air quality during lockdown were in the urban environment, notably for nitrogen oxides (NO_x) as emissions from vehicles fell. Urban NO_x 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 ($PM_{2.5}$) concentrations increased but this was largely due to weather effects, and urban ozone (O_3) concentrations increased due to secondary air chemistry effects caused by the fall in nitric oxide (NO) emissions.[61]

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.[62] 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.

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%,[63] 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.‡

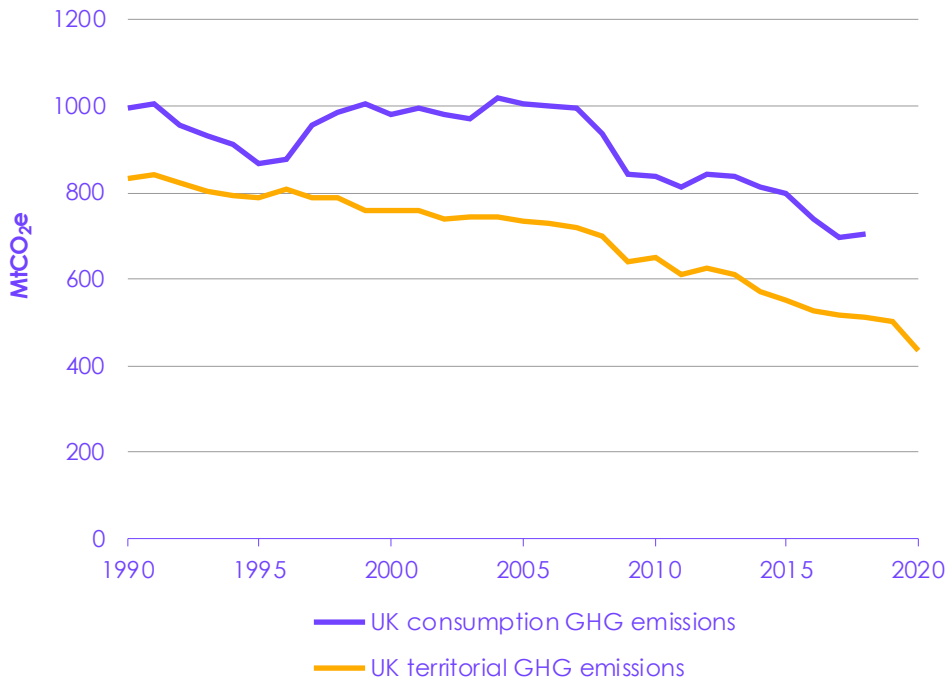
As consumption emissions accounts are generally more variable year-to-year than territorial emissions accounts, looking at the trend over several years is likely to be a more representative picture of underlying trends than year-to-year changes.

* 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.[64]

Changing trade patterns present both a risk and opportunity for the UK's consumption emissions and support of global decarbonisation efforts.

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.

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

[1] 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.

[2] YouGov (2020) *YouGov - Working from home*. Fieldwork: 2nd - 6th September 2020

[3] YouGov for Microsoft and CIPD (2020) *Work Smarter to Live Better*.

[4] CIPD (2020) *Embedding new ways of working post-pandemic*

[5] Department for Transport and CAA (2020) *Purpose of travel at selected UK airports*.

[6] Department for Transport (2019) *National travel survey*.

[7] YouGov (2021) *Business Flights Survey Sample: 14th December 2020 - 20th January 2021*.

[8] Department for Transport (2021), *National travel attitudes study: wave 4 (final)*.

[9] CAA (2021) *Air Passengers by Type and Nationality of Operator*.

[10] Department for Transport (2019) *National travel survey*.

[11] IATA (2020) *Air Passenger Market Analysis*.

[12] IATA (2021) *Outlook for the global airline industry – April 2021 update*.

[13] CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change*.

[14] Department for Transport (2020) *Port freight quarterly statistics: July to September 2020*.

[15] WTO Secretariat (2020) *Trade statistics and outlook: Trade shows signs of rebound from COVID-19, recovery still uncertain*.

[16] WTO Secretariat (2020) *Trade statistics and outlook: Trade shows signs of rebound from COVID-19, recovery still uncertain*.

[17] Department for Transport (2021) *Transport use during the coronavirus (COVID-19) pandemic*.

[18] 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.

[19] Transport Focus (2021) *Travel during COVID-19 attitudes to travel post-lockdown*.

[20] CCC analysis; BEIS (2021) *Provisional UK greenhouse gas emissions national statistics 2020*.

[21] BEIS (2021) *Energy Trends: UK electricity*.

[22] Reuters (2021) *Total back to pre-pandemic profit levels as oil prices rise*.

[23] McKinsey & Company (2021) *Global oil supply-and-demand outlook to 2040*.

[24] Reuters (2021) *Pandemic brings forward predictions for peak oil demand*.

[25] CAA (2021) *Air Passengers by Type and Nationality of Operator*.

[26] IATA (2020) *Air Passenger Market Analysis*.

[27] IATA (2021) *Outlook for the global airline industry – April 2021 update*.

[28] CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change*.

[29] WTO Secretariat (2020) *Trade statistics and outlook: Trade shows signs of rebound from COVID-19, recovery still uncertain.*

[30] Department for Transport (2021) *Port freight statistics, Table 0502.*

[31] CREDS (2021) *At a crossroads – travel adaptions during Covid-19 restrictions and where next?*

[32] Transport Focus (2021), *Travel during COVID-19 attitudes to travel post-lockdown.*

[33] SMMT (2021) *UK automotive looks to green recovery strategy after -29.4% fall in new car registrations in 2020.*

[34] SMMT (2021) *Used car sales: Q4 2020.*

[35] McKinsey & Company (2020), *How consumers' behaviour in car buying and mobility is changing amid COVID-19.*

[36] ONS (2020) *Coronavirus and homeworking in the UK labour market: 2019*

[37] ONS (2020) *Coronavirus and homeworking in the UK labour market: 2019.*

[38] ONS (2021) *Social behaviours during the different lockdown periods of the coronavirus (COVID-19) pandemic dataset.*

[39] ONS (2020) *Coronavirus and homeworking in the UK labour market: 2019.*

[40] ONS (2020) *Coronavirus and homeworking in the UK: April 2020.*

[41] ONS (2020) *Coronavirus and homeworking in the UK: April 2020.*

[42] CREDS (2021) *At a crossroads – travel adaptions during Covid-19 restrictions and where next?*

[43] IEA (2020) *Working from home can save energy and reduce emissions. But how much?*

[44] 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.

[45] Data suggests office occupancy was down more than 85% for half of the year. Metrikus (2021) *Metrikus Occupancy Index.* https://index.metrikus.io/

[46] 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/

[47] 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

[48] 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.

[49] ONS (2020) *The impact of the coronavirus so far: the industries that struggled or recovered.*

[50] US Energy Information Administration (2021) *Short-Term Energy Outlook (STEO) supplement: Developments in Global Oil Consumption.*

[51] BEIS (2021) *Energy Trends: March 2021.*

[52] BEIS (2021) *Energy Trends: March 2021: Natural gas imports and exports (ET 4.3 - monthly).*

[53] Reuters (2021) *Pandemic brings forward predictions for peak oil demand.*

[54] McKinsey & Company (2021) *Global oil supply-and-demand outlook to 2040.*

[55] CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change.*

[56] CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change.*

[57] Public Health England (2020) *Disparities in the risk and outcomes of COVID-19.*

[58] ONS (2020) *Updating ethnic contrasts in deaths involving the coronavirus (COVID-19), England and Wales: deaths occurring 2 March to 28 July 2020.*

[59] IFS (2020) *Sector shutdowns during the coronavirus crisis: which workers are most exposed?*

[60] AQEG (2020) *Impacts of Net Zero pathways on future air quality in the UK.*

[61] AQEG (2020) *Estimation of changes in air pollution emissions, concentrations and exposure during the COVID-19 outbreak in the UK.*

[62] N. Chater for CCC (2020) *Net Zero after Covid: Behavioural Principles for Building Back Better.*

[63] Defra (2021) *UK's Carbon Footprint 1997 – 2018.*

[64] EcoAct (2020) *The 10th Annual Sustainability Reporting Performance of the FTSE 100.*

Chapter 3

Underlying progress and enablers of progress

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 supressed 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.[1] 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

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.

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.[2] 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[3,4] 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[5] 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.

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.

- 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.[6] 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.

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 Climate Assembly UK was an important start in engaging the public more in climate policy decisions.

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.[7] 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.

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.[8] 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.[9] 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.[10]

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.

- 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.

HM Treasury's Net Zero Review final report is now two years in the making and has many questions still to answer.

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.

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,[11] and the International Energy Agency's Roadmap for the Global Energy Sector results in 14 million jobs created globally by 2030.[12] But the shift in jobs from some areas to others brings a significant transition risk.

A strategy is needed to ensure a just transition for workers.

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.[13] 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.[14] 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.[15]

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.[16]
  - 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.[17]
  - Nearly one in three FTSE100 companies have signed up to the UN's Race to Zero campaign.[18] 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).[19] 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.[20]

- 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_2 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.*

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 $MtCO_2e$, 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.

Government needs to invest in attractive alternatives to car travel, to reduce the use of high-carbon transport.

- 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.

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

		Latest Indicator			Milestones in the CCC pathway				
Metric		**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_2 emissions (gCO_2/km)	2020	-12%	113.0	51.4	3.3	0.0	0.0	
	New van CO_2 emissions (gCO_2/km)	2020	-2%	163.0	74.7	0.1	0.0	0.0	
	HGV emissions intensity (gCO_2/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	

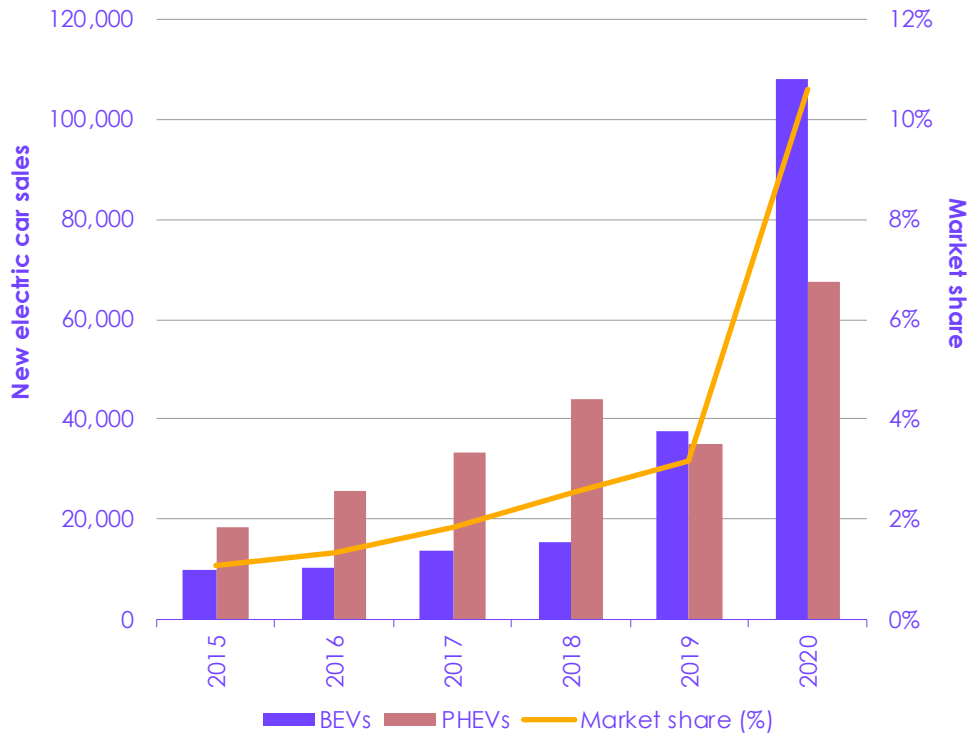
Source: DfT, SMMT and HMRC (2021); CCC analysis
Notes: 1. New car CO_2 figures are calculated on an NEDC test-cycle basis, to enable comparison with previous years. 2. While indicators that are calculated using travel demand (car-km per driver, car distance driven, van distance driven and HGV distance 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.[21] Research shows that battery prices have fallen by 13% from 2019 to 2020[22], and popular EV manufacturers[23] have been reducing prices in 2021.
  - Evidence[24] 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

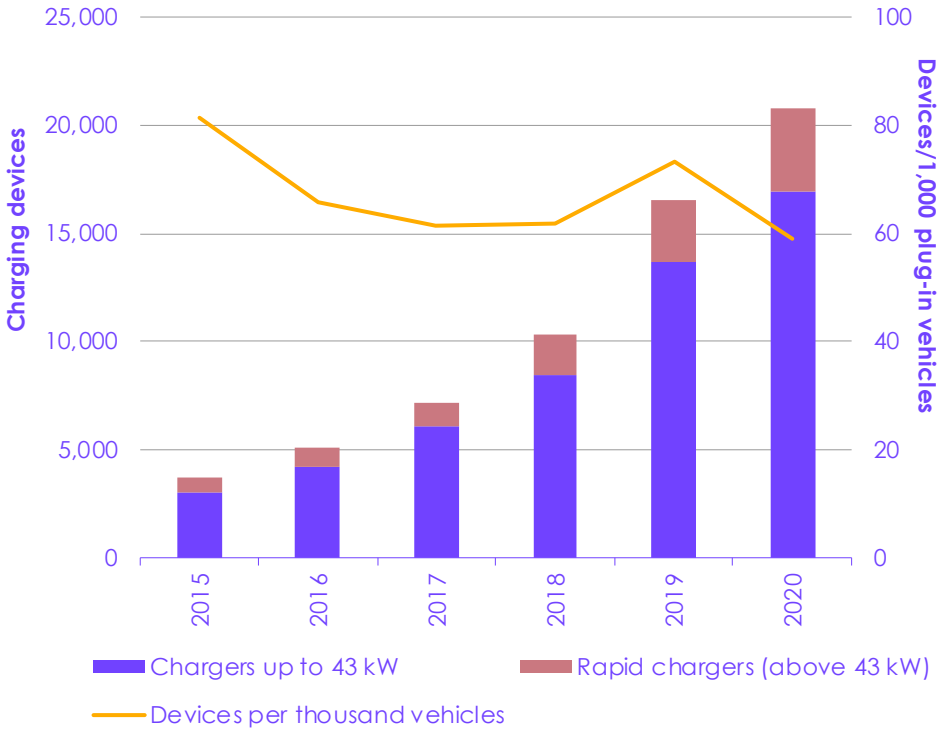


Source: DfT (2021); CCC analysis
Notes: Market share, shown on the right-hand axis, represents the combined sales of BEVs and PHEVs as a proportion of all new car sales in the given year.

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.[25] 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.

Figure 3.2 Total publicly accessible charging devices installed across the UK, and ratio of devices to the number of plug-in vehicles



Source: DfT, OZEV and ZapMap (2021); CCC analysis.
Notes: Includes all publicly accessible charge points across the UK at the end of October in the given year. The ratio, displayed on the right-hand axis, is over all plug-in vehicles operating at the end of Q3 in the given year.

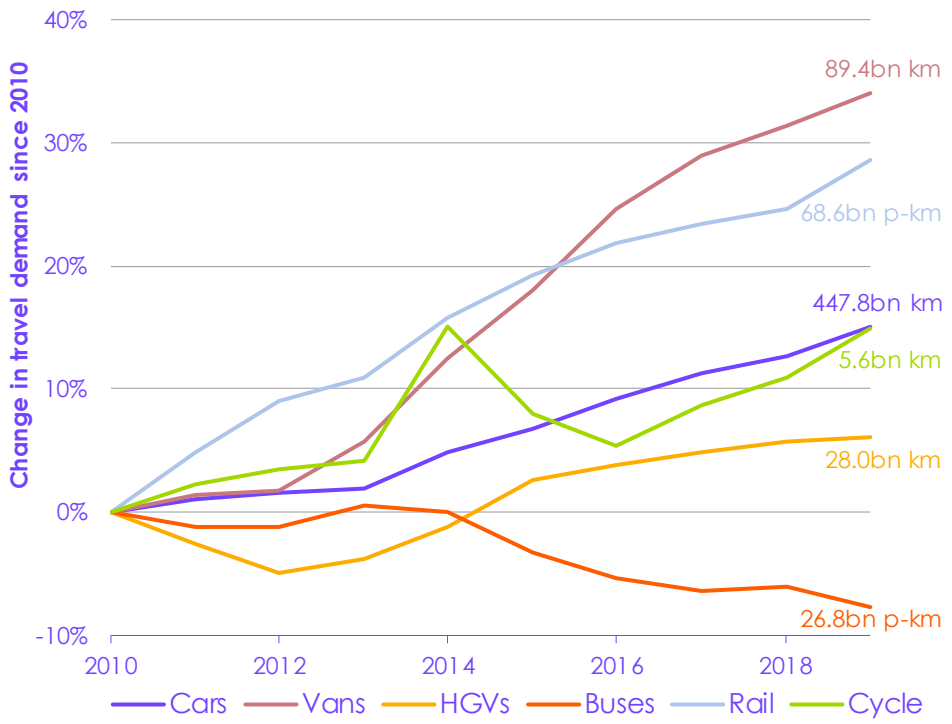
New car CO_2 intensities have risen in recent years, driven by the high proportion of large SUVs purchased.

- Between 2007 and 2016, the average CO_2 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%[26], 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[27]) 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.[28] A recent study[29] 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 MtCO2 of emissions in 2017.
  - From 2021 to 2022, rail fares will increase by the Retail Price Index (RPI) plus 1%, a 2.6% rise.[30] In contrast, the long-haul rates of Air Passenger Duty will increase in line with RPI and short-haul rates will not rise.[31]

Figure 3.3 Changes in travel demand by mode since 2010



Source: DfT, ORR (2021); CCC analysis.
Notes: The chart shows the percentage change in the number of kilometres travelled by each type of transport (total kilometres driven for cars, vans, HGVs, and cycles; total passenger-kilometres for buses and rail) in each year, compared to levels in 2010. The data labels show the absolute levels of demand for each mode in 2019.

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 $MtCO_2e$, 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).[32]

Table 3.2
Key metrics for buildings in the CCC Pathway to meet the Sixth Carbon Budget

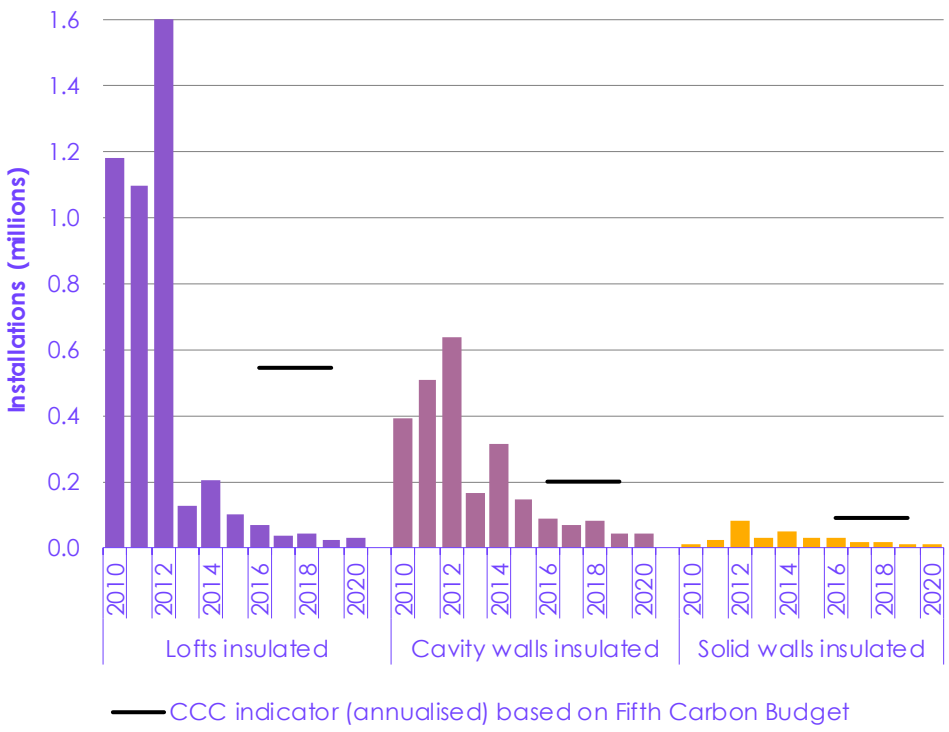
	Latest Indicator			Milestones in the CCC pathway				
Metric	**Year**	**Annual change**	**Value**	**2025**	**2030**	**2035**	**2050**	**Trend**
Heat pump installations (thousand per year)	2020	9%	36	415	1,075	1,435	1,525	
Lofts insulated (thousand per year)	2020	26%	32	710	675	200	0	
Cavity walls insulated (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).

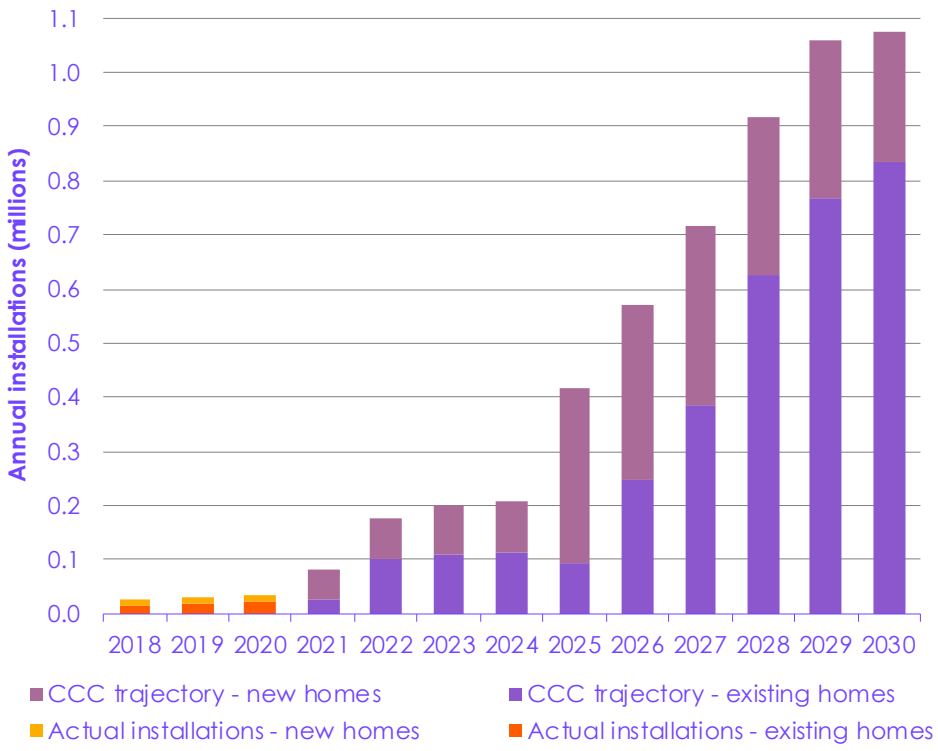
Figure 3.4 Home insulation rates by measure and year



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 $MtCO_2e$, 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.

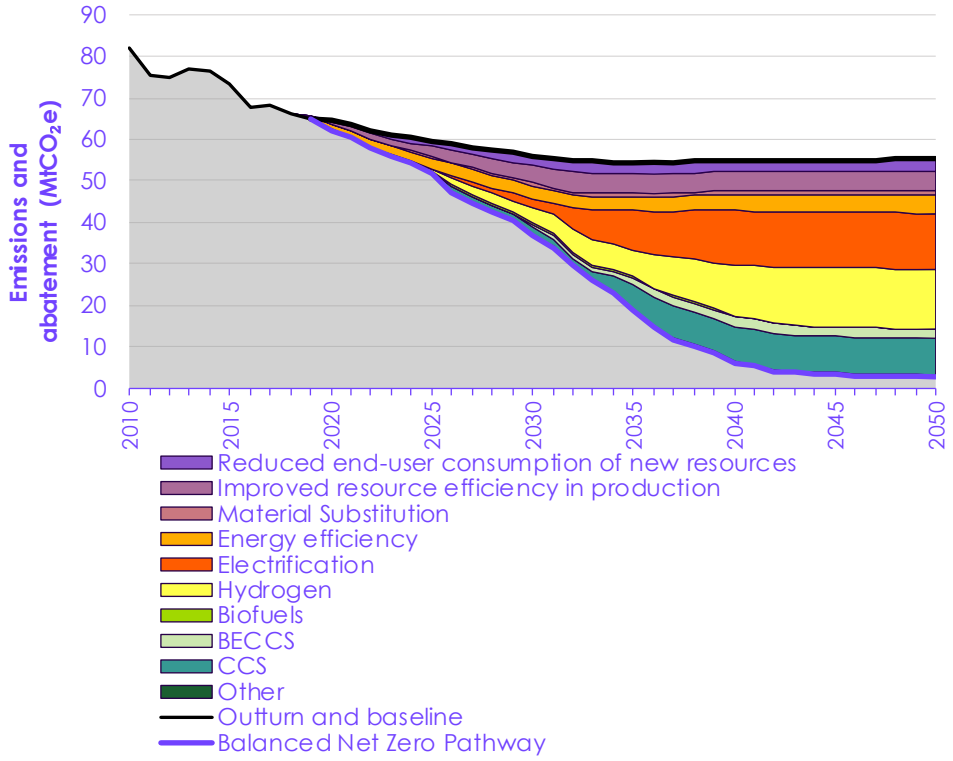
The path to Net Zero set out in our advice on the Sixth Carbon Budget sees emissions from manufacturing and construction reduce by 43% by 2030 and 71% by 2035 from 2018 levels, through improved resource and energy efficiency, material substitution, fuel switching and CCS, as set out in Table 3.3 and 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

		Latest indicator			Milestones in the CCC pathway				
Metric		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 ($MtCO_2$)	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[33] in industry have led to abatement of at least 1.1 $MtCO_2e$ in 2019, up from 0.9 $MtCO_2e$ in 2018, according to BEIS Energy and Emissions Projections.[34]

- 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_2e/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).

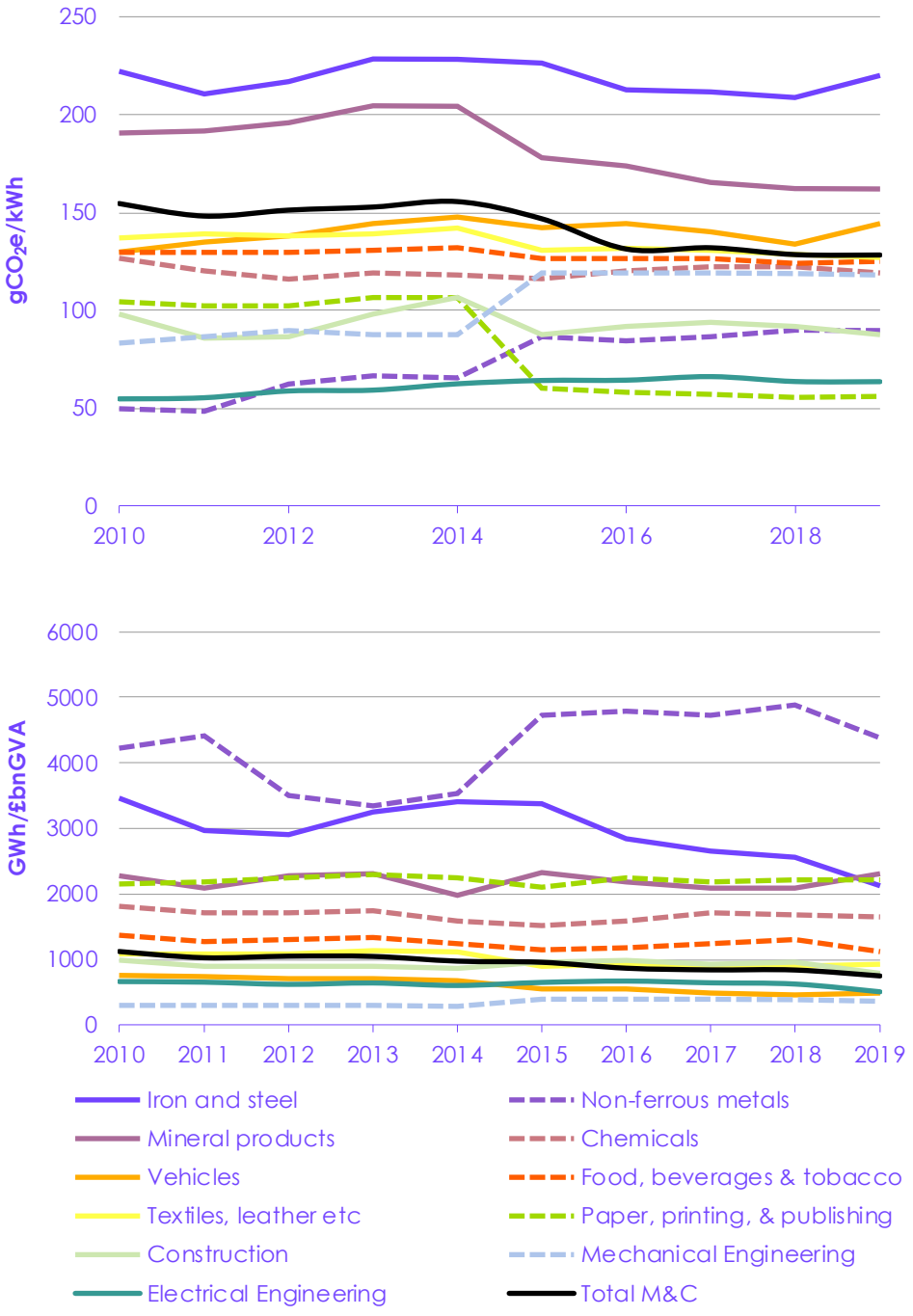
- Fuel-switching pilots, such as a commercial-scale biodiesel trial for glass manufacturing, have begun under the Government's Industrial Fuel Switching competition, with the intention of assessing the merits of different low-carbon fuels. CCS pilots are supported under the Carbon Capture and Utilisation 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 $MtCO_2e$ of emissions abatement in 2019, up from 1.7 $MtCO_2e$ in 2018.[35] This abatement is largely due to uptake of bioenergy supported by the Renewable Heat Incentive.[36]

- 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 $MtCO_2e$, 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_2 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

		Latest Indicator			Milestones in the CCC pathway				
Metric		**Year**	**Annual change**	**Value**	**2025**	**2030**	**2035**	**2050**	**Trend**
Agriculture and land use - GHG emissions	Agriculture ($MtCO_2e$)	2019	+1%	55.4	48.6	41.5	39.3	34.9	
	Land use, forestry and peat sector[1] ($MtCO_2e$)	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[2] (million)	2019	-1%	48	46	41	39	35	
Demand reduction	Weekly meat consumption[3] (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)[4]	2018	0	10	6	27	30	30	
	Peat area restored (000 hectares/year)[5]	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),[37] 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,[38] 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.

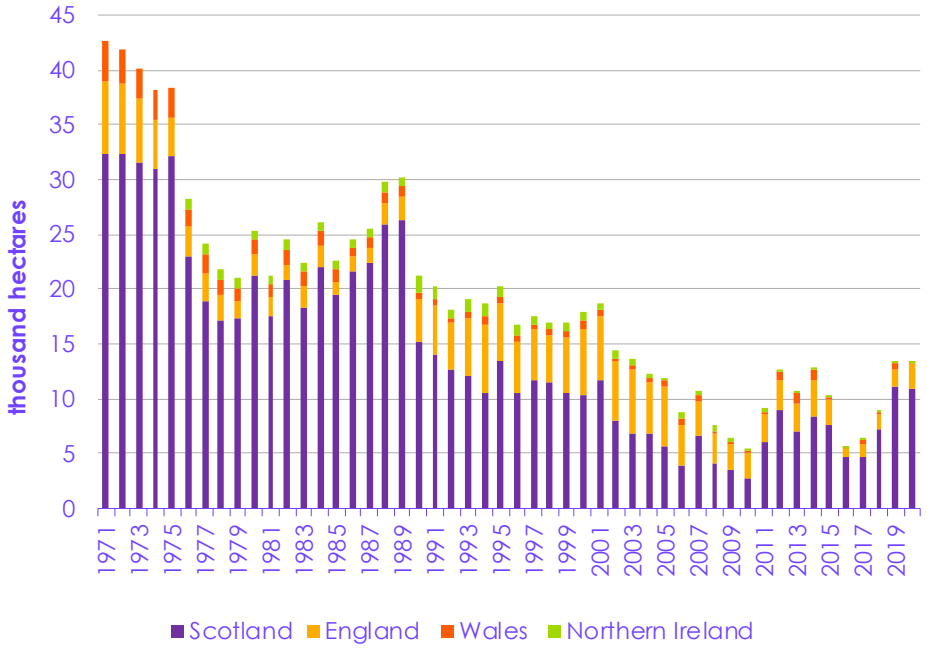
- Official data show that consumption of meat and meat products rose 3% between 2015/16 and 2018/19.[39] There has been a reduction in fresh meat products, but this is more than offset by a rise in processed meat. More recent survey data suggests an increased willingness to eat less meat in the future, 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.[40]

- 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.

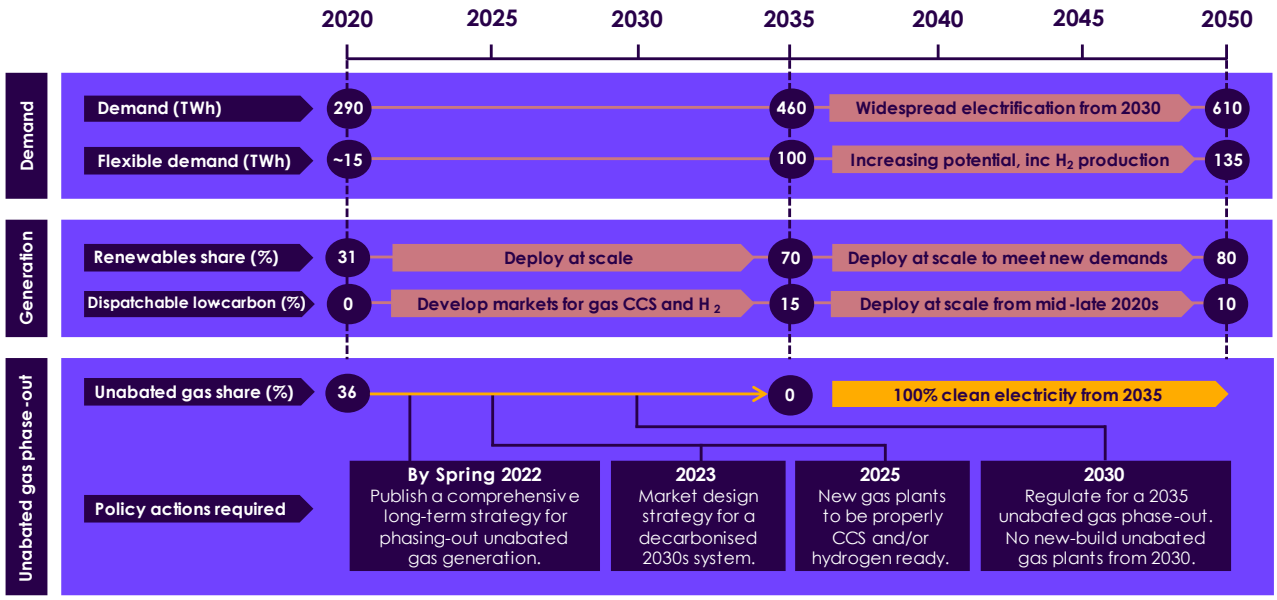
To allow the Committee to track progress against the Sixth Carbon Budget Pathway, we will be developing a comprehensive indicator framework for the agriculture and land use sectors to be included in next year's Progress Report. Key indicators that we will be developing include: agricultural emissions 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 $MtCO_2e$, 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_2/kWh. This needs to continue to fall substantially over the 2020s, to less than 50 gCO_2/kWh in 2030 and around 10 gCO_2/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

	Latest Indicator			Milestones in the CCC pathway				
Metric	**Year**	**Annual change**	**Value**	**2025**	**2030**	**2035**	**2050**	**Trend**
Grid intensity (gCO_2/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) *Energy Trends*.
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 $MtCO_2e$, 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.

Improvements in flight efficiency must be sustained to meet the Sixth Carbon Budget.

- 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

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

		Latest indicator			Milestones in the CCC pathway				
Metric		**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_2 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_2/passenger.

g) Fuel supply (37 $MtCO_2e$, 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 (%)[1]	2019	1% point fall	-1%	-22%	-54%	-77%	-97%	
	Fall in emissions from 2018 levels - oil and gas production and processing (%)[2]	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 $MtCO_2e$ in 1990 to less than 1 $MtCO_2e$ 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 $MtCO_2e$ of abatement required in our analysis by 2030, particularly in the context of possible network decommissioning due to reduced use of natural gas.

Emissions reductions in fossil fuel supply will need to increase rapidly to align to UK targets

- **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 $MtCO_2e$ 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.

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 $MtCO_2e$, 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 (%)[1]	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 (%)[2]	2019	-1% point	55	60	64	68	80	
Energy from Waste	Energy from Waste Emissions ($MtCO_2e$)	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'† 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.[41]

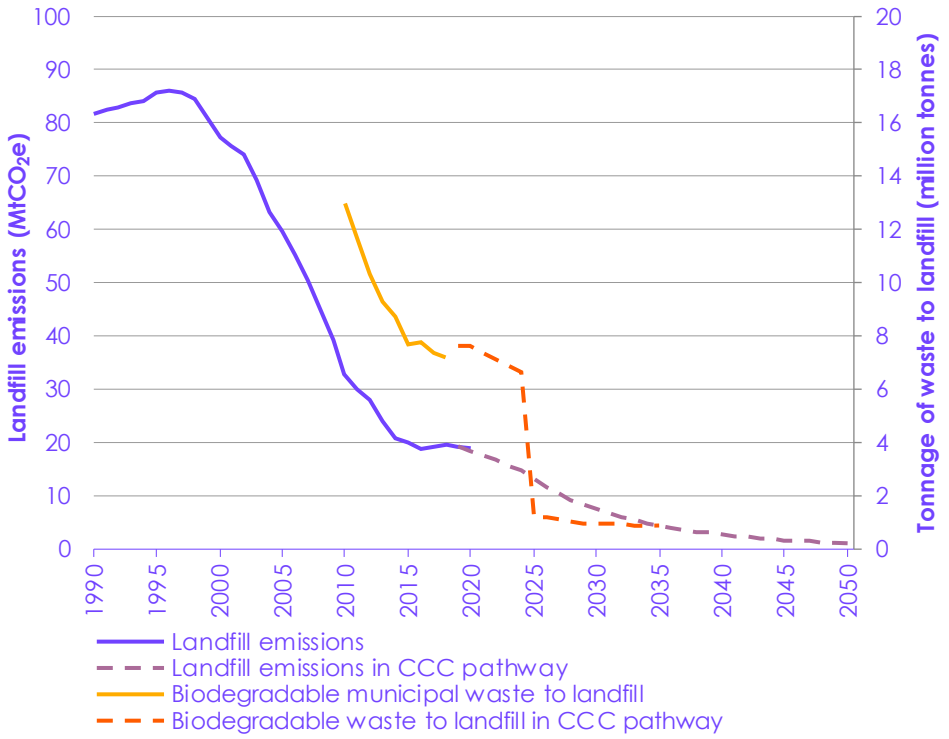
- In 2019, the latest year for which emissions data is available, emissions from EfW increased by over 10% on 2018, putting it on course to overtake emissions from coal power in 2020.
- If EfW usage continues to rise unchecked, then its emissions will exceed the CCC pathway while potentially undermining 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.

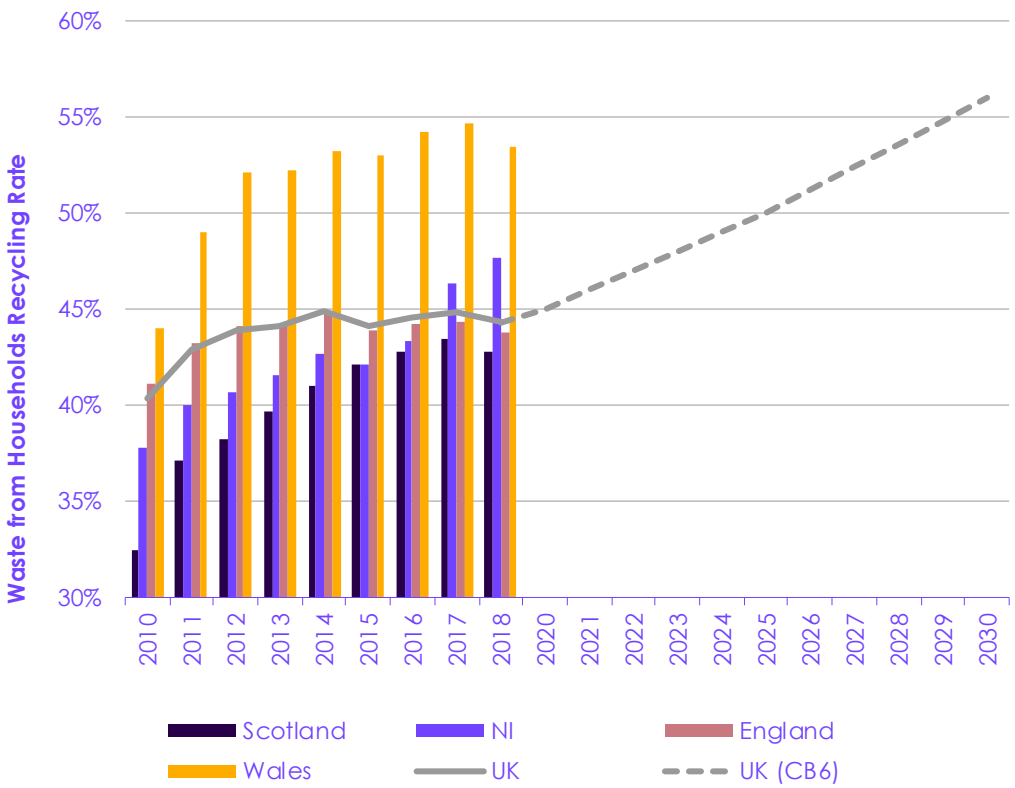
† 'Waste from Households (WfH)' is the agreed harmonised UK measure that was previously used to report household recycling to comply with the Waste Framework Directive (2008/98/EC). Under this Directive the UK was required to meet a target to recycle 50% of household waste by 2020.

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_2 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. Statuatory 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 $MtCO_2e$, 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 are still rising – the UK should lead in working internationally to reverse this.

- 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.

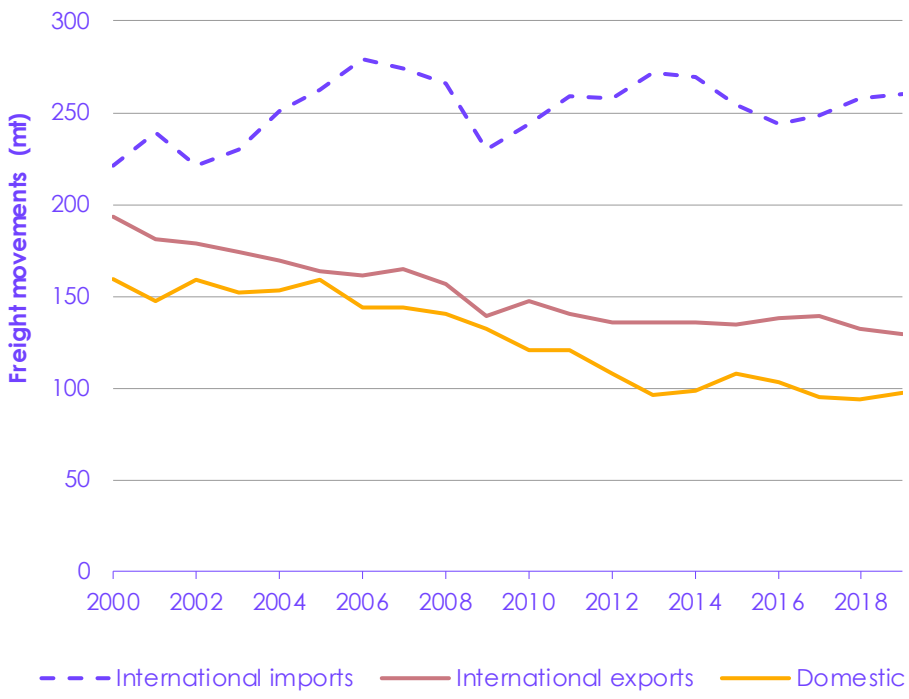
Table 3.9
Key metrics for shipping in the CCC Pathway to meet the Sixth Carbon Budget

	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).[42] Overall freight tonnages have fallen by 3%,[43] 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.[44] 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[45] 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[46] 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 $MtCO_2e$, 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.[47]

- **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 $MtCO_2$)	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_2 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_2 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

[1] CAST (2020) *CAST Briefing 05 - Tracking the effect of COVID-19 on low-carbon behaviours and attitudes to climate change.*

[2] Bank of England (2021) *MPC remit statement and letter and FPC remit letter*.

[3] National Audit Office (2020) *Achieving Net Zero*.

[4] Institute for Government (2020) *Net Zero: how Government can meet its climate change target*.

[5] Partha Dasgupta for HM Treasury (2021) *The economics of biodiversity: the Dasgupta review*.

[6] Louise Marix Evans for the CCC (2020) *Local Authorities and the Sixth Carbon Budget*.

[7] BEIS (2020) *Public Attitudes Tracker;* Energy Systems Catapult (2020) *Net Zero: A Consumer Perspective*

[8] CCC (2019) *Report from the Advisory Group on Costs and Benefits of Net Zero*.

[9] Public First (2021) *Options for Energy Bill Reform.*

[10] Committee on Fuel Poverty (2020) *Fourth Annual Report.*

[11] CBI (2021) *Seize the moment.*

[12] International Energy Agency (2021) *Net Zero by 2050: A Roadmap for the Global Energy Sector.*

[13] IDDR (2017) *Lessons from previous 'coal transitions'*.

[14] Just Transition Commission (2021) *A National Mission for a fairer, greener Scotland.*

[15] HM Government (2021) *The Queen's Speech 2021.*

[16] Financial Times (2021) *Europe's Climate Leaders 2021.*

[17] BSI (2021) *Net Zero Barometer Report*.

[18] UNFCCC (2021) *Race To Zero Campaign.*

[19] Z/Yen Group (2021) *The Global Green Finance Index 7.*

[20] EY (2021) *Renewable Energy Country Attractiveness Index (RECAI)*

[21] McKinsey & Company (2020) *McKinsey Electric Vehicle Index: Europe cushions a global plunge in EV sales.*

[22] Bloomberg New Energy Finance (2020) *Battery price survey.*

[23] Nissan (2021) *Price reduction for Nissan LEAF 40kWh and 62kWh unlocks full Nissan EV range for revised plug-in car grant*.

[24] Royal Haskoning DHV (2020) *The impacts of COVID-19 on travel patterns in the UK.*

[25] Department for Transport (2021) *Electric vehicle charging device statistics*.

[26] Society of Motor Manufacturers and Traders (2021) *Response to CCC request for data.*

[27] CCC (2018) *Annex to the 2018 Progress Report: growth in van demand*.

[28] RAC Foundation (2021) *Transport price index*.

[29] David Begg and Claire Haigh (2018) *The unintended consequences of freezing fuel duty.*

[30] Department for Transport (2020) *Rail fare rise to be delayed.*

[31] HM Revenue & Customs (2020) *Changes to Air Passenger Duty rates from 1 April 2021.*

[32] BSRIA (2021) *'Heat pumps market analysis 2020: United Kingdom', BSRIA World Market Intelligence.*

[33] 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.

[34] BEIS (2020) *Updated energy and emissions projections: 2019.*

[35] BEIS (2020) *Updated energy and emissions projections: 2019*

[36] BEIS (2020) *Digest of UK Energy Statistics (DUKES) 2020.*

[37] Defra (2020) *Crops for bioenergy dataset*.

[38] Defra (2020) *Agriculture statistics and climate change.*

[39] Defra (2020) *Family Food Survey 2018/19.*

[40] Yonder for Eating Better Alliance (2020) *Eating Better Survey ONLINE Fieldwork: 21st to 22nd September 2020.*

[41] 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*.

[42] Department for Transport (2019) *Port freight annual statistics*, Table 0102.

[43] Department for Transport (2019) *Port freight annual statistics*, Table 0201.

[44] International Maritime Organisation (2020) *Fourth greenhouse gas study*.

[45] International Council for Clean Transportation (2020) *Potential CO_2 reductions under the Energy Efficiency Existing Ship Index*.

[46] Tyndall Centre for Climate Change Research at the University of Manchester (2021) *Barriers and solutions for UK shore power*.

[47] UK Parliament Environmental Audit Committee (2018) *UK Progress on reducing F-gas Emissions.*

Chapter 4

Policy progress and gaps

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 26th 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

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:

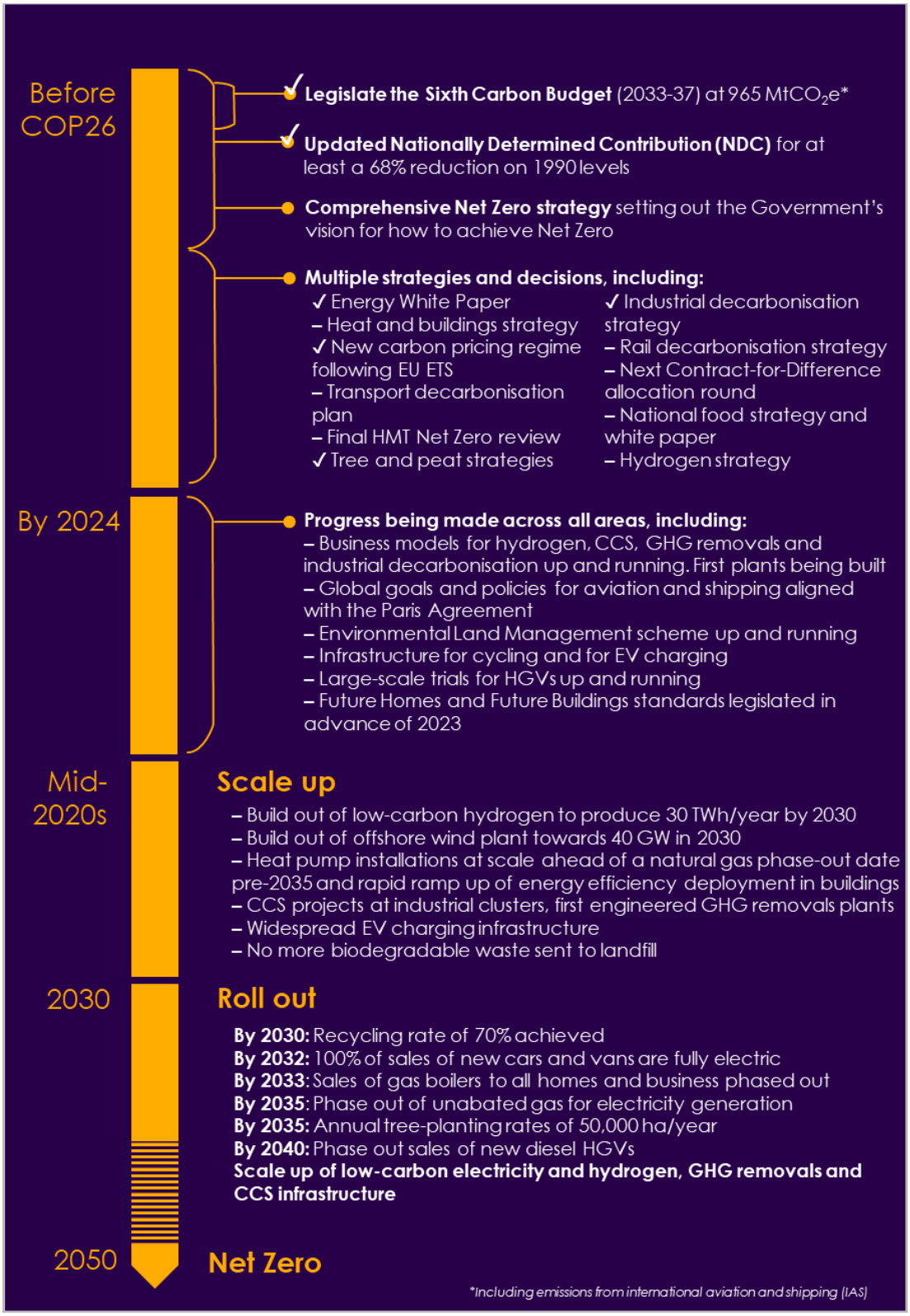
- **The 2020s: scale-up**. The UK must build supply chains and new markets for low-carbon consumer offerings (e.g. electric cars and heat pumps) so that these can scale from being niche offerings to dominating the market and fully pushing out sales of high-carbon alternatives by 2030, or soon after. 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	✓ Legislate the Sixth Carbon Budget at 965 MtCO2e, including emissions from international aviation and shipping • Net Zero Strategy, setting out how the Sixth Carbon Budget and Net Zero are to be met ✓ Energy White Paper • Heat and Buildings Strategy ✓ New carbon pricing regime following EU ETS • Transport Decarbonisation Plan • Final HMT Net Zero Review ✓ England Trees Action Plan ✓ England Peat Action Plan, including an end to rotational burning of certain upland peat sites • Hydrogen Strategy, and consultation on hydrogen business models • Governance framework and timeline for decisions on the conversion to hydrogen of the gas transmission and distribution networks • Rail Decarbonisation Strategy ✓ Industrial Decarbonisation Strategy • Net Zero carbon hospital standard, and further commitments towards delivering a Net Zero NHS • Publication of Greening Government Commitments • Ofgem's final business model approvals for the RIIO-ED2 period should accommodate network upgrades for EVs and heat pumps • Next Contract-for-Difference allocation round, targeting large volumes of renewables, towards 40 GW offshore wind by 2030	✓ Updated Nationally Determined Contribution (NDC) for at least a 68% reduction on 1990 levels (excl. IAS) ✓ Build on the UK's NDC to increase global climate ambition in the run up to COP26 • Strengthened UK Adaptation Plans ✓ Updated Green Book guidance on climate change ✓ Decision on funding model for CCS infrastructure • Ministry of Defence review of climate change and defence ✓ Call for evidence on policy for GHG Removals (GGRs) ✓ Consultation on Waste Prevention Programme for England and associated consultations on recycling collections, Extended Producer Responsibility and Deposit Return Scheme. • Consultation on mandatory food waste reporting • Consultation on including maritime in the Road Transport Fuel Obligation (RTFO) ✓ Scottish Government updated Climate Change plan • Conclusion of Green Jobs Taskforce and publication of Green Jobs Action Plan ✓ Environmental Land Management pilots • Implementation of minimum device standards for EV chargers • National Food Strategy and white paper • Welsh Government to publish a plan for meeting the second carbon budget • Net Zero Aviation Strategy ✓ North Sea Transition Deal
By the end of 2022	• Carbon capture, utilisation and storage (CCUS) business models decided for power, hydrogen and manufacturing and construction • 3rd Climate Change Risk Assessment published by Government (CCRA3) • Cross-Government Bioenergy Strategy	• Defra to publish a Nature Strategy for England • ICAO negotiations to set long-term Paris-compatible target for global aviation (align & strengthen CORSIA in 2023) • Strategy for shipping (including international shipping) that reflects UK Net Zero

By 2024	• Business models for hydrogen, CCS, GHG removals and industrial decarbonisation up and running. First plants being built. • Environmental Land Management (ELM) scheme up and running in England • Universal waste collections and recycling facilities in place across England • Implement a trading or auctioning system to deliver private sector investment in tree planting	• IMO negotiations revise 2050 target for global shipping in 2023, set new policies • Coal phased out of the power system • Legislation for the Future Homes and Future Buildings Standards introduced ahead of 2023, and should come into force by 2025 at the latest • Large-scale trials for HGVs in place
Mid-2020s	• Demonstrate low-carbon hydrogen at scale via 1 GW of hydrogen production capacity by 2025 • 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 • All new boilers 'hydrogen-ready' by 2025 at the latest	• CO_2 transport and storage infrastructure operational • Annual tree-planting rates of at least 30,000 hectares / year • First UK sustainable aviation plants operational, policy support in force • Main biodegradable municipal and non-municipal waste streams banned from landfill from 2025
By 2030	• Nearly 100% of new cars and van sales are battery-electric (or other zero-emission) vehicles • Heat pump installations at scale (1 million / year) ahead of a natural gas boiler installation phase-out date pre-2035 • All buildings except owner-occupied non-fuel poor homes achieve Energy Performance Certificate (EPC) C • Sales of oil and coal heating in homes phased out (2028) • Rented homes achieve EPC C and homes for sale achieve EPC C (2028) • Phase-out of the most harmful F-gases and restricting the use of all F-gases by 80%	• CCS and low-carbon hydrogen across 5 industrial clusters, capturing and storing 10 $MtCO_2$ per year and producing 25 TWh/year of low-carbon hydrogen • 40 GW of offshore wind installed in UK waters, reducing emissions from electricity generation to less than 50 gCO_2/kWh • Commercial roll-out of low-carbon ammonia and hydrogen starts in shipping, with at least one cluster (>2 TWh/year) • Recycling rate of at least 68% achieved across the UK, food waste 50% reduction • Commercial scale engineered GHG removals plants operational
Over the 2030s	• Sales of gas boilers to all homes and business phased out (by 2033) • Phase-out of sales of new diesel HGVs (by 2040) • All diesel trains removed from passenger rail operations (by 2040) • All ore-based steel-making near-zero emissions (by 2035)	• Phase-out of unabated combustion of fossil gas for electricity generation (by 2035) • Widespread roll-out of CCS, including on Energy from Waste plants • Annual tree planting rates of at least 50 kha/year (by 2035)
By 2050	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. Low-carbon technologies and behaviours continue to roll out at scale and all asset replacements continue to be low-carbon.	

Source: CCC analysis based on the milestones to delivering the Sixth Carbon Budget pathway, and HMG (2020) *The Government Response to the Committee on Climate Change's 2020 Progress Report to Parliament*, Policy Exchange (2020) *UK Energy & environment policy timeline*.
Notes: Ticks mark refer to actions that have been concluded.

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:

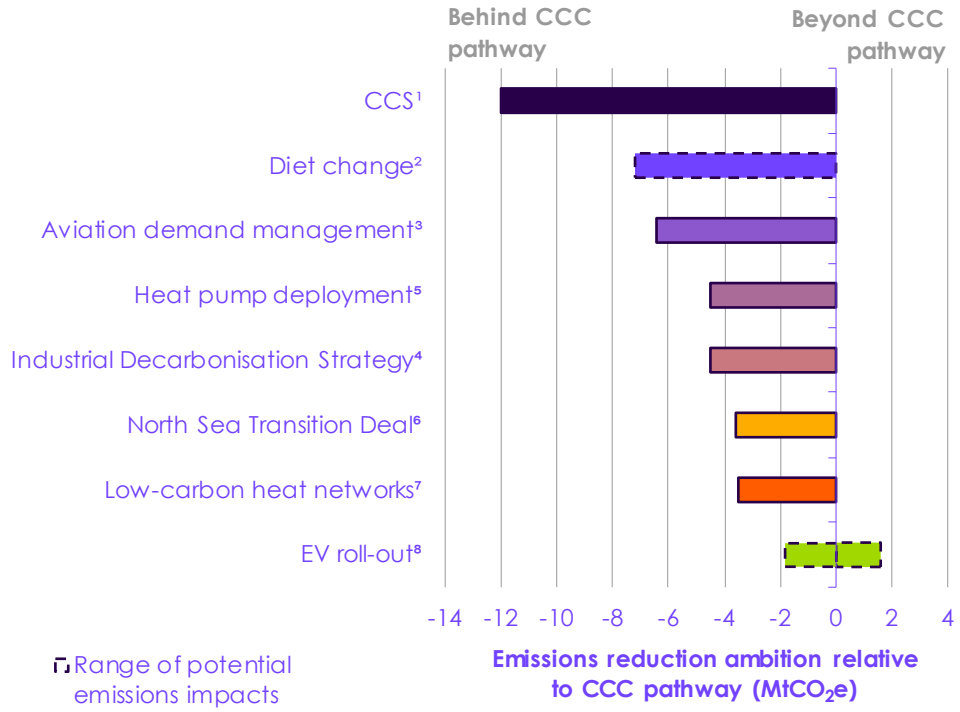
- The Government is not required to commit to the Committee's detailed sectoral pathways, nor our policy advice. But it must set out a credible alternative approach where it chooses not to.

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.
[1] Government CCS ambition for is 10 $MtCO_2$/year in 2030, compared to 22 $MtCO_2$/year in the CCC pathway.
[2] The level of diet change without explicit policy to support it is uncertain. Annual emissions could be up to 7.2 $MtCO_2e$ higher than the CCC pathway in 2030.
[3] Lack of ambition for aviation demand management would result in higher annual emissions of 6.4 $MtCO_2e$ in 2030 relative to the CCC pathway for aviation emissions.
[4] The Industrial Decarbonisation Strategy aims for a 67% reduction by 2035, compared to 73% in the CCC pathway.
[5] 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.
[6] The North Sea Transition deal commits to a reduction that falls short of the CCC pathway by 3.7 $MtCO_2e$ in 2030.
[7] 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).
[8] 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 [1]	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) [2]	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 [3]	10 $MtCO_2$ / year captured and stored by 2030, across 4 industrial clusters, including at least one power project	22 $MtCO_2$ / 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 [4]	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 $MtCO_2$ / year by 2030
Nuclear power [5]	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:

[1] 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.

[2] 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.

[3] 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.

[4] Government peatland restoration commitments include Scotland, Wales and England. CCC peatland restoration numbers in 2025 are UK-wide.

[5] 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.

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).

We are reporting on a moving picture of progress as several critical policy documents have not yet published, with many of these delayed.

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.

We see evidence of a multi-speed Government, with some departments' progress lagging behind others.

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.

Progress across the devolved administrations has also been significant over the past year.

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).[1,2]
- 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.[3]
- 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.[4]
- 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.[5]
- Published a **Transport Strategy (Llwybr Newydd)**, which places decarbonisation by 2050 at the centre of transport and infrastructure planning.[6]
- Published 'Beyond Recycling', a **circular economy strategy** that sets out policy to promote resource efficiency and make Wales 'zero waste' by 2050.[7]
- 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.[8]
- 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.[9,10]

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, which is broadly on track with some important gaps.

- **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.

* 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:

Delivery is falling short even where ambition is broadly on track.

- 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.

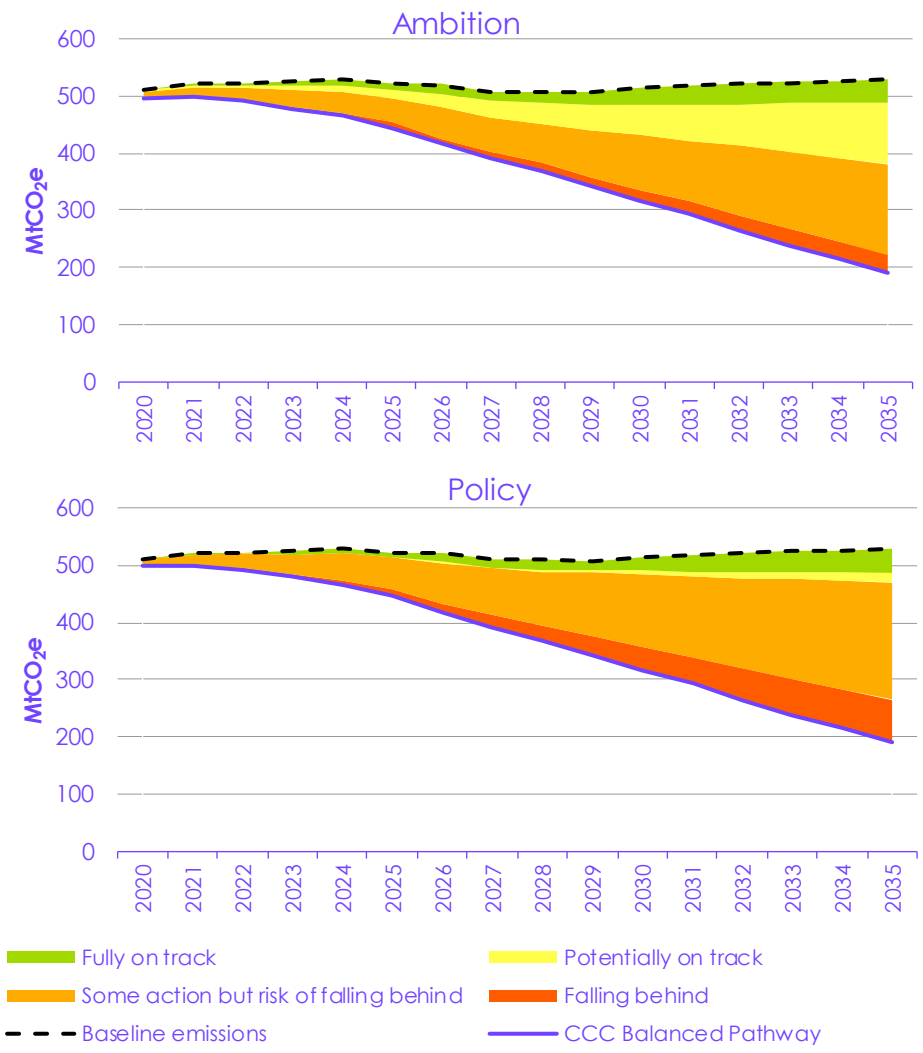
- The Ten Point Plan set a direction to phase out new internal combustion engine van sales by 2030, which is broadly in line with the pace of the transition required to meet the Sixth Carbon Budget, provided only a limited role for hybrid vehicles is allowed beyond this point. However, the **battery-electric 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.

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 **fully in line with or beyond CCC recommendations**	**Credible, proven policy** that is already working
Potentially on track, some risks	**Broadly in line with CCC recommendations**, subject to clarification	**Credible policy** in place (or imminent) **but not yet proven**, or **policy only covers the next few years** of scale-up but not out to Sixth Carbon Budget period (2033-37)
Some action, more significant risks	Some commitments but there are **gaps, or commitments are not ambitious enough**	**Policy in place** (or imminent) that is **limited in ambition**, or policy is in place but there are **risks of it ending without replacement**
Falling behind, major risks	**No, or very limited, ambition** stated	**None, very limited, or clearly ineffective policy** 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 $MtCO_2$ 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.

= falling behind, major risks = some action, more significant risks = potentially on track, some risks = fully on track, limited risks

Notes: See Table 4.4 for further description of the 'ambition' and 'policy' scores given to each source of abatement.

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.

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

We recommend implementation of a Net Zero test to ensure policy is compatible with climate objectives.

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:

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.

- **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.

- **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 economic recovery following COVID-19 should accelerate the transition to Net Zero, avoiding harmful lock-ins and an overshoot in emissions.

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_2/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.[11] 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[12], 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.

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 of new petrol and diesel cars and vans is welcome. The focus needs to be on fully battery-electric vehicles, rather than hybrids.

- 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_2 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).

Now is an opportunity to reinforce the increase in walking and cycling and positive public responses to lower air pollution following the pandemic.

- The Gear Change strategy[13] 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.

Public transport will need support to rebuild public confidence and avoid a car-led recovery.

- The Bus Back Better strategy[14] 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[15] 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[16] 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, [17] 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.

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 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[18] proposing to test battery-electric trucks in real-world operation, and a second[19] 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[20] for development of electric HGV propulsion systems with better range and improved energy efficiency and a commitment[21] 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.[22] 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

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.

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:

- **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.

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.

- **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 Voucher 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).[23] 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

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.

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

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.[24] 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

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.

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.

* 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.

  - **Hydrogen.** Government has committed to consult on a hydrogen supply business model that would incentivise hydrogen use by subsidising the cost of hydrogen production.

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'.

  - **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 $MtCO_2e$ 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.

The Waste Prevention Programme consultation proposed policies to improve resource efficiency.

- **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.

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.

Government has committed to consult on a target-consistent cap for the UK ETS and a call for evidence on product standards.

- **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 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 3$MtCO_2e$ 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.

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.

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.

- 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.

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_2 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.[25]

i) Progress in the past year

Trees

UK Government's afforestation targets are in line with the CCC pathway for 2025.

The UK Government has committed[26] 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.[27] The Welsh Government's current ambition remains at 2,000 hectares a year, with a commitment to increase that to 4,000 hectares by

an unspecified time. Northern Ireland's target of 18 million trees during this decade averages 900 hectares per year.[28]

£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.[29] 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_2O 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.[30] 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

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.

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.

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:

The Government should commit to phasing-out the use of unabated gas for electricity generation by 2035, subject to ensuring security of supply.

- **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 properly CCUS- and/or hydrogen-ready as soon as possible and by 2025 at the latest.

Barriers to delivery will need to be addressed, and investment will be needed to ensure networks can accommodate higher demand.

- **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

strategic investment required to ensure that electricity networks can accommodate this.

The Government should start planning for the market arrangements needed for a fully decarbonised electricity system in the 2030s.

- **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.

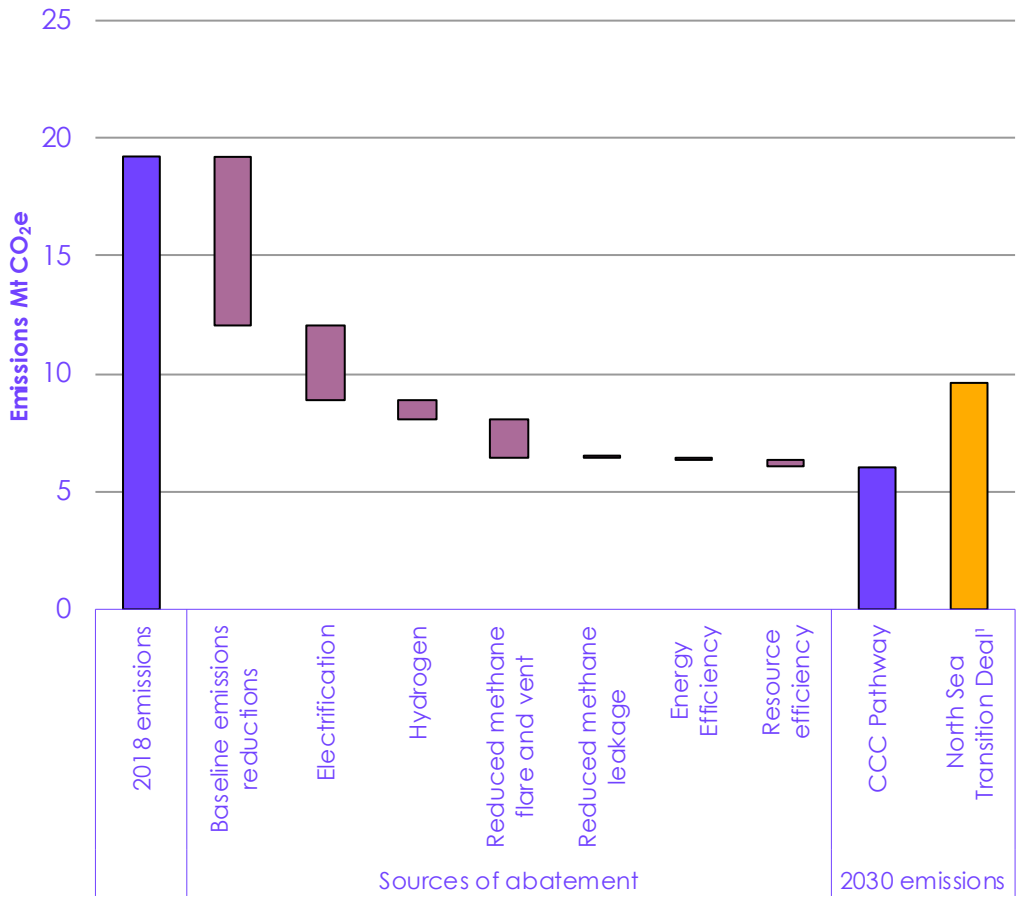
- The commitment for a reduction in emissions occurs in the context of declining oil and gas production in the North Sea. While it is difficult to forecast precise levels of production out to 2030, our baseline scenario – before actions to reduce the footprint of production – implies a 37% reduction 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.

Fossil fuel use should decrease by 95% by 2050.

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.

In the transition towards low-carbon fuels, some fossil fuel use can be consistent with UK targets.

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,

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.[31] 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 Liquified 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 polices 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.

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.

- 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'.

Delivering these actions requires different Departments to work closely together so Government should consider establishing new cross-Whitehall governance on waste and resource efficiency.

h) Aviation

The formal inclusion of international aviation in the Sixth Carbon Budget is an important step towards tackling these emissions alongside other UK emissions

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.[32]
- 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.[33]
- 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.[34]
- 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.

Managing aviation demand is a critical part of achieving the Net Zero target, future airport capacity needs must be considered alongside appropriate price incentives.

- **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_2 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[35] 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.

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_2 effects:

CORSIA credits should only be used towards ETS obligations if and when these meet minimum eligibility criteria. Non-CO_2 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_2 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_2 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.

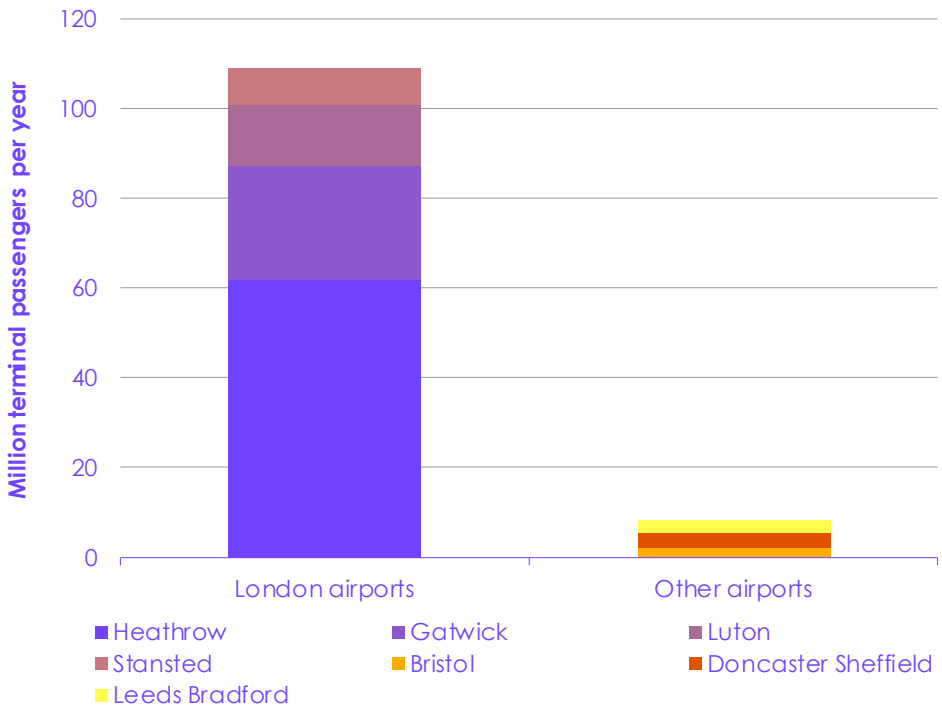
The fact that we have enough capacity in aggregate to achieve our emissions targets does not mean that capacity is always in the right place:

- 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_2 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-term-plans/), Doncaster Sheffield Masterplan (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,[36] selection of phase one of the BEIS Direct Air Capture and GGR competition,[37] and inclusion of GGR within the Scottish Government's Emerging Energy Technologies Fund.[38]

Alongside, during 2020-21 BEIS carried out a call for evidence on GGR.[39] 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

Innovation support for engineered Greenhouse Gas Removals needs to be complimented by policy development to set out and support deployment.

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_2, it is critical that CCS is established in a consistent timeframe and in a manner that allows for the usage of CO_2 pipeline and storage for removals.

Endnotes

[1] Scottish Government (2020) *Protecting Scotland, Renewing Scotland: The Government's Programme for Scotland 2020-2021*.

[2] Scottish Government (2021) *Scottish Budget: 2021-2022*.

[3] Scottish Government (2020) *Securing a green recovery on a path to net zero: climate change plan 2018 – 2032 – update*.

[4] Just Transition Commission (2021) *A National Mission for a fairer, greener Scotland*.

[5] Senedd Cymru | Welsh Parliament (2021) *The Climate Change (Interim Emissions Targets) (Wales) (Amendments) Regulations 2021*.

[6] Welsh Government (2021) *Llwybr Newydd: the Wales Transport Strategy 2021*.

[7] Welsh Government (2021) *Beyond recycling*.

[8] CCC (2020) *Letter: Lord Deben, Climate Change Committee to Edwin Poots MLA*.

[9] Northern Ireland Executive (2021) *Energy Strategy for Northern Ireland: consultation on policy options*.

[10] Northern Ireland Executive (2021) *Future Energy Decarbonisation Scenarios*.

[11] OBR (2021) *Economic and Fiscal Outlook*.

[12] OBR (2021) *UK Infrastructure Bank*.

[13] Department for Transport (2020) *Gear change: a bold vision for cycling and walking*.

[14] Department for Transport (2021) *Bus back better: a national bus strategy for England*.

[15] Department for Transport and Office for Zero-Emission Vehicles (2021) *Ending the sale of new diesel buses*.

[16] Scottish Government (2020) *Securing a green recovery on a path to Net Zero: climate change plan 2018-2032 – update*.

[17] Welsh Government (2021) *Llwybr newydd: the Wales transport strategy*.

[18] Department for Transport and Innovate UK (2021) *SBRI zero-emission road freight, supporting uptake of battery-electric trucks*.

[19] Department for Transport and Innovate UK (2021) *Zero-emission road freight strands 1-3*.

[20] 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*.

[21] Department for Transport (2021) *UK's first ever hydrogen transport hub kick-started by £3 million government investment*.

[22] RAC Foundation (2021) *Transport price index*.

[23] BEIS (2021) *Green Homes Grant voucher release, May 2021*.

[24] HM Government (2020) *The Government Response to the Committee on Climate Change's 2020 Progress Report to Parliament*.

[25] Defra (2021) *England Peat Action Plan*; Defra (2021) *The England Trees Action Plan 2021-2024*.

[26] Defra (2020) *England Tree Strategy Consultation*.

[27] Scottish Government (2020) *Update to the Climate Change Plan, 2018-2032*.

[28] Northern Ireland Department of Agriculture, Environment and Rural Affairs (2020) *Forest for our Future Programme*.

[29] Defra (2021) *England Peat Action Plan*.

[30] Defra (2021) *Nature for people, wildlife and climate – policy paper*.

[31] CCC (2020) *Sixth Carbon Budget – The UK's path to Net Zero*.

[32] Department for Transport (2021) *Implementing the carbon offsetting and reduction scheme for international aviation (CORSIA)*.

[33] Department for Transport, Civil Aviation Authority (2021) *Airspace Modernisation Plan*.

[34] Ministry of Defence (2021) *Sustainable fuels to power RAF jets* .

[35] HM Treasury (2021) *Consultation on aviation tax reform*.

[36] UK Research and Innovation (2021) *Greenhouse Gas Removal Demonstrators Programme*.

[37] Department for Business, Energy & Industrial Strategy (2021), *Projects selected for Phase 1 of the Direct air capture and greenhouse gas removal programme*.

[38] Scottish Government (2020) *Update to the Climate Change Plan 2018 – 2032*.

[39] Department for Business, Energy & Industrial Strategy (2020) *Greenhouse gas removals: call for evidence*.

Joint Departmental Recommendations

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 **Cabinet Committees** 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 **'Net Zero Test'** to ensure that all Government decisions are compatible with the legislated emissions targets.	2021 Priority recommendation
	Develop (with BEIS) a **public engagement 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 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 **local government** (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 **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: • Multiple risks to the UK from climate change impacts overseas 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 Adaptation Report Annex).	By 2023 Priority recommendation
	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.	2022
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the **Net Zero goal** and reflect the latest understanding of **climate risks.**	Now and ongoing
	Cabinet Office should build a strong **climate resilience capabilit**y 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 **public buildings and vehicle fleets** 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 **reduce travel demand**, for example encouraging home-working.	2021
International (With BEIS and the COP Unit)	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
	Work to bring forward additional **emissions reduction ambition** from countries that haven't yet strengthened commitments ahead of COP26.	H2 2021
	Place aligning **global COVID-19 recovery 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 **international carbon markets** at COP26 has high integrity and genuinely supports global ambition to tackle climate change.	H2 2021
	Develop the option of applying either **border carbon tariffs or minimum standards to imports** 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 **Net Zero goal** and reflect the latest understanding of **climate risks.**	Now and ongoing
Action in the run-up to COP26	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)
	Work to bring forward additional **emissions reduction ambition** 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 **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.	H2 2021
	Place aligning **global COVID-19 recovery** 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 **international carbon markets** at COP26 has high integrity and genuinely supports global ambition to tackle climate change.	H2 2021
	Develop the option of applying either **border carbon tariffs or minimum standards to imports** 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 **National Adaptation Programme** 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 **international climate policy** 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 **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 Adaptation Report Annex).	2023
	DIT should use trade policy to **encourage increased ambition** on both climate change mitigation and adaptation in other countries, including considering the role for border carbon adjustments and standards to **prevent carbon leakage.**	Spring 2022

Table A3 Recommendations for the HM Treasury (HMT)		Timing
	Complete the overdue **Net Zero Review**, which should: • Develop a plan for funding decarbonisation fairly, reviewing the distribution of costs for businesses, households and the Exchequer. • Set approach to near-term and long-term decarbonisation funding needs. • Consider policy implications for a just transition.	2021 Priority recommendation
	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.	2021 Priority recommendation
	For the coming five-year period (2023-2028), 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 Adaptation Report Annex).	2023 Priority recommendation
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the **Net Zero goal** and reflect the latest understanding of **climate risks.**	Now and ongoing
Funding	Increase resources for **local government** 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 **public buildings and vehicle fleets** 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 **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.	H2 2021
	Establish mechanisms (with BEIS) to close the substantial funding gap for **heat networks**, 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 **Heat and Buildings Strategy:** 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 **reforms to electricity pricing** 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 **carbon tax** (either as part of the UK ETS or a separate instrument) aimed at curbing rising emissions from Energy from Waste.	2022
	Reform **Vehicle Excise Duty**, 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
	Aviation tax reform 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 **Climate Change Levy** 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 **cap for the UK ETS** consistent with a credible path to the Sixth Carbon Budget for consultation by Q3 2021.	2021
	Develop (with DIT) the option of applying either **border carbon tariffs or minimum standards to imports** 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 **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
	In the **green gilt framework**, 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	Publish the overall **Net Zero Strategy**. It should: • 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. • Set out the approach to the key cross-cutting challenges of fair funding, just transition, skills, public engagement, local delivery, governance. • 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. • 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). • Introduce processes for monitoring progress and mechanisms to course-correct over time.	2021 Priority 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 Adaptation Report Annex).	By 2023 Priority recommendation
	Develop a **public engagement** 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.	2021-22 Priority recommendation
	Ensure **all departmental policy decisions**, and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.	Now and ongoing
International	Update the UK's long-term **low greenhouse gas emission development strategy with the UNFCCC** to reflect a formulated economy-wide plan to achieve Net Zero by 2050 (expected to be the Net Zero Strategy).	H2 2021
	Place aligning **global COVID-19 recovery plans** with the goals of the Paris Agreement as a core goal of the UK's G7 and COP26 presidencies.	H2 2022
	Publish a new strategy for the UK's **international climate policy for after COP26** - 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.	H1 2022
Jobs and skills	Working with DWP, DfE, the Home Office and MHCLG, develop a strategy for a **Net Zero workforce** 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 **support and create jobs**, especially in regions with reliance on industrial jobs.	Now and ongoing

Table A4 Recommendations for the Department for Business, Energy and Industrial Strategy (BEIS)		Timing
Supporting business action	**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
	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
	Determine appropriate regulatory arrangements, rules and guidance for the use of **carbon offsetting by UK corporates** 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 **innovation funding** (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
	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
	Review plan for improving **data collection** 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 **collect and report data** 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 **industrial decarbonisation data** 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 **cap for the UK ETS** consistent with a credible path to the Sixth Carbon Budget for consultation by Q3 2021.	2021
	Consult (with HMT) 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 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 **carbon tax** (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 **Carbon Offsetting and Reduction Scheme for International Aviation** (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 DIT) the option of applying either **border carbon tariffs** or **minimum standards to imports** 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 **heat strategy** to eliminate emissions from buildings through a clear direction for the next 30 years. This must include: • Standards covering all segments of the building stock, with support for consumers through the transition. • Plans to rebalance policy costs - in consultation with the Committee on Fuel Poverty and wider stakeholders - while making low-carbon solutions more financially attractive. • Plans to introduce Green Building Passports. • Formalisation of a governance framework to drive decisions on heat infrastructure including a role for area-based energy plans and zoning of heat networks.	2021 Priority recommendation
	Provide a stable long-term policy framework to support sustained **energy efficiency and heat pump** 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 **heat networks**, 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 **new liquid and solid fossil fuel heating** 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 **multi-year programmatic funding** 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 **new gas boilers to be hydrogen-ready** by 2025 at the latest, while ensuring that all new boilers outperform current and expected future air quality standards.	2021
	Implement improvements to the **Energy Performance Certificate** (EPC) and **Standard Assessment Procedure** (SAP) framework, including: • Ensuring EPCs drive deployment of the necessary energy efficiency measures and do so on a holistic basis to address overheating, ventilation, and moisture-risk. • Supporting delivery objectives across both energy efficiency and low-carbon heat, and valuing properly the benefits of low-carbon and flexible technologies. • Formally integrating a forward trajectory for declining grid carbon-intensity, in line with Government projections. • Addressing wider issues of quality/robustness, with a commitment to integrate in-use performance metrics from 2023. • Plans for the future role of Green Building Passports.	2022
	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 the 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 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. • 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.	2022
	Bring forward the date to reach EPC C in **social homes** to 2028, in line with the Private Rented Sector (PRS) proposals and finalise the delivery mechanism. Implement ambitious **PRS standards** for homes which drive fabric efficiency, while valuing deployment of cost-effective low-carbon heat alongside this. Implement the EPC B target for **PRS non-domestic buildings** in line with new proposals. Consult on options to cover the regulatory policy gap for **owner-occupied homes**.	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_2/kWh by 2030, with a total of around 350 TWh of low-carbon generation. Set out a schedule for regular auctions to procure **low-carbon generation**, 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 **unabated gas generation** by 2035, subject to ensuring security of supply.	2021 Priority recommendation
	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.	By Spring 2022 Priority recommendation
	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.	2023
	Develop mechanisms for strategic investment in coordination with Ofgem to ensure that **electricity networks** 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 **interconnectors**, 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 **Smart System Plan** and **Energy Data and Digitalisation Strategy**, 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 **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
Waste	Set out capacity and usage requirements for **Energy from Waste** 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 **new Energy from Waste** 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 Energy from Waste** 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 **electrification and hydrogen-use in manufacturing**, 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 **innovation** 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 $MtCO_2e$ of **industrial energy efficiency** abatement set out in the Industrial Decarbonisation Strategy and quantify how much abatement will come from each policy: • Set out the future role of Climate Change Agreements (CCAs) and any required CCA reforms. • Consult on mandating the use of Energy Management Systems and on Government support and incentives for implementing energy management standards. • Set out the role of energy efficiency standards and audit programmes. • Develop resources such as direct advice and training to address capacity and expertise gaps, and highlight available energy efficiency solutions, particularly for SMEs.	Spring 2022
	Ensure the policy package for decarbonising manufacturing addresses manufacturers' low appetite for investments with long **payback times**, either using grants or favourable loans, particularly for energy efficiency.	2022
	Work with the minerals industries to develop a detailed joint plan for **CO_2 transport from dispersed sites**.	Spring 2022
	Commit to **targets** for ore-based steelmaking and cement production in the UK to reach near-zero emissions by 2035 and 2040, respectively.	2021
	Deliver industrial **carbon capture contracts** (ICC) to enable final investment decisions on the first ICC projects by mid-2022.	H1 2022
	Deliver the proposed **CCS transport and storage** 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 **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 Climate Change Levy rates for electricity and gas.	2023
	Set out a strategy for decarbonisation of **off-road mobile machinery** 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	Step up efforts (with Defra) to deliver the **waste prevention and resource efficiency** improvements required as part of the pathway to Net Zero, including by: • 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. • Setting out how levels of resource efficiency improvements identified within the Industrial Decarbonisation Strategy will be delivered. • Beginning to develop and implement any additional policies needed to deliver these resource efficiency improvements, by the end of 2022. • Ensure cross-departmental working, potentially through new cross-Whitehall governance focused on resource efficiency.	Spring 2022 Priority recommendation (end 2022 for additional policies)
	Develop policies (with MHCLG, Defra and DfT) to drive more **resource-efficient construction** and use of existing low-carbon materials, including a substantial increase in the use of **wood in construction**. Policies should include: • 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. • The development of a fully-funded policy roadmap on the use of timber, including policies to support the development of UK wood supply chains. • Finalising the reporting methodology for whole-life carbon standards. • 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.	Spring 2022
	Consult on detailed proposals (with Defra) for **product standards and extended producer responsibility** 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 repairability, durability and upgradability of a product.	Spring 2022
	Work with business to encourage and **enable consumers to share**, lease and use products for longer while discouraging 'disposable' business models.	Spring 2022
Transport	Continue to support (with DfT and Ofgem) widespread deployment of **EV charging infrastructure**: • 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. • Further investment is needed to support on-street and other urban charging solutions for those without off-street parking and destination charging. • 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. • 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.	Now and ongoing Priority recommendation
	Produce a clear assessment (with DfT) of how best to re-use and **recycle EV batteries** and fund development of competitive, large-scale battery recycling facilities in the UK.	2021-22
	Continue innovation and demonstration support (with DfT) for **zero-carbon fuel technologies** and their use in shipping, and ship efficiency measures. Develop incentives for zero-carbon ammonia and hydrogen supply chains.	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 **GGRs in context** 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 **GGR strategy** 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 **demonstration of engineered GGR** at scale in the 2020s, either through amending existing policies or introducing new support mechanisms.	2022 Priority recommendation
	Build on the recently commenced **innovation programmes**, 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 **public engagement strategy** 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 **resilience and effectiveness of GGRs** 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 **Hydrogen Strategy** 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 **Biomass Strategy** 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 **biofuel conversion facilities** 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 **upstream emissions from oil and gas** production by 68% by 2030, relative to 2018 levels: • Develop policies to reduce emissions from existing oil and gas platforms, including developing carbon-intensity measurement standards for gas and oil. • 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. • Make plans to ensure flaring and venting is only permitted for safety reasons from 2025.	2021
	Work with Ofgem to make explicit how current and future policies will reduce emissions associated with **methane leakage** 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 **conversion to hydrogen** 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	The next **National Adaptation Programme**, due in 2023, should ramp up adaptation ambition, implementation and evaluation. It should: • 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). • 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. • Report how departments have addressed the top eight priority risks set out in the CCRA3 Advice Report for urgent action between 2021 and 2023. • 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. • Ensure the adaptation actions and the programme as a whole are framed around the principles for good adaptation outlined in the CCRA3 Advice Report: – Adapt to 2°C warming, assess the risks for 4°C – Prepare for unpredictable extremes – Assess interdependencies – Understand threshold effects – Integrate adaptation into relevant policies – Ensure adaptation is sufficiently financed – Avoid lock-in – Address inequalities – Consider opportunities from climate change • Specific actions to manage international climate risks should be included, setting out the direct response to the risks identified in CCRA3.	2023 onwards Priority recommendation
	Ensure that **adaptation is integrated** 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: • Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards. • Risks to soil health from increased flooding and drought. • Risks to natural carbon stores and sequestration (trees, soils and wetlands) from multiple hazards. • Risks to crops, livestock, and commercial trees from multiple hazards. 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).	By 2023 Priority recommendation
	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.	2021 Priority recommendation
	Implement measures to address **non-financial barriers to tackling emissions from land use and agriculture**, 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: • Improve knowledge exchange of low-carbon farming practices to provide confidence to farmers to take up measures to reduce on-farm GHGs. • 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.	2021-25 Priority recommendation

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Cross-cutting	Legislate the **Environment Bill** this year, using it to strengthen commitments on waste, resource efficiency, agriculture and land-use.	2021
	Develop (with DIT) the option of applying either **border carbon tariffs or minimum standards to imports** 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 **all departmental policy decisions**, 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 **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
	Continue to monitor **consumption emissions**. 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 **industrial decarbonisation data** 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 **degraded peatland**: • 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 (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).	2021-25 Priority recommendation
	Extend current ambition set out by the UK government and the devolved administrations to implement a comprehensive **delivery mechanism for new woodland** 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: • 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. • Ensure lowland peat soils are not left bare.	2021-23 Priority recommendation
	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
	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-Year Environment Plan.	H1 2022
	Make **interim targets for biodiversity** 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% **restoration for terrestrial and freshwater** protected sites should be extended to include all priority habitat sites.	2021
	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).	H1 2022
	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

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Agriculture and food	Provide **incentives and address non-financial barriers** across all of the UK to: • Plant **trees** on 2% of farmland by 2025 while maintaining their primary use, rising to 5% by 2035. • Extend **hedgerows** by 20% by 2035 and better manage existing hedgerows. • Increase the area growing **energy crops** across the UK to 6,000 hectares per year by 2025, and 30,000 hectares per year by 2035.	2021-25 Priority recommendation
	Implement measures to encourage consumers to **shift diets and reduce food waste** across the supply chain, including: • 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. • 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.	Start now and review mid-2020s for diet change Priority recommendation
	Introduce a strong **post-CAP regulatory baseline,** 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.	2021-23
	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
	Introduce a comprehensive plan and incentives to deliver **emissions reduction across all UK farms** through: • 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) & waste management (anaerobic digestion and slurry covers). • 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.	2021-25
	The landscape-level and on-farm measures set out above should: • **Leverage private and public finance** (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. • Be accompanied by a strong **monitoring, reporting and verification** system that uses the latest monitoring tools and technologies to create a strong institutional framework to verify actions across the UK.	2021-25
	Set out a strategy for decarbonisation of **off-road mobile machinery** 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 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 **Energy from Waste** 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 **Energy from Waste** 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 **Energy from Waste** 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 **funding arrangements for local authorities** 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 **carbon tax** (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% **recycling rate** 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
	Composting facilities should be incentivised to install forced aeration as a method of reducing on-site emissions.	From 2022
	Mandatory **business food waste** 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 **ban on landfilling of the main biodegradable waste** 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 **diversion of all wastes from landfill** (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 **methane capture and oxidation at landfill sites**, to decrease fugitive landfill methane emissions significantly.	2022
	Phase out **exports of waste** 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 **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
	Align with adaptation policies to ensure long-term **resilience and effectiveness of GGRs** 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 **carbon offsetting by UK corporates** 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	Step up efforts to deliver the **waste prevention and resource efficiency** improvements required as part of the pathway to Net Zero, including by:* • 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. • Setting out how levels of resource efficiency improvements identified within the Industrial Decarbonisation Strategy will be delivered. • Beginning to develop and implement any additional policies needed to deliver these resource efficiency improvements, by the end of 2022. • Ensure cross-departmental working, potentially through new cross-Whitehall governance focused on resource efficiency.	Spring 2022 Priority recommendation (end 2022 for additional policies)
	Consult on detailed proposals for **product standards and extended producer responsibility** 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 repairability, durability and upgradability of a product.	Spring 2022
	Develop policies (with BEIS, MHCLG and DfT) to drive more **resource-efficient construction** and use of existing low-carbon materials, including a substantial increase in the use of **wood in construction**. Policies should include: • 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. • The development of a fully funded policy roadmap on the use of timber, including policies to support the development of UK wood supply chains. • Finalising the reporting methodology for whole-life carbon standards. • 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.	Spring 2022
	Work with business to encourage and enable consumers to share, lease and use products for longer whilst **discouraging 'disposable' business models.**	Spring 2022
Buildings and 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: • 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.	2023
	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
	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, as well as to identify what further support could be offered to enable more comprehensive reporting on adaptation by the ports sector.	2023
	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

Table A5 Recommendations for the Department for Environment, Food and Rural Affairs (Defra)		Timing
Waste and wasterwater	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 **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
	Decisions on **investment in roads** 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 **resource-efficient construction** and use of existing low-carbon materials. DfT's focus should be on: • Finalising the reporting methodology for whole-life carbon standards • 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.	Spring 2022
	Ensure all departmental policy decisions, and procurement decisions, are consistent with the **Net Zero goal** and reflect the latest understanding of **climate risks.**	Now and ongoing
Electric vehicles	Develop a comprehensive policy package to **support the supply and uptake of EVs** to enable delivery of the 2030 phase-out of new petrol and diesel cars and vans. This will require: • 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. • 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. • Setting out ambitious UK regulations on new car and van CO_2 intensities to 2030, with more regular intervals than the EU's five years, requiring around a 55% reduction by 2025 and 97% by 2030.	Policy package: 2021 Support: Now and ongoing Priority recommendation
	Continue to support widespread deployment of **EV charging infrastructure**: • 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. • Further investment is needed to support on-street and other urban charging solutions for those without off-street parking and destination charging. • 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. • 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.	Now and ongoing Priority recommendation
	Produce a clear assessment of how best to re-use and **recycle EV batteries** 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 **walking, cycling and public transport** to reduce demand for higher-carbon travel: • Provision of infrastructure for active travel and other support schemes, as well as measures to make it less attractive to drive, are needed. • This should include maintaining positive behaviour shifts and addressing risks resulting from the COVID-19 pandemic. • Working across delivery bodies (e.g. local authorities) is critical.	2021-22 Priority recommendation
	Government should support the **public transport and shared mobility** sectors to recover from the COVID-19 pandemic: • Positive communications and messaging will be required to rebuild public confidence in the safety of public transport. • Financial support for the sector should be maintained while confidence and demand are rebuilt, to avoid the risk of operators cutting service provision. • Government should seek to reverse the increasing relative price advantage of car travel over public transport.	2021-22
	Set out a clear vision to deliver Net Zero in **rail,** 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 **phase-out** of new sales of all **diesel buses and coaches** by 2040 at the latest. • This should include a requirement for new sales of diesel vehicles operating on shorter, urban routes to end considerably sooner. • Local authorities should be empowered to continue driving zero-emission bus take-up and to deliver improvements to bus services.	2021-22
Freight and off-road mobile machinery	Implement large-scale **trials of zero-emission HGVs** in the early-2020s to demonstrate the commercial feasibility of these technologies and establish the most suitable and cost-effective technology mix.	Early 2020s
	Set out and implement a **strategy to transition to zero-carbon freight**, including: • Ending sales of new diesel HGVs by 2040 at the latest. • Stronger purchase and other incentives for zero-emission HGVs. • Infrastructure plans and support (e.g. ultra-rapid chargers for battery-electric HGVs and hydrogen refuelling stations for hydrogen HGVs). • Clean air zones.	2021
	Implement schemes to **reduce HGV and van use** 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 **off-road mobile machinery** 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
Shipping	Build on the **Clean Maritime Plan** 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
	Take a leadership role in working with the **International Maritime Organisation** (IMO) 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 **clean maritime cluster(s)** 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 **innovation and demonstration support for zero-carbon fuel** 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 **shore power** and electric recharging infrastructure.	Early 2020s
	Start monitoring **non-CO_2 effects** 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 **Aviation Decarbonisation Strategy**, 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 **airport capacity strategy** 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_2 effects.	2021-22 Priority recommendation
	Take a leadership role within the **International Civil Aviation Organisation** (ICAO), 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 **sustainable aviation fuel** (SAF) 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 **aviation tax reform** 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 **Carbon Offsetting and Reduction Scheme for International Aviation** (CORSIA) for flights covered by the UK ETS unless and until they can satisfy strict eligibility criteria (equivalence, additionality, permanence, sustainability).	2021-22
	Start monitoring **non-CO_2 effects** 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_2 effects alongside UK climate targets without increasing CO_2 emissions.	2021-22

Table A7 Recommendations for the Ministry of Housing, Communities and Local Government (MHCLG)		Timing
Cross-cutting	Support **local government** 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 Priority recommendation (funding for local areas at next budget)
	Ensure that **adaptation is integrated** 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: • Risks to human health, wellbeing and productivity from increased exposure to heat in homes and buildings (with DHSC). • 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).	By 2023 Priority recommendation
	Working with BEIS, DWP, DfE and the Home Office, develop a strategy for a **Net Zero workforce** 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
	Ensure that developments and infrastructure are compliant with **Net Zero** and appropriately **resilient to climate change** through proposed amendments to the Planning Bill.	2021-22
	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 Plan goals are met.	2022
	Ensure all departmental policy decisions, planning decisions and procurement decisions, are consistent with the **Net Zero goal** and reflect the latest understanding of **climate risks.**	Now and ongoing
Flooding	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 as a minimum: • 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). • Include an assessment of current and future flood risk under both 2°C and 4°C global climate scenarios. • Assess and manage the risk of flooding to local infrastructure as well as housing. • Include 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.	2022
	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
	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 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.	2022
	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

Table A7 Recommendations for the Ministry of Housing, Communities and Local Government (MHCLG)		Timing
Buildings	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-residential 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 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. • 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.	2021-22 Priority recommendation
	Develop and implement plans to make all **public-sector buildings and vehicle fleets** 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
	Implement improvements to the **Energy Performance Certificate** (EPC) and **Standard Assessment Procedure** (SAP) framework, including: • Ensuring EPCs drive deployment of the necessary energy efficiency measures and do so on a holistic basis to address overheating, ventilation, and moisture-risk. • Supporting delivery objectives across both energy efficiency and low-carbon heat, and valuing properly the benefits of low-carbon and flexible technologies. • Formally integrating a forward trajectory for declining grid carbon-intensity, in line with Government projections. • Addressing wider issues of quality/robustness, with a commitment to integrate in-use performance metrics from 2023. • Plans for the future role of Green Building Passports.	2022
Construction	Step up efforts to deliver the **waste prevention and resource efficiency** improvements required as part of the pathway to Net Zero, including by: • Setting out how levels of resource efficiency improvements in construction identified within the Industrial Decarbonisation Strategy will be delivered. • Beginning to develop and implement any additional policies needed to deliver these resource efficiency improvements, by the end of 2022. • Ensure cross-departmental working, potentially through new cross-Whitehall governance focused on resource efficiency.	Spring 2022 Priority recommendation (end 2022 for additional policies)
	Develop policies (with BEIS, Defra and DfT) to drive more **resource-efficient construction** and use of existing low-carbon materials, including a substantial increase in the use of **wood in construction.** Policies should include: • 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. • The development of a fully funded policy roadmap on the use of timber, including policies to support the development of UK wood supply chains. • Finalising the reporting methodology for whole-life carbon standards. • 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.	Spring 2022
	Set out a strategy for decarbonisation of **off-road mobile machinery** 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 A8 Recommendations for the Department for Digital, Culture, Media and Sport (DCMS)		Timing
Cross-cutting	Support BEIS in developing a **public engagement 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 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 **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
	Work in partnership with Ofgem to publish and implement a new **Smart System Plan** and **Energy Data and Digitalisation Strategy**, 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 **sport and culture strategies** 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 **Net Zero goal** and reflect the latest understanding of **climate risks.**	Now and ongoing
Digital infrastructure	Ensure plans for a **digital transition and fibre roll-out** 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
	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.	2022
	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

Table A9 Recommendations for the Department for Education (DfE)		Timing
	Working with BEIS, DWP, MHCLG and the Home Office, develop a strategy for a **Net Zero workforce** 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 **public engagement 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 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 **National Adaptation Programme** 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 **public-sector buildings and vehicle fleets** 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 **Net Zero goal** and reflect the latest understanding of **climate risks.**	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 **Net Zero goal** and reflect the latest understanding of **climate risks.**	Now and ongoing
	Working with BEIS, DfE, MHCLG and the Home Office, develop a strategy for a **Net Zero workforce** 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 **support and create jobs**, especially in regions with reliance on industrial jobs.	Now and ongoing
	Develop and implement plans to make all **public-sector buildings and vehicle fleets** 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 **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 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 **disease spread** as a result of climate change and other factors.	Now and ongoing
	Develop and implement plans to make all **public-sector buildings and vehicle fleets** 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 **health benefits**, 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 **Net Zero goal** and reflect the latest understanding of **climate risks.**	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 **National Adaptation Programme** 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 **Net Zero workforce** 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 **public-sector buildings and vehicle fleets** 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 **Net Zero goal** and reflect the latest understanding of **climate risks.**	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 **Net Zero goal** and reflect the latest understanding of **climate risks.**	Now and ongoing
	Develop and implement plans to make all **public-sector buildings and vehicle fleets** 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 **alternative fuels** (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 **EV charging infrastructure**: • 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. • Further investment is needed to support on-street and other urban charging solutions for those without off-street parking and destination charging. • Around 150,000 public charge points will need to be operating by 2025. These should be widely available across all regions of the UK. • 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.	Now and ongoing Priority recommendation
	Ensure all regulatory decisions, and procurement decisions, are consistent with the **Net Zero goal** and reflect the latest understanding of **climate risks**.	Now and ongoing
	Develop mechanisms for strategic investment in coordination with BEIS to ensure that **electricity networks** 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 **areas which are unlikely to be suitable for hydrogen** (such that electrification and alternatives can be prioritised), **alongside priority candidate areas for hydrogen**. 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 **utilisation of existing network capacity** 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 **Smart System Plan** and **Energy Data and Digitalisation Strategy**, 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 **interconnectors**, 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 **methane leakage** 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 **Net Zero goal** and reflect the latest understanding of **climate risks.**	Now and ongoing
	Include **decarbonisation** 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 **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

Table A16 Recommendations for the Office for National Statistics (ONS)		Timing
	Review plan for improving **data collection** 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 **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).	2022
	Improve the collection and reporting of **industrial decarbonisation data** 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 **Climate Change Plan Update.**	Now and ongoing
	Publish the finalised **Heat in Buildings strategy**. • 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. • 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. • 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.	2021
	Proposals in Scotland's Updated Climate Change Plan 2018-32 to set out a **route map for agricultural transformation** 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
	Renew efforts to improve **recycling and resource efficiency**, including by: Bringing forward the planned circular economy package for legislating within the forthcoming Programme for Government. 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. Legislating to ban key biodegradable waste streams going to landfill from 2025, and ensuring this is delivered through increased resource efficiency and recycling.	2021
	Publish a strategy setting out how the Scottish Government will achieve a 20% reduction in **car-kilometres** by 2030 and deliver 20-minute neighbourhoods. This should be supported by: Continuing to strengthen schemes to support walking, cycling, and public transport. Investment in infrastructure connectivity to lock in positive behavioural changes that reduce travel demand (e.g. home-working). Supporting the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.	2021
	Continue to support the expansion of Scotland's **public EV charge point network**, to ensure the EV transition works for all road users in Scotland.	Now and ongoing
	Maintain the provision of **interest-free loans** 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 **embed positive behaviours** 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 **aviation taxation** 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 **shipping** 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 **Net Zero Delivery Plan** 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, **long-term strategy for heat and energy** 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 **reduce demand for higher-carbon travel**. This includes: • Delivering a better, more integrated, decarbonised bus system. • Developing a network of connected local routes for walking and cycling. • Investing in infrastructure connectivity to enable delivery of the ambition for 30% of the workforce to work remotely on a regular basis. • Supporting the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.	2021-22
	Support delivery of a **charging network** 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 **accelerate afforestation rates** to deliver its share of the UK target to plant 30,000 hectares in 2025.	2021
	Build on strong progress made on **recycling and resource efficiency**, including by: • Implementing the policies set out in the recent 'Beyond Recycling' strategy. • Legislating and progressing towards the existing 70% recycling target, and set new ambitious targets for 2030. • Legislating to ban key biodegradable waste streams going to landfill from 2025, and ensuring this is delivered through increased resource efficiency and recycling.	2021

Table A19 Recommendations for the Northern Ireland Executive		Timing
	Legislate a credible **long-term emissions reduction target** 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 **net-zero-carbon energy system** by 2050, in line with the pathways recommended in our December 2020 advice.	2021
	Publish a coherent, **long-term strategy for heat and energy efficiency** in Northern Ireland's homes and other buildings; encompassing regulatory, policy and funding commitments to facilitate delivery. • 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. • 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.	2022
	Consult on an ambitious trajectory of **new-build standards** 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 **post-CAP framework** 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
	The Northern Ireland Executive should bring forward a **resource efficiency package** which matches the ambition of Wales and Scotland, including by: • Setting a target for 70% recycling across all wastes by 2030. • Policies to deliver such a target, as well as improving waste prevention and re-use. • Legislating to ban key biodegradable waste streams going to landfill from 2025, and ensuring this is delivered through increased resource efficiency and recycling.	2022
	Strengthen support for and provision of schemes to support **walking, cycling and public transport** to reduce Northern Ireland's high levels of car-dependence: • Strengthen schemes to ensure access to local amenities without dependency on cars. • Invest in infrastructure connectivity to lock in positive behavioural changes that reduce travel demand, e.g. home-working. • Support the public transport and shared mobility sectors to recover from the COVID-19 pandemic, including through recovery funding and positive communication and messaging.	2021-22
	Support the deployment of **public charge points** 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 **data on vehicle-kilometres** travelled by mode in Northern Ireland. This will help identify which actions are effective in encouraging modal shift away from car travel.	2021-22
	Long-haul air passenger duty, 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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Climate Change Committee

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