SOLAR CAMPAIGN ALLIANCE

Interested Party reference number: 20036462

Written Representation outlining objection to the Mallard Pass NSIP

Executive Summary

Section 1.	Introduction
Section 2	Further to Relevant Representation submitted by the Solar Campaign Alliance (SCA) in March, this section details of the lack of compliance of Mallard Pass solar farm with the National Planning Policy Framework (NPPF). It also considers the lack of compliance of this application with the agreed commitments of members of the trade association, Solar Energy UK, of which the developers behind Mallard Pass are members.
Section 3	Gives details of the lack of compliance of this application with Government policy more generally.
Section 4	Outlines the SCA's further concerns at the grading of the agricultural land in the scheme and the assumptions made by the applicant.
Section 5	Details concerns about the cumulative impact of Mallard Pass alongside other schemes on the UK's food security, since it represents a loss of a significant amount of high-quality farmland (including what is known as 'BMV').
Section 6	Comments on the sheer number and scale of solar developments on high quality farming land that are currently in the pipeline, and how this will impact the UK's food security. Mallard Pass should be considered in the context of this surge in applications and the cumulative impact of ground-mounted solar schemes on high quality agricultural land across the UK should be taken into account.

1. Introduction

My name is Dr Catherine Judkins and I am the current chair of the Solar Campaign Alliance (SCA, [redacted]. I am submitting this Written Representation on behalf of the SCA.

The SCA currently represents 88 individual community groups across the UK, who are campaigning to ensure that their concerns about large-scale, ground-mounted solar farms on greenfield land in their areas are heard. The members within the SCA are affected by a mixture of 'mega-scale' ground-mounted schemes on greenfield land (Nationally Significant Infrastructure Projects, NSIPs) such as Mallard Pass, Longfield, Sunnica, West Burton, etc., and also other schemes that are being considered through the local planning process.

Members of the SCA are not anti-solar or anti-renewable energy. Indeed, they recognise and support the importance of renewable energy sources in the UK and recognise that solar PV (if deployed appropriately) has a part to play as part of the renewable energy mix. Recent research by the UK Warehouse Association (UKWA) and the University College London (UCL) Energy Institute commissioned by CPRE, the countryside charity (1,2) has shown that there is significant solar energy generating potential from the UK's rooftops that is largely unused. Indeed, the UCL research suggests as much as 117 GW solar energy could be generated using the UK's rooftops and car parks alone. This is well in excess of the British Energy Security Strategy target of achieving 70 GW solar energy generation by 2035. The researchers question the need for taking large areas of greenfield land to meet our solar PV needs when the versatility of solar PV means that there is more than adequate space available for solar to be deployed on built surfaces without compromising other land uses (food production, ecology, housing, health and well-being, livelihoods, other developments, etc.).

The SCA opposes the inappropriate (and currently unmonitored and unregulated) development of solar PV on greenfield land across the UK and is particularly concerned about the lack of a coherent strategy to ensure that valuable farming land is protected to ensure that a careful balance between food security and energy security is delivered. We are calling for a proper land use strategy to be put into place as a matter of urgency and for our food security to be considered as a key factor when considering development on greenfield land.

The current number of solar applications on some of the UK's most valuable farming land is a huge concern and the scale of the projects being proposed will inevitably cause a decline in our food security – a position that we cannot afford to create as other countries from which we import food face their own battles with climate change. The potential land loss amongst the current groups in the SCA alone represents a loss of over 42,000 acres of high quality and versatile farmland (around 15,000 hectares), and more groups are joining the alliance each week. There are also other developments (housing, commercial, other renewable proposals, etc) that are being built on valuable farmland, so this all adds up to a very significant cumulative loss of food producing land in the UK.

When it comes to solar PV, the SCA agrees with the position of CPRE, the countryside charity (2) that rooftop and car park solar installations can offer a considerable amount of solar PV potential, which can be installed relatively quickly and cheaply, and do not compromise farming land. Our neighbouring countries such as Germany have demonstrated the feasibility of this.

We also strongly believe that if ground-mounted solar PV is deployed it should be on "previously developed or lower value land," as outlined in the Energy Security Strategy that was published earlier this year.

The SCA previously outlined its main objections to the Mallard Pass proposal in our Relevant Representation (RR) under the following categories (more details can be seen in the RR):

1. The scheme does not comply with the National Planning Policy Framework (NPPF) which stipulates that valuable farmland should be avoided. The land at the Mallard Pass Solar site sustains a range of high yielding arable crops.
2. The UK is currently importing a large proportion of its food, and restricted supply and food rationing is becoming more prevalent across the UK. Food security must be considered when looking at planning proposals that include such vast areas of highly productive farmland.
3. We do not believe that the impacts can be considered "temporary."
4. We have concerns about the site selection process and the significant impact that this scheme would have on the local landscape and on those who enjoy this landscape. This includes the inadequacy of the suggested mitigation measures.
5. We also have questions about noise impacts and the effect of visual and noise impacts on people's mental health and well-being.
6. The SCA also has significant concerns about the biodiversity claims and assessments and the long-term impacts this may have.
7. We also consider that traffic and transport impacts have not been adequately addressed.

In addition to the submissions in our RR, the sections below provide some additional details relating to objection points 1 and 2 above, which we feel warrant particular consideration in view of the current food shortages and policies on energy security and food security.

2) National Planning Policy Framework (NPPF)

- The updated NPPF was released in July 2021. The Mallard Pass proposal conflicts with the updated NPPF, which includes a strengthening of the environmental objective that requires sustainable development to protect and enhance our natural, built and historic environment. This includes making effective use of land and improving biodiversity. The use of over 2000 acres greenfield land for this "mega-scale" scale solar development conflicts with NPPF Chapter 11 (Para 119) as it does not make effective use of land. The land at Mallard Pass currently sustains a range of high yielding arable crops including wheat, barley, maize, rape seed, etc. Covering such valuable land in solar PV is not an effective use of the site, and particularly so when we know that other built surfaces are readily accessible and could be used.

- Mallard Pass also conflicts with NPPF Chapter 15, and specifically paragraphs 174-175 and 183, which cover 'Conserving and Enhancing the Natural Environment.' It is made clear that the economic and other benefits of best and most versatile (BMV) land *must* be taken into consideration and that such land should not be developed unless there are exceptional reasons. We do not consider there to be any exceptional reasons why Mallard Pass should be approved on BMV land. There are other sites that could be more suitable, but which have not been fully considered. We consider that the Mallard Pass site seems to have been driven by proximity to the Grid connection point, coupled with willing landowners, rather than properly accounting for the quality of the land and assessing the suitability of other sites. With advances in cable technology, proximity to the Grid should not be a determining factor in the site selection process, as there are many proposals where the energy generation is many kilometres away from the connection point (examples include Sunnica Energy Farm NSIP, which is approx. 11 Km from the Grid connection, as well as the well-known Xlinks project which aims to connect renewable energy generated in Morocco to the UK).

This NPPF policy section also clearly states that planning policy and decisions should protect and enhance valued landscapes.

Membership of Solar Energy UK

Aside from lack of compliance with the NPPF, it is also noteworthy that one of the UK's solar trade associations, Solar Energy UK, SEUK (of which the developers behind Mallard Pass are members) state in their 11 commitments for solar farms that:

1. We will develop on non-agricultural land or land which is of lower agricultural quality where this is available.

2. We will enhance the biodiversity and natural capital value of all solar sites, being sensitive and complementing nationally and locally protected landscapes and nature conservation areas.

3. We will deliver multi-functional land use by proposing co-location with agriculture and/or nature recovery projects for solar and energy storage developments.

4. We will minimise visual impact where possible, making visual enhancements, and including appropriate screening, such as tree planting and restoring hedgerows, throughout the lifetime of the project. These will be managed through landscape and visual impact assessments.

5. We will accommodate needs for rights of way and sites of archaeological importance

6. At the end of a project's life, we will ensure full decommissioning of the equipment and return the land in a similar or improved state as before.

7. We will engage with the community in advance of submitting a planning application.

8. We will support the local economy through local business rates, diversification of farm income and encouraging as many employment and training opportunities locally as possible.

9. We will act considerately during construction and ensure all health and safety issues are addressed throughout the lifetime of the project.

10. We will engage and provide detailed information to the local community and listen to their views and suggestions, including the provision of specific community benefit schemes, or use of the site as an educational opportunity, where appropriate.

11. We will work towards the highest supply chain standards possible, working with the UK and European solar industry to do so. Please note that more information on this will be made public in Autumn 2022.

SEUK also clarify that *"Ground-mounted solar projects should utilise previously developed land e.g. Brownfield sites, contaminated and industrial land, and land of lower agricultural quality (as identified in the Agricultural Land Classification (ALC)."*

They also state that:

"Sites should aim to avoid high levels of visual impact and seek to maintain and enhance the natural beauty of the landscapes." (reference source: Solar Energy UK. 11 Commitments on Solar Farms).

Mallard Pass appears to be in conflict with these commitments – especially commitments 1 and 2 - for appropriate solar developments.

- The significant scale and spread-out nature of the Mallard Pass development will cause harm to the context, setting and interinfluence of local heritage assets which makes the application contrary to NPPF Chapter 16 'Conserving and Enhancing the Historic Environment,' paragraphs 189, 194, 195, 199 and 200.

- Mallard Pass also conflicts with the updated NPPF's emphasis on preserving tranquillity (Chapter 15, paragraph 185. Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason) and the Government planning guidance regarding noise and existing areas of tranquillity.

<u>3. NPPF Link and Lack of Compliance with broader Government Policy</u>

Government policy has long aimed to protect valuable farmland. The Energy Security Strategy (7th April 2022) discussion of solar states that, *"We will continue supporting the effective use of land by encouraging large scale projects to locate on previously developed or lower value land*." Mallard Pass is on highly productive farmland.

In the Government Food Strategy issued on 13th June 2022 it states that "*It is possible to target land use change at the least productive land*" (Para 1.2.2).

The policy to protect valuable farmland can also be traced back to the NPPF of March 2012 (paragraph 112) in which it is stated that "economic and other benefits of the best and most versatile agricultural land" should be taken into account. It goes on to say that where significant development of agricultural land is demonstrated to be necessary, local planning authorities should seek to use areas of poorer quality and in preference to that of higher quality.

The Government also re-affirmed the importance of protecting our soils and the services they provide in the Natural Environment White Paper, The Natural Choice: securing the value of nature (June 2011), including the protection of best and most versatile agricultural land (paragraph 2.35).

A further example is provided in the letter below written by Eddie Hughes MP, former Ministry of Housing, Communities and Local Government, who wrote a letter to Kemi Badenoch MP on 2nd June 2021 stating, *"There are strong protections in place within national planning policy which guards against inappropriately sited solar farms…expects local authorities…to take account of the benefits of the best and most versatile farmland, to enhance the biodiversity and recognise the character and beauty of the countryside….Where a proposal involves Greenfield land, local councils are expected to consider whether the proposed use of any agricultural land has been shown to be necessary. Where high-quality agricultural land is involved, this would need to be justified by the most compelling evidence. We have been clear that the need for renewable energy does not automatically override environmental protections and the planning concerns of local communities, and that the views of local communities should be listened to….Where relevant planning considerations are raised by local residents these must be taken into account by the local council."*

It is clear that Government policy continues to strive to protect valuable farming land. The Mallard Pass development should therefore be rejected.

4. Loss of Farmland and Agricultural Land Classification (ALC) for Mallard Pass

The applicant appears to have changed their ALC assessments over the course of the application process, which raises some cause for concern as to what the 'true' assessment is. Nevertheless, the amount of Best and Most Versatile (BMV) land remains a significant portion of the site, and development on this type of land should be avoided, per the NPPF.

It should also be noted that there currently appears to be some confusion more generally regarding how BMV land is defined:

In 2015 the Ministry for Housing & Local Government (MHCLG) issued guidance on Best and Most Versatile Land (BMV) and that was classified as *Grade 3b and above*. This is conflicts with Natural England's 2021 position that BMV is Grade 3a and above.

In February 2019 a question was addressed to DEFRA by Rosie Cooper MP. The reply from George Eustice was that BMV is classed as Grade 3b and above.

This was re-affirmed during a meeting on 29th June 2022 of the Environmental Audit Committee of the House of Commons. The transcript of the dialogue between James Gray MP and George Eustice SOS DEFRA is as follows:

Q8 **James Gray:** Very briefly on a remark you made a moment ago, have you had recent discussions with the Department for Planning? I had a letter from it yesterday indicating it thought that grade 3b land was perfectly acceptable for solar. Is that right or not?

George Eustice: It is not right. This is something that we are discussing across Government at the moment. I looked at this issue in some depth in about 2015 when we had something of a solar rush at that time. We agreed with the then MHCLG that its chief planning officer would issue guidance to planning authorities that created a strong presumption against solar farms on the best and most versatile land and that is classified in law as grade 3b or above. Grade 3b land is classified as BMV land, best and most versatile.

Q9 **James Gray**: That needs to be clarified. At the moment DCLG is saying 3b is allowable for solar and you have said the opposite, so it needs to be clarified within Government. I think your point that 3b is not acceptable is spot on and absolutely right.

George Eustice: We issued this guidance, as I said, about six or seven years ago and this problem was resolved for some time. We are conscious that there have been a few quite big schemes in recent months or over the last 12 months where planning authorities seem to have either forgotten or started to disregard that advice. I don't think that new guidance was issued by MHCLG but if, as you say, it doesn't understand the legal definition of BMV land obviously we will that up with it, but 3b constitutes BMV land.

Since this latest meeting, members of the SCA have asked several MPs if the above represents government policy. Several have confirmed that it does, including James Gray MP, who said that "*Hansard speaks for itself and is decisive in a court of law*" and Sir Oliver Heald MP (QC) who said that, "*The Minister's statement in the House of Commons proceeding and recorded in Hansard can be relied on as a statement of Government policy.*"

It should therefore be concluded that land of Grade 3b and above is considered BMV in Government policy. Mallard Pass should not be developed. If the panels must be installed on land, other lower grade or brownfield sites should be sought.

5. Mallard Pass Connection with Current Conflicts between Land Use and Food Security

The average loss of the UK's agricultural land has been assessed at 40,000 hectares (96,000 acres) a year and rising. This figure is potentially much higher, with woodland targets set at 30,000 hectares a year, and infrastructure projects and housing expanding and increasing demand for land.

A study by the UK Centre of Ecology and Hydrology suggested a loss of two million acres between 1990 and 2025, and a 2014 study by the University of Cambridge (3) suggested a farming land shortfall of two million hectares (4.8 million acres) by 2030. Every projection shows that loss of productive land and new environmental schemes, while fundamentally a good thing, will reduce food productivity; the same applies to woodland areas. Land being used for energy purposes, e.g. the production of biofuels or for solar farms, will further reduce the food-growing areas (the tally for proposals in the SCA alone are over 42,000 acres and there are many more solar schemes in the pipeline).

Climate change and food production: A report from the University of Minnesota in conjunction with other universities has stated that the world's top 10 crops (barley, cassava, maize, oil palm, rapeseed, rice, sorghum, sugar cane, wheat) supply 83% of all calories produced on crop land. They state that yields have long been projected to decrease and that new research now shows that climate change has already affected production of these key energy sources. The average reduction is 1% and the impacts are greatest in Europe, Southern Africa and Australia. A UN report in 2019 stated that 10% of the world's population was undernourished and "climate change will accelerate the rate of severe food shortages". A report from The European Environment Agency in the same year said, "Crops and Livestock production is projected to decrease and may even have to be abandoned in Europe's southern and Mediterranean regions….. any benefits would be outweighed by the increase in extreme events negatively affecting the sector."

Specific examples in Europe include Spain where two thirds of the country is considered to be vulnerable to increasing desertification and accelerated soil erosion. Many African countries will be severely affected, for example 98% of Kenya's agricultural activity is rain fed and highly susceptible to climate change. In the USA research (USDA Tech Bull. 1935) indicates that climate change will lead to a decline in yield and nutrient density in key crops as well as decreased livestock productivity.

Impact on the UK: A report on food Security in the House of Commons library published in 2020 states that climate change will produce significant risks to UK food supply. The government Energy White Paper (December 2020) states that if there were no further temperature rise then 15% of UK land is classified as poor. If temperatures rise by 4 degrees centigrade then this poor land would increase to 70% of the total leading to a massive decline in UK food production.

A risk assessment produced for parliament (June 2022) emphasised the changes to food importation as a result of climate change.

40% of all food consumed in the UK is imported (25% of indigenous food types). 30% of all the food that is imported comes from the EU. 19% of fruit and vegetables come from Spain and 11% from the Netherlands. Overall, 45% of vegetables are imported and 84% of fruit, 4% of food imports come from Africa, with Kenya and South Africa being the dominant countries. A further 4% of food imports come from North America and 4% from South America. The majority of wheat the UK imports comes from the EU. 15% of wheat for flour is imported.

Analyses of imports against climate change impacts suggests that several countries the UK imports from will face problems; these include the EU and Spain in particular. Africa and especially Kenya and South Africa will also be hard hit by climate change. There will also be significant impacts in Australia and some South American countries. The overall food importation level is complex and is further affected by population growth and levelling off of crop yields, fragility of supply chains and a range of other factors. The war in Ukraine has added to the problems and complexity.

If more of the UK's farmland is lost to development (and particularly to solar development which requires large areas of land) it is highly likely that the UK will need to import more food, and this will become more difficult and more expensive as other countries feel the impact of climate change.

The Mallard Pass development should be rejected as it constitutes a loss of a significant amount of valuable farming land which must be kept in food production to maintain our food security. There are alternatives (lower grade land areas, brownfield sites and car parks and rooftops, etc) that do not pose such a threat to our food security.

6. Number and scale of solar farms across the UK on farmland

Mallard Pass, if approved, would occupy a significant area of Lincolnshire and Rutland. But schemes such as this should also be considered in a national context which will reflect the cumulative effect of all the solar farm proposals in the country and the impact on national food production.

There do not appear to be any accurate statistics available on the cumulative impact. Solar Energy UK claims that only 0.1% of UK land is under solar panels (ca. 56,000 acres, most of which would be on farmland in England). The Energy Security Strategy paper states that there is currently 14GW of solar capacity in the UK. If 1GW requires 5000 acres land, it follows that 14GW would require 70,000 acres of land (approximately 30,000 ha).

The issue is the potential loss of farmland as solar farms grow in number. The Energy Security Strategy states the Government expects a five-fold increase in solar to 70 GW by 2035. If all of this was land-based, it would require an additional 350,000 acres, which is 3% of the cropable area of England. This would impact food production, particularly since land loss is increased in many other ways.

In England there are 21 million acres of agricultural land. If 39% of this area is Grade 4 & 5, this means that 8 million acres of 'poorer quality' land are potentially available for development. There is no logical reason why Mallard Pass needs to be located on good quality soil, as there are alternative sites available.

7. References

1 UK Warehouse Association research on rooftop solar. Published Sept 2022. Available at [redacted]

(Included as Appendix 1)

2 University College London Energy Institute research, commissioned by CPRE, the countryside charity. Published 23rd May 2023. Available at [redacted]

(Included as Appendix 2)

3 2014 study by Cambridge Institute for Sustainability Leadership (CISL), available at [redacted]

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INVESTMENT CASE FOR ROOFTOP SOLAR POWER IN WAREHOUSING

August 2022

Introduction & scope of work

The Voice of The UK Logistics Industry

SYNOPSIS

This research project, commissioned by UKWA, investigated the overall case for installing rooftop solar photovoltaic (PV) systems in the warehousing sector. Warehousing has steadily been increasing its energy efficiency over the last 10 years, through improved lighting, electrification of material handling and system efficiency; however, rooftop solar projects have expanded more slowly. As the warehousing sector possesses approximately a third of all commercial roof space it has a large potential role to support the rollout of solar PV generation.

This report summarises the potential benefits for rooftop solar PV in warehousing for the sector's key players and the overall national and local benefits. The key barriers are described, future opportunities for increased deployment have been explored. Finally three priority areas addressing key barriers have been identified.

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Executive summary

What are the key benefits of rooftop solar on the UK's warehouses?

Warehousing is in a unique position for solar power, providing an unparalleled amount accessible roof space close to industrial and residential centres.

Rooftop solar PV provides, lower and secure electricity costs, reduced environmental impact, no additional land use and increased asset value and efficiency.

National and local benefits

UK warehousing has the roof space for up to 15GW of new solar, which would **double the UK's solar PV capacity.** This could meet National Grid's minimum requirements for solar expansion by 2030 according to their 2022 future energy scenarios (FES), producing up to 13.8 TWh of electricity per year enabling the warehouse sector to become a **net producer of green electricity.**

Rooftop solar PV in warehousing can play a significant role in delivering **local renewable energy**, particularly in urban areas where limited alternative options are [redacted]

Industry benefits

Commercial electricity prices have doubled since the start of 2022 and are set to continue to rise into 2023. Solar PV can **reduce annual electricity costs by 40-80%** and protect occupiers against future electricity price rises while preparing for increased demand from electrification of heat and transportation.

In aggregate rooftop solar PV has the potential to save the industry **£3 billon per year.**

Rooftop solar PV presents the s[redacted] opportunity to significantly **redu**[redacted] reducing CO_2 [redacted] while also providing a good financial investment.

For owners and landlords solar PV has a major role in **levelling up the UK's warehouses** increasing the value and desirability of the warehouse assets. It also supports the drive for increased efficiency and meeting energy performance regulations.

Executive summary

What are the barriers and future opportunities?

Investment costs, low electricity demand and grid connections are the main barriers to systems, and a culture shift is required to develop larger installations.

Electrification of heat and transportation will increase the need for low-cost electricity and improve solar PV economics in warehousing.

Improved aggregation and energy storage will enable larger solar PV arrays.

Key barriers

The low warehousing typical **electricity demand** limits the economically viable installation size and therefore the viability of using the full roof area. However up-front investment costs can remain high.

Electricity **grid network connections availability** can limit the maximum system size, incur costly upgrades and even prevent projects where grid constraints are very high.

Larger installations require adopting different market risk as a power producer, either through outsourcing or a **culture shift** in the sector to see warehouses as [redacted]

Future opportunities

Electrification of **heat**, new automation systems and critically electric **transportation** could significantly increase electricity demand in warehousing. This will **improve the economics** of rooftop solar through increased self-consumption.

Increasing initiatives to **streamline the aggregation** and resale of excess renewable energy from smaller facilities in local communities will enable **higher incomes** from exported power, allowing larger systems to operate more econo[redacted]

Reduction in the costs of **local** [redacted]**ility**, improving self-consumption and reducing impact on local network infrastructure.

Warehousing, net zero and rooftop solar PV

Why is now the time to investigate rooftop solar for warehousing?

[redacted]

[redacted]

[redacted]

[redacted]

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Warehousing, net zero and rooftop solar PV

A range of drivers are improving the attractiveness of solar PV

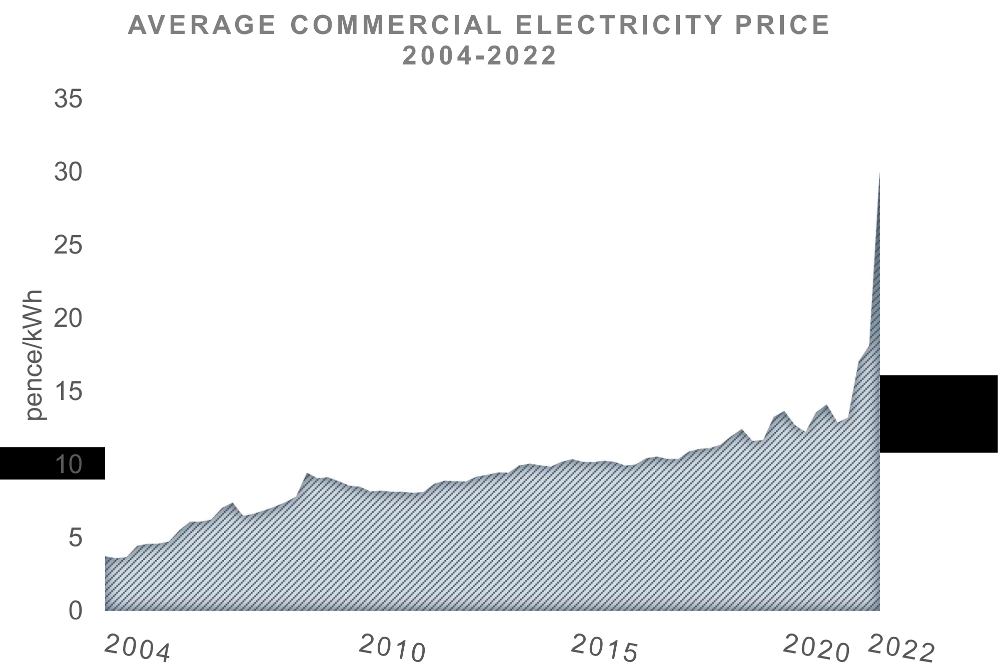
Solar is expected to expand greatly through the 2020’s to support the transition to net zero. Warehousing has a unique asset to support the rollout.

In the UK, following the end of the Feed-in Tariff (FiT), and the subsequent market drop in 2018/19, installations are increasing again and are forecast to rise through to 2025 at least.

A combination of increasing energy prices, the drive to net zero and the prospect of heat and transport electrification means there is a strong need for low cost, low carbon and reliable electricity in the warehouse and logistics industry.

Solar PV UK rollout expanded significantly in the early 2010’s due to generous feed-in tariff support. However, as this subsidy was reduced and ultimately removed in 2019, there has been a significant downturn in solar installations.

Solar panel cost reduction combined with energy price increases is improving the economics making solar PV [redacted] insta[redacted]



Source: BEIS, 2022 Q2 price through consultation

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Warehousing, net zero and rooftop solar PV

Why is now the time to invest in rooftop solar?

UK solar capacity is expected to increase two or threefold over the next 10-15 years to support the UK's net zero ambitions.

Solar installations are expected to rise to meet the UK's net zero ambitions. Analysis from National Grid[1], the Climate Change Committee[2] and National Infrastructure Commission[3] model a **doubling of solar capacity by 2030**, with some scenarios requiring much higher deployment. The UK Government published its Energy security strategy in April 2022[4], **proposed a five times in increase** in solar by 2035.

A major question is **where all this new solar capacity will be built;** over the last decade the majority of solar installations have been utility-scale ground-based systems, usually on farmland. With [redacted]

While regulatory ambitions and the market conditions for solar are improving, there **remain barriers to unlocking the full potential** opportunity of the UK's commercial rooftops and, in particular, the unique position in the warehousing logistics sector which has the largest combined commercial rooftop space.

This report summarises the potential **benefits** of rooftop solar in warehousing sectors key players and the overall national and local benefits. The key **barriers** to solar deployment are described and **future opportunities** for increased deployment are explored.

[redacted]

Benefits of solar PV

An overview of the key benefits of solar PV at the national and local level and the misaligned benefits for warehousing occupiers and landlords

[redacted]

[redacted]

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National benefits for rooftop solar in warehousing

What is the potential across the UK?

Warehousing provides a unique opportunity for large scale rooftop solar deployment, with approximately one third of the UK's total non-domestic buildings' roof space.

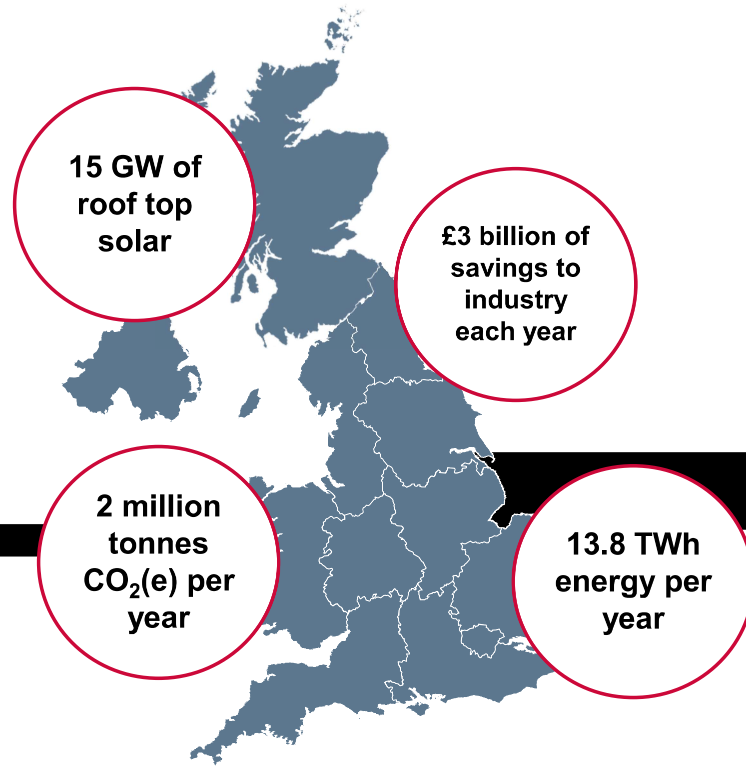
Rooftop solar power could transform the UK warehouse sector into a net producer of renewable electricity

With **only the largest 20%** of warehouses there is enough roof space to **double the UK's solar generation capacity** from 14 to 28 GW

National Grid's future energy scenarios[1] consider 12-29 GW of additional solar is required by 2030; warehousing could play a major role in the next decade.

With 15 GW of solar fitted, the warehouse sector could **generate ~13.8 TWh** of renewable electricity per year – transforming the sector from **net consumers to net producers.**

[redacted] gas.



National potential of rooftop solar on UK's warehousing
Calculations in annex

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Benefits for occupiers

Why should tenants be pursuing rooftop solar on their sites?

Rooftop solar is one of the most cost-effective CO_2 reduction measures for warehouses.

Payback times for solar PV have been falling due to increased electricity costs.

Third party financing options enable installations without initial capital investment.

Environmental, social and governance
Meet environmental impact and corporate social responsibility targets. Solar PV is a direct solution to decarbonisation compared to outsourcing or offsetting.

Immediate and future cost reduction
Payback for upfront cost can be as low as 4 to 6 years.[5] Driven by currently high energy prices. Third party financing options can provide immediate annual cost savings without [redacted] later to upgrade facilities to meet upcoming efficiency regulations.

*A 500 kW solar PV system (suitable for 100,000 sq. ft. warehouses) can **reduce CO_2** emission by around **65 tonnes per year**, equivalent to driving an HGV approximately 87,000 km

Benefits for landlords

Why should landlords invest?

Solar PV is a complementary investment to commercial property in its own right, while providing additional benefits.

Increased asset returns, value, customer attractiveness and meeting environmental obligations.

Rooftop solar PV de-risks meeting future regulations and prepares assets for electrification.

Return on investment
Rooftop solar PV is a good investment opportunity in its own right, providing an internal rate of return of 10-15%* on self financed projects.

Asset value and desirability
Solar PV systems have lifetime of 25 years adding to the total warehouse asset value. Increased ESG interest by institutional investors is leading to CO_2 emission-based investment criteria.

Lower energy costs are more attractive, [redacted] rating required by 2027. Solar PV can help meet this obligation while providing good financial return.

- The IRR is dependent on location, building size, orientation, onsite energy demand and through life electricity prices.

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Benefits for local areas

Why should local communities support rooftop commercial solar?

Warehousing is unique in providing extensive commercial rooftop space in urban and sub-urban areas, where other renewable energy options are limited.

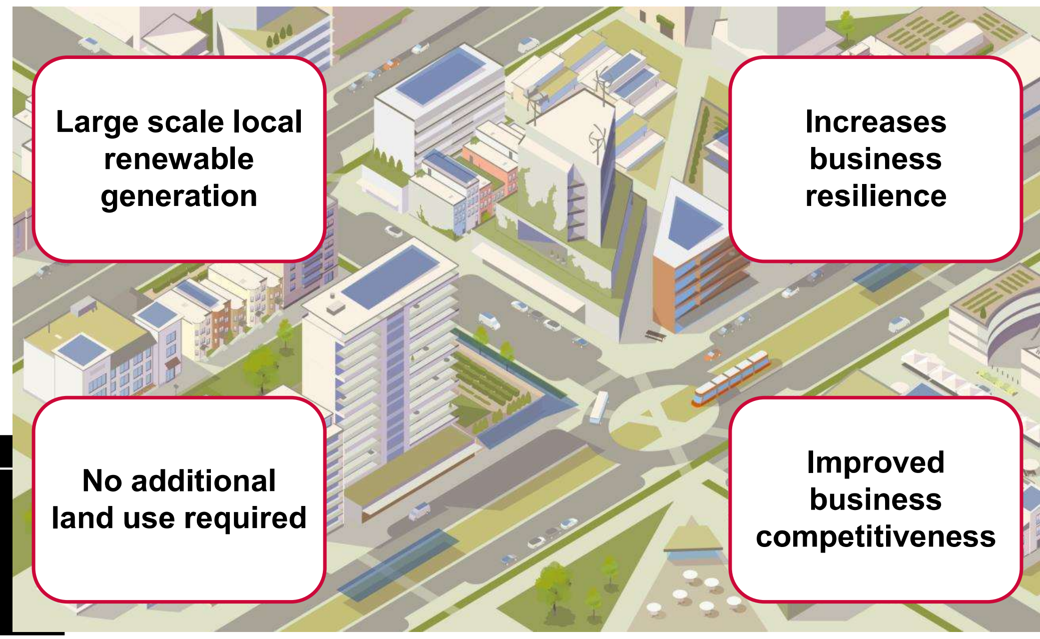
Rooftop solar on warehousing could be a significant element in local energy system planning.

It is ideally placed to meet the local net zero targets for 2030 as a ready to deploy technology.

Local area net zero planning targets
Local Government must play a major role in meeting UK's net zero targets.[6] In England, 91% of principal local authorities have commitments to decarbonise.

Warehousing rooftop solar PV provides large footprints in urban and sub-urban areas. The UK's 20% largest warehouses can provide 75million m², avoiding the need for additional land, equivalent to the footprint of 500,000* houses.

[redacted] emissions, increasing their attractiveness to customers through lower impact on the supply chain.



*Assuming average house plot area of 150m²

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Barriers

Examination of the key elements preventing or slowing the rollout of solar PV in the warehousing sector

[redacted]

[redacted] [redacted]

[redacted]

Barriers to scale-up

Four key barriers that slow commercial solar PV roll out

Most barriers reduce the size and potential uptake speed of solar PV in warehousing, rather than preventing installations.

Energy demand and economics

Energy demand in warehousing is relatively low per unit floor area and does not match solar PV generation profiles.

[redacted]

Business model and contractual barriers

As the logistics market becomes more specialised and segmented it is harder for many operators and owners to justify investing.

[redacted] ations with [redacted] window for [redacted] g conducted.

Project complexity and commercial risks

The complexity of the process and design options can be challenging and require specialist input.

[redacted] g and insuring leases create commercial barriers on liability for both tenants and landlords.

Local energy coordination and planning

Grid connection constraints are a major barrier to larger scale [redacted]

Local energy planning to support installations and help achieve higher uptake is currently lacking.

Economics of solar power

What are the main costs, incomes and complexities?

Solar power economics are driven primarily by upfront cost and the degree of self-consumption.

Solar variability adds further challenges in size optimisation.

The typically lower value of exported power means smaller systems are favoured to maximise on-site consumption.

The principal economics of solar project are straight forward:
Costs included:
- Upfront planning and development
- Upfront equipment and installation
- Through life maintenance

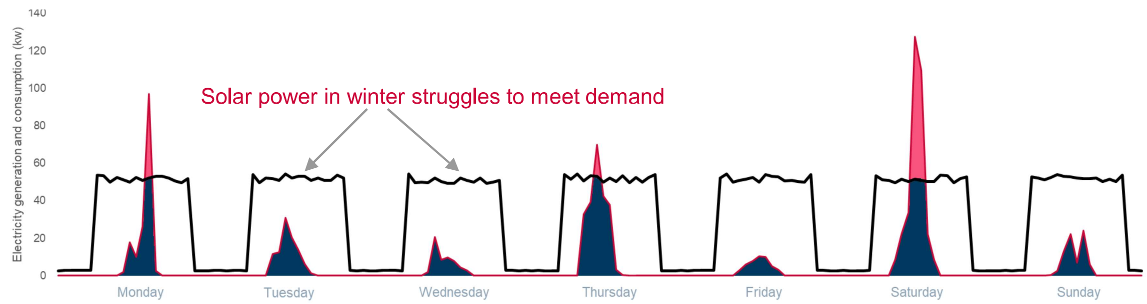
Upfront costs are typically around 70-80% of the overall project costs.

Income streams include:
- Self-consumption to avoid retail electricity costs
- Income from exported power.

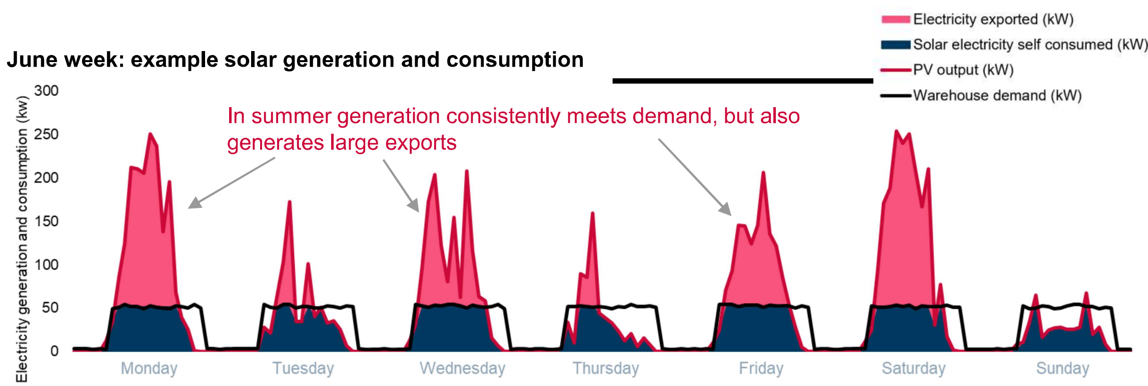
Avoided electricity costs are typically 2-3 times more valuable than exported power.

[redacted]

January week: example solar generation and consumption



June week: example solar generation and consumption



Illustrative examples – demand profiles simplified

Solar sizing and optimisation options

What is the impact on payback, profitability and emissions?

Understanding the primary aim of the project is important in determining the sizing approach.

Smaller installations with high self-consumption provide low risk returns, while larger systems can provide higher overall payback.

Optimise payback and return on investment

In this approach the solar system is sized to optimise the profitability of the solar system to balance payback time and system size.

This can generally be achieved by optimising for self-consumption and therefore the optimum PV array size is constrained by energy demand characteristics.

- Size(kWp): 150
- [redacted]

Maximise financial impact

A focus can be to maximise the net present return – this may reduce the profitability, but increase the overall return. While this increases the investment risk, the potential benefits are also increased.

This is typically constrained by grid connection and the potential for electricity exports and their value.

- Size(kWp): 400
- [redacted]RR(%): 9%
- [redacted]nergy (GWh): 9
- [redacted]arbon savings(tonnes): 1300
- [redacted]et present value(25yrs):£357k

Maximise environmental impact

Prioritising environmental impact aims to maximise generation to reduce CO_2 emissions as far as possible and therefore businesses' environmental impact.

This is primarily constrained by roof size and structure and the maximum allowable installation for the grid connection.

- [redacted]
- IRR(%): 3%
- Energy (GWh): 22
- Carbon savings(tonnes): 3300
- Net present value(25yrs):£317k

This is an illustrative example calculation, specific costs and payback is highly dependant on circumstances, assumptions in annex.

Business model and contractual barriers

How do existing warehousing business approaches deter investment?

Market segmentation, deters investment in solar generation due to the benefit being split by multiple parties.

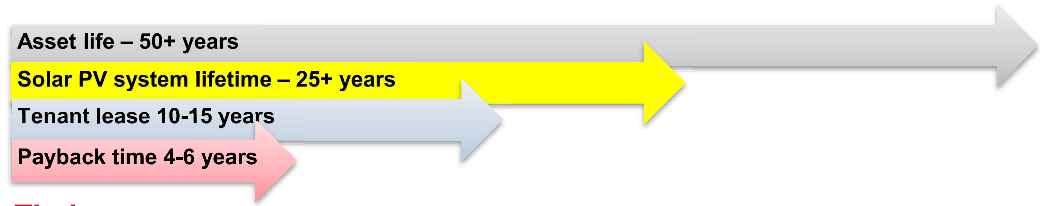
Long leases provide a short window for low friction contractual negotiations.

Business model and market segmentation

The warehousing market is increasingly segmented, in particular with the rise of third party logistic models requiring agile operations to manage short term customer contract risks (1-3 years) and shorter leases.

Solar PV projects are longer term investment 10-25 years and linked to the warehouse, this mismatch in timescales deters investment from occupiers.

Extracting the full benefits is [redacted]



Timing

Some occupiers are keen to invest to reduce costs and environmental impact. However, justifying investment in property you don't own is challenging unless there is sufficient time to make a return.

- Lease durations are typically 10-15 years while the payback time for rooftop solar - typically 4-6 years - means at the start of most leases there is sufficient time to realise financial benefit, however this diminishes quickly over time
- When remaining lease duration approaches [redacted] to invest.
- [redacted]he ideal solar PV installation time is at the start of a new lease every 10-15 [redacted]ears to simplify the contractual negotiations.
- [redacted]lder buildings with asset life of <25 years may not receive full benefit from solar and may also have higher cost installations.

Complexity and risk

What are the main risks that prevent, delay, or reduce installations?

There are a range of risks in installing a solar PV system, but as with any construction project careful planning and the use of experienced professionals can help minimise the impact.

Feasibility

In the feasibility phase, the key expenditures are feasibility assessment and surveys, design, legal costs. The key elements to address in this stage are:

- Structural: a professional survey is necessary to ensure chosen roof(s) can accommodate PV systems.
- Contractual: clear alignment between tenant, landlord or other parties either allowing rights for installation and roof access or commitment to resolve any issues identified.
- [redacted] to collaborate on detailed design and planning and permit applications.

Design and consenting

After establishing feasibility, a detailed site survey and financial modelling will be required to support a detailed system design. The next stages are:

- Application for grid connection permits: this critical stage can delay and limit the installation and therefore should be made as early as possible.
- Planning permission: this is rarely an issue for rooftop solar, as small scale solar is permitted development. However for installations >1MW there is specific [redacted] onths.
- [redacted]inalisation of legal agreements, [redacted]cluding power purchasing [redacted]greements.
- [redacted]inalisation of financing options and internal project approval for the investment.

Installation, operation and end of life

With all consents in place installation of the system can begin. The following factors are key risks:

- Quality of installation: critical to the long-term performance of the solar PV system.
- Disruption during installation: careful planning can enable installers to minimise or eliminate installation disruption as much as possible.
- Damage during installation: agreements with the installers to [redacted]

- Through- life performance monitoring and maintenance.
- Financial monitoring and management of export agreement and contracts.

End of life:

- Decommissioning, dismantling and recycling costs.

Local energy coordination and planning

How is lack of local energy planning obstructing installations?

Local energy planning does not currently coordinate grid upgrades or facilitate local energy generation and consumption.

Grid connection permits are a major barrier to rooftop solar installations, increasing costs and constraining project size.

In some cases, these additions can prevent projects from being developed.

Grid connection permitting

When building any solar project over 16A per phase (3.68kWp for a single phase or 11.04kWp three phase) the local distribution network operator (DNO) must be informed and provide prior permission. In response to an application, DNO's typically respond in 4 ways:

- Proceed with no constraints or charges
- Constraints on maximum system size and export limitation, without requiring grid upgrade costs. (Verification costs are required)
- Requirement to upgrade grid connection infrastructure, some cost must be born by the solar project owner.
- [redacted] tight[redacted]

[redacted] required, which diminishes project returns and increases installation time and complexity.

Local area energy planning

Deficit of local energy planning is acting as a barrier to commercial solar installations in warehousing.

As electricity usage and local renewable generation is increasing grid infrastructure needs to be upgraded to support the local community and businesses. These costs are typically shared through distribution use of system charges.

However when building solar generation projects, there is a currently a first come [redacted] available capacity for free. Late[redacted]at would typically be shared.

Solar PV has the potential to provide low-cost energy locally, increasing the value to the project owners, while also sharing benefits to local business/community energy costs. The matching of generation and customers is not currently coordinated and acts as a barrier.

Future opportunities

An overview of potential opportunities that will mitigate some barriers and enable increased benefits

[redacted]

[redacted] [redacted]

[redacted]

Technology drivers

What technology changes will increase the attractiveness of Solar PV?

Increasing local demand and self-consumption could enable significantly larger installations.

Energy storage has the potential to offset grid connection limitations and improve economics as costs reduce.

Electrification of transport

Decarbonisation of light and heavy goods vehicles is likely to cause be the biggest increase in energy demand in the logistics sector in the near future.

Whether through direct electrification or hydrogen conversion, decarbonisation of 25% of the UK's HGVs alone would require between 60-100%(8-14TWh) of the current annual electricity consumption of the whole warehouse sector.

HGV electric charging or hydrogen generation on-site at warehouses could [redacted]

Energy storage

On-site battery storage can improve solar PV financial viability by:

- Increasing the % of energy self-consumption and therefore increasing the economic value.
- Reducing the peak exports, therefore reducing the necessary grid connections or enabling larger installations.
- Opening up the opportunities for providing flexibility services and accessing new forms of revenue from the energy system.

Currently the capital cost of battery [redacted]

[redacted]ever, as costs further decrease and [redacted]econd life battery market grows, [redacted]ry storage systems could enable [redacted]ficantly larger solar installations on a wider range of warehouses.

Automation and light manufacturing

The warehousing and logistics industry is already estimated to have the highest proportion of automation of any industry[7] and is forecast to grow dramatically in the next 5-10 years to meet the high and growing penetration of e-commerce in the UK retail industry. This trend is likely to further increase the energy demand in some warehousing.

However, the overall energy demand [redacted] same throughput while others increase demand but significantly increase the warehouse efficiency.

Economics and business models

Improving the value of exported energy

Self-consumption dominates the economics of solar power, which is challenging for low demand warehousing.

Increasing the value of export power, greatly increase the optimum size of solar installation.

Power purchasing agreements for export

Larger installations can take advantage of power purchasing agreements (PPA) to significantly increase the value and decrease the risk of energy exports.

Sleeved PPA allows the user to have little knowledge of the electricity market, working with energy suppliers to manage the purchasing and sale of the electricity over the network. A number of specialist PPA companies provide this service.

[redacted]

Aggregation and virtual power plants (VPP)

An emerging opportunity for smaller installations is the increasing capabilities of aggregators to combine smaller generators into virtual power plants.

In this approach partnering with third party aggregator allows the solar PV owner to achieve higher value export. The aggregator is able to achieve a higher value by combining several solar PV systems (and potentially other assets) into a single VPP that can either bid directly into the electricity market, [redacted] PPA.

Community energy

New business models and approaches for local energy markets such as peer-to-peer trading can allow significant improvements in export price. These approaches are new and could bring more risk and complexity.

More sophisticated options, such as collective self-consumption can allow local communities to work together, maximising use of local energy and minimising the impact on the local grid. The current regulation in the UK makes [redacted]

The Voice of The UK Logistics Industry

Priority areas

What are the key priorities areas to alleviate barriers and enable widespread solar deployment

[redacted]

[redacted] [redacted]

[redacted]

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Priority areas

Identified priorities areas to enable widespread solar PV

Government can support solar PV deployment through tax incentives and electricity market reform and reduce barriers in accessing grid connections.

The industry must develop best practice approaches.

Investment costs

Whilst high energy prices are helping to improve solar PV economic performance, the investment costs are also increasing as solar panels installation is influenced by global inflation and supply chain pressure.

As 70%+ of costs involved in solar projects are upfront and interest rates are rising, financing these projects is increasingly challenging. In particular for small and medium businesses where cash flow is tight.

In April 2021 the UK government [redacted]

Grid connection permits

The UK grid is becoming more constrained with growing electricity demand and increased residential and commercial generation. This will increase costs when securing connection permits for rooftop solar and limit their viable size, therefore limiting the national, local and business benefits.

The department of business, energy and industrial strategy is currently reviewing the electricity market arrangements and Ofgem is consulting on the future of DNO/DSO structures.

[redacted] arrangements will improve [redacted]ning and reduce grid connection [redacted]ers for deployment of commercial [redacted]op solar.

Industry perception, knowledge and best practice

The knowledge and perception for solar PV projects is fractured with challenges regarding risks, costs, legal issues and business models.

There is a need to provide best practice guidance to the industry for solar projects, especially in regards to contractual arrangements between tenants and landlords, and the opportunities for third party financing.

[redacted] the key design options, economics financing and legal considerations.

Annex

References, calculations and acknowledgements

[redacted]

[redacted] [redacted]

[redacted]

UKWA
The Voice of The UK Logistics Industry

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5. Solar Energy UK: Corporate buyers' guide (2022)
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7. THE ECONOMIC IMPACT OF ROBOTICS & AUTONOMOUS SYSTEMS ACROSS UK SECTORS, BEIS Research Paper Number: 2021/043

[redacted]

[redacted] [redacted]

[redacted]

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Calculations (1/2)

Installation and energy generation capacity

BEIS Non-Domestic National Energy Efficiency Data Framework has been used to estimate total warehouse floor area. This data shows 35000 warehouses over 1000 sq. m (~10000 sq. ft) in size, with a total floor area of 150 million sq. m and average energy use of 11.2 TWh (75% of 14.4 TWh total electricity use)

Assumptions:

- Roof area = floor area
- Solar peak capacity = 200kW/m^2 = 5000m^2/MW
- Roof space fitted = 50%
- Average load factor = 11%

[redacted] 50% [redacted]

[redacted] =

Carbon and cost savings

Carbon savings
The UK average grid carbon intensity is currently between 150-250g/kWh, mid point of 200g/kwh has been used. Solar PV carbon intensity is typically quoted at 50g/kWh.

- Carbon saving of 150g/kWh has been calculated

13,800,000,000 kWh × 150g = **2.07 million tonnes**

Cost savings
New commercial contracts for electricity supply are starting at 33 pence/kWh (June 2022). Mi [redacted] around 5-7.5p/kWh. Export contra [redacted]

Assumptions:

- 50% average self-consumption
- 33p/kWh average self-consumption savings
- 10p/kWh average export income

7,900,000,000 kWh × 0.33 +7,900,000,000 kWh × 0.1 = £2,966,355,000 = **£3 billion**

Calculations (2/2)

UKWA
The Voice of The UK Logistics Industry

Opportunity for occupiers

Grid electricity carbon intensity in the UK is typically around 150-250g/kWh in 2021 – 200g/kWh was used.

Solar electricity carbon intensity is around 50g/kWh, including construction, installation and decommissioning.

500kWp solar plant is estimated to make 433,000kWh/year.

433,000 x150 = 65.0 tonnes.

[redacted]km: [redacted]

Solar sizing optimisation

Scenario – ambient warehousing looking to invest in solar power with following characteristics:

- 100,000 sq. ft
- Location: UK Midlands
- Electricity usage: 30kWh/m^2/year
- Operating 7 days/week (6am-8pm)
- Flat roof, all panels south facing

Solar techno-economic assumptions

- Equipment and Installation costs - £1000-1500/kW (including site, electrical and [redacted]
- Inverter cost and lifetime -10[redacted]

[redacted]

- Solar irradiance data – PVGIS-SARAH 2
- Slope, Azimuth - 41/-11 degrees,south facing
- System losses - 21%
- Performance degradation - 0.5%/year
- O&M costs -10 £/kWp/year
- Maximum solar - 200W/m^2
- Maximum roof space coverage- 60%
- Discount factor - 5%

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Acknowledgements

This report was developed with contributions from a wide range of organisations. In particular, we would like to thank the following organisations for their input and expertise in the development of this study.

- Solar Energy UK – *an established trade association working for and representing the entire solar and energy storage value chain representing a member-led community of over 300 businesses and associates.*
- ABP – *Associated British Ports operate 21 ports across the UK, supporting around 120,000 jobs. In 2021,17 of 21 ports have renewable energy generation projects, including 6.5MW of solar energy installed and new installations planned for 2022 and beyond.*
- Conrad Energy – *Conrad Energy's generation portfolio powers the equivalent of over a* [redacted] *embedded, flexible generation projects, solar and battery storage. Conrad Energy has over* [redacted] *uctur*[redacted] *to net zero by 2050*
- [redacted] *space developer, with five locations across the UK covering over* [redacted] *installation projects since 2011, with over 3000 sqm of PV* [redacted]

Please note the contents and conclusions of this report do not necessarily represent the views of any of these organisations.

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[redacted]

Shout from the rooftops:

delivering a common sense solar revolution

May 2023

CPRE The countryside charity

Contents

Executive summary

The accelerating climate emergency poses the single greatest threat to the countryside. Without urgent action, iconic features of our landscapes, including English oak trees and our rare chalk streams, could be lost from many places, throwing the survival of much of our best loved wildlife into doubt.

At the same time, the increased risk of severe flooding caused by climate change threatens both rural communities and our food security. Recent research by CPRE, the countryside charity, shows that more than 60% of England's finest agricultural land is within areas at the highest risk of flooding.[1] For these and many other reasons, it is essential for the countryside that over the coming decade we cut our carbon emissions. Critically, we need to complete the transition from reliance on fossil fuels to a new era of renewable energy.

Yet, despite the urgent need to exploit the best opportunities to generate the renewable energy our country needs, we have a vast and largely untapped resource: roofs. Along with surface car parks, roofs provide space to generate solar-powered electricity, very close to where it is needed. Making the best possible use of solar on roofs and car parks is a solution that will enjoy almost universal support.

By contrast, greenfield ground-mounted schemes done poorly can cause harm, provide little benefit to rural communities and become bogged down in contentious planning disputes. This briefing looks both at the potential of rooftop renewables and at the interventions needed to deliver them.

To better understand the full potential of rooftop solar energy in this country, CPRE commissioned experts at the University College London (UCL) Energy Institute to undertake an independent review of the land use implications of meeting targets, drawn from a series of well-established net zero greenhouse gas emission scenarios. Using this data, UCL has produced assessments of the total energy that could be generated from solar photovoltaic (PV) panels on rooftops across England as well as the land area that may be required for wind, ground-mounted solar and biomass in England in net zero scenarios.

Key findings

- Although ground-mounted solar projects will be needed in the short term to hit national decarbonisation, installing solar panels on new buildings, existing large warehouse rooftops and other land such as car parks, could provide at least 40-50 gigawatts (GW) of low carbon electricity, contributing more than half of the total national target of 70GW of solar energy by 2035.
- Longer term to 2050, and with further investment, there is potential for up to 117GW of low carbon electricity to be generated from roofs and other developed spaces, reducing the need for greenfield ground-mounted solar in the medium to long term.
- Meeting national solar energy targets through ground-mounted schemes alone could require between 0.9-1.4% of the land in England, covering as much as 1,800 square kilometres/ 180,000 hectares of our countryside – an area larger than the size of Greater London (157,000ha).

Recommendations

A number of barriers stand in the way of delivering a rooftop solar revolution. Many of these can be addressed through policy and regulation, making the most efficient use of the opportunities available.

To achieve a rooftop revolution and reach the target of 70GW of solar by 2035, CPRE is urging the government to take action in the following policy areas:

1 Develop a national rooftop solar target

Commit to a new target of ensuring that at least 40GW of the national target for 70GW of solar by 2035 is delivered through the lowest cost opportunities for rooftop solar installations, on new builds, commercial buildings and car parks.

2 Protect landscapes

Properly manage the potential impacts of solar development in the countryside by:

a. Introducing a land use framework to establish how the overall needs for built development, carbon sequestration, energy and infrastructure, food security and nature recovery should be integrated and planned for.

b. Revising national and local planning policy to set clearer overall policy principles for determining ground-mounted solar PV applications, following a sequential 'roof first' approach. This should prioritise opportunities to install solar panels on suitable brownfield land and avoid best and most versatile agricultural land and other land used by active, viable and sustainable farm businesses. It should also make greenfield solar permissions much more exceptional and time-limited and require provisions for multi-functional benefits and achieving best practice standards for landscape and natural capital.

3 Planning regulations

Amend planning regulations and the Future Homes Standard so they state that:

a. Local authorities should, working with parish and town councils (following the example of Kendal Town Council) and other community groups, carry out audits of potential roof and other developed spaces that can be used for solar panel installations. This can be done through amending existing brownfield land register regulations, which currently look at developed land suitable for additional new housing.

b. Solar PV or thermal panels on suitably orientated roofs should be a standard expectation for all new buildings, including homes.

c. Conversions and major external changes to existing buildings should require full planning permission (in other words, removing permitted development rights) unless they bring the building up to the Future Homes Standard or equivalent.

d. Planning permission should not be granted for commercial or public car parking spaces unless they also provide solar energy generation.

4 Financial support

Develop a holistic set of market-based actions to kickstart the rooftop revolution for homeowners, landlords, small businesses and community energy projects including::

a. Government backed low-cost loans for domestic and commercial rooftop solar installations as well as small-scale community support to encourage a step change in installation rates.

b. Upgrades to the Smart Export Guarantee to ensure higher minimum tariffs are available to homeowners and businesses selling electricity from rooftop solar installations to reduce payback periods and improve investment viability.

5 Community energy

Update national planning and energy policies to encourage best practice in community engagement and empower rural communities to set out where and how new renewable energy schemes can be incorporated in the countryside. This should build upon the Community Energy Visioning process, pioneered by CPRE and the Centre for Sustainable Energy in recent years.

6 Grid capacity

Work with Ofgem to require Distribution Network Operators across the country to invest in local grid capacity to better accommodate increased generation from solar and heat pumps. This should deliver new connections in a timelier manner and ensure that businesses and property owners interested in installing solar panels on their rooftops are quoted reasonable and proportionate connection costs and timescales.

The climate emergency and the countryside

The UK is facing a huge two-pronged challenge on energy: how to meet its net zero carbon target and how to address an emerging crisis in the supply and cost of energy, which is having a profound effect on the cost of living. For people living in rural areas, these challenges are greater because their homes are less energy efficient, are more reliant on heating oil, for which there is currently no price cap, and are more car-dependent.

Far and away the most cost-effective measures to address these challenges, both in cities and the countryside, are upgrading the insulation standards and heating systems of buildings to reduce energy demand, as well as designing places and transport systems that reduce car dependence. But in terms of generating energy, we have a vast and largely untapped resource: roofs. Along with surface car parks, roofs provide space to generate solar-powered electricity that is very close to where it is needed, and so it is vital to make full use of this resource.

Our overall vision for tackling the climate emergency is set out in our 'Greener, better, faster' report[2], which highlights three crucial objectives:

1. Phasing out fossil fuels and prioritising demand reduction and energy efficiency;
2. Investing in 'renewables done well' — that is, low carbon energy schemes that are good for the local economy, supported by host communities, benefit wildlife and minimise impacts on landscape, tranquillity and cultural heritage;
3. Empowering local communities through greater financial support for appropriately scaled community renewables, which are enabled by participative approaches to planning.

Meeting these objectives with the urgency that is required will mean some renewable energy infrastructure on greenfield sites. However, when greenfield schemes are approved that cause harm and are done without the support of local communities, they risk a backlash that will slow our overall progress towards decarbonising the UK's energy supply.

Developing more rooftop solar PV capacity has been a policy goal for nearly a decade after the government published its UK Solar PV Roadmap and Strategy.[3]

The 2014 Solar Strategy stated 'demand reduction, demand response and distributed generation work hand in glove to help us meet our energy security and climate goals'. It was a strategy aimed at democratising the energy market. It would, it was hoped, foster carbon negative households, with communities and businesses forming small energy enterprises — all creating a brand new, affordable energy market. This is a vision CPRE shares. However, the ambition for 20GW of solar by 2024 set out in the government's strategy has not been met. Current solar PV capacity is around 14GW, of which just 5GW is on rooftops in England.

With radical action now required to decarbonise the electricity grid by 2035, it is time for a step change in actions to deliver this rooftop solar revolution. This call has been recently echoed in the Net Zero Review[4], chaired by Chris Skidmore MP, which recommends delivery of up to 70GW of British solar generation by 2035. This ambitious target has just been endorsed by government.[5]

To show how solar can be done well, CPRE commissioned energy experts at UCL's Energy Institute to review the land use implications of the main UK net zero energy scenarios, with a special focus on the potential capacity of rooftop solar in England.[6]

By contrast, making the best possible use of solar on roofs and car parks is a solution that will enjoy almost universal support and will also increase household and community resilience. This briefing looks both at the potential of rooftop renewables to contribute to supply and at the interventions that could help deliver them.

UCL's review: main findings

The challenge

Experts from UCL's Energy Institute were asked to undertake an independent review of the land use implications of meeting targets drawn from a series of well-established net zero greenhouse gas emission scenarios - mainly from National Grid ESO's Future Energy Scenarios (FES) and the Committee on Climate Change's Sixth Carbon Budget (CCC 6CB). Using scenario data on capacity (gigawatts, GW) and output (terawatt hours, TWh) for the three main and most 'land hungry' low carbon energy technologies — onshore wind, solar PV and biomass — combined with an estimate of the land use per capacity (that is, energy density), UCL produced total land use areas for wind, solar and biomass in England.

Table 1 summarises the capacities and estimated land use of the renewables considered in the net zero greenhouse gas emission scenarios. UCL's key new findings compare the built environment PV potential (117GW) with the rural greenfield land take for England for ground-mounted solar (1.3% to meet a target of 74GW capacity).

In addition they show that onshore wind would require 1.3% of land in England to generate 7GW capacity and energy crops would need 8% of land to produce 52TWh output. These findings are discussed in greater detail below.

Table 1: Likely land use requirements in England for key technologies in 2050

		PV		Onshore wind		Offshore wind		TWh Energy Crops	
		Median	Range	Median	Range	Median	Range	Median	Range
Capacity	GW	74	52 - 83	7	5 – 9	88	52 – 112	52	31 - 59
Built environment potential	GW	117	-	-	-	-	-	-	-
Rural greenfield likely requirement*	GW	74	52 - 83	7	5 – 9	-	-	52	31 - 59
	km2	1,650	1,150 - 1,800	1,700	1,250 - 2,300	-	-	10,500	6,250 - 11,750
% England Area*	%	1.3%	0.9 - 1.4%	1.3%	1.0 - 1.8%	-	-	8.0%	4.8 - 9.0%

* Values for PV if completely ground-mounted on greenfield sites in rural areas. Values may not add up to 100% - for example, the same land could be used for both onshore wind and PV or energy crops. Values for energy crops are given in terms of output (terawatt hours) rather than gigawatts.

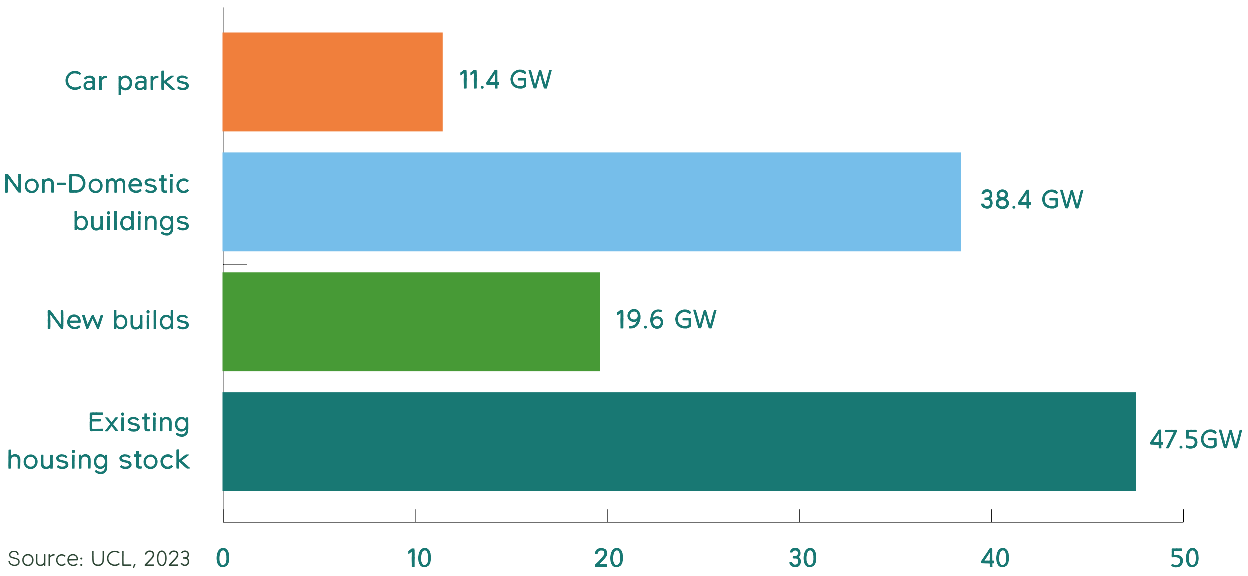
Solar

Using a series of conservative assumptions, a total area available for rooftop solar in urban areas in England was calculated, then multiplied by usability indices, which factored in roof type, roof pitch and layout, shading, panel design/fit and planning constraints.

In summary, the UCL analysis estimated a technical potential of 117GW of solar PV on 650 square kilometres of rooftops and car parks in England alone (see Figure 1).

It therefore concludes that there is sufficient urban and brownfield area to accommodate the range of PV capacities required in future to meet net zero scenarios, assuming 14GW of operational PV and 8GW in construction or with planning permission. Rooftop solar could provide for our energy needs using considerably less land compared to large-scale installations of onshore wind, energy crops or greenfield ground-mounted solar. It should therefore be possible to gradually phase out greenfield solar after 2030 and use the land for other purposes such as food growing, public access and nature recovery.

Figure 1: England urban solar potential



Source: UCL, 2023

Some of the urban potential will certainly be higher cost, and also take more time to be realised, than greenfield solar farms though this was not calculated in detail. UCL suggests that the most cost-effective strategy would be to install PV systems first on non-domestic and domestic roofs on new buildings (about 20GW on the basis of likely household and commercial growth to 2050) and on land currently covered by car parks (about 11GW). Retrofitting 37GW to the larger non-domestic rooftops would be low to medium cost and retrofitting 43GW to existing dwellings would be higher cost. So, roughly speaking, for urban PV, 31GW would be low cost, 37GW medium cost and 43GW higher cost. Given there is 14GW operational now, a further 69GW is needed to reach the maximum net zero emission scenarios target of 83GW. Approximately 67GW of this would be low and medium cost and the remaining 2GW would be higher cost. The costs and practicalities of urban or rural PV installation are variable and direct market costs would have to be balanced against environmental impacts and other considerations, such as the countervailing need for greenfield land for food security, biodiversity, landscape and amenity.

Onshore wind

The study also addressed the land use implications of meeting net zero targets through onshore wind energy and growing biomass (see Table 1 page 9). While the land take for onshore wind was roughly comparable to that for solar farms, it was noted that the impacts were quite different.

Large turbines had a visual impact across much wider areas but conversely, the smaller amount of ground occupied physically for turbine bases, access tracks and transmission infrastructure did allow for multiple land uses such as the grazing of stock. UCL also noted there is currently little planned expansion of onshore wind in the Department for Business, Energy & Industrial Strategy Renewable Energy Planning Database (REPD) but the national planning policy on onshore wind is currently uncertain. However, the cost of offshore wind is now becoming competitive with onshore and has a higher capacity factor, requiring lower balancing costs for storage.

Bioenergy

UCL found bioenergy to be the hardest technology to assess because of the complexity of biomass itself, competition with other land uses, its impacts, the variation in productivity per hectare of different crops and the energy losses in its processing and use for energy and for carbon sequestration.

The net zero scenarios in general assume a waste resource of 90-100TWh, imports of 40-110TWh and UK production of 30-95TWh. Production in England would cover about 10,500km2 (the median given in the scenarios) which corresponds to 8% of the country's land area. The REPD indicates plans for an increase of 10-20% in biomass electricity production. The volume of biomass, excluding food, in the net zero scenarios is estimated as about 75 million tonnes (Mt) which would be extracted from natural and agricultural ecosystems and then transported, processed and used. For comparison, the current UK cereal harvest is 23Mt; a further 56Mt of vegetable biomass, mostly food, is also transported by road.

Table 1 above also shows that, in very broad terms, land used for biomass could be expected to only produce a tenth of the energy per square kilometre compared to the the same area of land being used for solar panels. The UK is already a heavy user of imported biomass, primarily woodchip. The harvesting, transport, processing and emissions of this biomass all impose further carbon costs. There are thus significant impacts on current land use and patterns of transport and attendant carbon implications. This is underscored by a recent Royal Society report on land take for net zero aviation fuel which calculated that 68% of UK agricultural land would be needed just to meet current aviation fuel usage[7].

Demand reduction

Finally, from a recent study[8] on energy demand reduction, UCL noted that implementing a range of measures, including energy efficiency in buildings and behavioural changes, could reduce energy demand by up to 52% by 2050, relative to 2020 levels.

This would largely manifest itself in terms of reducing, through more efficient electrification processes, the amount of delivered energy. It is unlikely to mean a major reduction in the amounts of renewable technologies or land needed to generate this energy.

The benefits of rooftop solar

The positive features of rooftop solar have long been recognised. Ten years ago in the UK Solar PV Strategy, rooftop solar was at the heart of the government's vision whereby 'demand reduction, demand response and distributed generation, work hand in glove to help us meet our energy security and climate goals'.[9] It was also a strategy aimed at democratising the energy market with carbon negative 'pro-sumer' households, and communities and businesses forming small energy enterprises — all creating a brand new, affordable energy market. This is a vision CPRE shares.

The ambition in the PV Solar Strategy in 2014 was for 20GW to be installed in the coming decade. UK solar capacity currently stands at around 14GW, of which about 5GW is on rooftops in England. So the potential has yet to be realised. Ten years on, the Net Zero Review has called for a 'rooftop revolution' to help reach the overall target of 70GW of solar by 2035. The scale and urgency of tackling the climate emergency means that no option can be off the table, and some well-designed locally supported ground-mounted solar schemes will undoubtedly be needed for the rapid decarbonisation of our energy system. Nevertheless, the UCL research has shown that the 70GW solar target could eventually be met by urban and brownfield solar alone, allowing for a gradual phasing out of greenfield solar after 2030.

Other countries are showing the way forward, both in terms of measuring the potential of rooftop solar and then realising it. A 2019 European Union research project estimated an extra 680TWh could be generated using rooftop space in member states, which could account for nearly a quarter of current levels of electricity consumption[10]. About 30% of Germany's 51.4TWh solar output comes from small rooftop solar installations,[11] so more is generated by rooftops there than by all solar installations, both ground- and roof-mounted, in the UK. France is now mandating that all new car parks must also double as solar parks.

Recent research shows significant economic benefits for domestic installations, especially when PV is combined with heat pumps: in Germany, Spain and Italy, households which combined solar PV and a heat pump saved at least 60% off their annual bills and most of these savings are expected to be maintained into the future.[12]

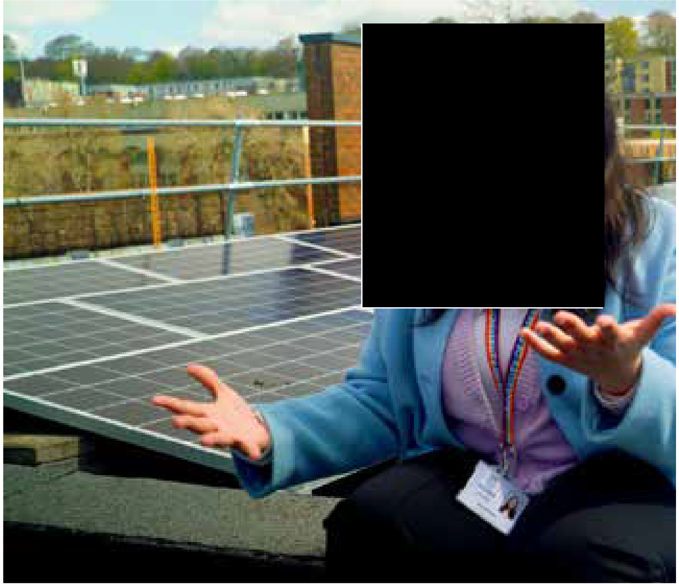
Although there is less sunlight in England, financial support for combined domestic solar PV and heat pumps should be a policy priority as they offer both system and economic efficiencies.

Recent industry evidence has also pointed out a major role for rooftop solar in the UK logistics sector. The UK Warehousing Association (UKWA) calculated that half of the UK's need for solar power by 2030 — that's 15GW, a figure slightly less than, but reasonably close to, the 17GW potential of warehouse roofs identified by UCL — could be met by solar on just a fifth of warehouse roofs, thereby doubling the UK's solar generation capacity. The UKWA report also notes that '(w)ith growing pressure on food security and housing there is an increasing need [to] consider commercial rooftops as a priority for locating PV capacity'.[13]

Rooftop solar therefore has a key part to play in protecting land for food production, including carbon-positive regenerative agriculture, and providing the vital space needed for nature recovery. About 10% of high grade best and most versatile (BMV) agricultural land developed for other uses between 2010 and 2022 was used for renewable energy schemes, including ground-mounted solar.[14] Taking high grade farmland out of food production to generate renewable energy is not a sustainable outcome, especially when there is huge untapped capacity for rooftop solar, as the UKWA and UCL research shows.

The true potential of rooftop solar

UCL's research gives an overall technical potential of 117GW of rooftop solar capacity for England, predominantly in constrained urban or built-up areas. In calculating the different rooftop resources, based on authoritative sources, usually government official data, the fraction of potential area available has been estimated conservatively. In addition, other reports have suggested land such as that around motorways and services stations, or railways and airports, would be potentially suitable, and this is worthy of further research.



It is clear there is huge potential for rooftop solar to be a significant solution to meeting net zero targets and, at the same time, reducing pressure on valuable greenfield land.

Cost and speed of installation, including grid connection, are clearly crucial factors in optimising the delivery of any form of low carbon power. But these need to be seen in the round — with issues such as community resilience, environmental impacts, competing land use and local amenity also being key determinants of where to site panels. It will often be more difficult and/or costly to retrofit solar panels to existing buildings, especially buildings with registered heritage qualities, than to include them in new buildings from the start. But there are increasing examples of good practice[15] showing how the two issues can be reconciled, and an increasing desire among leading heritage organisations to be proactive in retrofitting England's historic building stock.[16]

UCL's research shows that the biggest potential capacity, of around 47GW, is on existing roofs but this would likely be at higher cost. Nonetheless, there are crucial energy security advantages to retrofitting solar to households and commercial premises since this would greatly improve the energy performance of the UK building stock, which is currently the poorest in Europe. These advantages would be maximised when combined with deep retrofits for energy efficiency insulation programmes, the use of battery storage and roll-out of heat pumps.

From regional UK evidence it is very clear that the most cost-effective carbon measure that can be taken in urban areas is retrofitting buildings for insulation and heating upgrades.[17] This could readily be delivered by changes to planning policy and building regulations plus government support for a raft of energy efficiency measures (including solar retrofit as part of the Net Zero Homes Standard), as proposed in the Net Zero Review.

A considerable tranche of the non-domestic buildings also form part of the public estate, often under local authority ownership or control. Clear opportunities exist here for public investment, a priority reinforced by local authority net zero commitments and the need to source cheaper electricity. Similar advantages are also being championed in the private sector, notably in warehousing, where benefits cited by the UK Warehousing Association include cutting electricity bills by 40-80%, creating aggregate savings of some £3 billion per year, cutting CO_2 emission by 2Mt per year and also providing a good financial investment.

Transforming community energy:
Ashwater Parish Hall, North-West Devon

Nestled in a remote area of North-West Devon, the Ashwater Parish Hall has emerged as a prime example of a successful community-led rooftop solar project. Faced with the need to find a more affordable energy source, the Parish Hall Committee took the initiative to install rooftop solar panels during construction of the hall in 2010.

The decision was a no-brainer according to spokesperson Ivan Buxton, as it offered a clean energy source that wouldn't mar the picturesque surroundings, while lowering energy costs.

Initially, the hall hosted a dozen panels but a year later an additional six were added to power the community shop located in the hall's grounds. The project was expected to be cost-effective within six to eight years, thanks to the more generous government subsidies available in the form of feed-in tariffs at the time, and it lived up to expectations. The solar panels earned £17,000 over 12 years, with any excess electricity generated sold back to the grid for a profit. The benefits of rooftop solar have trickled down to the community, resulting in lower rental costs for the hall and providing power for the community shop. Ivan says the project also led to a sense of greater community cohesion.

‘It brought the community together. Previously, it was a bit more fragmented; you might have had some people fundraising for the church and somebody else for the school, but we all pulled together and had a number of regular events well-supported by the community.

Some concerns remain, such as rising electricity rates and practicalities of battery storage. Ivan believes there are added barriers to rolling out rooftop solar for communities, including lack of funding from local and national government, disincentives such as business rates and tax charged on solar panels and the wider issue of the lack of community say in the decision-making process on solar projects. Despite these challenges, he remains optimistic.

‘Our solar project snowballed from setting up a committee to raise money to maintain the hall and the shop, to securing funding for other projects. If we act as a community, the community can benefit.

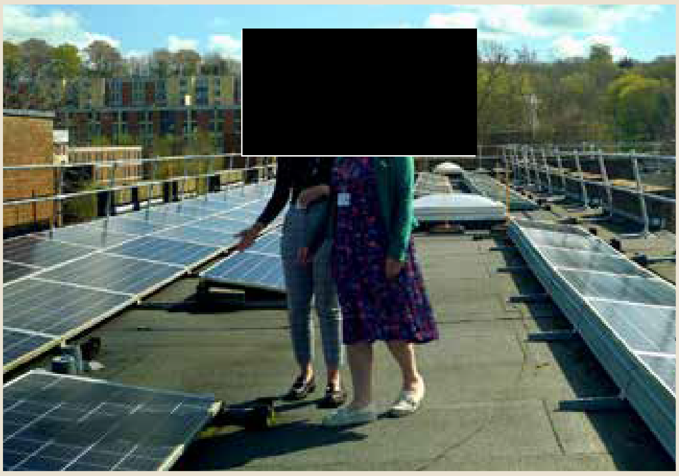
Decarbonising energy in the education sector:
University of Sussex

In 2017 the University of Sussex (UoS) made a strategic decision to reduce its carbon footprint by installing rooftop solar panels. The university's flat roofs were an ideal starting point. With rooftop solar seen as a practical and cost-effective option, it was an easy first step on its decarbonisation journey. It installed 3,144 solar panels which produced over 4GWh of renewable energy for the campus.

While the solar panels may not fully meet the energy demands of the university, they have helped reduce its reliance on non-renewable energy with a corresponding reduction in energy bills. And the initiative has been welcomed by the university community. Samantha Waugh, Sustainability Manager at UoS, described the project as a popular move after the university declared a climate emergency in 2019:

> There was an awful lot of passion from the students for a green revolution and decarbonisation. I've never worked somewhere with so much passion around sustainability because there's so many academics and students studying and teaching and researching this area.

Despite the project's success, Samantha says there is still room for improvement. The main challenge during the installation process was listed buildings and associated regulations. To comply, only unlisted buildings could be selected for solar installation at the time, which limited the scope of the project.



So there are ongoing heritage considerations. Nevertheless, Samantha believes there is substantial scope to build on the rooftop solar project. But she says more needs to be done to help others make the transition to clean energies, including increased government funding and incentives for businesses and homeowners to install rooftop solar and greater investment in electrical infrastructure to increase the grid's capacity for renewable energy.

> We are like a small town and there's only so much electricity supply we can access. We would like to see the government increase the capacity of the national electricity grid to help us further expand our renewable energy production and consumption as we move away from fossil fuels. Evidence suggests it is the financial levers that drive the change, so making it cheaper and easy to expand solar production is a win-win for everyone and our planet.

Assessing the potential for rooftop solar in Kendal

Kendal Town Council's Environment Committee commissioned a solar audit of the whole town after receiving a recommendation from Kendal Citizens' Jury on Climate Change.

The audit, completed in April 2022 , measured the height of terrain and alignment of every roof in Kendal, to assess which roofs in the town are most suitable for solar generation, using Ordnance Survey information and speciality mapping software.

Kate Willshaw, of Friends of the Lake District, welcomes the initiative:

> It is great to see the council listen to the local group, and seek an innovative approach to urgently act on climate change.

Together with Cumbria Action for Sustainability, which has experience of similar work in Burneside and Ambleside, the council looked at different options. One, for a community energy scheme, concentrated on the larger suitable buildings in Kendal which would allow all residents to invest and own shares. Another is a 'Solar made Easy' project whereby residents can access independent guidance, find suitable local installers and navigate the logistics such as how to engage with planning committees.

The audit will make it easier for residents to put solar panels on their roofs, should they wish to do so, even in conservation areas. The council is also considering a local energy scheme for Kendal to generate their own clean energy.

Rolling out solar above car parks in France

France is taking decisive action to become a global leader in solar energy generation. In response to growing pressure to transition away from nuclear energy, the country has passed a new law mandating the installation of solar panels on all large car parks. In January this year the French Parliament approved legislation that requires all new and existing car parks with more than 80 spaces to have at least 50% coverage with solar panels. The new law is expected to boost France's electrical capacity significantly, with French car parks generating as much electricity as 10 nuclear power plants.

The initiative — part of the umbrella Law for the Acceleration of the Production of Renewable Energy — is seen as a simple solution to the issue of limited space for solar panels in a densely populated country. Moreover, it is considered to have less of an impact on biodiversity than traditional solar farms, according to Arnaud Schwartz, president of France Nature Environment.

> Taking away agricultural land or open fields and giving it over to solar farms is unattractive, but covering parking lots harms biodiversity a lot less,

he says.

As the impact of the war in Ukraine is felt around the world, Europe is looking for more sustainable, cleaner energy closer to home. And as the push to move away from fossil fuels grows, and the cost of solar panels continues to drop, France's new policy promises to deliver major financial and environmental benefits at the same time as reducing competition for land use.

Barriers to delivery

A number of barriers currently limit the potential for rooftop solar to contribute significantly to UK solar targets. Many of these can be addressed by policy innovation, both in relation to the planning system and fiscal support. Both can and should be addressed urgently by government if its target of 70GW of solar by 2035 is to be reached. Taking more radical steps to reduce energy demand is also the least costly option and should be pursued as a 'no regrets' strategy of first resort. It will also allow scaling back of new energy targets across the board, reducing the impact on the countryside.

Although costs of solar are falling in general, a mixture of 'carrot' and 'stick' is required to encourage greater take-up of rooftop PV, especially in the domestic sector. Fiscal incentives should include low-cost finance deals and adjustment of price tariffs to improve the payback period and encouraging investment across the board. Changes to business rates that have penalised companies investing in rooftop solar generation[19] need to be reversed in order to encourage investment. Planning policies and regulations, including the Future Homes Standard, also need to be changed in several respects, as we set out in the section on recommendations.

Lack of access to the electricity network is also proving a major headache, especially for larger installations in the commercial and farming sectors.

Both UKWA and the NFU[20] point to the need for better and faster grid connection by local electricity companies (also known as distribution network operators or DNOs). It is frustrating that, despite these sectors' strong desire to invest and do the right thing, they are stymied by infrastructure failures. In CPRE's view, poor grid capacity in many areas of the country has also led to unnecessary distortion in the location of solar schemes. Industrial-scale solar arrays and battery storage facilities are often developed close to rural grid supply points (sub-stations) on the high voltage transmission network from where local distributors take electricity. Such sites are often inappropriate in terms of their impact on landscape, amenity and concomitant loss of farmland.

The UCL research suggests that urban distribution networks will need to be reinforced for heat pumps and electric vehicle charging. This extra capacity could potentially also accommodate solar PV export which - in general – will peak at different times of the day or year to heat pumps.

Finally, there is a potential trade-off between roof types since maximising solar capacity could have an impact on the look of many homes and streets. Optimal roof design for solar PV, for example, would favour simple, uncluttered roofs, avoiding dormers, mansards, chimneys, and would benefit from mono-pitch constructions, allowing for symmetrical, edge-to-edge installation on roofs. Such roof designs are currently rare in England. This needs addressing in national and local design guidance.

Further considerations

Although CPRE is mainly concerned with the land use and planning implications of a rapid move to a low carbon energy supply for the UK, wider sustainability and ethical issues also play their part in determining the efficacy and acceptability of all forms of energy supply.

Concerns have been raised recently about modern slavery in solar panel supply chains due to polysilicate processing by Uyghur forced labour in the Xinjiang region in China. This appears to have been a widespread problem in the UK supply chain, with panels sourced from tainted Chinese manufacturers for many private and public sector solar schemes.[21] As a result, Solar Energy UK, the main trade body for the UK solar industry, has issued responsible sourcing guidance.[22]

Any link between solar panel manufacturing and modern slavery is unacceptable and abhorrent. We need to urgently and decisively move away from a situation where panels and/or components are linked either directly or indirectly to modern slavery. The government should introduce co-ordinated industrial policies and a roadmap to make solar energy supply chains slavery free as soon as possible, and be able to confirm that all materials are from responsible sources. Supply chain transparency is vital to ensure there is no association with forced labour.

Similar problems apply in the battery storage supply chain, particularly linked with cobalt and lithium. These include human rights abuses in the Democratic Republic of Congo (DRC)[23] and unacceptable environmental standards in the production of a number of critical, rare-earth minerals used in key technologies, such as batteries and magnets for wind turbine generators. Again, responsible sourcing, including traceability and transparency in supply chains, is key.

Overview and recommendations

CPRE recognises that some greenfield solar schemes will be needed in order to meet net zero by 2050 and that — done sensitively — they should not be controversial. But the policy case for relying on industrial-scale solar installations on greenfield sites, in the face of community opposition, is a battle the government does not need to fight.

It is evident that a combination of rooftops, surface car parks, brownfield sites and small-scale community energy schemes — solar and wind — could make up the majority of our onshore renewable energy requirements, especially when coupled with better measures to reduce total energy demand that are currently missing from the government's approach. These would have a wide range of benefits in terms of community resilience and saving farmland for sustainable food growing and nature recovery. In addition, large amounts of offshore wind will be needed, and the environmental impacts of this should be properly assessed so that such development takes place in the least harmful locations.

This is reinforced by UCL's findings, detailed in this report, that urban and brownfield rooftop solar PV capacity could amount to at least 117GW, set against the new national target for 70GW by 2035. By comparison, ground-mounted solar could cover around 0.9-1.4% of all the land in England to meet targets set by authoritative carbon net zero emission scenarios (a maximum of 83GW by 2050). Median land-take estimates for England were also given for onshore wind (1.3%) and for bioenergy (8%). The figures for energy crops could raise significant concerns about change of land use , together with the impact from onward transport, processing and use.

Reducing energy demand is also fundamental to tackling the cost-of-living crisis, and because rooftop renewables would be almost universally supported by communities, they would be easier to deliver quickly and painlessly through the planning system.

Recommendations

To achieve a rooftop revolution, CPRE is urging the government to take action in the following policy areas:

1 Develop a national rooftop solar target
Commit to a new target of ensuring that at least 40GW of the national target for 70GW of solar by 2035 is delivered through the lowest cost opportunities for rooftop solar installations, on new builds, commercial buildings and car parks.

2 Protect landscapes
Properly manage the potential impacts of solar development in the countryside by:

a. Introducing a land use framework to establish how the overall needs for built development, carbon sequestration, energy and infrastructure, food security and nature recovery should be integrated and planned for.

b. Revising national and local planning policy to set clearer overall policy principles for determining ground-mounted solar PV applications, following a sequential 'roof first' approach. This should prioritise opportunities to install solar panels on suitable brownfield land and avoid best and most versatile agricultural land and other land used by active, viable and sustainable farm businesses. It should also make greenfield solar permissions much more exceptional and time-limited, and require provisions for multi-functional benefits and achieving best practice standards for landscape and natural capital.

3 Planning regulations

Amend planning regulations and the Future Homes Standard so they state that:

a. Local authorities should, working with parish and town councils (following the example of Kendal Town Council) and other community groups, carry out audits of potential roof and other developed spaces that can be used for solar panel installations. This can be done through existing brownfield land register regulations, which currently look at developed land suitable for additional new housing.

b. Solar PV or thermal panels on suitably orientated roofs should be a standard expectation for all new buildings, including homes.

c. Conversions and major external changes to existing buildings should require full planning permission (in other words, removing permitted development rights) unless they bring the building up to the Future Homes Standard or equivalent.

d. Planning permission should not be granted for commercial or public car parking spaces unless they also provide solar energy generation.

4 Financial support

Develop a holistic set of market-based actions to kickstart the rooftop revolution for homeowners, landlords, small businesses and community energy projects including:

a. Government backed low-cost loans for domestic and commercial rooftop solar installations as well as small-scale community support to encourage a step change in installation rates.

b. Upgrades to the Smart Export Guarantee to ensure higher minimum tariffs are available to homeowners and businesses selling electricity from rooftop solar installations to reduce payback periods and improve investment viability.

5 Community energy

Update national planning and energy policies to encourage best practice in community engagement and empower rural communities to set out where and how new renewable energy schemes can be incorporated in the countryside. This should build upon the Community Energy Visioning process, pioneered by CPRE and the Centre for Sustainable Energy in recent years.[24]

6 Grid capacity

Work with Ofgem to require Distribution Network Operators across the country to invest in local grid capacity to better accommodate increased generation from solar and heat pumps. This should deliver new connections in a timelier manner and ensure that businesses and property owners interested in installing solar panels on their rooftops are quoted reasonable and proportionate connection costs and timescales.

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