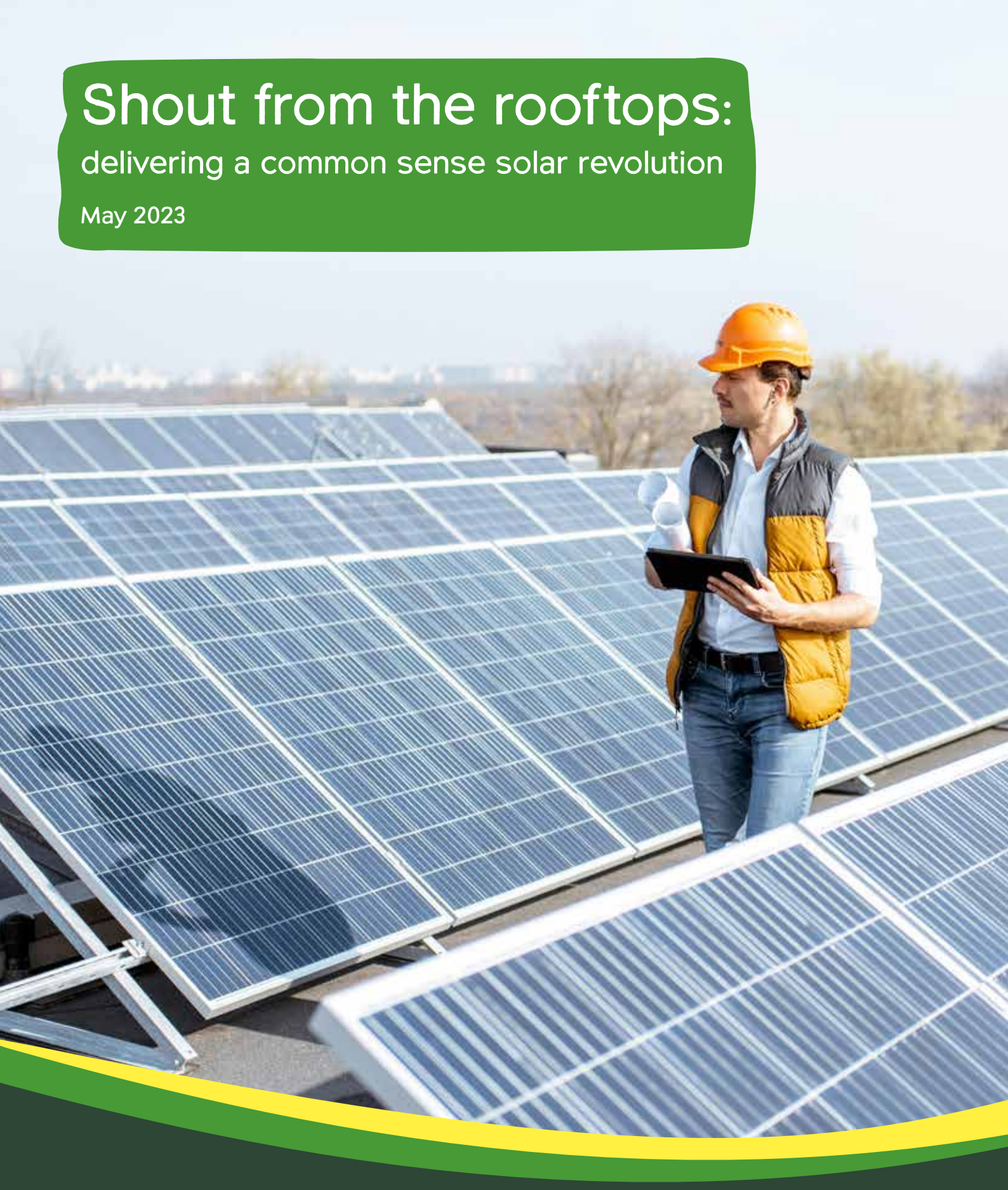
# Shout from the rooftops:

## delivering a common sense solar revolution

May 2023



The countryside charity

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# 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.

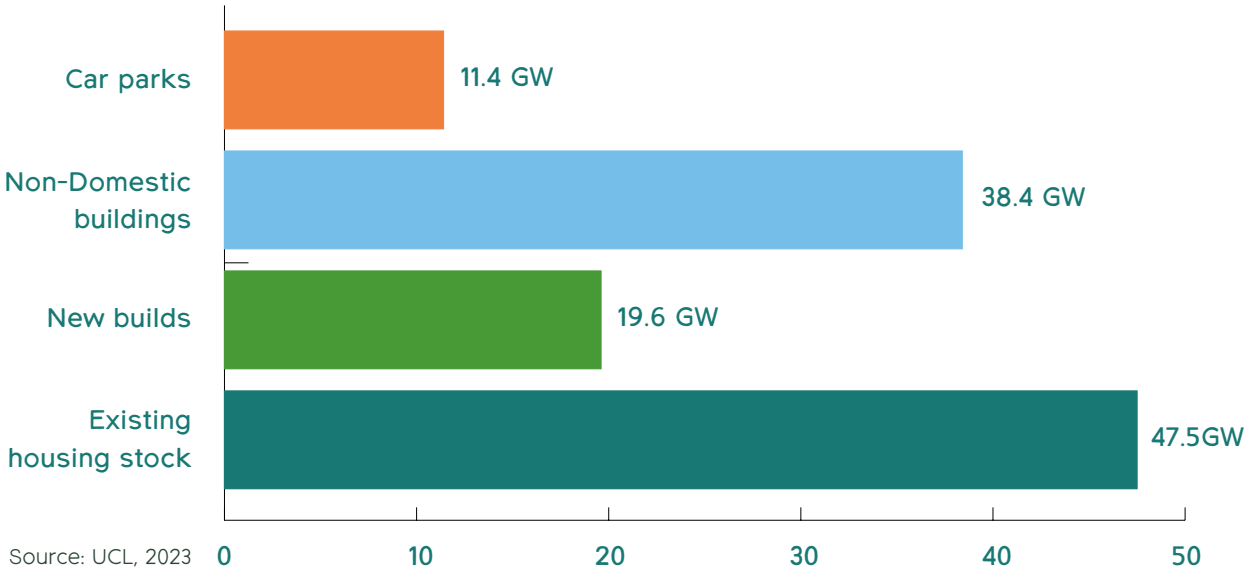
## Solar

**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 CO2 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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