

Lighting the way: international policies for making the rooftop solar revolution a reality

Executive summary

In 2023, CPRE published research by members of the UCL Energy Institute, which found that there is potential for up to 117 gigawatts (GW) of low carbon electricity to be generated from rooftops and other developed spaces across England.ⁱ This is substantially more than the government's target for 70 GW of solar energy by 2035.

To explore how this enormous opportunity can be realised at speed, CPRE commissioned WPI Economics to analyse approaches being taken internationally to deliver rapid growth in rooftop solar capacity. The findings of this research show that other major economies are pursuing a range of innovative policies to accelerate the deployment of rooftop solar and a bold and ambitious government here could turbocharge our installation rates by adapting these policies to a UK context.

Any government will be constrained by fiscal requirements and ideological preferences, but from stronger financial incentives to bolder deployment of power-purchasing agreements, bulk contracting, enhanced regulations, and forward-looking process reforms, there is clear scope for big interventions from a government of any colour.

The threat of the climate emergency means that we cannot afford not to act decisively, and future generations will not look back kindly on any administration that allows market failure to unnecessarily sacrifice swathes of our countryside to an energy system which uses our finite land inefficiently. With determination and commitment, the policies discussed in this publication offer a clear route to delivering a rooftop solar revolution that can cut bills, ensure our nation plays its part in preventing climate catastrophe, and save our countryside for nature, wildlife, and the future enjoyment of all.

Key findings:

- 1.** In Germany, financial incentives play a key role in promoting rooftop solar with generous grants and feed-in tariffs. Reforming the Smart Export Guarantee to deliver fixed-rate payments closer to the £0.08 per kilowatt hour offered in Berlin would substantially improve – by as much as double – the investment incentive for rooftop solar in the UK.
- 2.** In Japan, several local authorities are promoting power purchasing agreements (PPA) through a “zero yen” policy. The UK government should consider establishing a similar scheme, but on a national footing, to offer households the opportunity to have rooftop solar panels installed for free in return for a 10–20-year PPA through which they purchase the electricity they need.
- 3.** In China, a ‘whole-county’ solar policy is being used by local authorities to aggregate opportunities for solar developers to install solar panels on a wide range of buildings across a local authority area. Implementing a comparable policy in the UK could help turn disparate roof space into a single attractive contract for developers.

4. In the major economies achieving rapid deployment of rooftop solar, a number of authorities such as German states and the Japanese city of Kyoto have mandatory requirements for installations on new buildings. The UK government should implement similar regulations as swiftly as possible.
5. Countries like Poland and Italy are delivering process reforms aimed at streamlining and speeding up the installation of rooftop solar panels with (in Poland) up to a capacity of up to 150kW. The UK government has made important steps in this direction by reducing planning controls on installations of up to 50kW, but should consider opportunities to go further, such as giving rooftop solar projects priority access to grid connections.

The state of the solar sector in the UK:

The climate crisis is undoubtedly the greatest threat to the future of 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.

To save iconic species and landscapes as more than a memory for future generations, the decarbonisation of our national energy supply is an urgent requirement. To this end, the government has set a clear target for 70 GW of solar energy by 2035,ⁱⁱ but we are currently seeing a serious market failure in realising this transition.

Meeting these objectives with the urgency that is required will mean some renewable energy infrastructure on greenfield sites and CPRE has done significant work through our Community Energy Visioning project, to showcase best practice for delivering renewables done well in the countryside in collaboration with rural communities.ⁱⁱⁱ However, when greenfield schemes are approved that cause harm and are done without the support of local residents, they risk a backlash that will slow our overall progress towards decarbonising the UK's energy supply.

Government statistics show that solar photovoltaics accounted for just 4.1% of total electricity generation in the UK in 2022.^{iv} Installed solar capacity rose by only 1 GW in 2023, rising to a total capacity of 15.3 GW, of which 40% is sited in the largest utility scale schemes each over 5 MW.^v

Hypothetically, there is substantial ground mounted solar capacity in the pipeline across England, with analysis of the government's renewable energy planning database showing that 2486 ground mounted schemes have come forward with 1010 operational and 487 awaiting construction. Notably, just 60 applications, roughly 2 in every 100 proposed, have a share scheme to enable the local community to share in the profits of the development. If every single one of these projects had come to fruition, they would give a combined total capacity of 36,039 MW.^{vi}

Using the Renewable Energy Hub's estimate of 5 acres of land required per MW of ground mounted solar capacity,^{vii} this suggests that the current policy approach of relying on developer led ground mounted schemes to meet solar targets has already led to proposals to use 729.2 square kilometres of land for solar projects – an area larger than the cities of Birmingham, Manchester, Bristol, Liverpool, and Sheffield combined.

Consequently, the laissez-faire reliance on ground mounted solar is bringing our energy system into increasing conflict with protection of England's already damaged and highly fragmented landscapes. These projects are taking vital land that could be providing desperately needed habitats for rare wildlife^{viii}, with evidence suggesting a serious impact on ecological indicator species like bats, likely due to the loss and fragmentation of foraging sites.^{ix} Furthermore, with no clear land-use strategy, the proliferation of ground mounted solar schemes is leading to concerns of the piecemeal erosion of national food security, as

well as the loss of landscapes that have played a huge cultural role in our connection with English nature.^x

Perhaps most concerning of all, these ground mounted solar schemes are so slow to come to fruition that they increasingly seem to be incapable of delivering energy decarbonisation at the speed we need to play our part in preventing climate collapse. For example, no decision has been reached on the Sunnica project, nearly 5 years after the first official scoping was undertaken.^{xi} Similarly, the Cleve Hill solar park in Kent is still under construction and not producing electricity after 6 years.^{xii} Even comparatively small ground mounted solar schemes, take exceptionally long times to begin exporting electricity, such as the Bishampton project in Worcestershire which estimated a 3 month construction in the original application and is only now reaching completion following approval in June 2021.^{xiii} Clearly ground mounted solar is not delivering the shovel ready projects essential for meeting our climate targets.

Conversely, rooftop solar can be rolled out incredibly rapidly, with Solar Energy UK stating that domestic projects can be delivered in days, and installing and designing a commercial rooftop system can be completed 12 months faster than a ground mounted scheme.^{xiv}

Analysis undertaken by members of the UCL Energy Institute and published by CPRE in 2023 found that the total potential capacity for rooftop solar in England up to 2050 is enormous. In total, suitable rooftops could host 117 GW of solar capacity, of which an estimated 31 GW could be delivered on new buildings and on canopies over car parks at a comparable cost to ground mounted solar projects. Retrofitting solar panels onto the rooftops of larger non-domestic buildings like warehouses could provide space for a further 38.4 GW of low to medium cost installations, with space for an additional 47.5 GW of capacity on existing residential rooftops.^{xv} Thus, using even just the most low-lying fruit could allow us to meet 60% of the government's solar target with lower impacts and far greater benefits in terms of lowering bills because providing direct supply rather than simply adding to international commodity markets.

However, the evidence is also clear that we are failing to capitalise on these win-win opportunities. Currently, the UK Warehousing Association estimates that just 5% of warehouses across the country have rooftop solar installations,^{xvi} and as of December 2023 there are on average just 1945 homes with rooftop solar in each English constituency, albeit with a higher average of 3204 installations in primarily rural constituencies.^{xvii}

Moreover, recent research has also highlighted that these schemes have a much lower environmental cost than ground mounted schemes, with lower energy inputs, greenhouse gas emissions, and water consumption.^{xviii}

The ongoing rush for ground mounted solar sites, irrespective of the externalities, and the failure to capitalise on the opportunities of rooftop solar across the country indicates a major market failure in investment in solar energy for the future. Clearly the free hand of the market is not going to deliver the energy transition our country needs. The following sections explore what we can learn from policies in other major economies which could drive a different approach that delivers rapid deployment of rooftop solar across England.

1. Financial incentives: Germany's Solarstrombonus

Summary: Where major economies are achieving rapid deployment of rooftop solar, this is often driven by financial incentives. Rooftop solar growth in the UK has slowed dramatically since the withdrawal of feed-in tariffs and market maturity shows little sign of reversing this. In contrast, financial incentives for rooftop solar in Germany, including the Solarstrombonus feed-in tariff, are substantially more generous. Reforming the Smart Export Guarantee in the UK to deliver higher fixed-rate payments could unlock substantial investment in rooftop solar by guaranteeing long-term profitable returns for new installations.

Substantial financial incentives are a policy route taken by all the countries explored within this research, China, Germany, Poland, Italy, and Japan, on their path to rooftop solar expansion.

While the costs of solar PV declined by 60% for an average 4kWp (kilowatts peak) system, from 2010 to 2019^{xxix}, the recent peak in inflation has seen these costs begin to rise again and they remain prohibitively expensive for many, with the Federation of Master Builders estimating a required outlay of £6,800 for a typical three-bedroom home.^{xx}

The most successful UK financial incentive for rooftop solar panels was the feed-in tariffs scheme that run from 2010 to 2019, which provided guaranteed payments for generation and export of electricity from eligible installations. It was widely argued and expected that these subsidies could be withdrawn as technological improvements reduced the costs of solar panels and the market reached maturity.

However, experience has not borne this out. Despite the falling costs of solar panels, domestic solar photovoltaic (PV) installation rates averaged an annual increase of just 3% from 2016 to 2019 following a significant cut in the value of feed-in tariffs. This pales in comparison with the average 35% growth in annual installations achieved from 2012 to 2015 during the heyday of the feed-in tariff scheme.^{xxi} Clearly 'market maturity' is not sufficient on its own to achieve deployment of rooftop solar at the speed required, and the lack of financial incentives is stunting installation rates in the UK when we need faster action than ever. What can be learned from the experience of other countries?

The recent spike in gas and electricity prices has encouraged more of those in the UK who can afford to invest in rooftop solar panels to act to avoid high energy bills. Yet, while installation rates have recovered in the UK since 2019, with a 13% increase in installations in 2023 from 3.9 GW to 4.6 GW^{xxii}, Germany is experiencing far more rapid and sustained growth, with standalone residential PV installations quadrupling in the past 4 years^{xxiii}. So, while Germany achieved 7 GW of new domestic rooftop solar installations in 2023,^{xxiv} the UK managed just 661.2 MW of domestic installations.^{xxv} Much of the success of rooftop solar in Germany is due to the comprehensive package of financial incentives developed by German national and local authorities.

The German federal government guarantees a feed-in tariff or 'Solarstrombonus' paying solar power systems that are installed on residential or commercial property and connected to the public grid for the energy that they generate. The Solarstrombonus has made rooftop

solar one of the most financially profitable sources of electricity in Germany, with the feed-in tariff accounting for 60% of the revenue generated by solar power in the country in 2020.^{xxvi}

Moreover, individual states provide even more generous packages of financial incentives for rooftop solar installations. In Berlin the SolarPLUS program offers a package of support open to individuals, businesses, and community organisations, including:

- A feed-in tariff of 0.095 EUR (£0.08)/kilowatt hour (kWh) for the first 20 years of operation, guaranteeing a fixed price, even if the market price for electricity fluctuates.
- A one-time grant of 1,500 EUR for systems up to 3 kWp and 2,000 EUR for systems above 3 kWp.
- A loan with an interest rate of 0% for the first five years to finance the cost of rooftop solar installations.
- A subsidy for the removal of old roof tiles for solar systems that are installed on roofs with old, asbestos-containing roof tiles, so the approach is also providing public health benefits.^{xxvii}

In comparison, the UK's current financial incentives include grants under the Homes Upgrade Grant and Energy Company Obligation. Both of these schemes are welcome and rightly focus on those most at risk of fuel poverty, but with limited support for households on average incomes we are failing to realise huge opportunities for rooftop solar panels across the wider UK residential estate.

Similarly, the Smart Export Guarantee (SEG), the UK's current replacement to feed-in tariffs, is failing to properly incentivise the widespread uptake of rooftop solar we need to see across the country.

The SEG came into force in 2020, and places an obligation on licensed electricity suppliers to pay small scale low-carbon generators for the electricity they export to the National Grid. Unlike the Berlin SolarPLUS scheme, SEG payments are not fixed and can vary across different suppliers, although most offer low rates of just £0.03-£0.05/kWh.

With payments that are often less than half of those offered in Germany, and variable rather than fixed income streams, it is little surprise that the UK SEG does not incentivise rooftop solar installations as effectively as forward-looking feed-in tariffs like the Solarstrombonus. Crucially, the current structure of the SEG is not providing the long-term guaranteed revenue stream that can give individuals and businesses the confidence to take on loans to invest in rooftop solar.

This is further reinforced by the findings of the UK government's own behavioural research into the uptake of rooftop solar in this country. This study found that upfront costs are a major barrier for 66% of those considering installing rooftop solar panels and 69% of those who have rejected it as an option. Similarly, 47% of considerers and 43% of rejectors were

found to believe that they won't get a fair price for the electricity they sell back to the grid from rooftop solar installations.^{xxviii}

Given its ineffective structure, and the very low public awareness of the SEG, it is clear that the UK needs to reform its financial incentives to better match the success of the German model.

The UK's current fiscal position may not allow room for generous loans and grants that help households pay for the upfront costs of rooftop solar. However, this problem could also be overcome by reforming the SEG to set a higher minimum payment rate by energy suppliers much closer to the £0.08/kWh offered in Berlin, combined with a requirement for fixed payments over the lifetime of a registered rooftop solar scheme. Crucially, the government must amend the SEG so that suppliers can no longer set their own tariffs 'so long as they offer generators more than £0'.^{xxix}

Together, these reforms could help transform the SEG into a scheme that makes rooftop solar an attractive investment opportunity with a rapid rate of return, for a far wider range of individuals and businesses, unlocking a powerful new wave of private investment into this win-win technology.

2. Power purchasing agreements: 'Zero Yen Solar' in Japan

Summary: In the Tokyo and Kangawa prefectures of Japan, authorities are promoting the deployment of rooftop solar through a power purchasing agreement scheme called 'Zero Yen Solar'. This allows households and businesses to have solar panels installed on their rooftops for free in return for purchasing their electricity from the developers over a period of around 10 years. A similar national policy in the UK could eliminate the barrier of upfront costs for many households as well as reducing concerns about reliability and maintenance.

Reforming the SEG to ensure rooftop solar installers can be confident about long-term guaranteed returns on their investment will undoubtedly help uptake but there will still be many households, community organisations and businesses who find the initial capital outlay too daunting. Moreover, concerns around purchasing, and arranging the installation and maintenance of rooftop solar panels from safe and reliable suppliers is known to be 'a strong motivational barrier' for many people.^{xxx}

In Japan, where solar PV capacity has increased more than eighteenfold following the Fukushima nuclear accident in 2011,^{xxxi} authorities in the Tokyo and Kangawa prefectures are working with business to promote a form of Power Purchasing Agreements (PPAs) known as 'Zero Yen Solar', which offers a model for overcoming barriers to rooftop solar.^{xxxii}

The basic 'Zero Yen Solar' approach works by operators installing solar panels on customers' rooftops free of charge and in turn getting a return on their investment over a period of around 10 years through monthly fees and the sale of surplus electricity to the wider grid. The policy is delivered by local energy companies with funding support from the governments of the two prefectures.

Using PPAs to deliver rooftop solar in this way is not unique but it is clear that it could be a very effective tool for a UK government committed to delivering a rooftop solar revolution. Firstly, it eliminates the barrier of upfront costs for the property owner at a single stroke. Secondly, through the partnership of government and energy companies it offers a way to provide households and businesses with the confidence to take on rooftop solar through guaranteed fully licensed installers taking part in a scheme backed by public authorities. The peace of mind that you are guaranteed a reliable assessment of your roof and installation service would likely rapidly unlock opportunities for rooftop solar on many more buildings across the country.

Thirdly, this model also makes the lifecycle of rooftop solar much more convenient for ordinary households, as it is the relevant energy company that takes on the responsibility for maintenance of the panels during the contracted period of ten or more years. Furthermore, due to the high unit rate currently charged by major utility companies, rooftop solar PPA's could deliver particularly high financial benefits to energy consumers in the UK. With long-term contracts that sell the electricity generated to the user of the property at a fixed rate that significantly cuts their bills, whilst still delivering a healthy return on investment, the 'Zero Yen Solar' approach could reverse some of the recent squeeze on household and business finances that is currently dampening our economy.

Given the parlous state of local authority finances in the UK, translating the ‘Zero Yen Solar’ policy to a UK context would best be overseen by national government. An obvious solution would be for the Westminster government to establish a country wide scheme in collaboration with accredited rooftop solar companies, with funding to support on the ground oversight by local authorities. Individuals, community organisations and businesses could then apply directly to the national scheme for free installation and maintenance of solar panels on their roofs, in return for a 10–20-year PPA through which they purchase the electricity they need, with any surplus sold by the installer to the national grid. With proper resourcing, local authority teams could then vet buildings applying to the scheme based on pre-determined criteria.

In the context of political proposals for a publicly owned energy company, such as the Labour Party’s Great British Energy,^{xxxiii} it would be possible to take this approach in an even bolder direction. If a future government were to plan significant direct investment in the decarbonisation of electricity generation in this country, a free rooftop solar scheme that offers consumers guaranteed low bills could be publicly funded, with national or local government owning the solar panels. This would then open the opportunity for the government to not just promote large scale deployment of rooftop solar across the country, but also to secure long-term financial returns that could fund other future projects.

The Green Britain Foundation estimates that at least 50% of homes in the UK are highly suitable for rooftop solar, and a further 17% have an East or West facing roof that would be appropriate,^{xxxiv} establishing a nationally funded PPA rooftop solar scheme offers a huge investment opportunity to rapidly cut carbon emissions, lower bills, and raise long-term revenue without any additional land take.

Bulk contracts: China's "whole county" programme

Summary: China is achieving exceptionally rapid growth in rooftop solar capacity, and this is in part due to the 'whole county' solar policy. This approach aggregates the work to install solar panels on rooftops across an entire local authority area into a single profitable contract. Adapting this policy to a UK context could deliver faster deployment of rooftop solar by creating new and larger investment opportunities for developers.

Another major economic hurdle that is contributing to the misallocation of resources holding back the rapid rollout of rooftop solar, is the limited opportunities for economies of scale. Compared to the vast ground-mounted solar plants which are the subject of such fierce local opposition, a rooftop-by-rooftop approach to the delivery of solar inevitably appears a vastly less convenient prospect for developers.

More generally, this is why the UK's market-based approach to onshore renewable energy has slipped down a route which is largely replicating the old fossil fuel system with a comparatively small number of centres of generation, instead of taking the transformative opportunity for a distributed network with micro-generation spread widely across the country. Consequently, we are at risk of once again becoming trapped in an energy system that suffers from high transmission losses and is dependent on the vagaries of international commodity prices.

However, this misses the full picture of the aggregate roof space suitable for hosting solar panels. The UK Warehousing Association has estimated that there is space for 15 GW of new solar panels on warehouse rooftops, which would double the country's current solar PV capacity. Indeed, according to their 2022 estimates, the 20% largest warehouses alone can provide 75 million square metres of roof space, potentially sparing a land area equal to that required by 500,000 houses.^{xxxv}

In total, it is estimated that the rooftops of non-domestic buildings in the UK could provide space for solar panel installations with an enormous total capacity of 38.4 GW.^{xxxvi} Moreover, the evidence shows that the largest rooftops are where the greatest energy demand is, with the 6% of non-domestic buildings larger than 1,000m² responsible for 64% of electricity consumption.^{xxxvii} It is, therefore, unsurprising that utilising just 5% of the UK's potential commercial rooftop space for solar, could deliver energy cost savings estimated at £12.6 billion annually.^{xxxviii}

What levers are available to bring together the vast aggregate rooftop space suitable for solar panel installations to deliver development opportunities with significant economies of scale? China is currently achieving amongst the most rapid delivery of rooftop solar of any country, with 27.3 GW installed by 2021,^{xxxix} and roughly 1 in every 5 solar panels installed globally in 2022 sited on a Chinese building, thanks in part to a policy that offers an answer to this very challenge.^{xl}

The 'Whole County' PV pilot programme was initiated by China's energy regulator, the National Energy Administration, in 2021,^{xli} and has been strongly praised by organisations like the Centre for Energy and Clean Air.^{xlii} The policy works by municipal-level government

authorities tendering solar providers to install rooftop solar panels on all public buildings and other sectors in their area by a certain date. This is intended to align with national targets for PV installations to cover:

- 50% of the total roof area of party and government agency buildings
- 40% of the total roof area of public buildings such as schools, hospitals, and village committees
- 30% of the total roof area of industrial and commercial factories
- 20% of the total roof area of rural residences

Local authorities and village or town level developers work in partnership to identify suitable buildings to host the panels and organise contracts, with big developers purchasing the project rights and delivering installations once the permits for roofs across the county are secured.^{xliii}

Projects delivered through the Whole-County policy then use two potential models of ownership for the installed panels. The rooftop owners can choose to finance the panels themselves and sell the electricity they generate, or the installer can maintain ownership of the panels and lease the roof space from the building owner, with different approaches suitable according to circumstances.^{xliv}

676 counties, including city level administrative units, are participating in the policy, and by the end 2022 the potential capacity of registered projects had exceeded 66 GW – similar to Germany's entire solar capacity.^{xlv}

In this way, the Whole-County policy offers a model for local authorities and parish councils in England to successfully aggregate distributed opportunities for rooftop solar installation into a single large and attractive package for development. This results in powerful incentives throughout the value chain to maximise the delivery of rooftop solar,^{xlvi} secures lower installation costs through bundling many rooftops into a single contract, and reduces the soft costs associated with customer acquisition by tendering to a single supplier and installer.^{xlvii}

As with power purchasing agreements, the Whole-County policy is not a complete innovation. The Whole-County approach bears similarities to the 'Solar Together' schemes promoted by several local authorities across the UK. Through Solar Together, residents are given the opportunity to take part in a bulk order for rooftop solar installations, achieving 10-25% saving against average market prices through group-buying. However, to date, Solar Together's achievements are relatively modest, with 6720 installations that have a total capacity of 20 MW.^{xlviii} Crucially, the Whole-County approach tenders all the associated roof space to a single supplier and installer, creating a total estate large enough to match many ground-mounted opportunities and opening the way for greater economies of scale.

A UK equivalent of the Whole-County policy approach could be delivered at the district council and unitary authority level through local area energy plans (LAEPs), with central government funding through net-zero programmes. In the first instance, across each local

authority, with all suitable rooftops within the entire public estate, whether council, central government, NHS or any other publicly owned buildings automatically incorporated into a single contract for PV installations. The relevant local authority could then carry out an audit of buildings with suitable roof space for PV panels, which could focus on non-domestic buildings which we know offer the largest opportunities. As in China, local authorities could be set national targets for the proportion of different types that they should aim to include within the Whole-County contract. The owners of these buildings could then be invited to join the contract, with bids sought from certified developers to tender for installing solar panels across the whole aggregate roof space. For contract simplicity, the developer could then either sell the panels to the building owners, or lease the roof space and sell the generated electricity to the grid.

Adapting the Whole-County rooftop solar policy to the UK context could fundamentally transform the investment opportunities across the solar sector, speeding up delivery and redirecting resources towards the rooftop developments and easing mounting land-use pressure.

Making rooftop solar mandatory

Summary: Most major economies that are achieving rapid deployment of rooftop solar internationally are benefitting from regulations that require solar panels to be installed on the roofs of new buildings. The UK government is currently consulting on similar proposals and should set ambitious new standards making rooftop solar mandatory for suitable new houses and non-domestic buildings in this country.

One of the most straightforward and obvious opportunities for a substantial expansion of rooftop solar, is to make it a standard expectation of all suitably designed new buildings. In a survey of CPRE's own supporters, we found that 97% would support making rooftop solar panels a mandatory requirement for all new buildings and car parks to receive planning permission.

It is estimated that 1 in 5 of the buildings that will be occupied in 2050 is yet to be built,^{xlix} and analysis for CPRE by UCL academics in 2023 found that securing the installation of solar panels on the rooftops of new domestic and non-domestic buildings up to over the next 26 years could deliver a generating potential of 20 GW.^l That is a capacity over six times greater than Sizewell C.

Mandatory rooftop solar for new buildings is a clear opportunity to achieve electricity decarbonisation and greater energy security with minimal fuss, yet currently UK policy in this area is falling behind.

In Germany the national government has committed to making rooftop solar mandatory for new commercial buildings and to establishing them “as a rule” for new private buildings, while individual states are pushing even further forward with obligations for existing roofs being renovated and parking lots above a minimum size.^{li}

Similarly, in Japan in 2020 the city government in Kyoto set requirements for new and renovated buildings with a floor space of larger than 2,000 m² to install solar panels, while Tokyo has extended mandatory rooftop solar requirements to cover single-family homes and other smaller buildings as well.^{lii}

While the UK government has yet to capitalise on the opportunities for mandatory rooftop solar on new buildings in this country, at the time of writing the Department for Levelling Up, Housing & Communities (DLUHC) is consulting on changes to Building Regulations that offer hope for progress. In setting the Future Homes and Building Standards, the government is considering setting requirements for “high efficiency solar PV panels” to cover an area equivalent to 40% of the ground floor area of new domestic buildings, and 40% of the building's foundation area for side-lit spaces and 75% for top-lit spaces in the case of non-domestic buildings.^{liii}

CPRE strongly welcomes this consultation and calls on the government to implement the highest viable standards for mandatory rooftop solar on new buildings as swiftly as possible. In our response to the consultation, we have highlighted opportunities to go further to maximise the rooftop solar delivered as new buildings are constructed without the need for future retrofitting, especially on non-domestic buildings standards should increase the

coverage to 60% of a building's foundation area for side-lit spaces and 90% for top-lit spaces, where practicable.

Similarly, government can supercharge a rooftop solar revolution in the UK by amending planning regulations at the national level such that planning permission will not be granted for commercial or public car parking spaces unless they also provide solar energy generation. Furthermore, in line with the most dynamic international policies identified by WPI Economics' research, the government could introduce an 'if not, why not' approach to rooftop solar for building renovations and conversions. This could be achieved by suspending permitted development rights for major external changes to existing buildings unless they deliver upgrades to the Future Homes Standard.

By implementing policies for mandatory rooftop solar installations that match the ambition shown in other major economies, the government can realise a substantial growth in solar energy generation without requiring any additional land-use or public funding, thereby securing rapid action with minimal cost.

Process reforms:

Summary: Italy, Poland, and Germany are also pursuing process reforms that are variously aimed at streamlining and speeding up the installation of rooftop solar in their country. While the UK has made recent steps in a similar direction, more could be done by reducing the barriers for rooftop solar schemes to sell electricity directly to local households and businesses, and by considering giving priority access to grid connections for rooftop solar.

The analysis undertaken by WPI Economics has also highlighted the importance of process reforms aimed at streamlining and speeding up the delivery of rooftop solar as a further area of international policy action suitable in the UK context.

In Germany, the Federal Ministry of Economic Affairs and Climate Protection is removing electricity system certification requirements for rooftop solar projects with an output of up to 500 kW, substantially simplifying the process for these schemes to get connected to the electricity grid.^{liv}

Similarly, recent policy changes in Italy have been aimed at dramatically streamlining the process for the installation of commercial rooftop solar systems with a capacity of up to 200kW. Businesses in Italy are now able to begin installing solar panels on their rooftops with just a single application form – a major cut in red tape and bureaucracy and encouraging substantially larger rooftop projects.^{lv}

In Poland too, in 2022, government legislation introduced changes that allow individuals to install rooftop solar panels with a capacity of up to 150 kW without any requirements for building permits.

The UK has taken some similar steps in this direction, with planning permission not usually required for domestic rooftop solar installations up to 50kw assuming that the building is not listed or in a designated area. In November 2023, the government abolished the 1MW cap on permitted development for rooftop solar on commercial buildings and introduced a new permitted development right to allow the installation of solar canopies in non-domestic off-street car parks at ground level.^{lvi}

CPRE believes that the government should consider going further in streamlining the process for rooftop solar installations in this country. In 2016, CPRE and the BRE National Solar Centre^{lvii} published a best practice guide for rooftop solar installations that highlighted the importance of permitted development rights in cutting costs and unnecessary regulation for rooftop solar projects, whilst noting these rights do not apply in conservation areas.^{lviii} Given the urgent need to rollout rooftop solar across the country, the time has perhaps come to revisit this issue. Along with clearer and firmer best practice guidelines, the government should work with Historic England, who have published their own important work on this issue,^{lix} to explore the scope to instal solar panels on the rooftops of listed buildings and in protected landscapes more quickly without compromising historic significance or the natural beauty of the landscape.

As a supporter of the Local Electricity Bill campaign,^{lx} CPRE also calls upon the government to follow the example set in Poland and establish a Community Electricity Export Guarantee

and a Community Electricity Supplier Services Scheme that together would enable smaller-scale renewable energy schemes – especially community-owned and run ones – to sell their power directly to local households and businesses. This would make many more rooftop solar schemes financially viable by allowing residents to buy electricity directly from installations on local buildings like schools or community buildings, rather than forcing surplus energy to be sold at unfeasibly low prices to the large energy suppliers.

Perhaps more speculatively, there are two further process reforms that the UK government could pursue to ramp up investment in rooftop solar projects across the country. It is widely reported by businesses and individuals who wish to install solar panels on their rooftops that grid connection costs and delays are one of the biggest barriers holding them back, and in 2023 the UK had approximately 200 GW of electricity projects waiting for a grid connection.^{lxii} Given the enormous positive externalities associated specifically with rooftop solar as a source of renewable energy, in terms of cutting bills, protecting food security, and sparing land to support biodiversity, there is a strong argument that the government should consider directing National Grid and distribution network operators (DNOs) to prioritise onshore grid connections for rooftop solar schemes first.

Similarly, there has been considerable debate about whether planning policies currently give enough weight to the protection of farmland when considering the suitability of a site for ground mounted solar panels.^{lxiii} In both Japan^{lxiii} and China,^{lxiv} growing competition for land-use and concerns around food-security have played an important part in directing the development of solar projects increasingly onto rooftops. As similar concerns come to the fore in the UK, and ecological decline makes it increasingly difficult to justify the loss of land that could be simultaneously used for carbon sequestration and regenerative agriculture, there are strong grounds for reviewing relevant land use and planning policies. By updating the NPPF to clearly require solar applications to avoid land used by active, viable and sustainable farm businesses, the government can give a clear market signal that will direct business investment on the course of least resistance to maximising rooftop solar.

Challenges for further consideration:

Summary: Further work is needed to develop clear strategies for overcoming remaining barriers to the delivery of rooftop solar in the UK. Attention needs to be given to speeding up and lowering costs for grid connections, making it easier for leaseholders to benefit from rooftop solar, and tackling supply chain concerns and workforce shortages.

Although they lie beyond the scope of this publication WPI Economics' research has also highlighted several challenges that require further consideration and must be urgently addressed so the UK can deliver rooftop solar projects at the necessary speed to decarbonise our electricity system.

Firstly, as already referenced above the costs and exceptionally long timelines to get a grid connection for a new rooftop solar project is stymying the ambition of many households and businesses that are currently ready to invest in new installations. The government must make it a priority to work with Ofgem, National Grid and the DNOs to achieve a step change in investment on local grid capacity, with priority access for rooftop solar schemes.

Secondly, leasehold property arrangements are making it difficult for many households and businesses to securely invest in rooftop solar installations. The most recent estimates suggest that there are around 5 million leasehold dwellings in the UK, roughly 20% of the housing stock,^{lxv} and many warehouses and large commercial buildings are also occupied on a leasehold basis. The occupiers of these buildings currently must seek consent from the freeholder to have solar panels installed on their rooftops. At the same time, while leaseholders carry the financial cost of paying for rooftop solar installations, it is the freeholder who benefits from any increase in property value, creating a misalignment of incentives which impacts a significant proportion of the buildings in the UK. This is particularly problematic for rapidly growing small and medium-sized enterprises, who are likely to need to relocate as they expand.^{lxvi} To ensure that all suitable roof space across the UK is unlocked for solar PV installations, the government should explore ways to give leaseholders a legal right to have solar panels on the buildings they occupy, and give careful consideration to how leaseholders in particular can benefit from a national PPA scheme.

Finally, a rapid expansion of rooftop solar will have to overcome supply chain challenges and skills shortages within our national workforce.

Research has by Unison suggests that currently up to 97% of solar panels include components that could have been made by forced Uyghur labour in China.^{lxvii} Clearly this is morally abhorrent and different sources must be found. Organisations like the Big Solar Co-op are showing that ethical procurement is possible,^{lxviii} and the government must set stronger and clearer supply chain requirements for the solar industry, so that individuals and businesses can play their part in a rooftop solar revolution with confidence that they are not risking complicity with modern slavery.

At the same time, the solar industry estimates that up to 60,000 jobs could be required to meet the government's solar targets^{lix} and without a clear workforce strategy a lack of skills and manpower could become a major bottleneck for the rapid delivery of more rooftop

solar installations. Happily, this need also represents a significant opportunity for the UK economy, as it is estimated that approximately 70% of jobs in the oil and gas sector have direct skills overlap with low-carbon roles like those in the solar industry.^{lxx} Further work is needed to ensure that the UK meets the requirements of a rapid rollout of rooftop solar by training a skilled workforce with secure well-paid opportunities that offer a suitable transition for employees in the fossil-fuel sector.

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