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**Greater London Authority
June 2018**

Published by
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Front cover photograph courtesy of the Solar Trade Association and Solarcentury.
Copies of this plan are available from www.london.gov.uk/energy

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Mayor's foreword

One of my top priorities as Mayor is to make our city a healthier, cleaner place for all Londoners to live and work.

Since becoming Mayor, I have committed to making London the greenest global city and set an aspiration to make London zero carbon by 2050. I have also put into action the boldest and most ambitious plan to tackle air pollution of any major city and implemented new initiatives to fight fuel poverty.

We have made a good start, yet there's clearly much more to do. To help achieve our goals, not only do we need to insulate and future proof more buildings, but we need to generate more renewable energy and use low carbon electricity from the national grid in a smart way.

As Mayor, I want to give all Londoners access to affordable, green energy and empower them to better manage their energy use. Solar panels have a crucial role to play in helping us do this.

Solar power provides a way for Londoners to have a stake in their own energy generation. In Brixton, for example, solar power schemes have been installed that are owned by estate residents through share offers, creating engineering apprenticeships for local young people.

Even with our typical British weather, solar (photovoltaic) panels in London can generate up to half a household's annual electricity demand. But as well as making a significant contribution to energy provision, solar power is a visible demonstration of action, which can encourage others to follow suit and to learn more about renewable energy.

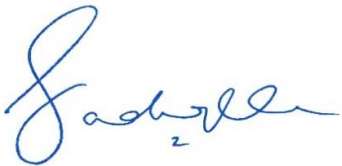
We have already seen this in action, with some schools installing solar panels to reduce their electricity bills and to engage students with important topics, like climate change, science and engineering.

But if we are to make the most of solar energy, there are some big challenges we need to overcome. London has fallen behind other areas of the UK and we urgently need to increase installation rates to catch up. Sudden changes to national policy have also had a real impact on the solar industry, and I want us to reverse some of the damage done in London by creating a steady demand for the technology.

In a densely populated city like London, there is limited space for large solar arrays. However - as we create much-needed housing and workplaces - we have a fantastic opportunity to install more solar panels on these new buildings, incorporating them into the design right from the start.

It has been estimated that as much as two gigawatts of solar capacity could be installed in London. I have set this as my long-term ambition, with an interim ambition of one gigawatt by 2030. As part of this, I am leading by example by installing 100 megawatts by 2030. This is going to be achieved by: ensuring more solar power is generated across the Greater London Authority estate; using planning powers to drive solar in new developments; supporting community projects; bulk buying solar to bring the costs down; and delivering solar panels through energy efficiency delivery schemes under my Energy for Londoners programme.

My London Environment Strategy and this solar action plan sets out in detail how we can achieve our ambitions. By embracing solar energy, we have an opportunity to make a real difference to the lives of Londoners – both now and in the future. I look forward to working with Londoners, businesses and public sector organisations right across our city to put London back on track to deliver our solar energy potential.

A handwritten signature in blue ink, appearing to read 'Sadiq Khan', with a small number '2' written below the name.

Sadiq Khan
Mayor of London

Executive summary

The Mayor wants to make London a zero carbon city, as set out in his Environment Strategy. For this to happen, London will need to be supplied by a range of efficient and clean energy sources. Energy generated from solar technologies will be part of this mix and London is aiming for two gigawatts of installed solar energy capacity by 2050. This action plan, the first of its kind for London, establishes how the Mayor will seize the opportunity for solar energy (box 1) in the capital and increase deployment in the coming years.

In the past decade, the UK has seen a dramatic increase in the number of solar energy installations. Despite recent setbacks, solar energy generation is set to grow further. Solar technologies are versatile and can be installed in a wide range of locations and sizes. These include domestic and commercial buildings and, where appropriate, large installations on the ground. Solar energy projects can be developed and installed very quickly, and the fuel - solar radiation - costs nothing and is pollution-free. However, London lags behind the rest of the country in realising the benefits of both solar photovoltaics and solar thermal technologies and there is a significant opportunity for London to increase its uptake from today's low levels.

Realising London's solar energy potential requires a buoyant and expanding solar energy industry. This will further bring down the costs of solar energy technologies and ensure they become competitive with fossil fuel based generation and other low carbon energy sources in the near future. Combining solar energy generation technologies with energy storage technologies (like batteries) enables onsite use of heat or power to meet demand at any time of day. It is therefore important that London maximises the potential for solar energy storage as technology costs continue to fall.

Box 1: What is solar energy?

Solar energy is energy obtained by capturing the radiant light and heat from the sun. A range of technologies enable this. For example, photovoltaic (PV) cells generate electricity, and solar thermal technologies collect the thermal energy from the sun and use this heat to provide hot water. Solar energy technologies provide a reliable source of renewable energy for heating and powering our buildings and infrastructure.

This plan sets out a range of actions to realise London's solar potential as part of the Mayor's Energy for Londoners (EfL) programme. EfL aims to make London's homes warm, healthy and affordable, its workplaces more energy efficient, and to supply the capital with more local clean energy.

To meet the zero carbon target, London will require significantly more solar energy generation to be installed: two gigawatts (GW) by 2050. The Mayor has therefore set an

ambition for London to achieve 1 GW of installed capacity by 2030, ten times more than today's levels, and 2 GW by 2050. This can't be achieved through the Mayor's leadership and programmes alone. It will need strong and supportive policy from national government, and the support of local government, the private sector, charities, and individuals. To play his part, the Mayor has set a target for his own programmes to almost double London's current installed capacity, installing an additional 100 megawatts (MW) by 2030.

Mayoral objectives and actions

1. Lead by example by maximising solar energy technologies on Greater London Authority group buildings and land
 - work with the GLA functional bodies to maximise installations across the GLA group, including estimating the potential and providing technical assistance
2. Encourage solar energy installations through the planning system
 - ensure that new developments include solar, where feasible, and work with boroughs to ensure planning policies do not unnecessarily restrict solar installation on existing properties
3. Help Londoners to retrofit solar energy technologies on their homes and workplaces through Mayoral programmes and funding
 - pilot and, if successful, extend 'Solar Together London', a reverse auction scheme to reduce costs for Londoners
 - help community solar energy projects get off the ground through grants from a London Community Energy Fund
 - encourage public sector organisations and providers of social housing to retrofit solar energy technologies on buildings, by promoting the use of technical assistance programmes delivered through Energy for Londoners
 - support projects that promote energy storage
4. Help Londoners to make informed decisions about investing in solar energy technologies

- promote the opportunity for installing solar and storage in homes and businesses through the use of spatial mapping and access to technical support
- provide clear guidance and information on installing solar energy technologies

Further government action

5. Call on government to set a national policy framework that unlocks London's solar energy potential
 - call on government to ensure national policy is introduced to support higher levels of solar energy deployment in London, as part of a package of national policy measures that enable London to meet its ambitious zero carbon target by 2050
 - work with regulators and electricity network operators to ensure the smooth roll out of projects, especially community-led schemes.

Introduction

Solar energy technologies are mature, proven and reliable sources of renewable energy with an important role to play in both the national and London energy mix. Electricity can be directly produced from photovoltaic (PV) cells, and solar heating technologies collect the thermal energy from the sun and use this heat to provide hot water or space heating. Solar PV and solar thermal technologies are clean and renewable and will play a part in meeting the Mayor's target for a zero carbon London by 2050.

Solar energy technologies can be deployed in a variety of locations and contexts including domestic roofs, commercial and industrial properties, and on the ground on brownfield sites, for example as solar farms. Solar PV and thermal systems enable households and businesses to independently generate electricity and hot water.

Solar energy technologies are not just important because of their energy production. They can also contribute to London's economic growth, through supporting the low carbon and environmental goods and services sector. This sector is currently worth £30.4bn to London's economy, and is estimated to employ around 5,000 to 10,000 people in the solar industry within London¹.

Solar energy technologies installed on buildings, usually on rooftops, bring additional co-benefits. They help to engage building owners, raise energy and climate change issues up community agendas, and influence how people value and use energy. Solar PV in particular can also be installed alongside other rooftop technologies, such as green roofs. Indeed, some research shows that vegetation can help increase the operational efficiency of solar PV panels by keeping them cool. Solar technologies aren't constrained to rooftop applications though, and the industry continues to innovate with emerging solutions such as building materials with integrated solar technologies, solar car ports and floating systems.

In the decades ahead, with the need to move to the electrification of heat and transport, demand for electricity is likely to increase. This is especially so in areas of large scale development (such as opportunity areas) where electricity substations may already be at or near capacity. Generating local electricity through solar PV can help meet current demand and ease stress on the national grid. Solar electricity can also help balance our demand for energy, for example by supplying buildings where peak demand aligns with solar generation – such as offices (typically used during the day). Combining electricity storage technologies, such as batteries, with solar energy generation technologies enables onsite use of solar generated electricity to meet demand at any time.

In addition to solar PV generating electricity for London, solar thermal also helps reduce gas consumption for hot water production. Although it is estimated to have a smaller

potential to provide energy from London's rooftops than solar PV, solar thermal often provides a competitive return on investment even without government financial support (typically around six years). In addition, solar thermal technologies can help tackle air pollution by reducing our reliance on polluting gas-fired heating systems to produce hot water.

The Mayor's ambition and objectives

In his manifesto, the Mayor committed to "make the most of the city's roofs, public buildings and land owned by TfL for energy generation by producing a solar energy strategy".

The actions set out in this plan fulfil that commitment and will put London on track to realising the potential of solar energy and maximising its contribution to the Mayor's zero carbon city ambition. They form part of the Mayor's Energy for Londoners (EFL) programme. EFL aims to make London's homes warm, healthy and affordable, its workplaces more energy efficient, and to supply the capital with more local clean energy.

Many of the factors that determine the speed of solar PV and solar thermal deployment in London are outside of the Mayor's control, such as manufacturing costs for panels or national government incentive schemes such as the Feed-in Tariff (FiT) or Renewable Heat Incentive (RHI)². However, the Mayor has a key role to play in promoting solar energy, providing guidance and encouraging Londoners to harness the benefits of solar energy technologies and associated storage.

This action plan sets out what the Mayor will do to maximise London's solar energy generation. Given London's limited amount of available space at ground level, rooftop solar PV is the main focus of this action plan. However, the action plan will also encourage the installation of solar PV and solar thermal technologies on vacant land or space alongside other infrastructure at ground level.

The plan has five objectives, with actions to achieve them under each:

1. Lead by example by maximising solar energy technologies on Greater London Authority group buildings and land
2. Encourage solar energy installations through the planning system
3. Help Londoners to retrofit solar energy technologies on their homes and workplaces through Mayoral programmes and funding
4. Help Londoners to make informed decisions about investing in solar energy technologies

5. Call on government to set a national policy framework that unlocks London's solar energy potential

Global context

Solar PV is on the rise globally. Prices for solar PV panels have plummeted over the last decade and this trend is expected to continue. The International Renewable Energy Agency suggests that the global average cost for electricity generated by solar PV could decrease by as much as 59 per cent by 2025 compared to 2015 prices³. Solar PV was the largest renewable energy employer in 2015 with 2.8 million jobs worldwide, an 11 per cent increase on 2014⁴.

As of the end of 2016, there was an estimated 300 gigawatts (GW) of solar PV installed worldwide, making up more than 1.5 per cent of global electricity demand. Rapid growth since 2015 is largely due to installations in the U.S. and China. The International Energy Agency suggest that this growth in global solar capacity will continue over the next few years reaching around 740 GW by 2022⁵.

National context

In the UK, there has been unprecedented growth in the number of solar panels installed on homes in recent years. Over the past decade, it is estimated that over 800,000 homes have had solar panels installed, helped by a reduction in cost of over 70 per cent⁶. Small scale domestic solar PV (systems typically <4 kilowatts (kW)) is the largest sub-sector of the UK solar PV market, for both number of installations and total capacity installed⁷.

However, in more recent years the solar industry has faced challenges, especially with reductions in financial support due to changes in government policies, particularly changes to the FiT in 2015. This resulted in support for domestic-scale solar tariffs reducing by 65 per cent from 12.47 to 4.39 pence per kilowatt hour (p/kWh). As a result, UK rates of solar installation have slowed. According to the Solar Trade Association (STA) domestic rooftop solar technology deployment fell by 75 per cent in the first quarter of 2017 compared to average deployment since the FiT began in 2010⁸.

Although the costs of solar PV panels have fallen significantly over the past decade, there has been a recent increase in costs for domestic solar PV installations in the UK (by approximately 10 per cent since early 2016). According to the STA this increase in costs is linked to low rates of current deployment since "cheap solar and sustaining strong cost reductions requires the high volumes of a solid market"⁹. Increasing deployment rates through further incentives could therefore provide more competitive prices, leading to a further increase in deployment.

In addition to these factors, government has increased business rates for buildings which have solar panels installed that generate electricity for use onsite. Some sites have faced six to eight fold increases in their business rates according to the STA¹⁰. Not only do these rates not apply to onsite fossil fuel energy generation in the UK they also do not apply to projects in Europe. This disproportionately affects the UK and weakens the financial business case for building owners to install solar PV. In some cases higher business rates are estimated to make solar PV a burden rather than a benefit¹¹. The STA has identified some solutions to avoid incurring business rates for solar on non-domestic buildings, but these introduce additional complexity for building owners¹².

These factors have also had an impact on jobs. A report commissioned by the STA in 2016 estimated that at least a third of jobs in the solar energy sector have been lost as a result of the recent decline in sales¹³.

However, despite changing government policy, there is reason to be optimistic about the national context. Solar PV is popular in the UK. According to the Department for Business, Energy and Industrial Strategy (BEIS) 82 per cent of respondents to their public attitudes survey supported solar PV¹⁴. Several energy suppliers are also now offering solar energy technologies and storage technologies as a compelling business model to generate revenue and reduce energy bills. Greater London Authority (GLA) surveys of sector experts suggest that, with a supportive government regulatory framework, within two to three years battery storage is likely to be a self-sustaining market.

London will be best placed to take advantage of this market trend if there is widespread familiarity with the technology, its associated business models and the logistics of battery installation and management.

Overview of solar energy in London

Solar potential in London

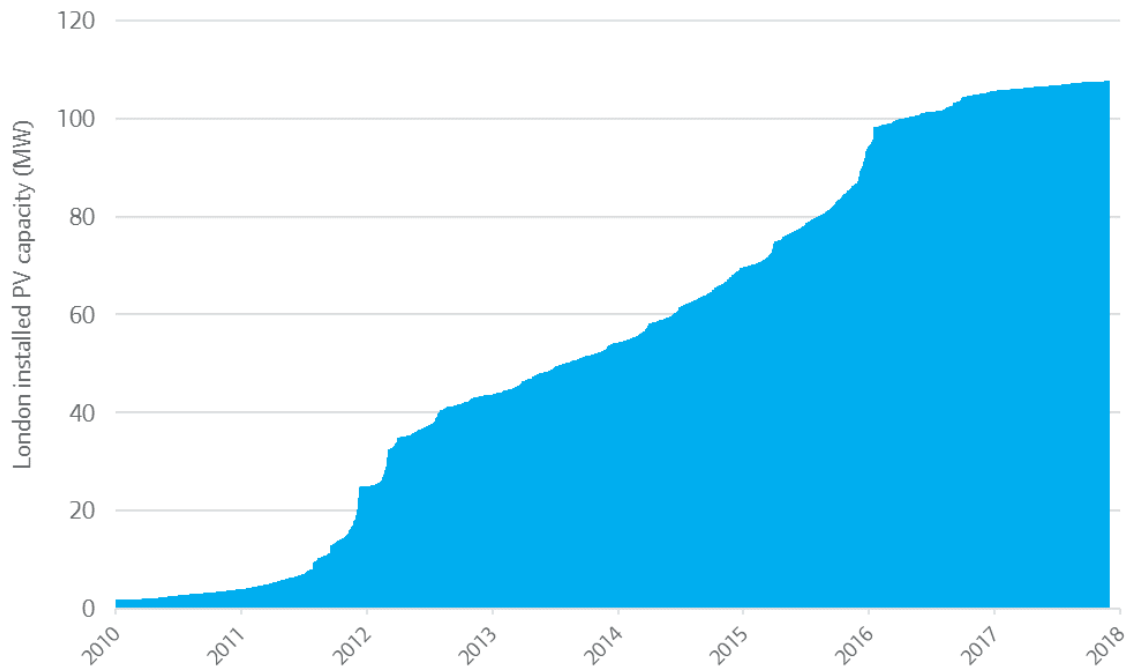
London has a large amount of potential space for solar PV and solar thermal technologies. Greater London covers an area of around 1,600 km², around one third of which is comprised of building rooftops¹⁵. But rooftops are not the only suitable area for solar technologies. London has a potentially huge, but unquantified, opportunity for installing renewable technologies on vacant land and open space, building facades, and alongside thousands of kilometres of roads and railway sidings.

However, London's economic potential for solar is less strong. The GLA assessed the economic potential for solar PV and solar thermal technologies on buildings as part of its zero carbon pathways modelling to inform the London Environment Strategy¹⁶. This took into account the economic constraints resulting from current government policies – predominantly the reduction to FiTs – and trends in deployment between 2010 and 2017. This study estimated that under an ambitious scenario¹⁷ solar PV installations could reach around 550 MW capacity by 2025, 850 MW capacity by 2030 and 2 GW capacity by 2050. Solar thermal could potentially contribute the equivalent of around an additional 100 MW by 2030.

Solar PV deployment

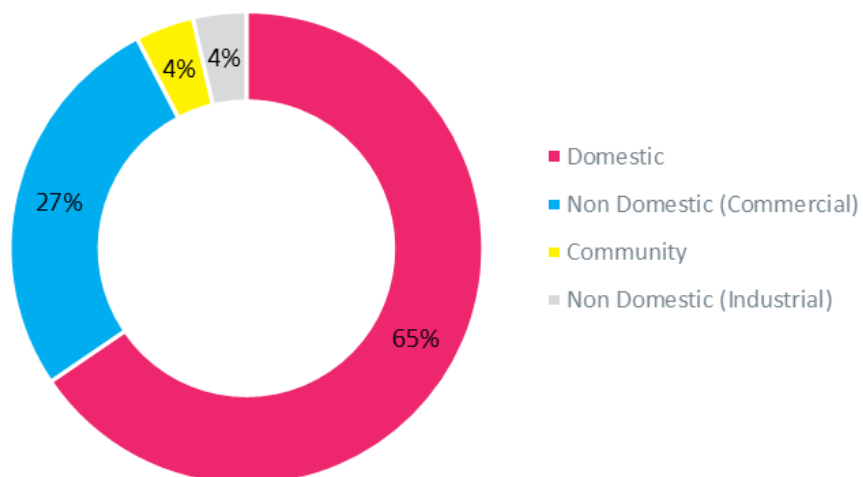
In 2016 solar PV registered through the FiT is estimated to have generated 80 gigawatt hours (GWh) in London, 0.2 per cent of the capital's total electricity demand, from a capacity of around 108 MW as of the end of 2017¹⁸. Around 5 MW has been recorded through the Renewables Obligation scheme and Renewable Energy Guarantees of Origin certification¹⁹. Figure 1 shows the impact of the national solar PV FiT, introduced in April 2010, which accelerated solar PV installations in London nineteen-fold (capacity is thought to be less than 5 MW prior to 2010). Almost three quarters of solar PV capacity in London was installed on domestic buildings, with commercial buildings providing the next largest contribution (see Figure 2). Average capacity per home is estimated to be around 3.3 kW, meeting around half of a home's annual electricity demand, and around 20 to 25 kW for commercial and community buildings. This increases to 95 kW for industrial installations, of which there are far fewer (around 40) in London.

Figure 1 - Solar PV installations in London claiming the FiT since introduction in April 2010



Source: Ofgem (2018)

Figure 2 - Proportion of FiT registered installed solar PV capacity in London by host building type

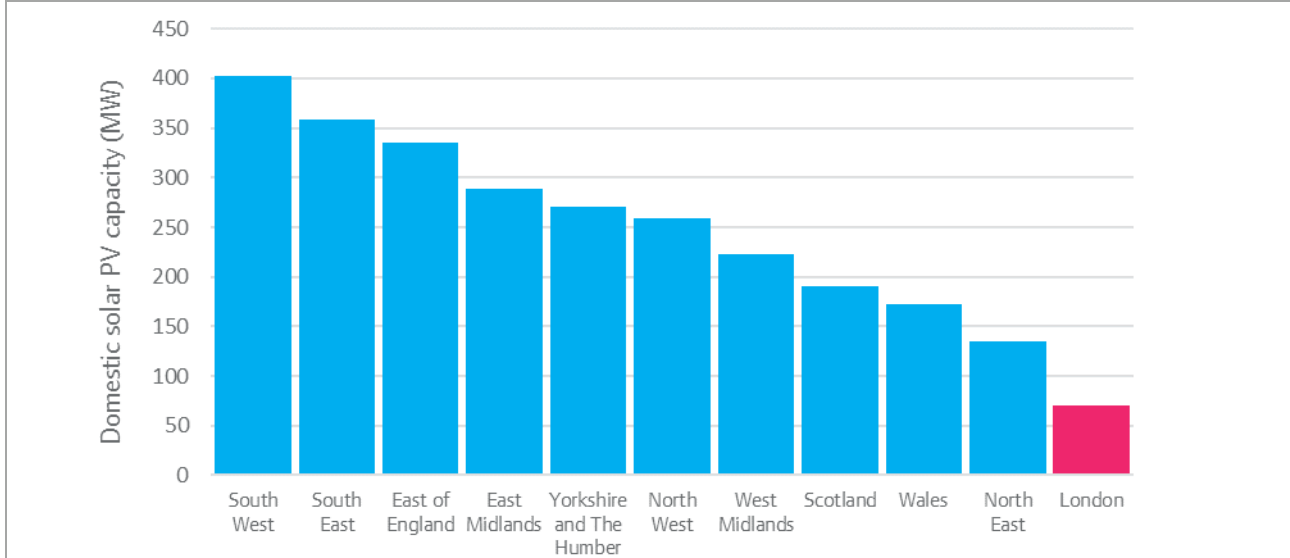


Source: Ofgem (2018)

The most recent data (to December 2017) shows that London continues to lag behind other regions in the UK in relation to solar PV installation. London has only three per cent

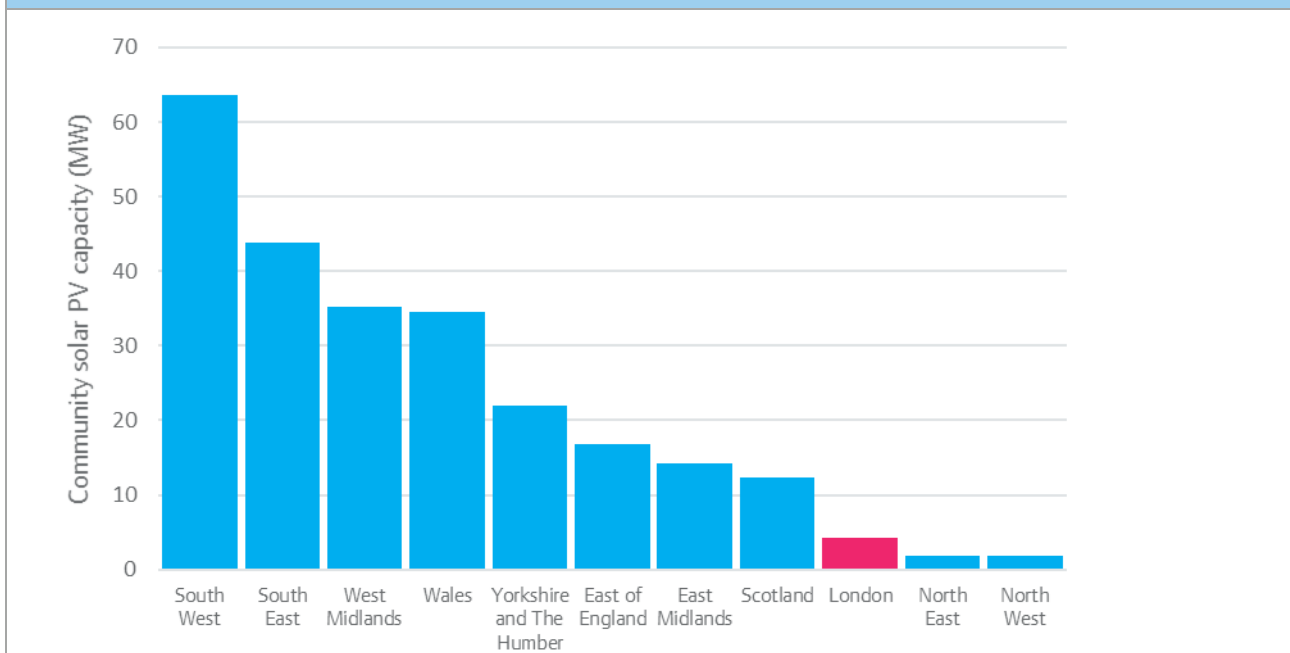
of total domestic capacity registered through the FiT for England and the lowest of any region in the UK²⁰ (Figure 3). However, London performs slightly better on community installations (i.e. those on communal buildings), as shown in Figure 4 (in which the latest FiT data allocates community installations by region).

Figure 3 - Sum of FiT registered installed solar PV capacity for domestic properties by UK region (December 2017)



Source: Ofgem (2018)

Figure 4 - Sum of FiT registered solar PV capacity for community properties by UK region (December 2017)



Source: Ofgem (2018)

Solar thermal deployment

As of November 2017, London had 258 accredited domestic solar thermal schemes, out of a national total of 8,508²¹. These largely provide hot water for buildings. From November 2011 to December 2017, although London had an additional 99 non-domestic RHI accredited installations with a capacity of 38 MW, less than 1 MW of this is thought to be solar thermal. Government has stated its intention to continue to support solar thermal technologies through the RHI, confirming that the solar thermal incentive should remain at a rate of 19.74p per kWh²². GLA modelling suggests that London has the potential for 6,800 domestic and 1,200 non-domestic solar thermal installations by 2030.

Barriers and opportunities

The upfront capital cost of installing solar PV is still fairly high (around £4,000 - £6,000 for a typical family home in the UK). This can discourage Londoners from investing in the technology. However, there are a number of other reasons for London's low uptake of solar PV. The greatest barrier is uncertain national policy. Government has reduced its financial support through the FiT for solar energy technologies, citing the fall in costs of technology. However, since the reduction in the FiT, the uptake of solar energy technologies across the country, including London, has plummeted and is unlikely to regain previous levels without a supportive policy framework to address delivery barriers. There is concern that the FiT will be closed to new applicants in the future and this would further stifle growth.

Given this, the Mayor is committed to providing leadership to stimulate the market in London and overcome some of the capital's specific barriers and challenges including:

- 50 per cent of London's homes are flats, compared with sixteen per cent in the rest of England²³. Flats are logistically harder to retrofit than a single dwelling and often require agreement from tenants, leaseholders and freeholders. The Mayor currently has limited powers to require freeholders to consider solar PV, for example if more than half of leaseholders are in favour of installation. Blocks of flats also have significantly less roof space per home compared to houses
- 28 per cent of all London's homes are privately rented, compared with 18 per cent in the rest of England²⁴. Landlords often have little incentive to install solar PV as they do not receive any benefit from the savings on energy bills unless it is included in the rent but have to pay the upfront cost. Likewise tenants have little incentive to invest in a property they do not own
- a high number of rented commercial buildings²⁵. As with privately rented homes, the landlord-tenant split means there is often little incentive for solar energy technologies to be installed
- difficulty in accessing suitable homes and workplaces. This could, for example, be due to narrow roads and little space for grounding the scaffolding needed to install

rooftop panels. These challenges also have the potential to increase installation costs

- unsuitable locations, and over 1,000 conservation areas, which are half of England's total. Dense development and tall buildings can lead to sub-optimal conditions for electricity generation from solar PV due to shading. In addition, GLA analysis indicates that solar PV installations are 50 per cent less likely to be installed in conservation areas in the built environment, mainly due to heritage considerations
- competition for roof space, and lack of suitable space for large ground level solar installations, like solar farms. Roof space is often used for other building service equipment, or has unsuitable structures. In addition, competing use for land limits the deployment of larger scale solar PV on the ground (such as solar farms, which are more prevalent outside of London)

The Mayor's actions to increase solar energy in London

To contribute to London's zero carbon target by 2050, it is estimated that London will need to install up to 2 GW of solar energy by 2050 and around 1 GW by 2030. Working together with Londoners, building and estate managers and owners, businesses and community groups, this ambition is achievable. But it will require government to provide consistent and long term policy certainty to enable the UK solar industry to grow with confidence, and achieve cost reductions through greater deployment rates.

The Mayor proposes to undertake actions within his powers to increase the level of solar energy technologies installed in London. It is estimated that these proposed actions could deliver around an extra 100 MW of installed solar energy generation in London by 2030 to contribute to the broader aim.

This will be achieved through the following actions:

1. Lead by example by maximising solar energy technologies on Greater London Authority group buildings and land

The GLA group has already installed solar PV on their estates, including:

- City Hall – 67 kW of panels installed through an energy efficiency retrofit that took place in 2008
- Transport for London (TfL) – solar panels installed at several sites, including TfL's 55 Broadway HQ, Paddington Underground station and Vauxhall bus station, together produce around 245 kWp of electricity. PV at Vauxhall bus station is estimated to provide a third of the station's electricity
- London Fire Brigade (LFB) – 56 fire brigade buildings currently host solar PV arrays with an estimated cumulative capacity of around 740 kWp. It also has fifteen solar thermal installations. Over half of LFB's buildings now have solar PV and/or thermal panels and LFB has a target to meet 12 per cent of its energy demand from renewable sources including solar energy technologies by 2020/21
- Metropolitan Police Service (MPS) – operates and maintains 23 solar arrays. During 2016/17 the PV arrays generated around 400 MWh of electricity. The MPS

benefited from £80,000 in FiT payments and £33,000 in avoided electricity costs in 2016/17

- London Legacy Development Corporation (LLDC) - PV arrays generate around 350 MWh of electricity per year

These projects have provided the GLA group and its building and estate managers with invaluable experience in progressing solar PV installations. However, the installations to date represent a small fraction of the buildings and property owned or managed by the GLA group.

The Mayor will therefore call on the GLA group to continue to map potential for solar energy generation on their estates in 2018 and maximise the potential to install solar energy technologies. This will include identifying and prioritising potential sites and infrastructure, setting a solar energy target, making finance available, and utilising the Mayor's delivery programmes, such as the Decentralised Energy Enabling Project (see page 22) and RE:FIT (see box 8) where appropriate, to install solar PV. The Mayor will support this by providing mapping tools where appropriate, sharing best practice and monitoring the level of solar installations.

Several GLA group members have already started this process. For example, TfL has prioritised rolling out solar PV on its property as part of its recent business plan. Following a competitive tendering process through the RE:FIT delivery framework Engie is now working to install around 1.1MW of new solar capacity on a variety of TfL buildings. The first panels will be delivered as part of TfL's new Train Modification Unit at Acton Depot and installed from early 2019. Should this first phase be successful, further projects will be undertaken on TfL's land and buildings. London Fire Brigade has already assessed the solar potential for the majority of its fire stations and has been installing solar over the past decade.

Railway sidings and other vacant land and infrastructure owned by the GLA group also provide a vast area of currently underutilised space (especially where not used for wildlife habitat) for solar PV installation. However, installation and maintenance of solar PV

Box 2: Transport for London's solar mapping

In 2010 Transport for London undertook a high level study of the potential to retrofit solar energy technologies on London Underground stations and depots, office buildings, bus stations and garages. Those which had no roof space or were significantly overshadowed were eliminated. This was followed by a detailed analysis of the challenges surrounding the use of renewables to take a typical station completely 'off grid', which found the costs to be prohibitive.

In 2016 it completed a more detailed analysis of the majority of its building stock (over 1,000 buildings including offices, depots and stations) to determine the suitability and potential generation of solar PV.

panels can be complicated by difficult access and meeting the necessarily strict safety precautions.

As part of maximising solar generation, the Mayor will work with the GLA group to investigate delivering solar energy projects on challenging sites to determine how greater barriers to deployment can be overcome. This may include working with community energy groups and others to install solar energy technologies on GLA group land. Sites will be selected where the business case for investment is uncertain due to a lack of evidence on constraints. By managing projects from initial scoping through to installation the lessons that are learnt will provide more robust evidence to inform the business case for future installations. To overcome site-specific challenges the projects may require the use of technologies that are relatively new to the market, helping to incentivise innovation and also providing evidence for the performance of new products. Dependent on the success of these projects, the Mayor will consider encouraging other public sector land owners and managers to install solar PV on vacant land or make it available to community energy groups.

2. Encourage solar energy installations through the planning system

New developments

The London Plan is the Mayor's regional strategic development plan. Under current energy policies the London Plan and local borough plans are delivering solar PV on major developments. Most planning applications referred to the Mayor for his final decision incorporate solar PV and in recent years these developments have committed to an estimated 6 MW of solar PV per annum²⁶. In the London Plan the Mayor expects solar to be considered by boroughs and developers to help achieve carbon targets. Planning applications referred to the Mayor will continue to be reviewed to maximise opportunities for renewables including solar. Training and support will be provided to borough planning officers to maximise opportunities for renewables as part of developments that are not referred to the Mayor.

Through his London Plan, the Mayor encourages major developments to use onsite renewable energy technologies (such as solar PV and solar thermal) where feasible to help meet carbon reduction targets. Where energy assessment targets are not achievable onsite, the London Plan allows developers to meet carbon targets through delivering installations offsite or through the payment of offsetting funds. The Mayor will continue to support boroughs to collect and utilise carbon offset contributions from new developments to retrofit solar energy technologies on existing buildings, potentially also helping to identify locations that may be suitable for solar PV projects that could be supported through borough offset funds. This will need to be balanced against other competing uses for offset funds, such as energy efficiency measures. The Mayor will publish guidance to Local

Planning Authorities on the allocation and use of offsetting payments to deliver carbon offsetting projects and the option of pooling funds.

For large 'strategic' developments (i.e. large developments referred to the Mayor) where estimated demand for power exceeds current grid capacity, developers will need to work with the Distribution Network Operator to determine the most cost-effective way to provide a reliable and affordable electricity supply. A local micro grid powered by solar, combined with storage may be able to contribute to this.

Where there is potential for larger scale solar installations at ground level within the GLA boundary, applications referred to the Mayor will be judged on a case by case basis, in line with London Plan policy and consider the impacts in the local area and the wider benefits for London. A solar farm in the Green Belt is likely to be considered 'inappropriate development' and applicants must demonstrate 'very special circumstances' to justify planning permission. The Mayor is keen to support solar farms on appropriate sites outside of the Green Belt.

Existing buildings

Opportunities to install solar energy technologies on existing buildings in London are currently being missed. In principle, permitted development rights (set at a national level) enable the installation of solar panels without planning permission, even within conservation areas. Installations on listed buildings require planning permission wherever they are located.

The experience of the Mayor's RE:NEW programme (see box 3) suggests some inconsistency in the approach by boroughs to the application and interpretation of permitted development rights. This is particularly prevalent in conservation areas. Within conservation (or heritage) areas local authorities can remove permitted development rights through an Article 4 Direction, thereby requiring planning permission to be granted before work can start. This can potentially result in planning permission being refused or the imposition of conditions that make the PV installation unfeasible.

Box 3: RE:NEW Programme

RE:NEW is a technical assistance project and is part of the Mayor's Energy for Londoners programme. It gives technical advice and support to London boroughs and social housing providers on the measures, technologies and funding they can use to make their housing stock more energy efficient and low carbon.

Solar PV, where appropriate and feasible, is one of the measures that RE:NEW encourages. Since 2009, the programme has supported delivery of over £23m of solar PV projects in around 9,000 homes, reducing carbon emissions by an estimated 1,700 tCO₂ each year.

The Mayor will therefore work with boroughs to map the variance of planning approaches across London. Findings from previous studies will be used to inform guidance to aid a more consistent application of solar PV, solar thermal technologies and other energy efficiency retrofit measures on properties in conservation areas, while respecting heritage considerations. Whilst there has been innovation in the design of solar energy technologies that has made them more sympathetic to their surroundings, it is important that this continues and these technologies are brought to mass market soon.

3. Help Londoners to retrofit solar energy technologies on their homes and workplaces through Mayoral programmes and funding

Solar PV on housing

Different housing tenures in London have differing levels of solar PV installations, and require different approaches and incentives to encourage further uptake. The Mayor would like to see more private and social landlords increase installation rates of solar PV on their housing stock and pass on the energy cost savings to their tenants. This will have social benefits in helping to alleviate fuel poverty. With the anticipated cessation of the national FiT, the Mayor will seek to support innovative delivery models for solar PV that are financially attractive to landlords without national subsidy.

As part of the drive towards whole-house energy efficiency retrofit the Mayor will introduce a successor to the current RE:NEW programme to help support an increase in the installation of solar PV on London's social housing (and privately rented homes where possible). Social housing represents approximately a quarter of London's total homes and is an important and growing market for solar PV. As multiple homes are owned by a smaller group of boroughs and social landlords, it provides an opportunity to aggregate demand for solar PV across housing stock alongside wider energy efficiency retrofit.

Although some boroughs and housing providers have already retrofitted solar on their housing stock, some lack the capacity and resources to take the same action, and reduced FiT rates have weakened the

Box 4: Solar Together London

Solar Together London, a pilot project launched in March 2018, is a reverse auction where the roles of seller and buyer are reversed compared to a usual auction. Multiple buyers state their intention to purchase solar panels, and their demand is pooled together, or aggregated, typically by one organisation so they become a single buyer. The sellers need to compete to sell high quality solar panels to the aggregated buyers, with the lowest priced bidder winning.

This form of collective purchasing helps to reduce costs, drive up quality and take the hassle out of buying solar panels compared to buying separately.

business case. As part of the Mayor's Energy for Londoners programme, RE:NEW (and its successor programme, to be launched in 2018) provides technical assistance to boroughs and social housing providers to help overcome these challenges.

In addition to RE:NEW, to support an increase in the installation of solar PV on owner-occupied and privately rented homes, the Mayor is piloting 'Solar Together London' (see box 4). This collective approach to purchasing solar panels aims to reduce the costs of solar PV to Londoners through a reverse auction approach. A similar scheme in Norfolk has successfully aggregated demand for solar PV installations and driven down costs through economies of scale. The scheme is estimated to have increased installation rates by 83 per cent, and saved households an average of 16 per cent on the installation cost of solar PV²⁷. This is a similar model to Solarize NYC, a citywide initiative to drive solar uptake and reduce costs through multiple group purchasing campaigns in New York. If it is successful, the Mayor will investigate expanding this programme to target household across other Boroughs, and expand to other types of homes including the social housing sector.

Through a rigorous supplier vetting process and by auditing installations, best practice standards will be ensured so that Londoners benefit from high quality solar PV systems.

Through his Energy Leap project the Mayor will deliver some of the first zero energy retrofits in London and the UK, and will trial payment mechanisms including the ability to recoup some or all of the capital cost of the refurbishment work, and energy performance guarantees, which in turn could support the increased uptake of solar energy technologies. As evidence is unclear on the value that solar energy technologies and energy efficiency measures can add to a property, Energy Leap will also undertake post-retrofit valuations. If successful, Energy Leap will lead to a larger demonstrator project which will seek to overcome other key challenges including more complex building types and mixed-tenure properties.

The Mayor will support pilots to test how energy storage solutions can be delivered alongside solar PV to help keep solar an attractive option in a post FiT scenario. The installation of rooftop solar PV coupled with batteries is a key part of the Energy Leap project and the Mayor is also supporting the Sharing Cities demonstrator project in

Box 5: Sharing Cities demonstrator

Sharing Cities is a €25m smart city demonstrator programme run in partnership with Greenwich, Milan, Lisbon, Bordeaux, Burgas and Warsaw. The programme aims to use data and digital approaches to connect existing and new buildings, transport and energy infrastructure to reduce energy demand, bills and emissions.

The Mayor will work with Greenwich to retrofit five residential housing blocks, including integrating low carbon measures such as renewable heat, solar panels, battery storage and the installation of smart digital heating and electricity controls in individual apartments.

Greenwich (see box 5). This project is assessing feasible sites for using solar PV combined with batteries to store electricity for use later in the day, while also exploring the feasibility of integrating electric vehicle charging facilities in order to optimise energy use and manage demand on the local distribution network. The Mayor will also consider promoting battery storage through offers and marketing in Solar Together London, and providing information on the GLA website.

There is also potential to utilise solar PV technology combined with battery storage to help tackle fuel poverty by providing cheap clean electricity to fuel poor homes. The 24/7 Solar project, which is part funded by National Energy Action (NEA), is being led by Camden Council working in partnership with Islington and Waltham Forest councils. The scheme tests the potential benefits of using batteries to store surplus electricity generated and not used during the day to then supplement the householder's evening demand. The Mayor is keen to work with NEA and London boroughs to use the results from the 24/7 pilot to inform the potential development of successor projects.

Community solar

Community energy groups are usually local residents that come together to generate, own, manage, or reduce consumption of energy. In London these groups currently own and operate at least 750 kW of solar PV situated on churches, social housing blocks and schools. These have often been financed through the purchase of shares by members of the community. Other than generating clean renewable energy, community energy projects bring additional benefits to local areas. For example, profits from many schemes are re-invested into the community and are used to deliver energy efficiency advice and energy management audits to help local homeowners or businesses reduce their energy use.

Community energy groups can provide highly effective skills, experience and local knowledge to help raise funding for the delivery of solar projects. However, with little dedicated funding, and London's residents working on projects in their spare time, such groups are sometimes limited in their ability to deliver solar PV projects. In addition to this, key financial support has ended. For example, these groups are no longer supported through tax relief offered by government's (Seed) Enterprise Investment Schemes. Government's Urban Community Energy Fund²⁸, which provided a valuable source of funding to help the development of hundreds of community energy projects in the critical early stages, has also now closed.

Research by Community Energy London (CEL) - a new hub for London's community energy groups - suggests that a cost effective way to support community energy groups is through providing funds to help scope and develop a detailed business case for projects.

To support community energy in London, the Mayor launched the London Community Energy Fund in October 2017 which helps community energy groups get solar projects off the ground. The first phase offered grants of up to £15,000, used to support the development stages of community solar projects (including storage technologies). Funding could be used, for example, to carry out preliminary viability studies for solar energy or develop a financial business case. The grant funding pays for the work required to get a community energy project ‘investor ready’, i.e. ready to be financed.

Thirteen projects have been awarded funding in the first phase of the London Community Energy Fund, across eight London boroughs. The successful projects include developing solar projects on schools, community centres, churches, sports centres and other buildings used by local communities, as well as investigating financially viable delivery models for solar in a post FiT scenario. Project work will be completed in summer 2018, with groups then expected to install panels by the end of 2018. The GLA will continue to work with CEL (see box 6) to evaluate the first phase of the Fund and will release further funding support. Alongside this the GLA will support the smooth roll out of community projects by helping CEL to build relationships with key stakeholders to enable community energy projects to overcome the main barriers they face.

Box 6: Supporting Community Energy London (CEL)

The Mayor has supported the development of CEL²⁹ by providing free meeting space at City Hall and co-funding research into the current state of the sector and what support it requires. CEL is closely aligned with Community Energy England, which represents the sector nationally. CEL is in its infancy but aims to facilitate networking amongst groups, acting as a forum to share learning and expertise, and supporting the development of projects within London’s unique built environment.

In addition to this support, the Mayor will link any potential community grant scheme to the Decentralised Energy Enabling Project (DEEP) where suitable. DEEP will provide technical, commercial, financial and other advisory and support services to help public and private energy suppliers to develop, procure and bring into operation larger-scale renewable and local energy schemes. It aims to take energy projects through an end-to-end process from feasibility and business case, to procurement and delivery. DEEP has a target to directly support the delivery of 3 MW of renewable energy capacity, installed by September 2019.

Finally, in order to stimulate demand for community energy, the Mayor will evaluate the effectiveness of using Licence Lite (a junior electricity supply licence) to enable smaller suppliers such as community groups to sell electricity to the public sector (see box 7).

Box 7: Licence Lite

The Licence Lite Project enables smaller local electricity suppliers to sell power to the market without the significant licensing requirements and costs that larger suppliers need to meet. The project acquired an Ofgem junior electricity supply licence to buy locally generated low carbon electricity at a higher price than suppliers would otherwise receive from the wholesale market and sell to GLA group facilities.

Licence Lite came into operation in January 2018 and the pilot is set to run for one year, during which the project will be evaluated for potential continuation. Licence Lite is currently buying electricity from Scottish and Southern Energy's combined heat and power plant in Woolwich and from Peabody Service's 11 solar PV installations on its housing in Hackney and Southwark. It is selling the power to Transport for London, with nPower as the Third Party Licence Supplier. Other solar generators in London could potentially join the project if the Mayor continues with Licence Lite beyond the pilot.

Solar PV on non-domestic buildings

Solar PV systems for non-domestic buildings have similar benefits to those of domestic systems including lower electricity bills. However, they generally tend to be larger installations so have the added advantage of generating larger amounts of electricity and being better able to match onsite generation with onsite demand (including through the use of energy management systems).

Box 8: The RE:FIT programme

RE:FIT is part of the Mayor's Energy for Londoners programme. It addresses the lack of technical expertise and (increasingly) capacity within many public-sector organisations by providing free-of-charge expert support to public sector bodies (including London boroughs, NHS bodies, schools, universities and colleges, central government departments and cultural and heritage organisations). In addition to the free support provided by a team of experts, RE:FIT offers access to a framework of 16 suppliers enabling organisations to procure suppliers quickly, efficiently and economically to deliver energy saving measures, and guarantee energy savings.

The scope of RE:FIT has been extended to offer support to more organisations, bringing a greater focus on solar energy, and expanding its scope to include the retrofit of non-building assets, such as LED street lighting and electric vehicle charging infrastructure. By 2020 the programme aims to have reduced emissions by nearly 25,000 tCO₂e per year, saved at least 68 GWh of energy and retrofitted over 400 buildings from a range of public sector bodies.

The Mayor wants to see more public buildings like schools, hospitals, universities and government buildings at the forefront of the move to solar energy generation. His RE:FIT programme offers free support to public sector organisations to develop low carbon energy projects including the installation of PV (see boxes 8 and 9). The Mayor will continue to support the public sector to retrofit their buildings with solar generation measures through the RE:FIT programme.

Box 9: Installing solar PV on the Western International Market through RE:FIT

The London Borough of Hounslow used RE:FIT to install a large solar PV array on the Western International Market. This was a two million pound project including 8,500m² of solar panels alongside battery storage. This project has an estimated payback period of around seven years, and is delivering annual carbon savings of almost 800 tonnes.

Box 10: Higher education and solar projects

London's higher education establishments contain not only large buildings that often have good potential for solar energy measures, but also students who have the ability to deliver community solar projects. In 2016, students from SOAS University of London used crowdfunding to install 114 solar panels on the university building. This is believed to be the first student-led community energy project in the UK.

Where possible RE:FIT will work with clients to help achieve the most cost effective PV installations across their portfolio. The Mayor will also work with universities and other higher education institutions to identify solar projects and utilise the lessons learnt from successful projects such as SolarSOAS (see box 10).

Within the commercial sector, some of the barriers to the deployment of solar PV are thought to be similar to those that prevent building owners and tenants from taking up energy efficiency measures. These include the ability to access capital, suitability of the building stock, and split incentives, primarily around ownership between the freeholder/landlord and tenant. The Mayor will investigate how these barriers can be overcome as part of a review of ways to reduce emissions from London's small and large businesses. The Mayor will work with networks and organisations of businesses to increase the installation of solar energy technologies, for example by helping to identify opportunities, especially for larger solar arrays on commercial property, and engaging organisations around flexible electricity demand.

As with residential buildings there is potential for solar PV, especially when combined with battery storage, to help reduce peak demand for electricity in commercial and public sector buildings, which can benefit the regional and national electricity network. FlexLondon is a Mayoral initiative that aims to reduce London's estimated peak electricity demand by 15

per cent including through increased use of local, low carbon projects. It will help develop projects that demonstrate how London can eventually access around 1 GWe of flexible electrical demand by 2050. Solar projects play an important role in making power demand more flexible by supplying electricity locally, potentially reducing energy costs and minimising the need to invest in reinforcing London's electricity grid.

4. Help Londoners to make informed decisions about investing in solar energy technologies

Discussions with the solar industry in London have identified that one of the key roles the Mayor can play is promoting the potential of solar energy and the multiple benefits it can bring to Londoners. Other large cities including Tokyo and New York have developed interactive maps to demonstrate opportunities for solar energy at a building level. They have also used these platforms to provide a 'one-stop shop' for information on solar programmes, rebates, tax credits, and information on installing and interconnecting solar PV and solar thermal systems. Such platforms provide a focal point for raising interest, awareness and developing new projects.

The Mayor will promote the opportunity for installing solar and storage across households and businesses through the use of spatial mapping information and technical support where required. This will help building owners by saving them time and money ahead of undertaking site-specific suitability studies.

The Mayor will provide access to clear information and guidance on how to install solar PV and solar thermal technologies, details of available support mechanisms and guidance for maintenance (including health and safety requirements) of solar systems. This will signpost to further information including trusted certification schemes, the distribution network operator, emerging technologies and existing tools to estimate solar potential on homes and workplaces. This information for landlords, tenants and homeowners alike will increase knowledge of the potential for solar panels in both the private rented sector and in owner-occupied homes. This may be particularly useful for outer London boroughs where there are many homes with unutilised potential for solar panels, and for identifying opportunities through schemes such as Solar Together London.

The Mayor will also use spatial data on solar opportunities to support the delivery of solar energy technologies through his other Energy for Londoners projects and to potentially identify suitable sites for temporary solar installations in London, for example on vacant land and across the GLA group. The Mayor will map sites of known solar installations in London and ask Londoners to add locations where they have installed solar energy technologies.



5. Call on government to set a national policy framework that unlocks London's solar energy potential

National government policy on solar energy currently favours large scale solar farms. With limited vacant land compared to other regions, this places London at a distinct disadvantage. As part of the Mayor's advocacy to government to ensure that London achieves its ambition and trajectory to be zero carbon by 2050, the Mayor will advocate that consistent and long term national policy is in place to support higher levels of small-scale solar deployment in London. This will enable the London solar industry to grow with confidence, and achieve cost efficiencies through greater deployment rates. The Mayor

will continue to call on government to undertake the following actions to help achieve the aims of their Clean Growth Strategy:

- provide a clear plan for the FiT and other financial support mechanisms to provide long-term confidence to businesses and homeowners to invest in solar energy technologies. This should include a 'post-parity' plan to ensure that solar energy technologies do not reach a cliff edge once they reach grid parity, and also how to make the most effective use of any potential FiT budget underspend to support more small scale solar generation including community energy
- remove the increase in business rates for buildings that have solar panels which generate electricity for use onsite. This increase is also acting as a disincentive to install small scale renewables
- work with energy companies to investigate the benefits of net energy metering to incentivise solar. Net metering is a billing system that pays energy system owners for the electricity they add to the grid, and is enabled through the adoption of smart meters
- work with regulators and electricity network operators to enable the smooth roll out of projects by clarifying and simplifying processes (such as export meter installations), and ensuring the growth in local solar generation will align with the requirements of grid operators' networks
- overcome regulatory barriers to support battery deployment as a key technology to make the most of solar PV power generation. To encourage greater uptake of batteries alongside solar panels the Government should consider reducing VAT to 5 per cent for batteries installed in domestic buildings that already have solar PV panels

Getting involved

This plan sets out what the Mayor believes is necessary to increase solar energy generation in London. It sets out some actions he will take but London's true solar potential will only be realised if action is taken by London's residents, businesses, community groups, the public sector and others. This plan is therefore a call to action to people from across London to make the most of the capital's solar opportunity.

Details of how you can be involved - whether as a homeowner, landlord, business, solar generator or community energy group – can be found on our website:

www.london.gov.uk/energy.

Endnotes

¹KMatrix (2015) London's Low Carbon Market Snapshot 2015

²<https://www.ofgem.gov.uk/environmental-programmes>. The Feed-in Tariff (FiT) scheme is a government programme designed to promote the uptake of renewable and low-carbon electricity generation technologies. The Domestic Renewable Heat Incentive (Domestic RHI) is a government financial incentive to promote the use of renewable heat.

³IRENA (2016) The Power to Change: Solar and Wind Cost Reduction Potential to 2025

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⁶KPMG (2015). UK solar beyond subsidy: the transition

⁷Feed-in Tariff (FIT): quarterly report – Issue 28 (2017). Available at <https://www.ofgem.gov.uk/environmental-programmes/fit/contacts-guidance-and-resources/public-reports-and-data-fit/feed-tariffs-quarterly-report>

⁸<http://www.solar-trade.org.uk/sta-sounds-deployment-alarm-solar-hits-crunch-point/>

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¹²www.solar-trade.org.uk/current-business-rate-solutions

¹³PwC (2016). Seeing through the gloom: UK solar seeks stability after subsidy cuts

¹⁴BEIS (2016). Energy and Climate Change Public Attitude Tracker (Wave 19)

¹⁵GLA analysis (2017)

¹⁶GLA (2018). Mayor's London Environment Strategy

¹⁷This scenario assumes that centralised funding supports some projects, local authorities and housing associations de-risk schemes and undertake direct investment, leading to greater investor confidence and acceptance of a lower rate of return.

¹⁸BEIS (2016). Regional Renewable Statistics. Available at <https://www.gov.uk/government/statistics/regional-renewable-statistics>

¹⁹See footnote 2 for definitions, available at <https://www.ofgem.gov.uk/environmental-programmes>

²⁰Please note this data does not include Northern Ireland

²¹Ofgem (2017) Domestic Renewable Heat Incentive Quarterly Report Update: November 2017

²²Solar Trade Association (2017) Webpage available at <http://www.solar-trade.org.uk/sta-solar-thermal-win/>

²³GLA (2017). Housing in London: 2017

²⁴GLA (2017). Housing in London: 2017

²⁵GLA (2017). Housing in London: 2017

²⁶<https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/energy-monitoring-reports>

²⁷<http://www.councils.coop/case-studies/norfolk-collective-solar-scheme-norwich-city-council>

²⁸ <https://www.gov.uk/guidance/urban-community-energy-fund>

²⁹ <http://communityenergy.london/>

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