Department of Energy & Climate Change

UK Solar PV Strategy Part 1: Roadmap to a Brighter Future

October 2013

Contents

Foreword by the Rt. Hon. Gregory Barker MP, Minister of State for Energy and Climate Change

This is a truly exciting time for UK solar. In the last three years, under the Coalition Government, the sector has gone through a period of profound change, challenges and staggering growth.

We have deployed almost 2.5GW of solar and installed solar PV on nearly half a million homes as well as thousands of businesses and community sites.

The DECC central forecast estimates that the UK is likely to reach 10GW by 2020. But I believe we can go faster and further.

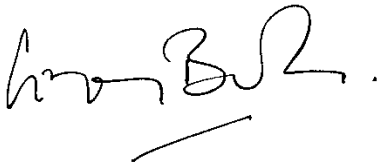
Along with many in the industry, I think that up to 20GW of deployed solar is not only desirable but also potentially achievable within a decade. But we will only meet such an ambitious level of deployment if we all work in even closer partnership and achieve grid parity sooner.

Delivering such an ambition will require even greater innovation, new skills, relentless downward pressure on costs - right through the whole supply chain and a much more dynamic grid network - all of which we will seek to examine in the full strategy which we will publish early next year.

But big ambition must also be matched by a much greater sensitivity to impacts on landscape, visual amenity and biodiversity. Local communities must be willing partners in solar expansion; not just consulted but respected and where ever possible, financial partners in local projects.

The global solar sector is going through a period of hyper-change. We must make sure we grasp solar PV's full potential, along with the British jobs and wide economic and environmental benefits that it can bring, as we compete with growing confidence in the global race.

Rt. Hon. Gregory Barker MP



Executive Summary

1. Solar PV is one of the eight key renewable energy technologies that can help to create a clean, balanced UK energy mix[1]. It has significant advantages: it is versatile and scaleable, with deployment possible in a wide range of locations including domestic and commercial buildings and where appropriate on the ground; solar projects can be developed and installed very quickly; and the fuel - solar radiation, is free.

2. The UK has seen a significant level of solar PV deployment together with significant cost reduction over recent years with installed costs estimated to have fallen around 50 per cent between 2010 and 2012[2]. The ability to deliver further reductions in the installed costs of solar PV will determine the level of sector growth and the ability for the levelised cost of solar PV to become competitive with other low-carbon electricity sources.

3. As of June 2013, the UK now has 2.4GW installed capacity generating 1.4TWh during July 2012 to June 2013[3]. The Government is committed to substantially increasing the deployment of renewable energy across the UK and recognises the potential role and contribution that solar PV can play in helping to meet the UK's target of 15 per cent renewable energy from final consumption by 2020[1], and in supporting the decarbonisation of our economy in the longer term.

4. The extensive deployment of solar PV across the UK has become increasingly visible to the public at all scales and is among the most popular renewable energy technologies. Recently solar received the highest public approval rating of all renewable energy technologies at 85 per cent[4]. We need to ensure that this level of support can be maintained – including by ensuring that solar PV is appropriately sited, and allow for greater community engagement. We do, however, expect on-going deployment of the technology to continue at all scales.

5. All these factors mean that the time is right for the Government to set out its vision of the strategic direction for solar PV in the UK – making sure that our policies support the appropriate deployment in a sustainable, cost-effective way. We need to provide certainty to investors, solar developers, and the households, communities and businesses affected by solar PV.

[1] DECC (2012) UK Renewable Energy Roadmap Update 2012
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/80246/11-02-13_UK_Renewable_Energy_Roadmap_Update_FINAL_DRAFT.pdf
[2] Provided as part of the FITs Comprehensive Review by Cambridge Economic Policy Associates (CEPA) Cambridge Economic Policy Associates Ltd and Parsons Brinckerhoff (2011) Updates to the Feed-in Tariff Model Documentation of Changes for solar PV Consultation
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48136/2174-cepa-paper.pdf
and Parsons Brinkerhoff (PB) (in October 2011[2]) and by PB (in May 2012) Parsons Brinckerhoff (2012) Solar PV Cost Update
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43083/5381-solar-pv-cost-update.pdf
[3] Energy Trends, September 2013, table ET 6.1 https://www.gov.uk/government/publications/renewables-section-6-energy-trends
[4] DECC (2013) Public Attitudes Tracker Wave 5
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/198722/Summary_of_Wave_5_findings_of_Public_Attitudes_Tracker.pdf

6. This Roadmap sets out four guiding principles, which form the basis of Government's strategy for solar PV. These principles are:

   I. **Support for solar PV should allow cost-effective projects to proceed and to make a cost-effective contribution to UK carbon emission objectives in the context of overall energy goals** – ensuring that solar PV has a role alongside other energy generation technologies in delivering carbon reductions, energy security and affordability for consumers.

   II. **Support for solar PV should deliver genuine carbon reductions that help meet the UK's target of 15 per cent renewable energy from final consumption by 2020** and in supporting the decarbonisation of our economy in the longer term – ensuring that all the carbon impacts of solar PV deployment are fully understood.

   III. **Support for solar PV should ensure proposals are appropriately sited, give proper weight to environmental considerations such as landscape and visual impact, heritage and local amenity, and provide opportunities for local communities to influence decisions that affect them***.*

   IV. **Support for solar PV should assess and respond to the impacts of deployment on: grid systems balancing; grid connectivity; and financial incentives** – ensuring that we address the challenges of deploying high volumes of solar PV.

7. This Roadmap sets out these principles – covering what has been done to date, and where further work is needed. Further work will be completed ahead of publishing the Solar PV Strategy in spring 2014 which will assist the development of policy and the growth of the sector.

8. This further work will be framed by the Solar PV Strategy Group and input from the Task Forces. It will include analysis and feasibility of cost reduction potential; analysis of the life cycle emissions of solar PV; greater understanding as to the likely proportions of domestic, industrial and ground mounted solar PV by 2020; and further analysis to explore how to manage the grid systems balancing with significant levels of solar PV deployment.

Section 1 - Introduction

Solar PV: The Policy Context

9. Solar photovoltaic (PV) technology is a mature, proven technology and is a reliable source of renewable energy with an important role to play in the UK energy generation mix. The Government is committed to increasing the deployment of renewable energy across the UK and recognises the potential role and contribution that solar PV could make in helping to meet the UK's target of 15 per cent renewable energy from final consumption by 2020 (see Box 1).

Box 1: 2020 Renewables Target

The 2009 Renewable Energy Directive set a target for the UK to achieve 15% of its energy consumption from renewable sources by 2020. This compares to 4.1% in 2012. Very good progress has been made, but the scale of the increase over the next seven years represents a huge challenge and will require strong contributions from all three sectors of electricity, heat and transport. The mix of renewable energy generation needed to meet the 2020 target will comprise several technologies able to make a significant contribution to meeting the target. Solar PV is one of the eight key technologies set out in the Renewable Energy Roadmap Update 2012[1].

10. Solar PV can be deployed in a variety of locations and contexts including domestic roofs, commercial and industrial properties, and on the ground in brownfield and greenfield sites. It enables consumers and businesses to independently generate electricity, providing greater competition in the market; increases consumer choice; and given the relative cost and ease of installation in comparison to other renewable energy electricity technologies, makes an attractive option for homeowners, helping them save on their energy bills while contributing towards the delivery of our renewables target.

11. Solar PV is not just important because of its energy generation potential – it can also contribute to UK economic growth. The solar industry in the UK has a thriving installation sector. There is also a manufacturing capacity in the UK, albeit small, particularly in innovative and building integrated solar PV. The rapid growth in the sector means that the long-term jobs and investment potential of the sector is difficult to predict with certainty but sector estimates[5] indicate that the industry holds the potential for tens of thousands of jobs (including within the dedicated solar PV and wider construction sectors that are focussed on solar PV installation and deployment). DECC will work with the sector and the National Solar Centre (NSC) to develop more-reliable methodologies to measure jobs and investment.

12. The UK is an increasingly important player in the European market for solar PV. In May 2013, the European Photovoltaic Industry Association report indicated that the UK has a 6 per cent share of deployed capacity across Europe (in comparison to Germany with 44 per cent and Italy with 20 per cent)[6]. Although the UK has less sunshine (and

[5] Renewable Energy Association (2012) Made in Britain http://www.r-e-a.net/resources/rea-publications
[6] EPIA (2013) Global Market Outlook for Photovoltaics 2013 – 2017 Page 20
http://www.epia.org/fileadmin/user_upload/Publications/GMO_2013_-_Final_PDF.pdf

therefore lower load factors[7]) than other countries, our climate - in southern England in particular – is similar to that in Germany[8], where deployment of solar PV is considerably higher[9].

Box 2: Solar PV Cost Reduction

The UK has seen a significant level of solar PV deployment together with significant reduction in costs in recent years, with installed costs estimated to have fallen by around 50%[2]. Large-scale solar PV is already comparable with other key renewable energy technologies - cheaper than offshore wind, but more expensive than onshore wind. There is a progressive cost reduction trajectory assumed in the period out to 2016 and 2020, reflecting the advancements made in technology development and supply chains, indicating a reduction in levelised costs of around 20% by 2020.

If this rate of cost reduction continued into the 2020's, solar PV would be competitive in levelised costs terms with other large-scale generation technologies such as combined cycle gas turbines (CCGT) by 2025[10] (see Figure 6 for more information).

13. Solar PV currently accounts for 12 per cent of renewable electricity capacity in the UK and 2.9 per cent of renewable electricity generation[11]. As of the end of June 2013, 2.4GW installed capacity (with electricity generation during July 2012 to June 2013 of 1.4TWh[11]) of which 1.7GW is small-scale (mainly domestic) Feed-in Tariffs (FITs) and 0.2GW (mainly) large-scale under the Renewables Obligation (RO)[12]. As set out in the UK Renewable Energy Roadmap Update 2012, analysis indicates that there is a potential deployment range of 7-20GW (equivalent to 6-18TWh), with 20GW being the technical maximum level of solar PV deployment by 2020[1].

14. More recently, the publication of the draft Electricity Market Reform (EMR) renewable energy strike prices has shown a modelled expectation for solar PV of 1.8GW – 3.2GW coming forward under the RO and CfD to 2020. In addition to this, central assumptions for small-scale FITs indicate 7.5GW of solar during the same period, giving a modelled total of 9.3GW -10.7GW solar PV deployed out to 2020[13]. This represents a mid-range scenario based on the draft strike prices quoted across the technologies[14]. As explained in the Roadmap Update, movement towards the 20GW top limit of deployment (or above 10GW as National Grid have indicated by their modelling[15]), without generation being frequently constrained off, is likely to require significant technology cost reduction

[7] Defined as average load divided by the peak load in a specified time period.
[8] GIS data indicates[8] by calculating the annual average between the period 2004 and 2010, in Germany irradiation levels vary from 850kWh/m² in the north west to 1200kWh/m² in the south; whilst in the UK levels vary between 700 kWh/m² in the north to 1200 kWh/m² in the south. SolarGIS © 2013 GeoModel Solar s.r.o. Germany: http://solargis.info/doc/_pics/freemaps/1000px/ghi/SolarGIS-Solar-map-Germany-en.png UK: http://solargis.info/doc/_pics/freemaps/1000px/ghi/SolarGIS-Solar-map-United-Kingdom-en.png
[9] Energiewende (2013) Germany's Recent Solar Energy Record In-Depth http://theenergycollective.com/thomas-gerke/248721/sunday-solar-sunday-germany-s-july-7-solar-power-record-depth.
[10] DECC (2013) Electricity Generation Costs 2013, Table 13 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223940/DECC_Electricity_Generation_Costs_for_publication_-_24_07_13.pdf
[11] Energy Trends (September 2013) Tables 6.1 https://www.gov.uk/government/publications/renewables-section-6-energy-trends
[12] Energy Trends (September 2013) Table 6.4 https://www.gov.uk/government/publications/renewables-section-6-energy-trends
[13] National Grid (2013) EMR Analytical Report p40 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223655/emr_consultation_annex_e.pdf
[14] DECC (2013) EMR Consultation on the draft Delivery Plan on p.32. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/238867/Consultation_on_the_draft_Delivery_Plan__amended_.pdf
[15] National Grid (2012) Briefing Note for DECC on Solar PV Deployment https://www.gov.uk/government/publications/solar-pv-electricity-systems-and-the-national-grid-a-briefing-note-for-decc

together with developments in tools to help balance the supply and demand of electricity including demand-side response utilising smart meters, energy storage, interconnection and flexible generation[1].

15. Solar PV policy is not without its challenges. In particular, solar PV deployment requires careful consideration to ensure appropriate use of land and buildings, and ensures that the views of local communities are heard (see page 24). There are also uncertainties associated with effects of significant deployment, particularly because large volumes of solar PV is embedded generation and can create challenges for grid systems balancing (see page 29). Gaining access and connecting to the network also creates local grid issues (see page 32). Government also needs to ensure that financial incentives are working to encourage deployment and are cost-effective (see page 33).

Solar PV in the UK

16. At present, there are three main markets for solar PV in the UK - domestic, building mounted[16] and ground mounted. In addition to this, there is a small but growing market for building-integrated photovoltaics (BIPV).

17. **Domestic:** Solar PV is a reliable and well established method of generating electricity, suitable for a vast number of homes in the UK. Sunlight is free so once the installation has been paid for, electricity bills can be reduced - protecting the homeowner against the rising costs of electricity while reducing carbon emissions. It enables consumers to independently generate electricity, providing greater competition in the market and increase their level of consumer choice. A typical domestic installation can be as large as approximately 4kW capacity.

18. **Building Mounted:** There are a range of commercial and non-domestic properties in the UK that vary in size and category. These include, but are not limited to, offices, industrial property, hospitals, schools, hotels, retail, farm buildings, and warehouses. Small commercial buildings can typically accommodate PV systems between 4kW and 100kW, while larger commercial buildings allow larger arrays, the largest in the UK currently being 5MW. PV systems for commercial use have similar benefits to those of domestic systems but with the added advantage of generating larger amounts of electricity and generally being able to better match on-site generation with on-site demand.

19. **Ground Mounted:** These differ from building mounted PV systems because they generally supply power at grid distribution level. The land area required for a 1MW fixed tilt array including security fencing is approximately 6 acres (or 2.4Ha; the equivalent size of four football pitches). Output from ground mounted PV can also be optimised in terms of orientation and tilt by using mechanisms to track the Sun.

20. **Building Integrated:** Building Integrated PV (BIPV) refers to photovoltaic systems that generate electricity and function as part of the building. Products such as windows, walls, façades and roofs can be designed as BIPV (e.g. solar shingles/tiles) and architects can use these products to provide both function and style. This emerging

[16] In this context this refers to solar PV installed on commercial and industrial buildings and other building mounted installations at a larger scale than domestic systems (e.g. schools, community buildings).

market, which straddles the building industry and the solar power industry, offers a new way to develop revenue streams for both parties.

21. A framework of policies is in place to drive investment in solar PV in the UK at a wide range of sizes, and in a wide range of locations. Box 3 sets out the financial support framework which solar PV projects can access.

Box 3: Financial support for solar PV

Government's main mechanism to drive the deployment of solar PV is the financial support it provides. Without this support, solar PV would not be able to compete in the electricity market as its costs are currently higher than those of conventional generation. Over time, however, as costs of solar PV come down, this support will be reduced.

Large-scale solar PV generation (in the main above 5MW but also down to 50kW) is currently supported by the **Renewables Obligation** (RO). This places an obligation on UK electricity suppliers to source a specified proportion of the electricity they supply to customers from renewable sources. It is administered by Ofgem who issue Renewables Obligation Certificates (ROCs) to generators for every megawatt hour (MWh) of eligible renewable electricity they generate. ROCs can be sold to a supplier, which allows generators to receive a premium in addition to the price of their electricity. A comprehensive review[17] of the RO support rates was concluded in 2012 and is leading to a reduction in subsidies for the majority of technologies.

The RO will close to new generation on 31 March 2017. From 2014 onwards, the primary financial support mechanism for new large-scale renewable generation will be **Contracts for Difference** (CfDs). A CfD is a long term private law contract that pays the generator the difference between an estimate of the market price for electricity (the 'reference price') and an estimate of the long term price needed to bring forward investment in a given technology (the 'strike price'). The fixed strike price means that investors in low carbon plant are protected from wholesale price volatility and costs to the consumer will be capped. The EMR Delivery Plan consultation[18], published in July 2013, proposed strike prices for large-scale solar PV[19] .

The **Feed-in Tariffs** (FITs) scheme was introduced in April 2010 with the intention of encouraging deployment of small-scale (up to 5MW), low-carbon electricity generation. The scheme has been a success with over 450,000 installations (2.2GW capacity) registered by June 2013. Of these, around 99% are solar PV installations. FITs generators receive three financial benefits from the scheme: a generation tariff for all electricity generated by the installation; an export tariff for surplus electricity exported to the local grid; and savings on their electricity bill from generation used on site. The FITs Comprehensive Review[20], which concluded in July 2012, sought to improve value for money and reduce tariffs in light of falling costs. It introduced for solar PV a new 'degression' mechanism to enable tariffs to respond more nimbly to market developments by allowing tariffs to reduce in line with deployment.

[17] DECC (2012) Consultation outcome Renewable Obligation Banding Review https://www.gov.uk/government/consultations/renewables-obligation-banding-review
[18] DECC (2013) Consultation on the draft Electricity Market Reform Delivery https://www.gov.uk/government/consultations/consultation-on-the-draft-electricity-market-reform-delivery
[19] Both Ground mounted and Building mounted
[20] DECC (2012) Feed-in Tariff Comprehensive Review Phase 2a https://www.gov.uk/government/consultations/solar-pv-cost-controls-comprehensive-review-phase-2a

22. As at the end of December 2012, solar PV represented 1.8 per cent of total generating capacity[21]. There has been 1.4TWh of total generation by solar PV in this year to the end of June 2013, representing 0.4 per cent of the UK's total generation[22], Figure 1 shows the deployment split across the UK, showing that the majority of deployment is based in England[22]. Figure 2 shows solar PV installed capacity across the different size markets, showing the dominance of domestic installations[21]. Figure 3 shows the most recent data up to end June 2013 of solar PV deployed across the financial incentive schemes, with the small-scale FITs seeing the most up-take[23].

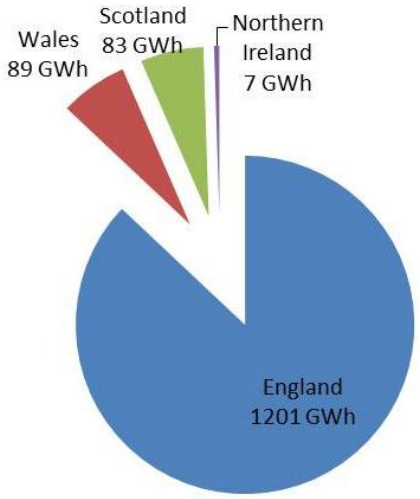


Figure 1 Solar PV generation (GWh) end Dec - end June 2013 across the UK[22]

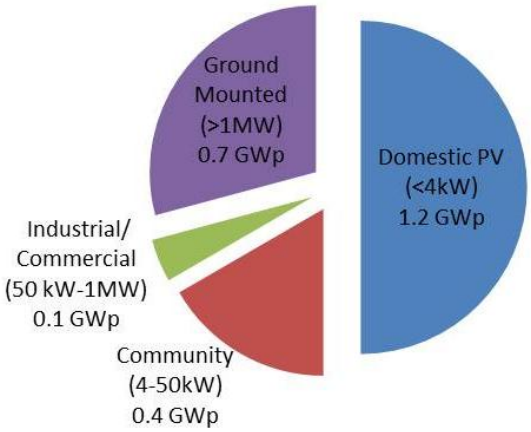


Figure 2 Solar PV installed capacity end Dec – end June 2013 (GWp) across the different size markets[21]

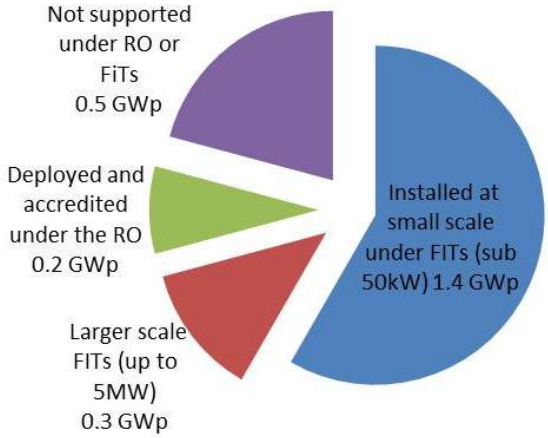


Figure 3 Solar PV installed (GWp) capacity as at end of June 2013 across financial incentive schemes[23]

[21] DUKES (2013) Table 5.13: https://www.gov.uk/government/publications/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes
Ground-mounted (>1MW) includes stand-alone schemes.
[22] Energy Trends (2013) Tables 5.1 and 6.1: https://www.gov.uk/government/publications/electricity-section-5-energy-trends and https://www.gov.uk/government/publications/renewables-section-6-energy-trends
[23] Energy Trends (September 2013) Table ET 6.4 https://www.gov.uk/government/publications/renewables-section-6-energy-trends
'Not supported under RO or FiTs' includes MCS registered <=50kW; ROOFIT accredited >50kW- 5MW; sites not yet accredited under FiT, RO or ROOFIT from the Renewable Energy Planning Database. Also includes any unaccredited part of capacity at RO sites.

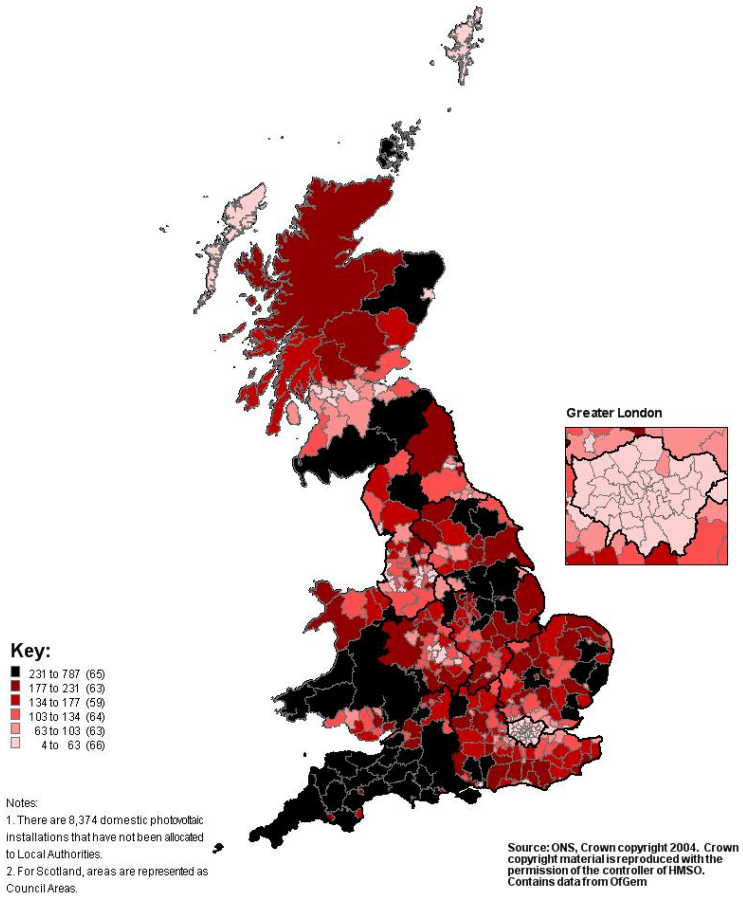


Figure 4: Feed-in Tariffs in the UK – Number of domestic PV installations per 10,000 households by Local Authority, as at end of June 2013

23. Figure 4 shows the distribution of domestic installations in the UK indicating that deployment of solar PV across the UK is highest in south west England[24]. Estimates of large-scale deployment under the RO indicate approximately 44 per cent are also located in south west England[25]. This clustering effect can create difficulties in local grid management – this is addressed on page 32. The FIT has also driven rapid growth in Scotland[26], Wales[27]and Northern Ireland, which has also experienced considerable interest in solar PV at all scales, particularly at domestic level but also increasing interest in the non-domestic sector including farm buildings[28].

[24] DECC (June 2013) Sub-regional Feed in Tariff statistics https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics

[25] DECC (October 2013) REPD Database https://restats.decc.gov.uk/app/reporting/decc/monthlyextract
Currently there are 284 operational solar projects within the UK. 126 of these are in the South West, representing 44.4% of the national total. Of these 126 projects, 123 or 98% of them have an installed capacity ≥50kW and 49 or 39% of them have and installed capacity ≥5MW.

[26] 25,850 installations in Scotland. DECC (June 2013) Sub-regional Feed in Tariff statistics. https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics

[27] 28,622 installations in Wales. DECC (June 2013) Sub-regional Feed in Tariff statistics. https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics

[28] Current overall deployment is approximately 6 MW from over 1000 generating stations accredited under the Northern Ireland Renewables Obligation (NIRO). Whilst small in UK terms, this represents a more than 200% increase since late 2011.

Case study 1: Solar PV - Bentley Motors – UK's Largest Rooftop Array

The Bentley Factory in Crewe built in the 1940s is ideally situated to generate solar power as the "saw tooth" factory roofs are south facing at an angle of 20 degrees. It is the UK's largest rooftop solar PV array, owned and operated by solar power generator, Lightsource Renewable Energy and installed by main contractor Solarcentury.

Over 20,000 solar PV panels have been installed generating enough electricity adequate to power over 1,200 households covering 3.45 hectares of roof space which would otherwise be un-utilised. Lightsource Renewable Energy entered into a power purchase agreement with Bentley Motors, making it possible for the electricity generated during working hours to be used directly by the factory and for the electricity generated at weekends and times of low demand, to be fed back into the National Grid. At peak generation times, the system will produce up to 40% of Bentley's energy requirements.

The installation on Bentley's factory demonstrates the potential for solar energy to be generated on commercial roof-tops in the UK and is a clear example of how businesses can gain greater pricing certainty for the future whilst reducing their carbon footprint. With the build only taking 16 weeks, it shows the speed at which installations of this size can be completed even when constructed in tandem with existing business activity.

Developing engagement with the solar industry

24. The Government has increased its strategic focus on the solar PV industry as deployment has increased. The Solar PV Strategy Working Group held its inaugural meeting in March 2013, jointly chaired by DECC and the NSC. It includes members from the main trade bodies, manufacturers, financiers, developers, installers, and others. It provides
a forum for discussion of Government policy relating to solar PV deployment; and identifies solutions to barriers to the sustainable deployment of solar PV in the UK.

25. Reporting to the main Strategy Group, five Task Forces are proactively addressing issues and barriers. These address: Land Use and Sustainable Deployment; Engagement; Grid and Networks; Innovation; and Bankability and Finance.

26. The findings of this work will be presented as part of the forthcoming full Strategy document. This analysis will enable us to develop a set of actions for the future development of solar PV in the UK that will shape future policy decisions.

Section 2 – A Framework of Principles

27. The time is right for the Government to set out its vision of the strategic direction for solar PV in the UK – making sure that our policies support the appropriate deployment in a sustainable, cost-effective way. We need to provide certainty to investors, solar developers, and the households, communities and businesses affected by solar PV.

28. This section sets out four guiding principles, which form the basis of Government's strategy for solar PV. These principles are:

I. **Support for solar PV should allow cost-effective projects to proceed and to make a cost-effective contribution to UK carbon emission objectives in the context of overall energy goals** – ensuring that solar PV has a role alongside other energy generation technologies in delivering carbon reductions, energy security and affordability for consumers.

II. **Support for solar PV should deliver genuine carbon reductions that help meet the UK's target of 15 per cent renewable energy from final consumption by 2020** and in supporting the decarbonisation of our economy in the longer term – ensuring that all the carbon impacts of solar PV deployment are fully understood.

III. **Support for solar PV should ensure proposals are appropriately sited, give proper weight to environmental considerations such as landscape and visual impact, heritage and local amenity, and provide opportunities for local communities to influence decisions that affect them.**

IV. **Support for solar PV should assess and respond to the impacts of deployment on: grid systems balancing; grid connectivity; and financial incentives** – ensuring that we address the challenges of deploying high volumes of solar PV.

Principle 1 – Support for solar PV should allow cost-effective projects to proceed and to make a cost-effective contribution to UK carbon emission objectives in the context of overall energy goals.

Why is this principle important?

29. The key objectives of Government energy policy are to ensure the future security of electricity supplies; to drive the decarbonisation of our electricity generation; and to minimise costs to the consumer. Cost-effective deployment of renewable energy technology, including solar PV, is a central element of our strategy.

30. There are a number of challenges to overcome to ensure that solar PV can fulfil its deployment potential. In particular, cost reduction is central to ensuring we can deploy significantly greater levels of both small-scale and large-scale solar PV, and ensuring costs for bill-payers are minimised.

31. The key drivers to cost reduction include 'learning curve' effects; maximising opportunities in technology innovation; improving construction techniques; and exploiting supply chain competition and the overarching economies of scale.

What do we already know?

32. Driven by advances in technology and economies from an increasing global scale of production, the cost of solar PV has declined steadily over time and quite dramatically. Figure 5 shows DECC-published estimates for costs of domestic (assumed as sub-4kW) solar PV. The comparison of three separate studies of cost estimates29 show that since the beginning of the decade, the costs of solar PV have fallen by over 50 per cent.

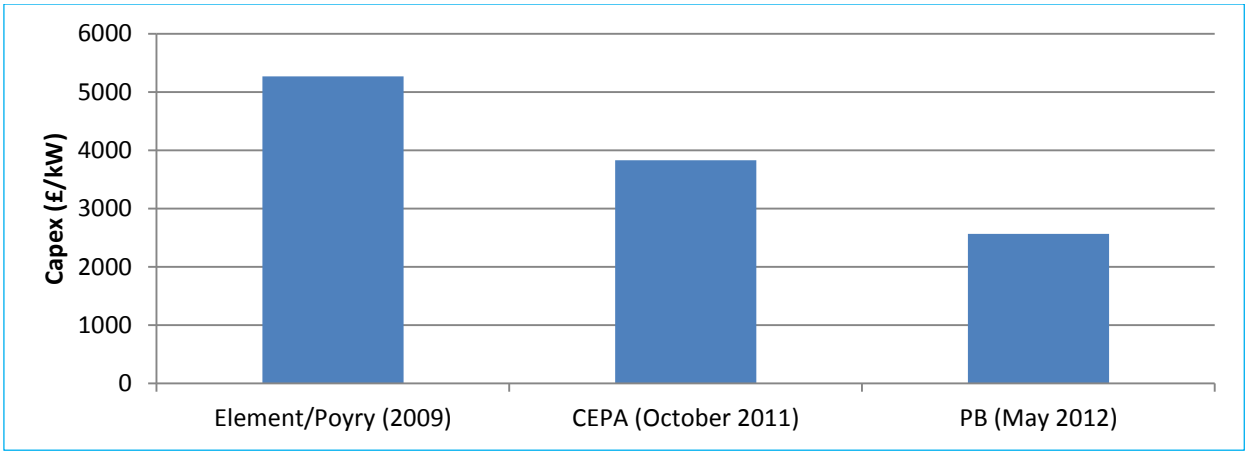


Figure 5: Estimates published by DECC of capex for domestic (<4kW) solar PV installations[29]

[29]Provided as part of the FITs Comprehensive Review by Cambridge Economic Policy Associates (CEPA) Cambridge Economic Policy Associates Ltd and Parsons Brinckerhoff (2011) Updates to the Feed-in Tariff Model Documentation of Changes for solar PV Consultation https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48136/2174-cepa-paper.pdf
and Parsons Brinkerhoff (PB) (in October 2011[29]) and by PB (in May 2012) Parsons Brinckerhoff (2012) Solar PV Cost Update https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43083/5381-solar-pv-cost-update.pdf

33. The costs of different kinds of energy generation are often expressed as 'levelised costs'– that is, average cost over the lifetime of the plant per MWh of electricity generated, expressed in £/MWh. Figure 6 compares the levelised costs of both small-scale (typical domestic <4kW installation) and large-scale (>5MW installation) solar PV with other generation technologies (for example, onshore and offshore wind, and gas). The levelised costs presented here are calculated using 'technology specific' discount rates[30] which reflect the relative financing costs of each technology.

34. Figure 6 shows that large-scale solar PV is already comparable with other key renewable energy technologies - cheaper than offshore wind, but more expensive than onshore wind. There is a progressive cost reduction trajectory assumed in the period out to 2016 and 2020, reflecting the advancements made in technology development and supply chains, indicating a reduction in levelised costs of around 20 per cent by 2020. If this rate of cost reduction continued into the 2020's, solar PV would be competitive in levelised costs terms with other large-scale generation technologies such as CCGT by 2025[31].

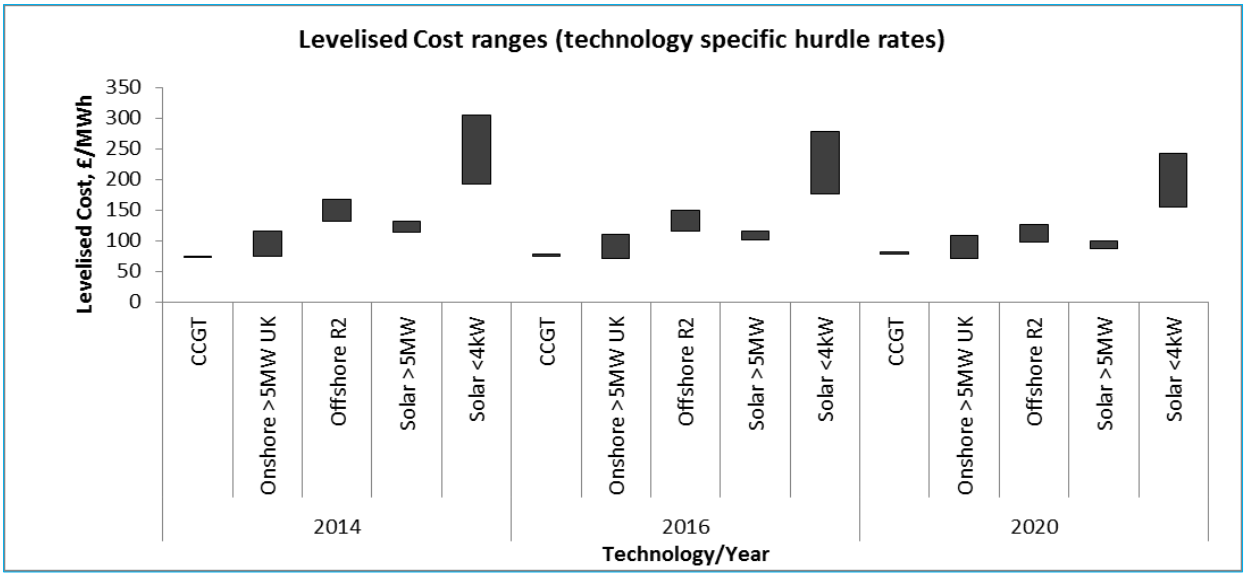


Figure 6: Estimated levelised cost comparison of electricity generation technologies[30].

35. However, this does not imply that significant small-scale solar PV deployment will only be possible at high levels of subsidy. Households' required rates of return are likely to be spread over a wider range than those of typical investors in larger scale projects, reflecting the large variations in investment preferences. Many households looking to invest in small-scale solar PV will therefore target a significantly lower rate of return than assumed in calculating hurdle rates in Figure 6 above. Furthermore, households enjoy the added benefit that solar PV can offset some of the costs of electricity consumption.

[30] DECC (2013) Electricity Generation Costs 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223940/DECC_Electricity_Generation_Costs_for_publication_-_24_07_13.pdf. The hurdle rate for small-scale solar (8% pre-tax, real) is the mid-point of the hurdle rate range for domestic investors assumed in modelling for Phase 2A of the FITs Comprehensive Review Government response (4.5-11.5%). For more details see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43080/5391-impact-assessment-government-response-to-consulta.pdf

[31] Assessment based on Table 13, DECC (2013) Electricity Generation Costs 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223940/DECC_Electricity_Generation_Costs_for_publication_-_24_07_13.pdf

36. That said, although significant cost reductions have occurred in recent years, the costs of the basic materials are relatively high and the level of cost reduction that is feasible to achieve grid parity is still very uncertain, particularly in areas with modest solar radiation like the UK[32]. Current cost uncertainty is also as a result of European Commission anti-dumping and anti-subsidy cases (see Box 4 below).

Box 4: European Commission anti-dumping and anti-subsidy

In the short-term, solar PV module prices have been affected by the recent complaint by a group of European manufacturers which has led the EU Trade Commissioner to launch an investigation into whether the Chinese manufacturers have been benefiting from dumping or subsidies (unfair trade practices[33]). The European Commission concluded that there has been dumping and proposals have been made for a minimum import price and an import volume cap for Chinese solar products imported to Europe or, for some Chinese companies, for them to undertake to sell into the EU at no lower than an agreed minimum price. However, final decisions are yet to be made on the anti-dumping and anti-subsidy cases. In the context of setting a Strategy for solar PV deployment, the impact of these anti-dumping and anti-subsidy investigations remains uncertain but does affect the sector in the short-term. The UK Government is actively involved with the cases and will continue to work to influence the outcomes and track the impact of decisions made. We expect final decisions on the anti-dumping proposals to be taken in December 2013 and we will take account of these in the Strategy document.

Innovation and Technology Development

37. Innovation is key to improving performance and efficiency of mono- and poly- crystalline and hybrid panels in order to bring down the cost of production[1].

38. Solar PV technologies have developed significantly over time, and different technologies are at different states of maturity. Mature **first generation technologies**, such as crystalline silicon, dominate the market with their low costs and with commercially viable efficiency. They are a relatively mature PV technology with a wide range of well-established manufacturers.

39. **Second generation technologies**, which use thin films to reduce high manufacturing and materials costs, are similarly reaching maturity. Innovation for first and second generation technologies is primarily focussed on installation standardisation and system optimisation.

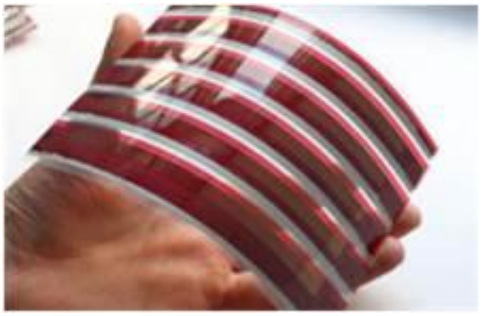
40. **Next generation photovoltaics** (e.g. excitonic PV cells[34]) – which are not yet commercial at scale (except for concentrated solar PV) – and **solar PV supply chains** require innovation to reduce costs, increase efficiencies and lifetimes, as well as ensuring they can be effectively integrated into energy systems. Innovation in these

[32] IRENA (2012) Renewable Energy Technologies: Cost Analysis Series Solar Photovoltaics, Vol 1 Issue 4/5 http://www.irena.org/DocumentDownloads/Publications/RE_Technologies_Cost_Analysis-SOLAR_PV.pdf
[33] Dumping is the practise of selling at prices in the export market lower than in the exporter's domestic market. Subsidies is the practice of governments or other public bodies providing financial benefits which confer benefits on companies.
[34] Excitonic solar cells are a new research area that use polymers, dye molecules or quantum dots to harvest the sun's energy to generate electricity e.g. Organic PV; dye sensitised solar cells; hybrid and tandem solar cells.

areas is key to long-term further cost reduction and realising the deployment potential of solar PV.

41. The UK has well-established research and development activity in place for a range of photovoltaic technologies and applications, which are predominately focussed on academic research of next generation technologies (see Box 5 below).

Box 5: Innovation in the UK



UK Government funding for solar innovation is provided via the Low Carbon Innovation Coordination Group (LCICG)[35], which brings together the major public sector-backed organisations that are supporting low carbon innovation, with a view to maximising the impact of UK public sector funding for low carbon technologies. Over the last three years, the UK Research Councils have spent around £10m annually on solar energy research, with current investments by the Engineering and Physical Sciences Research Council (EPSRC) totalling £48m. Managed solar research activity in the UK is now mostly directed through the new SUPERGEN Supersolar Hub, developed by a consortium of UK universities, which has been designed to consolidate and coordinate existing solar research groups and is focussing its research on new materials and systems performance[36]. The Technology Strategy Board works to accelerate economic growth by stimulating and supporting business-led innovation. Its strategy is therefore focussed on supporting the growth potential of next generation PV technologies. The TSB has contributed approximately half of the investment for a portfolio of solar-related projects totalling some £26m across areas including materials, manufacturing, electronic sensors and photonics, and supply chain innovation.

42. While crystalline-silicon is the most mature PV technology, there still exists significant potential for reducing manufacturing costs through technology innovation and economies of scale[32]. According to Mehta and Maycock (2010), both low and high-cost manufacturers could halve their production costs by 2015[37].

43. In addition, making cost reductions in balance of systems (BoS) (including mounting materials, racking, inverters, wiring, installation labour, financing and contractual costs, permitting) is essential to see industry deploy at significant scale in the UK. However, the opportunities for BoS cost reduction are more fragmented – due to the myriad of players within the market (developers, installers, suppliers, regulators, utilities and building owners) that need to cope with varying sites, regulatory systems and customer demands, together with a lack of knowledge-sharing that exists across the industry[38]. Developers need to consider this in their own business plans to create synergies across the sector.

[35] DECC Low Carbon Innovation Coordination Group http://www.lowcarboninnovation.co.uk/
[36] Organic Solar PV Cell module. Photo: Solar Press UK Ltd.
[37] Mehta, S. and P. Maycock (2010), The PV Supply Chain: Manufacturing, Technologies, Costs, Greentech Media Research and PV Energy Systems, 11 October
[38] Rocky Mountain Institute (2010) Achieving low-cost solar PV: Industry workshop recommendations for Near-term balance of system cost reductions. http://rmi.org/Content/Files/BOSReport.pdf

Case study 2: Innovation/Cost Reduction - Naked Energy Hybrid Panel 'Virtu ™'

Naked Energy[39] is an award winning British design and innovation business, founded in 2010, developing Virtu ® – a patented hybrid solar panel that generates both electricity and heat for commercial and residential applications. One Virtu array with 1.5m^2 of absorber area is able to generate over 1.35kW of combine heat and power. In one year this could offset approximately 340kg of CO_2 - around three times as much as a conventional PV panel with the same power rating (250Wp)[40].

Virtu is versatile, modular in design and with the combined ease of installation and reduced physical footprint and materials it makes for an attractive proposition.The key innovation is a highly efficient heat transfer mechanism that has been extensively tested and validated by Imperial College London (with approximately 90% of the radiation being captured and converted in to heat and power). On-going environmental tests are being conducted with one of the UK's largest utility companies prior to an integrated pilot with a leading supermarket group.

Naked Energy is currently working with UK manufacturing partners on a design and process for volume manufacture to develop a reliable and cost effective solution for homes and businesses that can form part of a balanced UK energy mix.

UK Manufacturing, Jobs & Investment

44. Maximising the economic benefit to the UK is an important element of our strategy for solar PV. To date, the UK solar PV sector has been largely characterised by downstream activity such as system design and installation. While there is some manufacturing capability in the UK, the larger proportion of economic activity and jobs have come from installation[41].

45. The UK solar PV manufacturing base is relatively small – as the majority of processes take place outside the UK, mostly relying on imports to provide modules to the industry. However, Sharp Solar in Wrexham, north Wales has been manufacturing solar PV since 2004 together with more specialist module manufacturing provided by Romag and GB Sol. In addition, there are numerous supply chain companies who have taken advantage in the rapid growth of PV manufacture including NSG Pilkington, Dupont, SAFC Hitech, IQE and Crystalox.

46. In addition, the UK does have significant, specific strengths in innovation which can contribute to future economic growth. Manufacturing and scale-up of new technologies often takes place at the point of invention, creating local jobs and products capable of profiting from wider global markets. The strong academic and innovation expertise in the UK means that we have the potential to create and provide world-leading

[39] Naked Energy (2013) http://www.nakedenergy.co.uk/
[40] Assuming the heat generated displaces gas as a primary source and the array receives an average of 1000 hours of solar irradiation
[41] Renewable Energy Association (2012) Made in Britain http://www.r-e-a.net/resources/rea-publications

commercial technology but also to export those skills and knowledge. Next generation PV, excitonic technologies - including both dye-sensitised cells and organic and hybrid PV - are a growing research area in the UK. Research Council (RCUK) activities were recognised as world-leading by the International Review of Energy Research[42]. In addition to primary research, the UK introduced the first assembly line for flexible excitonic cells[43]. Our research strength promises to be a platform for the UK to build on its lead in this area.

47. The rapid development of the sector has meant that it has been difficult to obtain reliable data on permanent jobs arising from growth of the industry. However, the readjustment of FITs and the RO should allow growth within the sector in the UK to normalise over the next few years, notwithstanding the effects of any anti-dumping tariffs imposed by the European Commission. Over this period a better view of the economic growth and jobs potential of the solar PV sector in the UK to 2020 and beyond will become clearer. Government will continue to monitor the growth of the sector and consider the further policy steps needed in light of this.

What are the next steps?

48. The Innovation Task Force (chaired by Loughborough University), working with EPSRC, anticipates areas for system cost reduction and new technologies. The group includes support from UK Universities and the industry, and will address a range of issues for future development of PV. This further work by the Task Force, DECC and its partners, some of which will be undertaken ahead of publication of the Strategy, will include the following:

- Within first generation technology development, further work is needed by the sector to coordinate to find business synergies and opportunities to align their design strategies. The sector will need to identify what approach is optimal for the greatest impact. This work will be coordinated by the NSC and the Innovation Task Force.

- DECC will complete further analysis of the levels of cost reduction required to deliver different levels of solar PV deployment over the next decade, and assess whether these are feasible given evidence on technology learning rates and likely sources of cost reduction in the solar PV sector. This analysis will be done in light of the on-going European Commission anti-dumping case against imported panels and cells.

- DECC will continue to work, through the Solar PV Strategy Group and in collaboration with the NSC and trade associations to determine reliable methodologies to access data on jobs and investment in the UK solar PV sector. These will be an important indicator on the effectiveness of Government policies on solar PV deployment and the economic benefit which this creates for the UK economy.

[42] Research Councils UK (2010-2012) Review of Energy http://www.rcuk.ac.uk/Publications/reports/Pages/Energy2010.aspx
[43] SPECIFIC (2012) http://www.specific.eu.com/capabilities/pilot

- In partnership with UKTI, DECC will continue with on-going activity to promote UK expertise in the solar PV sector abroad. A number of trade missions led by Greg Barker, for example, to India and Central Africa and the Middle East have sought to underline the UK's ability to provide design and installation solutions and to promote innovative UK solar PV products. A further trade mission to Saudi Arabia is planned for the autumn.

- DECC will continue to concentrate our efforts through the LCICG and the Research Councils on next generation photovoltaics where the UK leads[42] and to build on our success, by collaborating with small, medium and large private sector partners. The EPSRC have also co-funded with TSB an innovation centre in Swansea working on "Buildings as Power Stations" where solar panels can be adapted to building materials and structures. This work is led by Swansea University with Tata Steel as the main industrial partner. The TSB is a partner in the Solar Eranet[44] focussing on UK business opportunities for collaborations across Europe to accelerate technology development and deployment of next generation technologies.

- Innovation and research will also continue to look at module degradation and characterisation during accelerated ageing. This will be of benefit to companies working in the UK as module characterisation over a lifetime is intrinsic to commercialisation. This research is developing into being able to perform international standardisation and accreditation testing which will aid companies working in the UK to comply with international standards. The TSB runs funding programmes for business that are developing new products and processes for next generation photovoltaic technologies and systems, the three main programmes are Smart, Knowledge Transfer Partnerships (KTP) and Innovation Vouchers[45].

[44] Solar Eranet: www.solar-era.net
[45] Technology Strategy Board Innovation Vouchers. www.innovateuk.org

Principle 2 – Support for solar PV should deliver genuine carbon reductions that help meet the UK's target of 15 per cent renewable energy from final consumption by 2020.

Why is this principle important?

49. Solar PV and other renewable energy technologies can displace more carbon intensive generation from our electricity supply. However, GHG emissions occur at various stages of the process to convert a raw material or renewable energy source into energy.

50. Consideration of life cycle emissions (LCE) for solar PV, going beyond point-of-use enables us to identify and understand the reasons for hotspots along its life cycle where emissions are significant; where these key emissions are located and how they impact on solar PV deployment in the UK (see Figure 7). This will enable Government to assess how best to support solar PV technology by enabling it to maximise the delivery of genuine carbon reductions to help meet carbon emissions objectives whilst also taking into account the complexity and extent of the supply chains that exist for the solar PV sector.

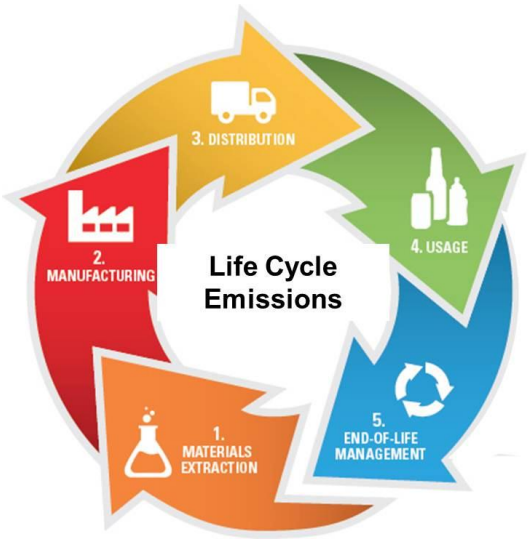


Figure 7 Key phases of Life Cycle Emissions Assessment[46]

What do we already know?

51. The lifecycle of the dominant silicon-based PV consists of several stages, with the raw material extraction and manufacturing phases being the most significant. The raw material extraction for the PV module and silicon cell manufacture is an energy intensive process and balance of system manufacture includes the production of steel, aluminium and other metals[47].These phases account for 60-80 per cent of the emissions[48,49]. The life cycle emissions of solar PV have been well researched and

[46] Image adapted from U.S. Environmental Protection Agency http://www.epa.gov/climatechange/climate-change-waste/life-cycle-diagram.html
[47] The Commission on Climate Change, Ricardo- AEA (2013) Current and Future Lifecycle Emission of key low carbon technologies and alternatives http://www.theccc.org.uk/wp-content/uploads/2013/09/Ricardo-AEA-lifecycle-emissions-low-carbon-technologies-April-2013.pdf
[48] NREL (2012) Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics http://www.nrel.gov/docs/fy13osti/56487.pdf

documented and recent studies continue to show a wide variability in results. This is not only due to the type of technology assessed, but is also attributed to several key factors including solar radiation - countries where solar radiation is higher will give lower LCEs; the lifetime - the higher the lifetime the lower the LCE; the performance ratio - the higher the performance and efficiency the lower the LCE; and the type of installation (rooftop building integrated/standalone or ground-mounted) – the type of installation will affect insolation in addition to material requirements for the balance of system.

52. A study giving a detailed analysis of recent studies on lifecycle analysis (LCA) of solar PV[50] shows a range of 20 – 100gCO_2e/kWh; whilst another study[51] shows a higher variability with 13 – 130gCO2e/kWh. Despite the wide ranges, there is consensus that the type of panel, the climate conditions where the panels are installed and the local conditions of the type of electricity input during manufacture play a key part in providing differing results. In comparison with other technologies – onshore and offshore wind power have a relatively small carbon footprint range of between 3 – 28gCO_2e/kWh[51]. Onshore and offshore turbines show similar emission factors because large emissions during the construction phase can be compensated for by the higher productivity of offshore turbines[52]. The average emissions from fossil fuelled CCGT in the UK was significantly higher with a footprint range of 350 – 410gCO_2/kWh[51].

53. With a significant amount of research completed and other work already underway, it is important to consider the varying methodologies associated with life cycle assessment of emissions; the assumptions and the impact they have on the outputs; particularly with a view to the impact of the location of PV cell and module manufacturing.

What are the next steps?

54. The Innovation Task Force, DECC and its partners will undertake:

- Further work to understand the life cycle emissions that apply to solar PV deployment in the UK; particularly in relation to the current markets from which solar panels are sourced. DECC will undertake a detailed analysis of current findings to help shape solar PV policy in order for it to deliver genuine carbon reductions that help meet UK carbon reduction objectives.

[49] Alsema, E. A. and de Wild-Scholten, M. J. (2006). Environmental impacts of crystalline silicon photovoltaic module production. Paper presented at the 13th CIRP International Conference on Life Cycle Engineering, Belgium.
[50] Hsu, D.et al (2012) Life Cycle Greenhouse Gas Emissions of Crystalline Silicon Photovoltaic Electricity Generation Systematic Review and Harmonization, Journal of Industrial Ecology Volume 16, Issue Supplement s1, pages S122–S135, April 2012 http://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2011.00439.x/pdf
[51] Turconi, R et al (2013) Life Cycle Assessment of electricity generation technologies: Overview, Comparability and limitations, Renewable and Sustainable Energy Reviews 28: 555 -565.
[52] Pehnt M. (2006) Dynamic life cycle assessment of renewable energy technologies, Renewable Energy, 31:p55-71.

Principle 3 – Support for solar PV should ensure proposals are appropriately sited, give proper weight to environmental considerations such as landscape and visual impact, heritage and local amenity, and provide opportunities for local communities to influence decisions that affect them.

Why is this goal important?

55. Bringing forward appropriately sited solar PV installations is an essential part of a responsible UK energy policy. Recently solar has achieved highest public approval rating of all renewable energy technologies at 85 per cent[53]. However, Government recognises the importance of ensuring that installations are appropriately sited, and that we exploit the potential of roofs and brownfield sites.

56. The marked increase in deployment of solar PV over the last three years has seen installation at all scales. Permitted development rights for micro-generation have facilitated the deployment of solar PV at smaller scale by removing the need for formal planning permission for many small installations. In addition, there has been a significant increase in large-scale ground-mounted solar PV – 700MW deployed in the period end of Dec 2012 up to June 2013[21]. A proportion of this deployment has been on brownfield/previously developed land (such as the 32MW Wymeswold solar farm, sited on a disused airfield) or connected to existing commercial or industrial facilities such as Thames Water's installation of 5MW of solar PV at three of their London water treatment plants. In addition, a significant proportion has been sited on greenfield sites where these have met planning policy requirements.

57. The key issue is ensuring that proposals to deploy solar PV take account of the circumstances of each project. A brownfield site may contain a Site of Special Scientific Interest or be part of an Area of Outstanding National Beauty. Likewise, even plots of the highest grade agricultural land could include areas which are in themselves lower grade and could legitimately be used for solar PV deployment. There is increasing evidence that, if well planned and managed, there can be biodiversity benefits arising from the deployment of solar PV at large scale. Furthermore, a number of developers and environmental organisations are already developing biodiversity plans in conjunction with solar PV deployments[54].

58. DECC is working with other key Departments, including the Cabinet Office[55] and the Ministry of Defence (MoD) to promote installation of solar PV on under-utilised brownfield land and roof space in the Government and Defence Estate. The UK's planning regimes include robust safeguards to ensure that developments, including solar PV installations, are properly sited and that individuals, communities and the landscape itself are protected against any unacceptable impacts. This means that

[53] DECC (2013) Public Attitudes Tracker Wave 5 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/198722/Summary_of_Wave_5_findings_of_Public_Attitudes_Tracker.pdf

[54] German Renewable Energies Agency (2010) Solar Parks – Opportunities for Biodiversity, A report on biodiversity in and around ground-mounted photovoltaic plants. http://www.solar-trade.org.uk/media/Biodiversity-in-Solarparks.pdf ; Natural England (2011) Technical Information Note TIN101, Solar Parks: maximising the environmental benefits http://publications.naturalengland.org.uk/publication/32027; Parker, G; McQueen C (2013).
Can solar parks provide significant benefits for biodiversity? Preliminary Study http://www.solar-trade.org.uk/media/Can%20solar%20parks%20provide%20significant%20benefits%20for%20biodiversity%202%202.pdf

[55] Which covers Government Procurement Service & Government Property Unit.

issues such as visual amenity, land use and other environmental impacts are an important consideration within the planning process. The planning system systems in the UK[56] also provide many opportunities for local people to participate in key decisions affecting their areas. The Coalition Agreement included a commitment to supporting community energy projects, which can play an important part in raising awareness about low carbon energy and in giving communities control over their own energy supply.

What do we already know?

59. In July 2013 the Department for Communities and Local Government, in association with DECC, published revised planning guidance for renewable energy developments. This provides guidance on the implementation of the planning policy for England set out in the new National Planning Policy Framework which was published in March 2012.

60. The revised guidance on renewables provided planners with more specific guidance on the issues that they should consider in relation to large-scale solar PV planning applications. The revised guidance makes clear that the need for renewable energy does not automatically override the need for planners to properly scrutinise the effects of renewables deployment. It underlines the need for planners to ensure that the impacts of proposed renewable energy deployments are acceptable, including impact on visual amenity and effects on cultural and heritage landscapes.

61. In addition to this formal guidance, the industry is increasingly taking action to provide guidance to developers on planning and to develop and promote best practice. Earlier in the year, the NSC, a subsidiary of the Building Research Establishment, published guidance for planners and developers on large-scale solar PV[57]. It draws on the experience of Cornwall Council in considering sites for suitability for solar PV deployment. In August 2013, the Solar Trade Association published its '10 commitments"[58] for solar developers to promote best practice, including, avoiding the use of high grade agricultural land; activity engaging communities; minimising visual impacts and returning land to previous use.

62. In Scotland, online planning guidance in respect of solar PV can be found on the Scottish Government website[59]: Northern Ireland has a devolved planning regime and 'Planning Policy Statement 18: Renewable Energy'[60], aims to facilitate the siting of renewable energy generating facilities in appropriate locations within the built and natural environments. Permitted development rights have been introduced for the installation of solar panels up to 50kW on domestic properties, schools, businesses and farm buildings.

63. Recently there has been increasing coverage in the media on large-scale ground-mounted installations that have been developed; and particularly those on higher

[56] Separate planning systems operate in Scotland, Northern Ireland, England and Wales.
[57] Building Research Establishment (2013) National Solar Centre http://www.bre.co.uk/page.jsp?id=2983
[58] Solar Trade Association (2013) Solar Farms 10 Commitments http://www.solar-trade.org.uk/media/STA%2010%20commitments%20v%2010.pdf
[59] Scottish Government, Large Photovoltaic Arrays http://www.scotland.gov.uk/Resource/Doc/212607/0113235.pdf
[60] Department of the Environment Northern Ireland (2009) Planning Policy Statement 18: Renewable Energy http://www.planningni.gov.uk/index/policy/policy_publications/planning_statements/planning_policy_statement_18_renewable_energy-2.htm

grades of agricultural land[61]. The Government is keen to see renewable energy installations that are developed sustainably. The National Planning Policy Framework states that:

"*The Planning policies and decisions should encourage the effective use of land by re-using land that has been previously developed (brownfield land), provided that it is not of high environmental value. Local planning authorities may continue to consider the case for setting a locally appropriate target for the use of brownfield land. Local planning authorities should take into account the economic and other benefits of the best and most versatile agricultural land. Where significant development of agricultural land is demonstrated to be necessary, local planning authorities should seek to use areas of poorer quality land in preference to that of a higher quality.*"[62]

64. The guidance further states that:

"*Particular factors a local planning authority will need to consider include:*

- *encouraging the effective use of previously developed land, and if a proposal does involve greenfield land, that it allows for continued agricultural use and/or encourages biodiversity improvements around arrays;*

- *that solar farms are normally temporary structures and planning conditions can be used to ensure that the installations are removed when no longer in use and the land is restored to its previous use…*"[63]

What are the next steps?

65. In meeting the Coalition commitment to support community energy projects, in June 2013, the Government launched the Call for Evidence on Community Energy, ahead of a Community Energy Strategy to be published in the autumn 2013. It will identify the potential of community energy projects in the UK to bring benefits to communities while helping to tackle climate change and maintain energy security. It will consider how to help community energy projects overcome the main barriers they face. It will include all types of 'community energy' projects – not just renewable electricity projects, but also projects focused on generating heat; energy-saving initiatives; collective purchasing and switching schemes (where communities club together to get a better deal on their energy); smart grids (using improved grid technologies to help communities save money by using energy at times of lower demand); and any combination of these. Community energy could range from a small church group talking about energy or helping out with leafleting, all the way through to joint ownership of a wind farm with a commercial development.

[61] Ministry of Agriculture, Fisheries and Food (1998) Agricultural Land Classification of England and Wales: Revised guidelines and criteria for grading the quality of agricultural land.
http://archive.defra.gov.uk/foodfarm/landmanage/land-use/documents/alc-guidelines-1988.pdf
[62] Department for Communities and Local Government (2012) National Planning Policy Framework, Paras 111-112.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf
[63] Department for Communities and Local Government (2013) Planning practice guidance for renewable and low carbon energy, Para 27
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/225689/Planning_Practice_Guidance_for_Renewable_and_Low_Carbon_Energy.pdf

66. The Land Use and Sustainable Deployment Task Force, chaired by the National Farmers Union, is identifying how we can work within the planning policies, incentives and guidance, to give a mechanism to allow development of large and medium- scale arrays that will be acceptable to developers, environmental groups, local communities and planners alike. Further work will be undertaken by the Task Force, DECC and its partners, some of which will be undertaken ahead of publication of the Strategy. They will:

- Develop a code of best practise for use by large-scale developers, planners, environmental groups; and communities, encapsulating the best principles of all;
- Develop principles for the development of community schemes; and
- DECC will consider the distribution of potentially suitable deployment sites across domestic, commercial and industrial roofs and large-scale ground mounted sites.

67. The Engagement Task Force, chaired by the Solar Trade Association, will improve access to deployment opportunities by engaging with a range of sectors, including determining means of improving deployment in the business and industrial sectors. For example: to open opportunities on Government Estate; ideas on improving use of business rooftops; working with Chartered Surveyors and estate agents to improve understanding of how PV provides added value to homeowners. In particular it will:

- Actively engage with MoD and the Cabinet Office to allow access to the MoD estate for development of solar PV; and
- Work with the Bankability and Finance Task Force, chaired by the British Photovoltaics Association (BPVA), to identify legislative issues and to develop legal and financial frameworks to allow improved financing of building mounted schemes.

Case study 3: National Trust, Wales

The National Trust has recently installed six 50kW PV arrays near its mansions across Wales. These systems have been installed near some of the most designated park lands and buildings in the country., As part of its 2020 energy goal, the National Trust intends to reduce its use of fossil fuels for heat and electricity by 50% by 2020 – including 'growing its own energy'[64].

The location of these systems has necessitated the development of impact assessment tools and mitigation planning. These assess their impact on a site's 'statement of significance' – a National Trust methodology for capturing what is special about a site. The National Trust ensured that the selected sites did not impact on areas outside the estate e.g. they were sited behind hedges, trees or other natural features.

[64] National Trust (2010) Energy: Grow your own http://www.nationaltrust.org.uk/document-1355764773127/

With informed and careful planning and appropriate detailing, solar PV can be considered as appropriate in sensitive landscapes and on designated buildings.

For example, at the ancient Powis Castle near the town of Welshpool, the 50kW PV field array is located behind the hedge of the main approach drive to this 100,000 visitors per annum site. The resulting 45MWh of electricity annually is powering a 27kW ground source heat pump for the Victorian greenhouses of the commercial plant nursery and is also supplying the energy for the main garden tea room. When the sun is shining and the visitors are at National Trust properties, the solar PV is also generating, which makes for a good match for both a conservation organisation and tourism operator.

Principle 4 – Support for solar PV should assess and respond to the impacts of deployment: on grid systems balancing; grid connectivity; and financial incentives.

Why is this principle important?

68. With significant increases in solar PV deployment, it is necessary to ensure that wider impacts of solar PV deployment are assessed and monitored with regard to:

- Managing integration into the electricity system and market;
- Ensuring timely and affordable grid access; and
- Ensuring value for money through financial incentives.

Managing integration into the electricity system and market

69. With significant levels of solar PV deployment in the UK there are increasing challenges in maintaining a secure and cost effective balance of the UK electricity system. Small-scale installations such as domestic roof mounted systems are not visible generators to network operators; they act as a demand reduction over the network[65]. The network operators do not have control of these installations. At local levels, significant export of electricity can also lead to voltage rises which need to be controlled to ensure stable operation of the system.

70. The whole electricity system has certain operational requirements for stable and secure operation, which depend on the generation mix at the time, network variables and the demand for electricity. As such, there is an interaction between solar PV and wind generation technologies connected to the system and 'must-run' plant (e.g. less flexible generation such as nuclear; minimum operational requirements from coal or gas) in varying degrees, depending on deployed levels.

71. These system requirements around plant that 'must run' mean that one of the more challenging times for managing the system is when demand levels are at their lowest – known as system minima.

72. With increasing PV deployment, it is likely that the larger proportion would be small-scale installations. In this scenario, the minimum energy demand to be met in the summer, due to PV generation effectively reducing demand seen across the electricity system as a whole (and at times when overall energy demand is also lowest, for example summer Sundays and bank holidays), would reach a threshold where excess generation by solar PV would start to create significant operational and cost implications.

[65] Larger installations are also likely to be connected to distribution networks - although some could at a very large scale potentially be connected to transmission networks (subject to distribution and grid code requirements).

What do we already know?

73. National Grid published their Solar Briefing Note[66] in December 2012 in which they indicated that above 10GW of solar PV deployment would make managing the grid significantly more challenging. Since that analysis was completed, National Grid has continued to work with DECC to consider this issue. Having undertaken further analysis of the level of minimum demand, National Grid has updated their paper with an additional note[67] which confirms that 10GW of solar PV in Great Britain can be accommodated without significantly changing operational practices; but that above this level will make managing the grid significantly more challenging.

74. This work[67] indicates that there are requirements as to the way in which the electricity system is operated, particularly in relation to less flexible generation such as nuclear and combined heat and power needed for heat, and plant which is providing technical services to the system operator. These requirements around plant that 'must run' mean that at times when demand levels are at their lowest, additional solar PV generation that cannot be controlled, raises challenges to reducing total generation output down to the required level.

75. However, system minima is dependent on the level of electricity demand. If we electrify heat and transport, the electricity demand would increase, and then the 10GW threshold could relax. Conversely, if electricity demand continues to fall the 10GW threshold is likely to be lower.

What are the next steps?

76. The Grid and Networks Task Force, chaired by National Grid, is working with the Electricity Network Association, Distribution Network Operators (DNO), technology experts and developers, to help develop improved access and integration into the electricity transmission and distribution networks. Continued work by the Task Force, DECC and its partners that will be undertaken ahead of publication of the Strategy will include:

- Work to explore measures and technological advances to manage grid systems balancing with increasing levels of solar PV.

- Continued work to develop mitigation technologies to help balance the supply and demand of electricity. This includes the following policies and programmes:

  - DECC's Smart Metering Programme[68] which aims to replace over 53 million standard gas and electricity meters with smart meters between now and 2020.

  - Ofgem's Low Carbon Network Fund to trial new technologies and innovative approaches by distribution network operators in Great Britain[69] (see Case Study 4).

[66] National Grid (2012) Solar PV Briefing Note for DECC https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66198/National_Grid_-_solar_PV_briefing_note.pdf
[67] National Grid (2013) Solar PV Assessing the Impact of Minimum Demand http://www.nationalgrid.com/corporate/About+Us/futureofenergy/
[68] DECC (2013) Helping households cut their energy bills https://www.gov.uk/government/policies/helping-households-to-cut-their-energy-bills/supporting-pages/smart-meters

- DECC's Energy Storage Technology Demonstration Competition[70].

- EPSRC Grand Challenge Funding in energy storage and networks [71] and the Energy Technology Institute (ETI) Energy Storage and Distribution Programme[72].

- Ofgem is reviewing the existing GB electricity network system planning and delivery arrangements, including for interconnection, through its Integrated Transmission Planning and Regulation (ITPR) project[73]; and Government is developing its own evidence base on the impacts of further interconnection and we envisage publishing a policy statement around the end of 2013[74].

Case study 4: Low Carbon London Smart Metering Trials

Low Carbon London[75] is a pioneering learning programme, set up in January 2011 and led by UK Power Networks. It aims to use London as a test-bed to develop a smarter electricity network that can manage the demands of a low carbon economy, including intermittent generation such as solar and wind power. The project will conclude in December 2014 and is funded using £20.6 million from the Low-Carbon Network fund and £6.6 million from UK Power Networks and key project partners.

UK Power Networks, and Low Carbon London partner EDF Energy, have installed nearly 6000 smart meters in domestic consumers' homes throughout the London area during 2011/12. These smart meters are being used to monitor changing consumer demand patterns and the subsequent effect on London's electricity network. Those with smart meters were then offered a unique electricity tariff to test whether consumption patterns could be changed by reducing the tariff price when more electricity is expected to be generated through low marginal cost renewable sources and increasing it when renewable output is expected to be low or at times of temporary network constraint.

The tariff has been designed such that most anticipated high and low wind output scenarios will be tested during the course of 2013. Whilst designed as a wind-following tariff, the methodology could in future be replicated with some adaptation to address anticipated day-on-day variations in solar PV output. The trials are on-going. The learning from these trials will have wide UK applications. UK power networks, working with Imperial College London, plan to publish a full set of reports after the trials conclude in June 2014.

---

[69] Ofgem (2013) Low Carbon Networks Fund http://www.ofgem.gov.uk/Networks/ElecDist/lcnf/Pages/lcnf.aspx
[70] DECC (2013) Closed Schemes (Still Current) Energy Storage Technology Demonstration Competition https://www.gov.uk/innovation-funding-for-low-carbon-technologies-opportunities-for-bidders#closed-schemes-still-current
[71] ESPRC (2011) Energy Storage Grand Challenge http://www.epsrc.ac.uk/funding/calls/2011/Pages/energystoragegrandchallenge.aspx
[72] ETI Energy Storage & Distribution Programme http://www.eti.co.uk/technology_programmes/energy_storage_and_distribution
[73] Ofgem (2013) Integrated Transmission Planning and Regulation (ITPR) Project: Emerging Thinking https://www.ofgem.gov.uk/ofgem-publications/52728/itpremergingthinkingconsultation.pdf
[74] DECC (2012) Electricity System Assessment of Future Challenges https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48549/6098-electricity-system-assessment-future-chall.pdf
[75] http://lowcarbonlondon.ukpowernetworks.co.uk/

Ensure timely and affordable grid access

77. In the short term, timely and affordable grid access arrangements are vital to delivering new solar PV generation projects to help meet our low carbon emissions and renewable energy targets. The tasks required to get a solar PV system connected to the grid vary with the size of generating plant but generally, the larger the plant the more complex the connection requirements. Small-scale solar PV is not currently experiencing the same difficulties as some larger-scaled installations.

78. Under the Electricity Act, DNOs are obliged to offer a connection to any customer that wishes to connect to the network (which vary in applicability and detail across the Devolved Administrations). As a result, DNOs are overwhelmed by the volume of enquiries they receive and the number of enquiries that result in new connections is low (estimated between 10 per cent and 15 per cent). According to the Energy Network Association and developers, there are two main reasons for this: a lack of publicly available information for developers and installers to assess spare network capacity in a particular region, and the absence of fees in submitting connection applications.

What has already been done?

79. Ofgem has established the Distributed Generation (DG) Forum to identify and overcome barriers to the connection of distributed generation to the grid, and also introduced incentive mechanisms to improve DNO performance[76.] Recognising that more can be done to provide quicker connections, in March 2013 Ofgem published its Strategy to strengthen these incentives[77], including financial penalties for failing to demonstrate good customer service to DG and large connection customers. In addition, following the establishment of the DG Forum, the DNOs developed action plans on how they would work to improve their engagement with customers and these are an element of their business plans[78]. The Smart Grid Forum is looking at how smart grid technologies and associated commercial arrangements can improve the connection of distributed generation, including solar PV (see Case Study 4 for further detail).

80. The RIIO-T1 transmission price control[79] for 2013-21 began on 1st April 2013 in order to consider the costs associated with network requirements to accommodate larger volumes of renewables. Under this, Ofgem has agreed funding of up to £21.5bn for the Transmission Owners to expand, replace and maintain the GB transmission network. In areas where there is limited network capacity, the DNO may have to undertake reinforcement works at a cost to enable a new connection and to accommodate a customer's requirements. In order to address the issue of undertaking advance grid reinforcement works, where there is a wider need, Ofgem's RIIO-ED1 Price Control Review will allow DNOs to undertake speculative investment ahead of need and will be incentivised to use 'smart solutions', which can avoid or defer the need for reinforcement and therefore provide more timely and value for money connections.

[76] Ofgem The Broad Measure of Customer Satisfaction (BMCS) https://www.ofgem.gov.uk/electricity/distribution-networks/network-price-controls/customer-service and the connections Guaranteed Standards of Performance (GSOPs) http://www.ofgem.gov.uk/Networks/ElecDist/QualofServ/GuarStandds/Pages/GuarStandds.aspx.pdf.

[77] In particular, they will introduce a Time to Connect incentive for small customers and an Incentive on Connections Engagement (ICE) for major demand, unmetered and all DG customers. http://www.ofgem.gov.uk/Networks/ElecDist/PriceCntrls/riio-ed1/consultations/Documents1/RIIOED1DecOverview.pdf

[78] Ofgem, Distributed Generation http://www.ofgem.gov.uk/Networks/ElecDist/Policy/DistGen/Pages/DistributedGeneration.aspx

[79] Ofgem, RIIO-T1 Price Control https://www.ofgem.gov.uk/network-regulation-%E2%80%93-riio-model/riio-t1-price-control

81. While there are a number of similarities to the GB grid, the position in Northern Ireland is slightly different. The Northern Ireland Authority for Utility Regulation (NIAUR) regulates the single DNO, Northern Ireland Electricity (NIE). A grid connection offer can only be considered once the generator has received planning permission, where appropriate. Parts of the Northern Ireland grid network are nearing capacity due to the increasing amounts of small-scale generation connecting, particularly onshore wind. This is leading to increasing connection costs and timescales and work is underway by NIE to consider how more information on grid 'hot spots' can be made accessible to generators at an early stage and prior to submitting costly planning applications. In addition to this, NIAUR has set up the 'Renewables Industry Group' to tackle the issue, including the consideration of connection to the 11kV network for small-scale renewable generators.

What are the next steps?

82. The Grid and Networks Task Force, DECC and its partners will continue to undertake work, some of which will be undertaken ahead of publication of the Strategy, and will include the following:

- DNOs will provide network hotspot maps to show where connections can be made more quickly;

- Continued work on RIIO ED1 (DNOs have now submitted their business plans for RIIO ED1. In recognition of difficulties identified by people trying to connect to the distribution network, Ofgem has introduced two new incentives to improve DNO performance in this area. For smaller connections, a time to connect incentive has been introduced to help shorten the connection time for these customers. Following consultations, it was agreed that larger developers felt that flexibility of DNOs was more important than shortening connection times so an Incentive on Customer Engagement is being introduced which will set minimum terms of engagement which DNOs will have to fulfil or receive penalties. Ofgem is currently consulting appropriate targets for these incentives and how these incentives/penalties should be split[80]. This consultation closes on 30 October, and a further response will be subsequently issued in early 2014.); and

- The NSC will look at legal means and potential for developers to share network upgrade costs to enable deployment.

[80] Ofgem (2013) Consultation RIIO-ED1 customer service and connection incentives https://www.ofgem.gov.uk/ofgem-publications/83052/riioed1custserviceconnectionincentivesopenletter040913.pdf

Enabling Financial Predictability

83. The predictability of financial mechanisms that exist for the sector is critical to providing the industry with confidence to continue to invest. At the moment, incentives are necessary as solar PV is yet to become competitive with other energy sources in the UK. The Government has put in place a range of incentives and support mechanisms to support solar PV (which vary in applicability and detail across the Devolved Administrations). There are three main mechanisms that enable greater financial predictability: Feed-in Tariffs (up to 5MW[81]); Renewables Obligation Certificates (until April 2017 for >50KW); and the enduring regime of Contracts for Difference (available from 2014, for projects >5MW). In Northern Ireland, both small and large-scale technologies are currently incentivised through the Northern Ireland Renewables Obligation (NIRO).

What has already been done?

Feed-in Tariffs Scheme (FITs)

84. In the last year, the Feed-in Tariff (FITs) scheme for small-scale renewables has been reformed, through the FITs Comprehensive Review, which was concluded in December 2012. The Review sought to improve value for money and reduce tariffs in light of falling solar PV costs. Taken as a whole, the changes resulting from the Comprehensive Review will place the FITs Scheme on a sustainable footing; providing the transparency, longevity and confidence needed within the industry. The particular mechanism to control costs and provide greater certainty over future tariff rates to potential solar PV generators and investors is quarterly degression, which was introduced on 1 August 2012 (for a more detailed explanation of how quarterly degression will work see the Government Response to Phase 2A of the Comprehensive FITs Review[82]).

Renewables Obligation Certificates (ROCs)

85. The banding of Renewables Obligation Certificates has seen significant changes take place this year, including for solar PV >50kW. The solar PV consultation on the levels of banded support under the Renewables Obligation (RO) for the period 1 April 2013 to 31 March 2017 closed on 19 October 2012 and the Government response was published on 18 December 2012. This set out the decision to establish two separate bands for solar PV under the RO: one band for building-mounted solar PV; the other band for all other types of solar PV. These bands came into force on 1April 2103 and are set out in Ofgem's guidance[83].

86. Similar RO banding changes were introduced in Scotland at the same time following a separate public consultation. In Northern Ireland, similar ROC bands and levels for solar PV above 250kW came into operation on 1 May 2013. However, in light of subsequent evidence brought forward by the industry, Northern Ireland is consulting on slightly different ROC levels for ground mounted stations above 250kW for the period 2014/5

[81] The Government is proposing to take powers, via an amendment to the Energy Bill, To enable the maximum capacity for support under the FITs scheme to be increased from 5MW to 10MW, for community energy projects only.
[82] DECC (2012) Feed-in Tariff Comprehensive Review Phase 2a https://www.gov.uk/government/consultations/solar-pv-cost-controls-comprehensive-review-phase-2a
[83] Ofgem (2013) Renewables Obligation: Guidance for Generators http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Documents1/RO%20guidance%20for%20generators.pdf

to 2016/17[84]. The Department for Enterprise, Trade and Industry is also undertaking a review of small-scale support under the NIRO[85], including solar PV, with a view to introducing any revised ROC levels in April 2015.

Contracts for Difference (CfDs)

87. To bring forward the billions of pounds of investment needed in new, low-carbon electricity generation and associated network infrastructure, the Government has published key information on CfDs[86] and consulted on draft strike prices for renewable technologies in the draft EMR Delivery Plan[87]. They will enable a technology mix that is value for money for consumers, along with the upper limits on annual spending on low-carbon generation (including CfDs, the RO and the small-scale FITs scheme) as agreed in the Levy Control Framework[88].

88. The draft strike price for solar PV was set out in the consultation on the draft Delivery Plan[87]. The draft strike prices have been informed by analysis from National Grid, who assessed the impact of different strike prices on the Government's objectives. At the time of publishing this Roadmap, DECC is analysing the responses to this consultation which will inform the final strike prices published in the Delivery Plan in December. The strike prices for key technologies come down over time showing that as technology costs come down, consumers will be paying less. These strike prices are set to be consistent with the RO levels of support[89] (though adjusted down as the CfD protects the investor against additional risks), allowing continuity and continued investment in the renewable energy industry.

What are the next steps?

89. The Finance and Bankability Task Force is working with financial and legal experts, as well as developers, to increase understanding of the solar PV sector among financiers and investors and identify means of improving access to finance. Continued work by the Task Force, DECC and its partners will be undertaken ahead of publication of the Strategy and will include the following:

- Producing a quick guide to solar PV financing for developers and installers;
- Identifying ways of reducing the risk for building owners of roof mounted PV, including working with the insurance industry;
- Working with the Engagement Task Force to develop legal and financial frameworks to allow improved financing of building mounted schemes;
- DECC will continue to operate the FITs degression mechanism during the current budgetary period;

[84] DETI NI (2013) Consultation Proposed Changes to the Northern Ireland Renewables Obligation – Ground-mounted solar PV above 250kW http://www.detini.gov.uk/here
[85] DETI NI (2013) Energy Website for forthcoming information www.energy.detini.gov.uk
[86] DECC (2013) Electricity Market Reform https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform
[87] DECC (2013) Consultation on the draft Electricity Market Reform Delivery https://www.gov.uk/government/consultations/consultation-on-the-draft-electricity-market-reform-delivery
[88] The mechanisms and headroom arrangements underpinning the Levy Control Framework remain unchanged.
[89] The existing support scheme for large-scale renewable generation.

- DECC will address the increasing need for a Feed-in Tariff for large-scale community projects. The Government is taking powers, via an amendment to the Energy Bill, to enable it to increase the maximum capacity for FITs support from 5MW to 10MW;

- DECC will continue to monitor deployment, through the ROO-FIT[90] and MCS[91] databases for schemes subsidised by the FIT, and through the RO database for registered schemes subsidised by the RO. It is essential that DECC continues to review the quality of the data it receives and use. We will aim to improve data collection as far as possible. We will use the REPD database[92] to improve our understanding of the pipeline for large-scale solar projects (>1MW), which will be augmented by sector intelligence. The NSC will provide a source of subject area expertise, but its formal role, if any, is yet to be defined;

- DECC will continue to put in place clear policy regarding RO Transition to ensure a smooth and straightforward transition from the RO to CfDs as the main financial support mechanism for large renewable generation. DECC is offering a transition period between the introduction of CfDs in 2014, and the closure of the RO to new entrants on 31 March 2017. During that transition period, new renewable generation will be able to choose between the two schemes. DECC's detailed proposals for the transition period and closure arrangements for the RO in England and Wales are set out in the RO Transition Consultation published on 17 July 2013.[93] That consultation closed on 25 September, and DECC is currently assessing responses, in order to inform the implementation of the final policy and process via a RO (Amendment) Order 2014 to come into force on 1 April 2014;

- Scottish Government will continue with their equivalent transition arrangements for the RO(S). The Scottish Government's consultation on equivalent transition arrangements for the RO(S) was published on 2 September 2013, and will close on 2 November 2013.[94] (Because of reforms to the Single Electricity Market in Northern Ireland, the Northern Ireland Executive does not plan to open its market to CfDs until 2016 at the earliest). The Northern Ireland Executive expects to implement similar transition arrangements to those for England, Wales and Scotland, for the period between the introduction of CfDs in NI, and the close of the NIRO on 31 March 2017; and

- The draft EMR Delivery Plan consultation closed on 25 September 2013. We expect to publish final strike prices in December 2013 (subject to State Aid and Royal Assent of the Energy Bill). The EMR programme remains on track for implementation with the first CfDs under the generic regime expected to be signed in the second half of 2014, and the first capacity auction anticipated around the end of 2014. Full details are available of the EMR package[95].

[90] ROO-FIT (Ofgem): https://www.ofgem.gov.uk/environmental-programmes/feed-tariff-fit-scheme/applying-feed-tariff/roo-fit
[91] Microgeneration Certification Scheme (MCS): http://www.microgenerationcertification.org/
[92] REPD database: https://restats.decc.gov.uk/cms/planning-database/
[93] DECC (2013) Consultation on Transition from the Renewables Obligation to Contracts for Difference https://www.gov.uk/government/consultations/transition-from-the-renewables-obligation-to-contracts-for-difference
[94] Scottish Government (2013) Consultation on Transition from the Renewables Obligation to Contracts for Difference http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Obligation-12-13/ConsultationTransitionRO
[95] DECC (2013) Electricity Market Reform https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform

Section 3 – Setting Future Policy Direction

90. This Roadmap document forms the first element of a two part Strategy process. The second part will be a full Strategy Document which will be published in spring 2014. The Strategy Document will further explore the actions which will be needed to be taken by Government and the sector to maximise the sustainable, affordable deployment of solar PV in the UK. DECC will report on the outputs of the work as set out in this document including the following key aspects:

- DECC will complete further analysis of the levels of cost reduction required to deliver different levels of solar PV deployment over the next decade, and assess whether these are feasible given evidence on technology learning rates and likely sources of cost reduction in the solar sector. This analysis will be done in light of the on-going European Commission anti-dumping case against imported Chinese panels;

- DECC will continue to work, through the Solar PV Strategy Group and in collaboration with the NSC and trade associations to determine reliable methodologies to access data on jobs and investment in the UK solar PV sector;

- DECC will consider the distribution of potentially suitable deployment sites across domestic, commercial and industrial roofs and large-scale ground mounted sites;

- DECC will undertake a detailed analysis of current findings to help shape solar PV policy in order for it to deliver genuine carbon reductions that help meet the UK's target of 15 per cent renewable energy from final consumption by 2020; and

- DECC and partners will work to explore measures and technological advances to manage grid systems balancing with increasing levels of solar PV.

Department of Energy & Climate Change
3 Whitehall Place
London SW1A 2AW
www.gov.uk/decc

URN 13D/251