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## The Case for Solar Energy in Scotland

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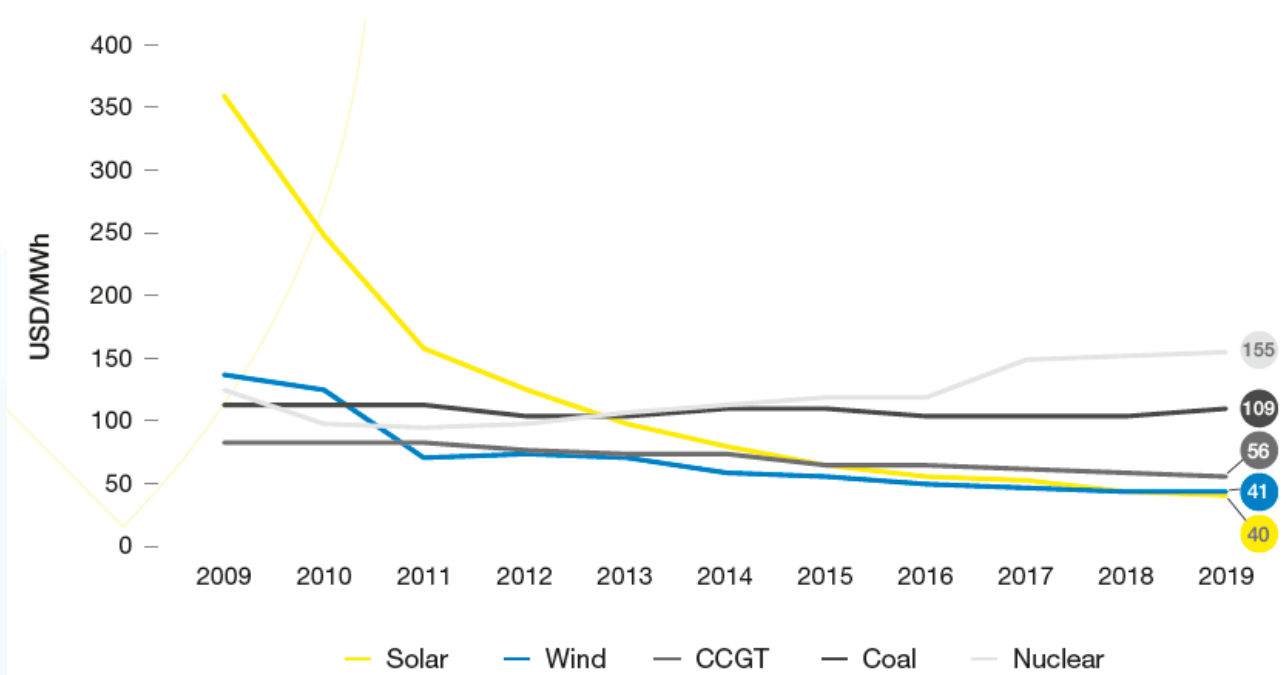


Figure 3: Solar Electricity Generation Cost in Comparison with Other Power Sources 2009-2018. Source: Solar Power Europe "Global Market Outlook for Solar Power 2020/2024", June 2020

## 2 The Case for Solar Energy in Scotland

A number of policy and contextual factors are itemised in Section 6 Policy, Markets & Finance relating to solar in Scotland. These demonstrate the strong decarbonisation ambitions of Scotland and mention solar as a contributing factor in the future energy mix. It would be fair to say, however, that the true potential of solar has yet to be fully recognised by government, industry or wider society and that stated expectations remain lower than could be achieved with a more systematic and strategic focus. For example, the Scottish Government Energy Strategy 2017 states that "there is enough capacity in Scotland to power the equivalent of over 50,000 homes." This however, is a remarkably low and unambitious estimate: indeed, it is even lower than has already been achieved (see Section 1 Introduction). In contrast, a simple calculation shows that Scotland's entire annual electricity consumption of 36 TWh could be met with 20%-efficient PV panels covering around 0.27% (216 km<sup>2</sup>) of the country's area (the area of Glasgow = 175 km<sup>2</sup>). Utilising all of this may not be straightforward in practice, but it serves to illustrate the enormity of the resource.

## 2.1 How Well Does Solar Work in Scotland?

Installing solar power in Scotland has tremendous potential even though it doesn't receive as much solar irradiation as places such as Africa, India or Southern Europe. Solar power potential in the UK and Scotland is not dissimilar to Germany, the largest PV market in the world, which already had 24.7 GW of PV installed by 2011<sup>10</sup>.

At the individual level, "a typical domestic rooftop 4 kWp system in Scotland can generate about 3,400 kWh of electricity a year – that's similar to the amount of electricity used by one family house and the same amount of electricity as it takes to turn the Falkirk Wheel 2,200 times. It will save approximately 1.3 tonnes of carbon dioxide every year."<sup>11</sup>

In fact, Scotland has a very similar solar radiation profile to the rest of the UK (Figure 4). The University of Edinburgh has carried out research into the solar resource across Great Britain taking 10-years of weather data into account<sup>12</sup>. From this, a comparison of the potential output of a typical domestic solar installation (a 4 kWp roof-mounted array) between various representative conurbations in the UK has been produced:

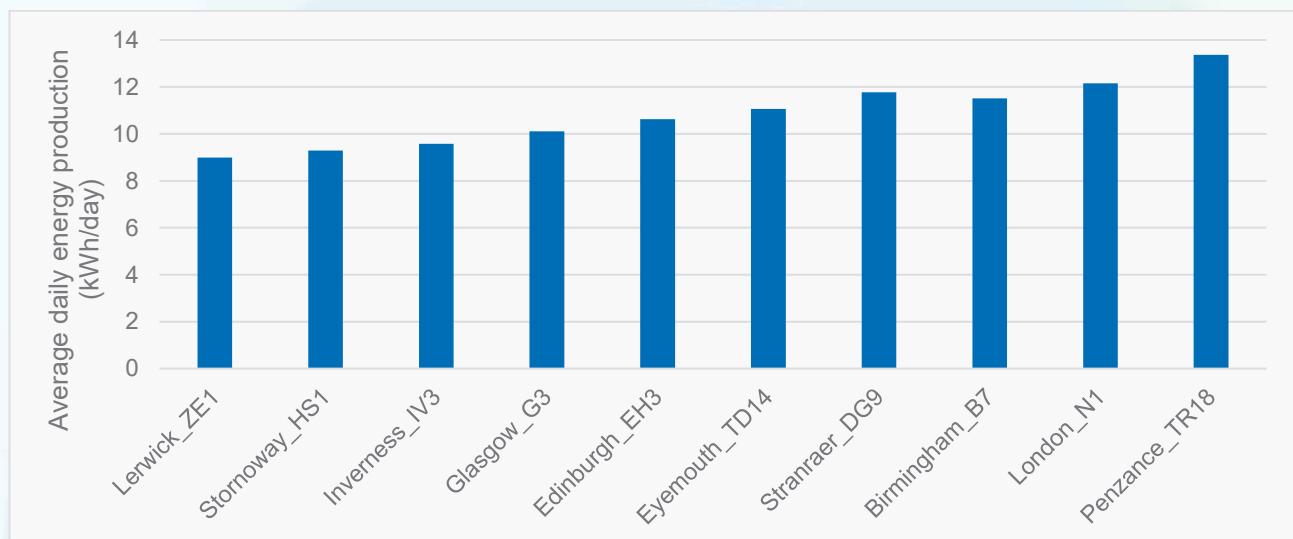


Figure 4: Average daily energy production of a typical domestic array across selected postcodes

As can be seen from Figure 4, the average energy output of a domestic installation in Edinburgh is 10.6 kWh/day, which is only 13% less than London, at 12.2 kWh/day.

<sup>10</sup> European Photovoltaic Industry Association (EPIA) (2012) "Market Report 2011"

<sup>11</sup> <https://energysavingtrust.org.uk/renewable-energy/electricity/solar-panels>. Accessed 17 February 2020

<sup>12</sup> Thomson, R, Sun, W & Harrison, G 2019, 'Developing a spatially and temporally explicit solar resource dataset for Great Britain', *The Journal of Engineering*, 2019 18 5269-5273. <https://doi.org/10.1049/joe.2018.9264>

Another question that arises with regards to solar power in Scotland is the seasonal and temporal variation. This has also been investigated, with a particular focus on London and Edinburgh.

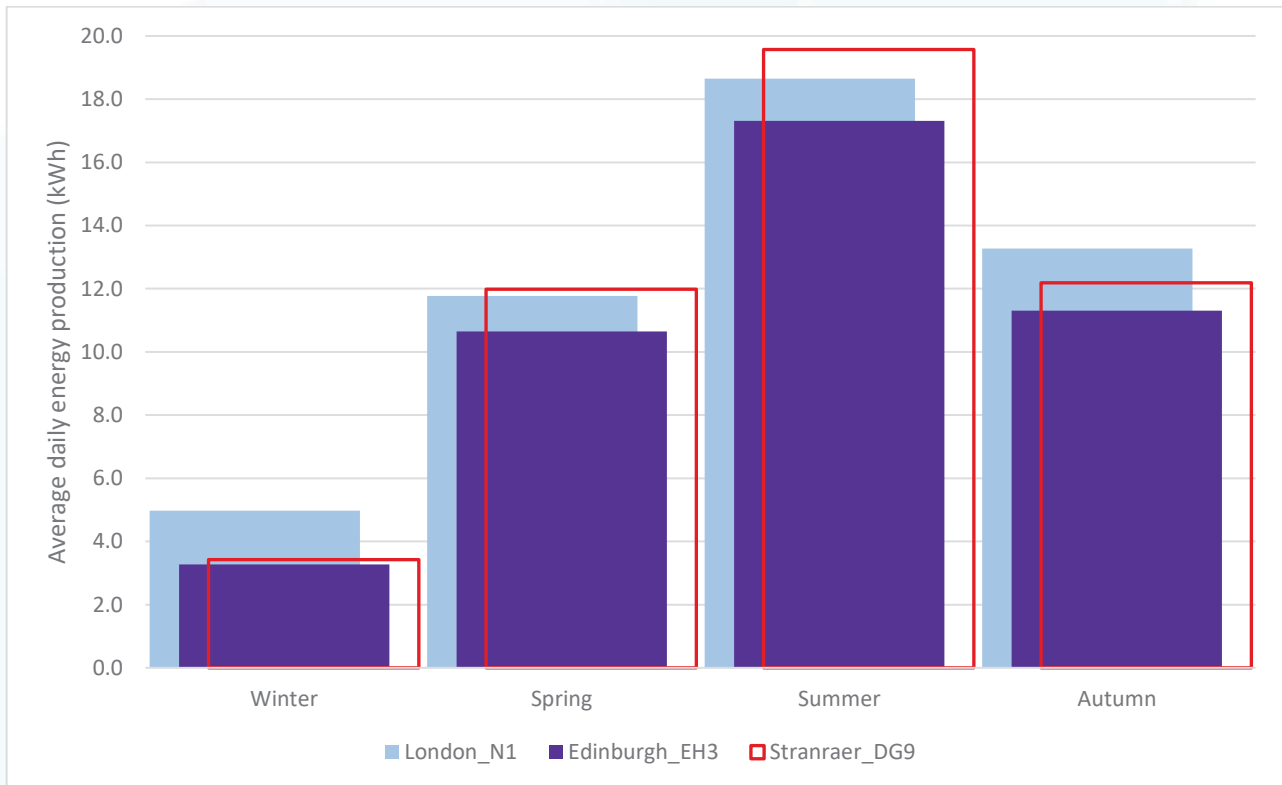


Figure 5: Average seasonal energy output of a typical domestic array in Edinburgh, London and Stranraer

It can be seen from Figure 5 that the seasonal fluctuations in Scotland are similar to those experienced in London. The efficiency of a solar panel in London will be similar to one in Edinburgh. Denmark, with a comparable latitude, climate and population to Scotland, expects to increase solar PV from 955 MW (2018) to 2015 MW (2023)<sup>13</sup>, which is five times Scotland's current capacity.

<sup>13</sup> SolarPower Europe (2019) "EU Market Outlook for Solar Power / 2019 – 2023", 2019

## 2.2 How Much Electricity Could Solar PV in Scotland Produce?

There are two parts of this question. The first is the available solar resource, as already discussed, and the second is about how many Solar PV panels (the maximum potential capacity) could be installed in Scotland. These considerations can then feed into realistic targets for solar PV deployment in Scotland, something that is currently lacking.

It is challenging to accurately estimate the maximum potential capacity of solar PV in Scotland. Existing estimates for the UK are largely based on modelling studies augmented by available data on buildings and land-use. Based on a preliminary review of available published estimates for maximum potential solar PV capacity in the UK<sup>14 15</sup>, adjusted values have been calculated for Scotland. The most optimistic estimates for potential practical solar PV capacity in Scotland are (*p* = *peak power output*):

- 8 GWp for domestic roof-mounted solar
- 3 GWp for commercial roof-mounted solar
- 21.5 GWp for ground-mounted solar farms, per percent of Scotland's land devoted to solar PV

The available solar resource can be described in terms of an average capacity factor for Scotland (estimated to be 10.7%, 10.8% and 11.3% for domestic, commercial and ground-mounted arrays respectively)<sup>16</sup>, which allows the potential annual energy production to be calculated:

- 7.5 TWh/yr for domestic roof-mounted solar
- 2.8 TWh/yr for commercial roof-mounted solar
- 21.3 TWh/yr for ground-mounted solar farms, per percent of land devoted to solar PV

**On the above basis, Scotland's entire electricity demand equivalent (36 TWh/year) could be met using domestic and commercial roofs, plus 1.2% of land area.<sup>17</sup>**

These figures provide context for any proposed solar PV deployment target for Scotland. The "Net Zero Technical Report" of the Committee on Climate Change (May 2019)<sup>18</sup> states that over the period to 2035, up to 54 GWp solar PV could be needed in the UK and that further deployment is likely to be needed over the period to 2050. If Scotland captured 10% of this UK growth, that would lead to 6 GWp capacity by 2035, which is clearly achievable within the maximum capacities outlined in this section above.

<sup>14</sup> UKPVMA 2020 "A vision for UK PV: An up to date and accurate analysis on the investment case for solar photovoltaics (PV) in the UK", 2009. UK Photovoltaic Manufacturers Association.

<sup>15</sup> MacKay D, "Sustainable Energy-without the hot air", UIT Cambridge, 2008.

<sup>16</sup> Thomson, R, Sun, W & Harrison, G, 'Developing a spatially and temporally explicit solar resource dataset for Great Britain', The Journal of Engineering, 2019 18 5269-5273

<sup>17</sup> Scottish Government, "The Scottish Energy Strategy: The Future of Energy in Scotland", December 2017

<sup>18</sup> Committee on Climate Change "Net Zero Technical Report", 2 May 2019