Energy Targets – Evidence Paper

Background

Welsh Government has started the process of setting targets for energy. This paper provides the data and analysis to support the setting of a target for renewable electricity generation. The proposal is a target for:

- % of electricity consumed in Wales generated from renewable energy.

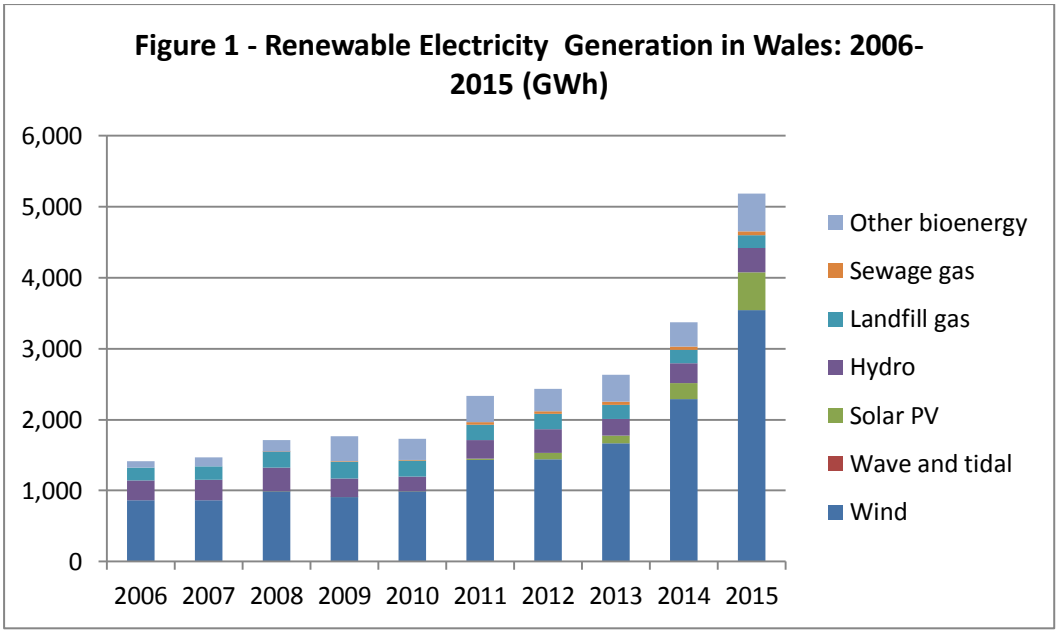
Data availability

Generation - data is available from BEIS on electricity generation from renewable energy in Wales up to the end of 2015. The results of the Energy Generation in Wales study will be available in November (up to end 2016). There are a number of large wind projects due to come on line in the next few years and we can use this information to forecast the increased renewable generation we are likely to see in the short term. The indicative capacities of the Strategic Search Areas can be used to project future potential of renewable generation. The Swansea Bay Tidal Lagoon and Wylfa Newydd (nuclear) can also be factored in to projections.

Consumption - data is available from BEIS on electricity consumption in Wales to the end of 2015. Forecasting data on future electricity consumption in Wales is not straightforward and demand beyond 2030 is difficult to predict as there are uncertainties on how fast electric vehicles and electric heating will deploy. Consumption may rise with increased deployment of EVs and electric heating. However, the National Grid's Future Energy Scenarios (2016) suggest this may be modest for their 'Two Degrees' scenario. Perhaps more important is peak demand, which is a key defining parameter for network design. The National Grid recently announced that meeting the recent UK Government announcement of no new petrol or diesel cars by 2040, would likely increase peak demand by 8%.

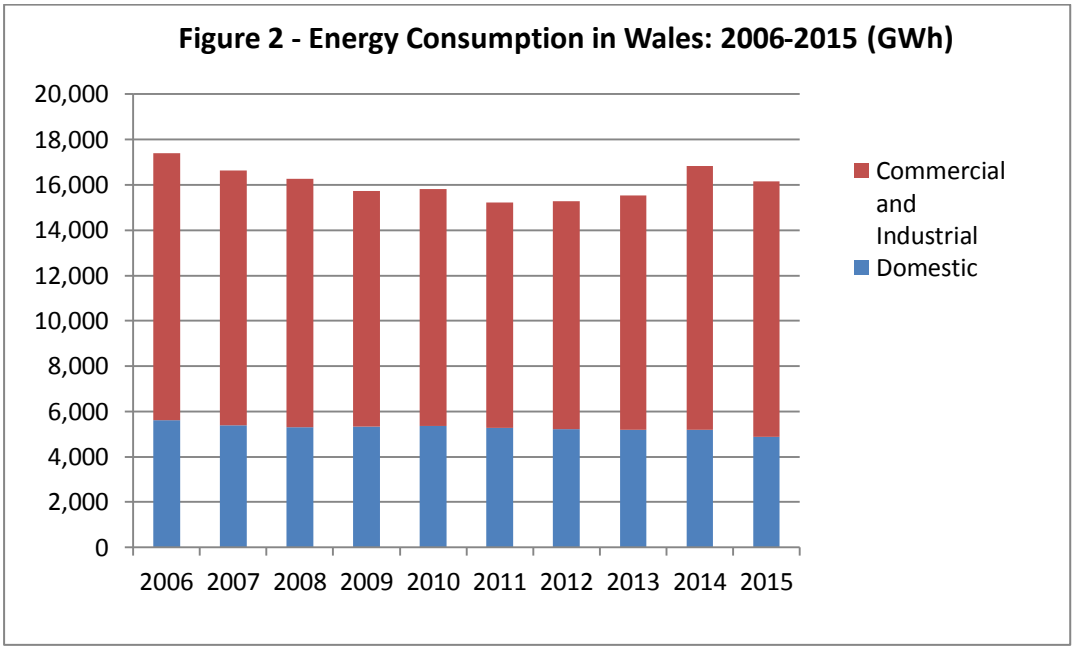
Analysis

The following charts and tables provide analysis of electricity generation and consumption in Wales.



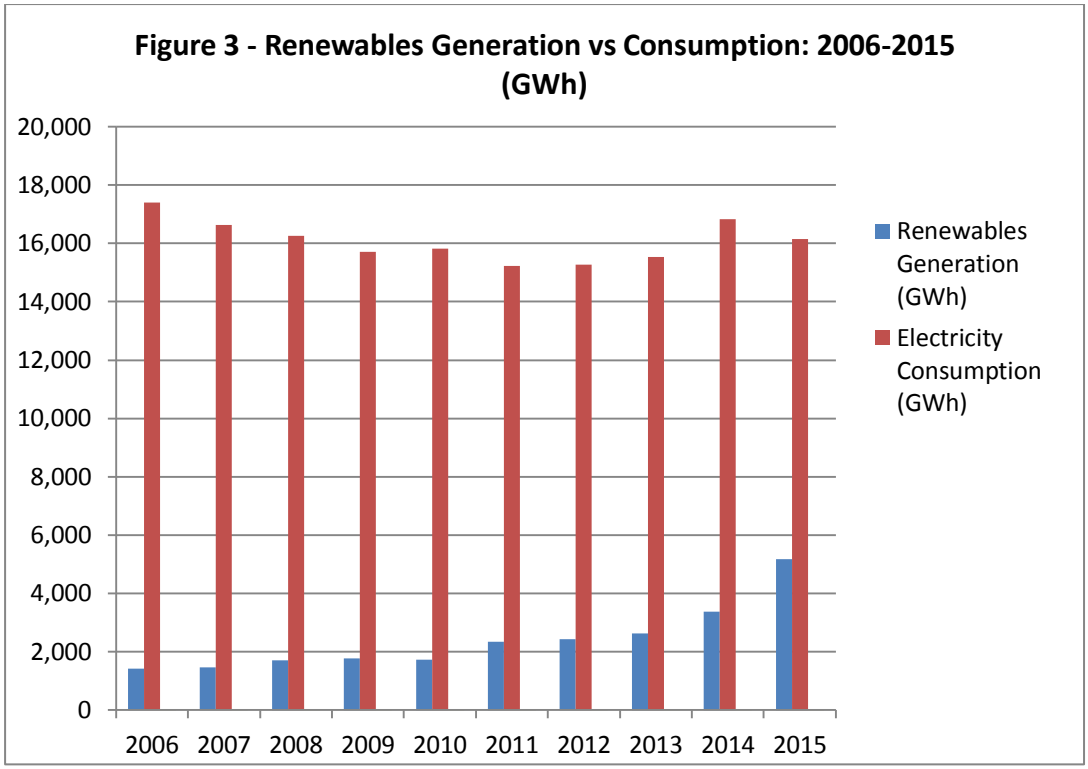
https://www.gov.uk/government/statistics/regional-renewable-statistics

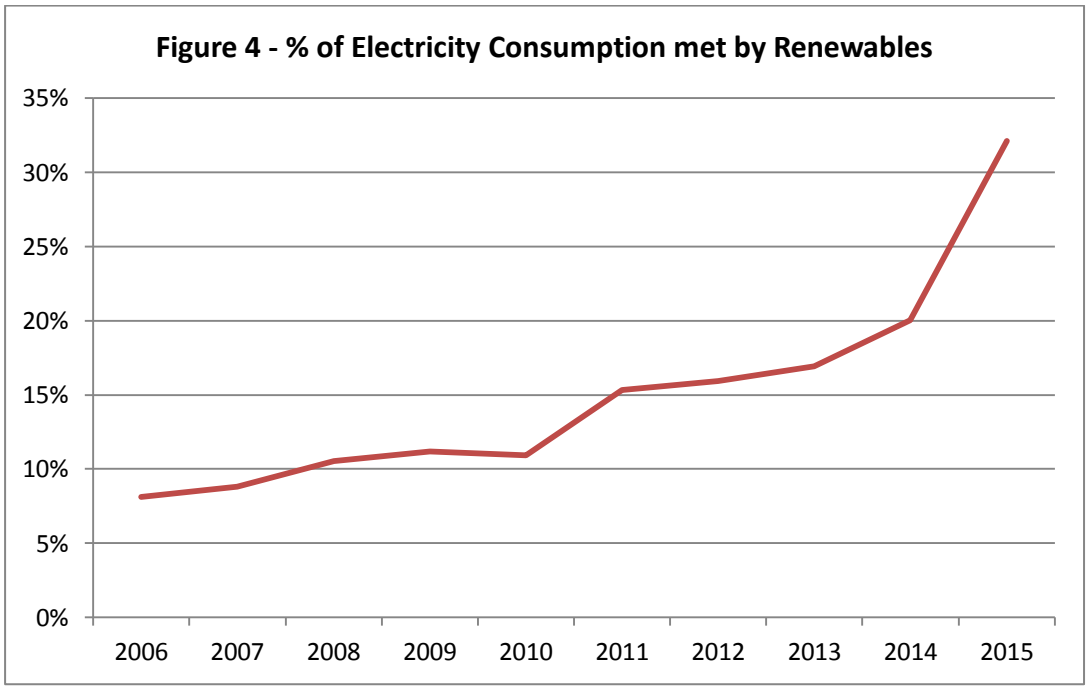
Electricity generation from renewable sources has grown from 1.4 TWh in 2006 to 5.2 TWh in 2015 (increase of 271 %).



https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics-2005-to-2011

Energy consumption was at its lowest in 2011 at 15,226 GWh. Consumption in 2015 was 7% less than in 2006 at 16,145 GWh.





The % of electricity consumed in Wales generated from renewable sources has increased steadily over the last decade increasing from 8% in 2006 to 32% in 2015.

Future Deployment

- Swansea Bay Tidal Lagoon, with an **installed** capacity of 320MW, is predicted to provide 530GWh of **generation** each year. This represents 3.3% of Wales' electricity consumption (based on 2015 consumption data of 16,145GWh).
- There remains capacity for on-shore wind development across Wales, both within the Strategic Search Areas (SSAs) identified in TAN8, and outside of them.
- As of 01 April 2017 there was 625.10MW of **operational** capacity within the 7 SSAs, out of a **total** indicative capacity of 1666MW. This represents 38% of capacity of the SSAs. There is a further 254MW of operational capacity outside of the SSAs.

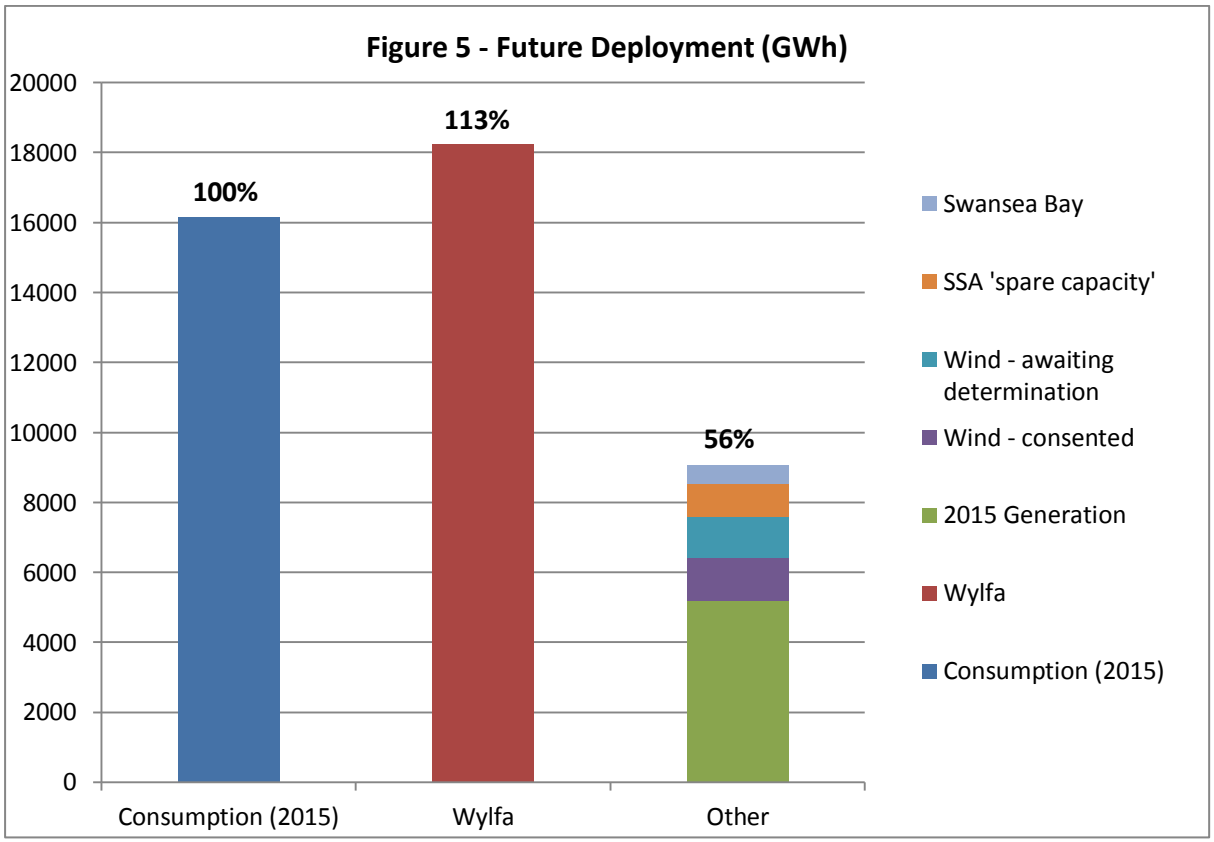


Figure 5 shows the percentage of demand future low carbon energy projects would meet. Metered electricity consumption in 2015 in Wales was 16,145 GWh. 32% of this consumption was met by renewable generation in 2015. There is potential to meet an additional 15% of consumption if the onshore wind developments which have been consented but not yet built are realised, and the wind developments awaiting determination by the planning system are consented and built. Swansea Bay Tidal Lagoon has the potential to meet 3% of the 2015 level of electricity consumption. For reasons of practicality this paper does not look at the potential of other renewable energy technologies deployed at smaller scales, although these also have the potential to contribute to meeting energy consumption.

Based on 2015 consumption, Wylfa Newydd has the potential to meet more than the total electricity demand of Wales, although the electricity produced would be low carbon so would not qualify as renewable. Wylfa Newydd has an anticipated minimum installed capacity of 2,700MW. If a load factor of 77% is achieved, Wylfa will provide more than 18,000GWh of electricity per annum, which is 113% of electricity consumption.

Future Demand

National Grid, UKCCC and BEIS have all produced predictions for future energy demand. These scenarios cover a wide range of potential energy futures, and vary significantly in their assumptions and outputs.

National Grid's Future Energy Scenarios (FES) includes a prediction on electricity demand for each of its five scenarios (two degrees, slow progression, steady state, consumer power and high electrification). See figure 5.11 in the Charts Workbook of the following:

http://fes.nationalgrid.com/fes-document/

The projections produced by National Grid are at a UK level. It is possible to disaggregate the data to a Wales level by comparing electricity demand in Wales over recent years to UK electricity demand. Table 1 shows Wales electricity demand has been on average 5.53% of the UK demand over the last 10 years, taken from:

https://www.gov.uk/government/publications/energy-trends-december-2016-special-feature-articles

Year	UK (GWh)	Wales (GWh)	Wales % of UK
2006	353,967	20,802	5.88
2007	351,057	20,020	5.70
2008	350,352	18,812	5.37
2009	330,098	17,745	5.38
2010	337,078	18,511	5.49
2011	325,243	18,206	5.60
2012	324,588	17,909	5.52
2013	323,292	16,439	5.08
2014	309,676	15,818	5.11
2015	312,194	19,186	6.15
		Average	5.53

Table 1 – Electricity demand: UK vs Wales

UKCCC predict electricity consumption in 2050 could be between 50% and 135% above the level of 2014. See page 36 of the following:

https://www.theccc.org.uk/wp-content/uploads/2016/10/UK-climate-action-following-the-Paris-Agreement-Committee-on-Climate-Change-October-2016.pdf

UKCCC have estimated future electricity demand in Wales for each year out to 2050, based on the proportion of UK electricity demand currently consumed in Wales.

BEIS also produce projections on energy demand emissions annually. Their projections are based on low growth and high growth scenarios. The range of increase in demand by 2030 is 11% for low growth and 15% for high growth and can be found here:

https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016

BEIS express their projections in Kilotonnes of Oil Equivalent (ktoe). The year on year percentage change in electricity demand in ktoe at UK level can be applied to the baseline year for Wales's electricity demand (2014) to calculate disaggregated future demand.

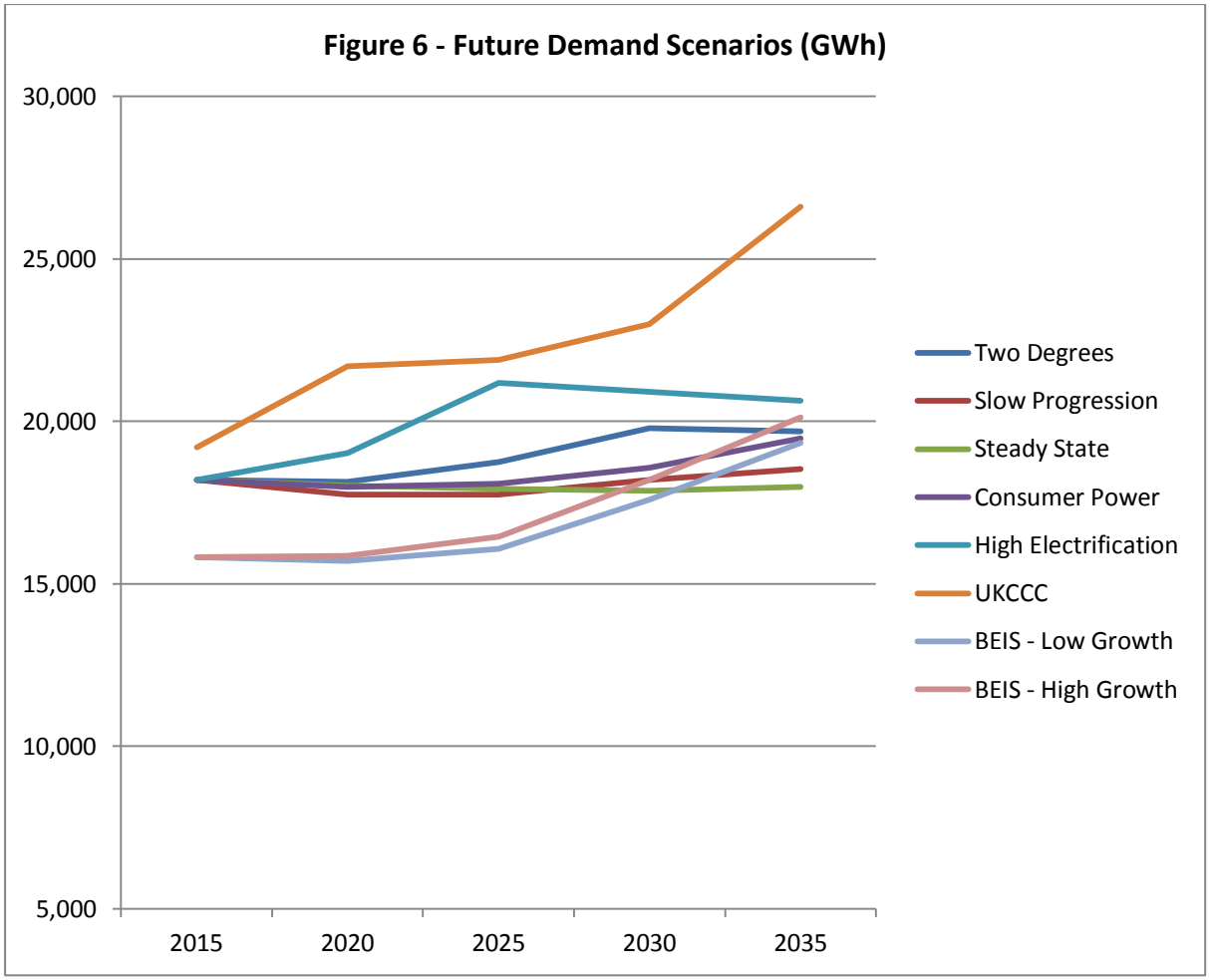
	Two Degrees	Slow Progression	Steady State	Consumer Power	High Electrification	UKCCC	BEIS - Low Growth	BEIS - High Growth
2015	18,194	18,194	18,194	18,194	18,194	19,200	15,813	15,813
2020	18,138	17,751	18,028	17,973	19,023	21,700	15,701	15,862
2025	18,747	17,751	17,917	18,083	21,180	21,900	16,078	16,459
2030	19,797	18,194	17,862	18,581	20,903	23,000	17,592	18,206
2035	19,687	18,526	17,973	19,466	20,627	26,600	19,331	20,133
2040	20,240	18,802	18,194	20,406	22,397	31,700	-	-
2045	21,401	19,079	18,581	21,235	24,498	36,700	-	-
2050	21,678	19,355	18,968	22,452	26,268	40,500	-	-

Table 2 – Projected electricity demand for Wales

Table 2 shows projections for future electricity demand in Wales. It uses National Grid, UKCCC and BEIS modelling. The red highlighted figures show the lowest projected demand for the year. The green highlighted figures show the highest projected demand for a year. The data is displayed graphically in figure 6.

Demand: In 2025, the UKCCC has the largest projected demand at 21,900 GWh, 38% above the 2014 baseline (15,818 GWh). In 2035, the same scenario has a projected demand 68% above the baseline. The lowest projected demand in 2025 is BEIS's low growth scenario at 16,078 GWh, just 2% above the 2014 level. In 2035, National Grid's steady state projects the lowest demand at 17,225 GWh, 14% above the baseline.

Installed Capacity: In 2030, the additional installed capacity of onshore wind required to maintain our current percentage of electricity demand from renewables of 32% is estimated as 259MW (low demand) and 1049MW (high demand). The median value is 376MW. To achieve 50% of electricity demand from renewables the range is 405MW to 1,640MW with a median value of 588MW, and for 70% the range is 567MW to 2,296MW with a median value of 823MW. For a 100% target the range is 810MW to 3,279MW with a median value of 1176MW.



Wind has been chosen to provide an illustrative example of the capacity required to fulfil these levels of demand, as wind currently represents the lowest cost solution. However, in reality the energy system comprises a range of renewable, low and higher carbon energy generation technologies which operate at different load factors.

To put this in to context, Pen y Cymoedd onshore wind farm has an installed capacity of 228MW, which with a load factor of 25.2% will generate about 500GWh of electricity per annum.

The load factor measures how much energy a plant can generate in practice, as a percentage of the maximum energy it could theoretically generate. No plant will have a load factor of 100%, because they will not always be generating due to climatic conditions (wind not blowing, sun not shining) and the need to be shut down periodically for maintenance and safety reasons.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/556694/Regional_spreadsheets__2003-2015__-_Std_LFs.xls

The load factor for onshore wind in Wales is 2.3 times greater than for solar PV (25.2% vs 11%). It would require a solar farm of approximately 520MW to generate the equivalent amount of electricity as Pen y Cymoedd wind farm. A 520MW solar

farm would require an area of more than 1,000 hectares, the equivalent of 1,485 football pitches.

In July, the Renewable Energy Planning Database listed 285MW of solar PV awaiting construction, under construction or awaiting determination. This represents 275GWh of generation.