

Cover illustration: Regen

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Ministerial foreword



Welsh Government is committed to accelerating the transition of the energy system, particularly through the increased deployment of renewable energy. Two projects which have recently become operational help to symbolise the change taking place in Wales. The Pen y Cymoedd windfarm is now the largest onshore wind project in England and Wales. Awel Aman Tawe's wind development is wholly community owned, meaning all its profits are kept within the Aman Valley and their shareholders.

We need many more such projects of all scales and technologies to transform our energy system. My priorities are to increase energy efficiency in Wales, to reduce our reliance on energy generated from fossil fuels and to actively manage the transition to a low carbon economy. We must continue to grow the economy whilst also reducing emissions and minimising the impact on people's energy bills.

The energy targets I set out in my Statement in September this year clearly demonstrate the Welsh Government's commitment to delivering a low carbon energy system and securing benefits for Wales. Our first target is for Wales to generate 70 per cent of its electricity consumption from renewable energy by 2030. Our second target is for at least 1 GW of renewable electricity capacity to be locally owned by 2030. I also expect new renewable energy projects to have at least an element of local ownership by 2020.

I commissioned the Energy Generation in Wales study to provide a complete picture of energy generation in Wales. The study updates the Low Carbon Energy survey we published in 2015 and for the first time includes details of fossil fuel generation and energy storage capacity in Wales. This study also shows what progress has been made on increasing the capacity of energy generation in local ownership.

Wales has made very encouraging progress on renewable energy, despite the challenging investment environment now faced by developers. We now have more than 67,000 renewable installations recorded across Wales. Renewable energy capacity has increased by 47 per cent since 2014 and makes up 18 per cent of all electricity generation in Wales. There has been a 97 per cent increase in renewable heat capacity, and 575 MW of renewable energy capacity is now in local ownership.

By using our abundant natural resources in a sustainable way, we can ensure energy continues its important role in achieving our energy and decarbonisation targets. Our key priority remains to deliver a prosperous and secure low carbon Wales.

Lesley Griffiths

Cabinet Secretary for Energy, Planning and Rural Affairs

Introduction

The Energy Generation in Wales 2016 report sets out the current energy generation capacity of Wales – and how it has changed.

The aim of the report is to support the Welsh Government with the development of energy policy, helping to evidence the economic, community and environmental benefits from the development of Welsh energy projects.

The report brings together a wide range of data sources to analyse the total capacity of renewable, nuclear and fossil fuel electricity generation, renewable heat and storage in Wales. The analysis builds on the 2014 Low Carbon Energy Generation report, looking at the growth of renewable energy in 2015 and 2016 and the growth prospects of each technology.

Energy generation deployment is broken down into the 22 local authority areas in Wales. This has been done to enable analysis of the local factors, including natural resources, local planning policies and other demographic factors, which may favour different technologies.

To illustrate the range of different technologies and scales of deployment in Wales, the report includes case studies of some of the many energy projects installed.

The report also examines the current ownership of energy assets in Wales. The value of local ownership of energy assets has been recognised by the Welsh Government, and is now a key part of Wales' energy strategy, with a target of 1 GW of locally owned renewable electricity capacity by 2030.

This report

- Breaks down Welsh electricity and renewable heat generation by technology, capacity and local authority area to the end of 2016.
- Calculates that 43 per cent of electricity consumption comes from renewable sources.
- Identifies over 67,000 renewable energy projects in Wales.
- Estimates that 575 MW of installed renewable capacity is locally owned.

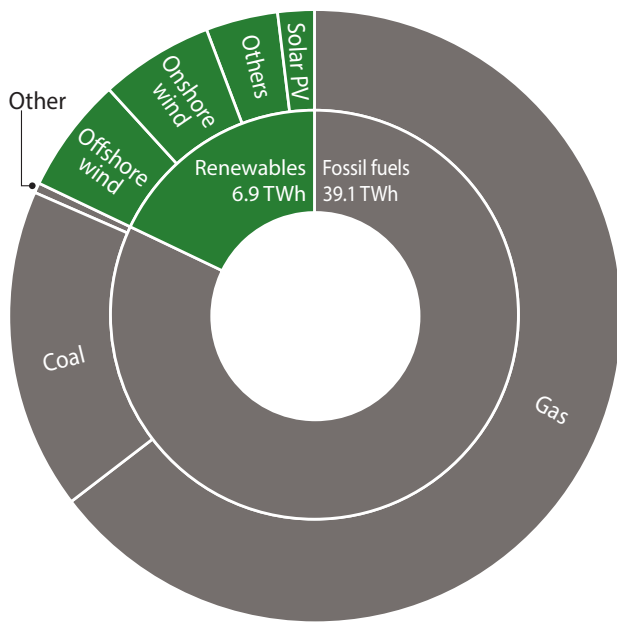
Technologies analysed

- Renewable electricity and heat technologies.
- Nuclear power stations.
- Electricity storage technologies.
- Fossil fuel electricity generation (coal power stations, closed and open cycle gas turbines, reciprocating engines, diesel generators and combined heat and power plants).

Electricity generation in Wales

Wales is a part of an interconnected European electricity network, with flows into and out of the country. The country generated an estimated 38.8 TWh of electricity in 2016 and consumed approximately 16.1 TWh*. Wales is, therefore, a net exporter of electricity.

Wales' electricity generation

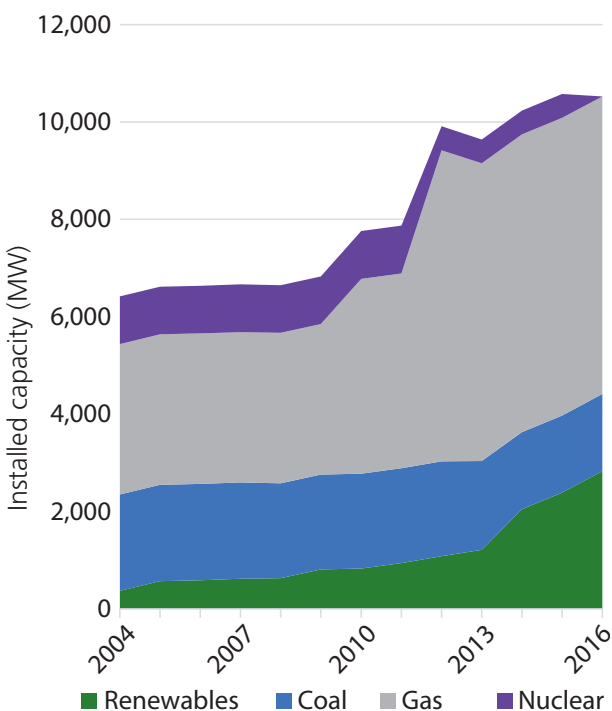


Of the estimated 38.8 TWh of electricity that was generated in Wales in 2016, 6.9 TWh was from renewables. Electricity generation from renewables has grown rapidly in recent years, having doubled in the last five years.

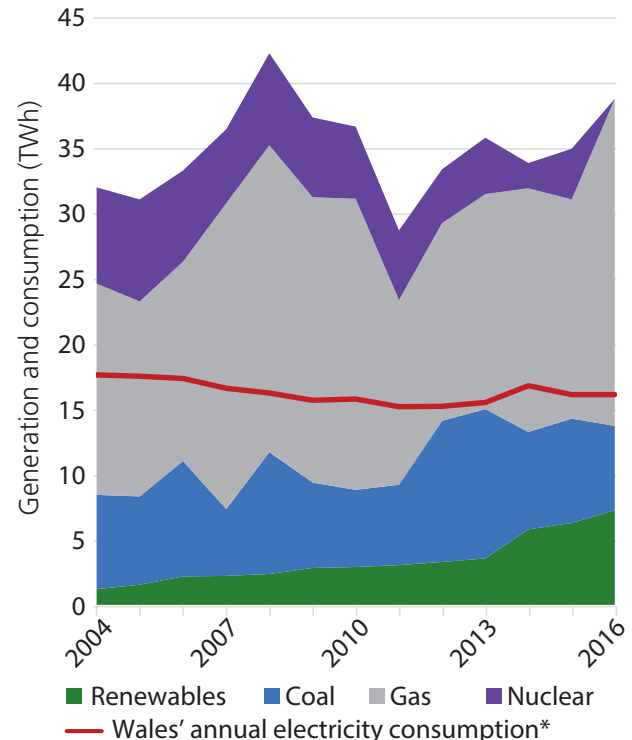
The remaining 31.9 TWh of generation was from fossil fuels. Six Combined Cycle Gas Turbines (CCGT) plants and one coal power station provide 95 per cent of fossil fuel electricity generation.

Storage capacity is dominated by two large pumped hydro projects in North Wales, which can store over 2 GW of electricity generating capacity.

Electricity capacity trends



Electricity generation trends



* 2016 BEIS sub-national consumption data is not yet available. It is assumed there is no change from the 2015 data.

Electricity generation in Wales

- Wales uses around 93.5 TWh of energy per year – a figure that has reduced by 14 per cent since 2005.
- Electricity consumption accounts for approximately 16.1 TWh of total energy consumption, with the rest being used for heat and transport.
- 6.9 TWh of electricity consumption is met by renewable generation.
- Including fossil fuel generation, Wales generates an estimated 38.8 TWh of electricity and is, therefore, a significant net exporter of electricity.
- Wylfa nuclear power station, on the Isle of Anglesey, stopped generating in 2015 after 50 years of operation. There are now no nuclear power stations currently generating in Wales.

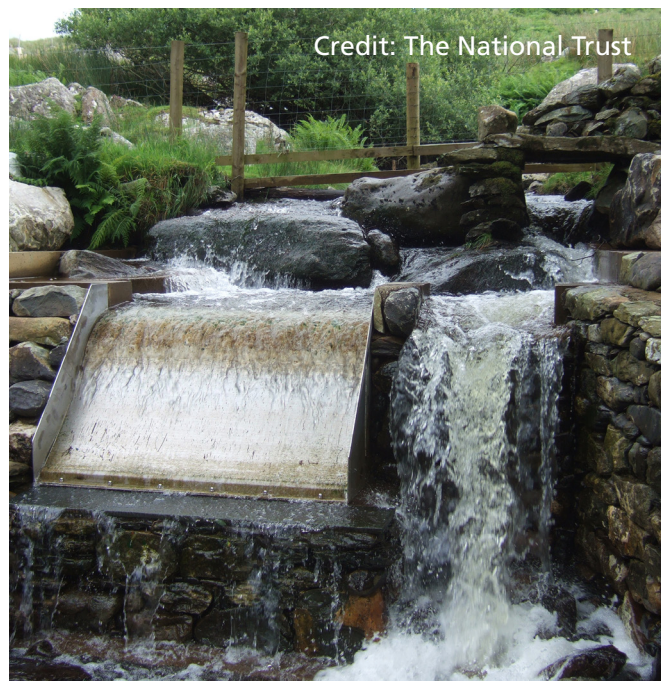
Key points on renewable generation in 2015 and 2016

- Gywnt y Mor offshore wind farm off the North Wales coast was commissioned in 2015, adding 576 MW of capacity.
- Onshore wind capacity increased to 920 MW, including the largest onshore wind farm in England and Wales, the 228 MW Pen y Cymoedd wind farm.
- Wales is home to the UK's largest solar PV project, Shotwick Park, at 72.2 MW.
- Anaerobic digestion has jumped from 15 to 53 projects in the last two years.

If you're unsure of any units or abbreviations used in this report, refer to the Abbreviations page at the back of the report - page 42.

Technologies	Number of projects	Electricity	
		Capacity (MW)	Estimated generation (GWh)
Renewables ⁺	67,021	2,853.7	6,890
Coal	1	1,586.0	6,633
Diesel	10	202.0	119
Gas	61	6,143.0	25,140
Fossil fuels total	72	7,930.9	31,892
Battery storage	50	0.5	-
Pumped hydro	2	2,088	-
Storage	52	2,088.5	-

⁺ See page 6 for more detail



Case study: Berthen Hydro

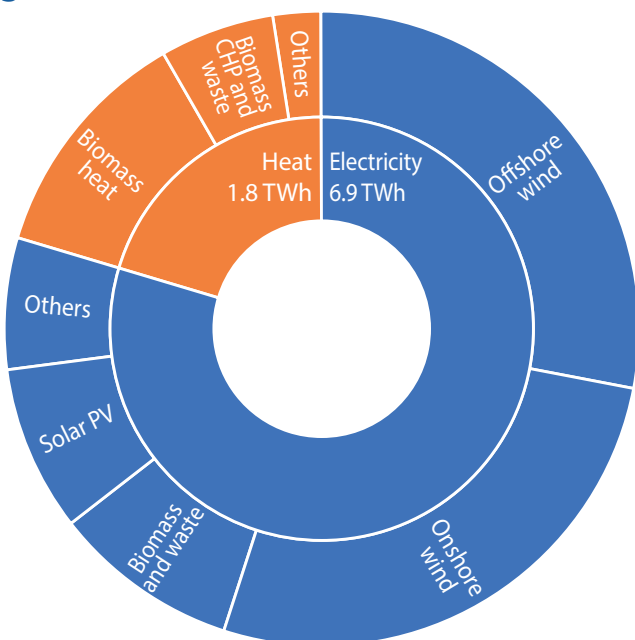
The National Trust's 100 kW Berthen Hydro on the Afon Berthen has been supplying energy to 100 households in the town of Bethesda in an "Energy Local Club". The trial uses price signals and communications to encourage householders to shift electricity usage to periods when the hydropower plant is generating, with resulting average bill savings of around 30 per cent. In 2018, there are plans to bring a second hydropower plant, Ynni Ogwen, into the Club and to double the number of households involved.

Renewable energy in Wales

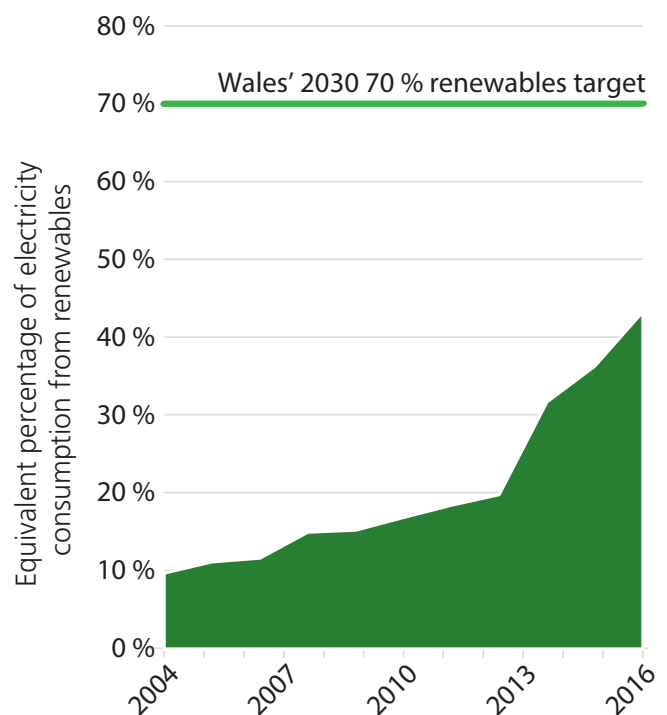
In 2017, the Welsh Government announced a target of meeting 70 per cent of electricity demand from Welsh renewable sources by 2030. Wales has made good progress towards meeting this target, with an estimated 43 per cent* of electricity consumption in Wales met by renewable generation in 2016. However, significant network, market and policy challenges remain in closing the gap to the 70 per cent target.

Wales also produces approximately 1.8 TWh of useable renewable heat, equivalent to 6 per cent of current gas consumption. Much of this is generated from projects using biomass as fuel.

Renewable electricity and heat generation



Growth in the percentage of electricity from renewable sources in Wales



Renewable electricity in Wales

- Approximately 17.7 per cent of total electricity generated in Wales is from renewables. This generation is the equivalent of 43 per cent of electricity consumed in Wales annually.
- Approximately 69 per cent of renewable electricity generated in Wales comes from wind, with 35 per cent from offshore wind and 34 per cent from onshore wind.
- There was 2,854 MW of renewable electricity capacity in 2016.
- Whilst solar PV makes up 30 per cent of installed renewable capacity, its lower capacity factor means that solar PV provides 11 per cent of renewable electricity generation.

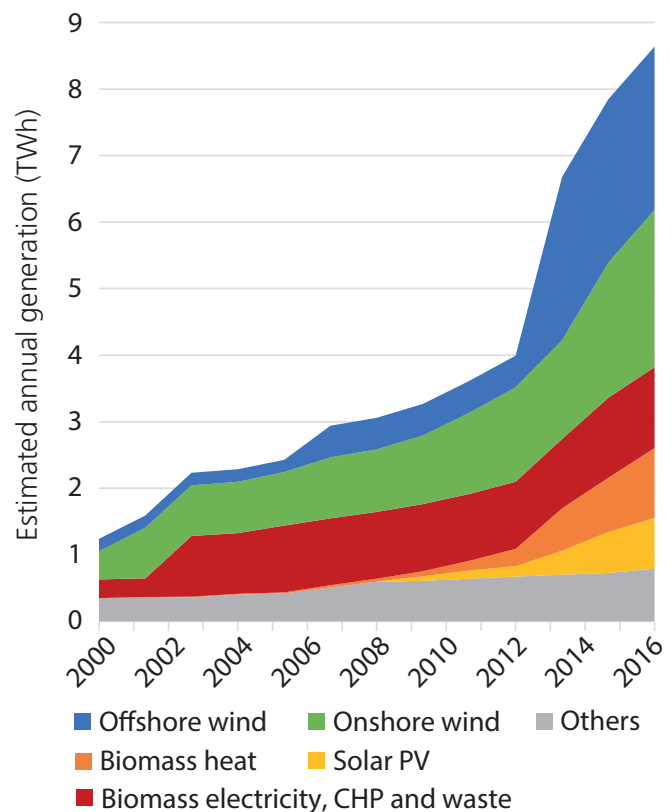
* 2016 BEIS sub-national consumption data is not yet available. It is assumed there is no change from the 2015 data.

Renewable energy technologies	Number of projects	Electricity		Heat		CO ₂ savings (kilotonnes CO ₂)
		Capacity (MW)	Estimated generation (GWh)	Capacity (MW)	Estimated generation (GWh)	
AD	53	15.0	79	8.7	53	44
Biomass	2,958	0.1	1	338.7	1,038	251
Biomass electricity, CHP and waste	24	137.2	824	91.3	504	450
Heat pumps	3,760	-	-	40.9	79	22
Hydropower	276	163.2	300	-	-	124
Landfill gas	23	32.6	162	-	-	67
Offshore wind	3	726.0	2,419	-	-	997
Onshore wind	867	920.2	2,331	-	-	961
Sewage gas	9	9.8	37	11.8	73	31
Solar PV	54,575	849.7	759	-	-	313
Solar thermal	4,473	-	-	12.3	8	2
Total	67,021	2,854	6,912	504	1,755	3,260

Renewable heat in Wales

- There was 504 MW of renewable heat capacity in 2016.
- Biomass made up 67 per cent of 2016 renewable heat capacity.
- Biomass saw the largest increase in renewable heat capacity in 2015 and 2016, an additional 133 MW of capacity installed through nearly 1,000 projects.
- Heat pump capacity and project numbers also increased consistently in this time, adding 13 MW from over 1,100 installations.
- The installation rate of solar thermal projects has continued to slow in 2015 and 2016.
- The number of anaerobic digestion projects with thermal generation has increased by over 50 per cent.

Renewable energy generation



The local picture

There has been an increase in the number of renewable energy projects and renewable capacity in every local authority area in 2015 and 2016. Powys, Carmarthenshire, Pembrokeshire and Flintshire have each added over 1,000 renewable energy projects since 2014. Powys, which covers 25 per cent of the area of Wales, has the highest installed renewable heat capacity at 115 MWth, and the highest total number of renewable projects with over 6,000, around 10 per cent of the total.

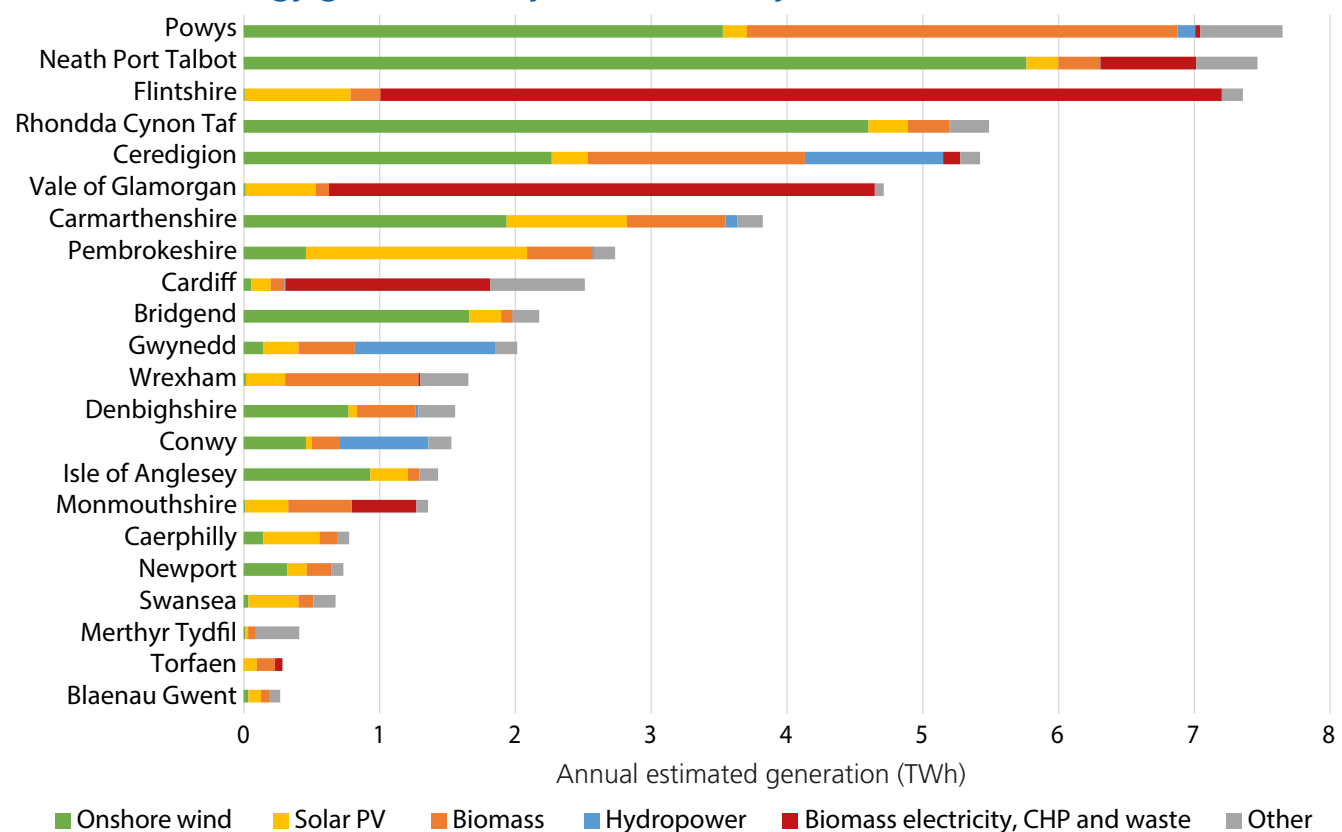
Top five local authorities by percentage of electricity consumption met by renewables

Local authority	Renewable electricity capacity	Per cent
Vale of Glamorgan	114.7	86 %
Ceredigion	185.3	79 %
Rhondda Cynon Taf	205.7	60 %
Powys	183.6	55 %
Neath Port Talbot	250.6	44 %

Powys has the highest combined renewable electricity and heat capacity at 299 MW, one of seven local authority areas with a total of over 200 MW.

The Vale of Glamorgan is the local authority that produces the most renewable electricity as a percentage of that consumed within the area, due in large part to the co-firing of biomass with coal at Aberthaw power station.

Renewable energy generation by local authority



Local authority electricity and renewable heat generation totals	Renewable heat and electricity				Fossil fuel electricity		
	Number of projects	Total capacity (MW)	Estimated generation (GWh)	CO ₂ savings (tonnes CO ₂)	Number of projects	Electrical capacity (MWe)	Estimated generation (GWh)*
Blaenau Gwent	1,021	16.0	27	10	2	32.0	-
Bridgend	2,539	104.5	219	89	4	25.2	-
Caerphilly	2,965	59.5	78	30	1	0.1	-
Cardiff	3,494	66.8	253	95	2	10.0	-
Carmarthenshire	5,266	218.0	384	145	1	10.0	-
Ceredigion	3,208	243.2	545	195	2	10.3	-
Conwy	1,799	71.8	154	59	3	2.0	-
Denbighshire	2,229	62.4	157	53	2	1.2	-
Flintshire	3,386	214.6	740	204	3	1,900.5	-
Gwynedd	3,009	111.3	203	75	1	0.1	-
Isle of Anglesey	2,173	78.5	144	57	1	0.1	-
Merthyr Tydfil	734	11.4	41	16	2	41.8	-
Monmouthshire	4,077	64.6	136	47	1	0.0	-
Neath Port Talbot	1,864	264.5	751	300	6	598.5	-
Newport	2,201	37.9	74	27	5	904.7	-
Pembrokeshire	4,703	225.4	275	104	5	2,330.5	-
Powys	6,222	298.9	769	257	4	0.7	-
Rhondda Cynon Taf	3,944	219.7	552	220	8	71.9	-
Swansea	3,097	51.4	68	25	2	44.4	-
Torfaen	2,054	16.8	29	9	2	0.4	-
Vale of Glamorgan	2,172	118.7	478	195	5	1,892.0	-
Wrexham	4,815	73.8	166	50	5	24.5	-
Offshore	3	726.0	2,419	997	-	-	-
Unknown	46	1.8	4	1	5	30	-
Total	67,021	3,357	8,667	3,260	72	7,931	31,892

* Not disclosed due to local authority specific data not being consistently available

Ceredigion was the authority with the greatest increase in renewable heat capacity in 2015 and 2016, due to the commissioning of two large biomass projects, registered under the Renewable Heat Incentive (RHI).

Neath Port Talbot has the highest renewable electricity capacity with nearly 251 MWe. The area also saw the highest growth since 2014, with 167 MWe of new electrical capacity, predominantly due to the commissioning of the Pen y Cymoedd wind farm, which it shares with Rhondda Cynon Taf.

Top five local authorities for domestic RHI installations

Local authority	Number of domestic RHI installations	Percentage of houses in local authority with RHI installation
Ceredigion	354	1.13 %
Powys	635	1.07 %
Carmarthenshire	514	0.64 %
Pembrokeshire	338	0.62 %
Denbighshire	239	0.58 %

Locally owned renewable energy

In 2017, the Welsh Government announced a target for 1 GW of renewable electricity generation capacity to be locally owned by 2030 and for all renewable energy projects to have an element of local ownership by 2020.

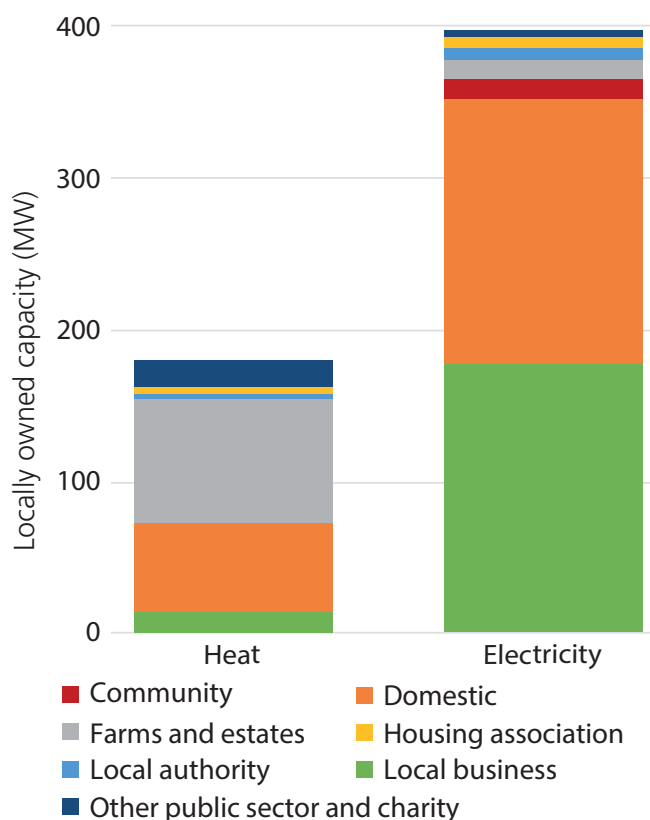
By December 2016, 575 MW of locally owned renewable energy capacity had been installed across Wales, made up of 397 MW of electricity and 177 MW of heat. This is a 40 per cent increase since 2014. Domestic installations saw the most significant capacity growth, with a 74 MW increase on 2014 totals.

Locally owned capacity makes up 5 per cent of the total capacity for all generation projects in Wales and 17 per cent of all renewable energy capacity.

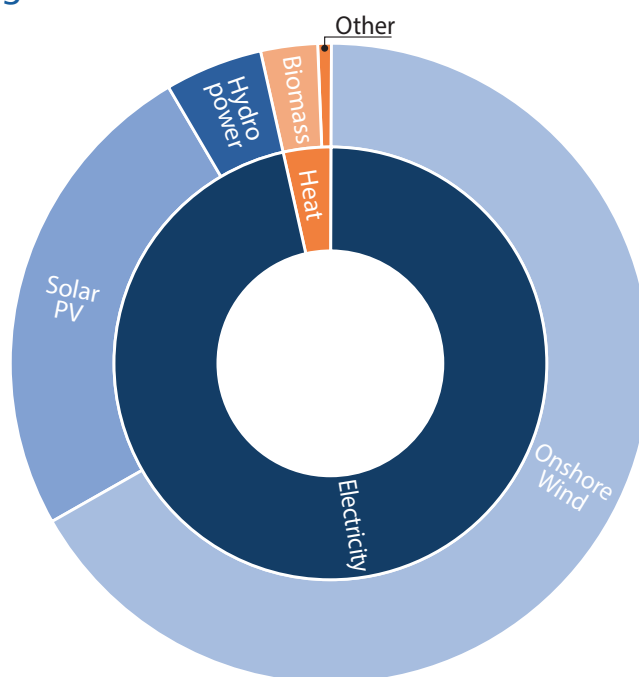
In total, there are 62,420 locally owned projects, 93 per cent of all renewable energy installations. 54,908 projects are domestic installations, of which the majority are solar PV installations.

Measured by capacity: 41 per cent (233 MW) is under domestic ownership; 33 per cent (191 MW) is owned by local businesses and 16 per cent (93 MW) is owned by farms and estates. In the case of farms and estates this is largely renewable heat capacity with 489 biomass schemes and 37 anaerobic digestion plants.

Locally owned renewable electricity and heat capacity by type



Community renewable energy generation



Definition of ownership

The definition for 'locally owned' covers projects owned by households, communities, local authorities, housing associations, other public sector bodies, charities (including faith organisations), further education establishments, local businesses (registered in Wales) and Welsh farms and estates. This definition is comparable to the Energy Saving Trust's report on community and locally owned renewable energy in Scotland, with the addition of domestic projects to the overall local ownership total. The figures are likely to be an underestimate, particularly for projects owned by businesses based in Wales, due to limitations in the source data.

Ownership category	Total capacity (MW)	Capacity (MWe)	Capacity (MWth)	Number of Projects	Estimated generation (MWh)
Community	13.4	13.1	0.3	141	22
Domestic	232.8	174.5	58.3	54,908	299
Farms and Estates	93	12.5	80.6	666	322
Housing Association	11.6	7	4.6	5,655	11
Local Authority	11.7	8.5	3.2	299	33
Local Business	190.7	177.4	13.3	345	520
Other public sector and charity	21.4	4.4	17	406	56
Total	575.7	397.4	177.3	62,420	1,262

Community

Community renewable energy projects reached 141 installations by December 2016, totalling 13.4 MW. This has increased by 11.7 MW from 2014 totals. Annual generation totalled 22,366 MWh, with renewable electricity generation from onshore wind and solar PV contributing 92 per cent. Awel Aman Tawe's 4.7 MW community owned wind farm in the Swansea Valley is not included in the data as it was commissioned in January 2017.

Fossil fuels

The ownership of fossil fuel projects has not been fully assessed, in particular because data on the ownership of small scale fossil fuel generators is not readily available. However, it is worth noting that at least 80 percent of all fossil fuel capacity in Wales is not locally owned.



Credit: Carmarthenshire Energy

Case study: Carmarthenshire Energy

In 2016, Carmarthenshire Energy successfully installed a 500 kW wind turbine in Salem. This is one of largest community owned renewable energy installations in Wales. A 10 kW rooftop solar PV installation and 5 kWh battery storage scheme have also been completed at the Salem Community Hall.

Alongside support from the Welsh Government, Carmarthenshire Energy raised over £1m towards the cost of these projects through community share offers.

Low carbon technologies

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Anaerobic digestion

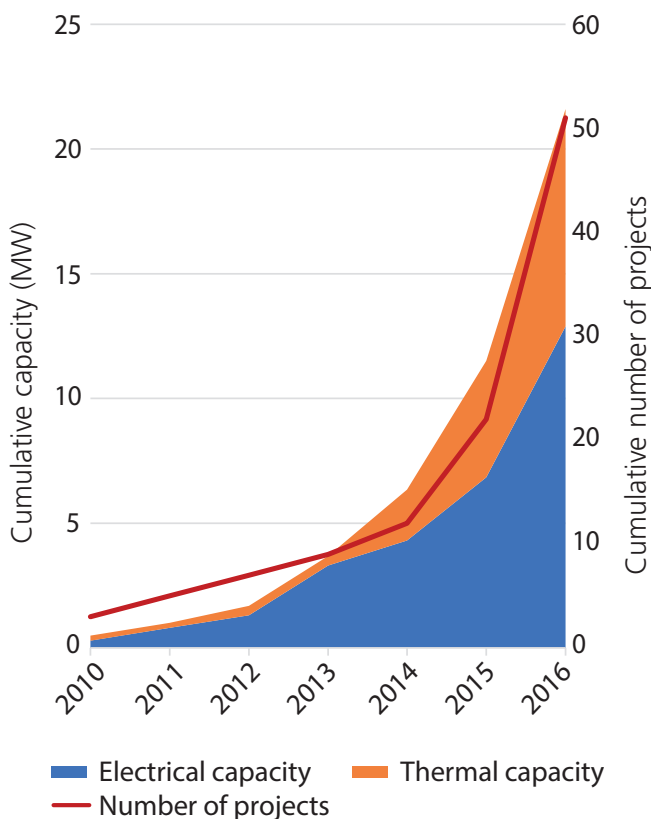
There is nearly 24 MW of anaerobic digestion (AD) capacity in Wales from 53 projects, a significant increase since 2014. Two thirds of the capacity is electrical (15.0 MWe) and one third (8.7 MWth) is thermal.

Analysis

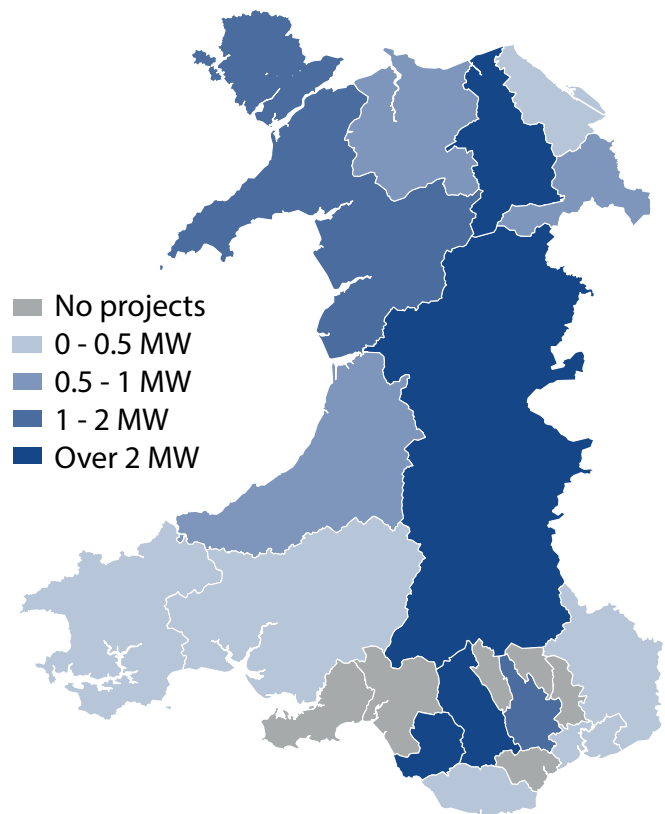
At the end of 2014, there was a total of 15 AD projects in eight local authorities. At the end of 2016, there were 53 plants, distributed across nearly all local authority areas. Growth accelerated in 2015, with nine projects commissioned and a further 29 projects commissioned in 2016. Thermal capacity has increased significantly as a proportion of total AD capacity since 2015, with subsidies favouring heat production over electricity. Of the 29 projects added in 2016, 26 had thermal generation registered under the RHI.

Most of the remaining projects commissioned in 2016 were large food waste plants, which added 5.8 MW of electricity capacity. One of these is the largest AD plant in Wales, Stormy Down in Bridgend, which was commissioned in January 2016 with an electricity capacity of 3.2 MWe. To date, apart from one project in the sewage gas sector (see page 27), there are no projects in Wales producing biomethane for the gas grid or transport.

AD deployment over time



Geographic distribution of AD



Future

Small and farm scale AD has significant potential in Wales due to the availability of suitable waste resources and on farm sites. However, subsidies have been reduced for AD, as deployment has triggered depressions in both the FIT and RHI. Although the UK government plans to reset the RHI tariff for AD for heat and biomethane production, AD developers argue that the proposed reset will still result in a tariff below what is needed to unlock projects. Continued deployment of small scale AD will be dependent on subsidies being sufficiently high; as unlike solar PV, there are no expected significant cost reductions or innovations that would make it widely viable without subsidy or with a low subsidy in the near term.

Deployment of larger scale AD has greater potential to be viable at lower subsidy rates. Large scale AD has the potential both to access a number of waste sources and to benefit from a range of value streams, including producing electricity and heat, processing waste, providing balancing services for the network, or exporting green gas for heat or transport. Projects producing biomethane for injection to the gas grid or transport fuels are expected to be a growth area in the near future.



Case study: Bryn Group AD

The Bryn Group in Caerphilly, South Wales commissioned a 1.4 MWe AD plant in 2016. This AD plant is located on a dairy farm that also provides quarrying, recycling and waste management services to the local area. Having previously composted waste, their new AD unit mixes food waste and farm slurry to export electricity to the grid and produce fertiliser digestate.

Biomass heat

There is 339 MWth of capacity from 2,958 biomass heat projects in Wales, which is capable of meeting the equivalent heat demand of nearly 85,000 Welsh households. Biomass deployment grew rapidly in 2015, with 763 new projects adding over a third of the total capacity. However, 2016 saw lower growth with only 200 new projects.

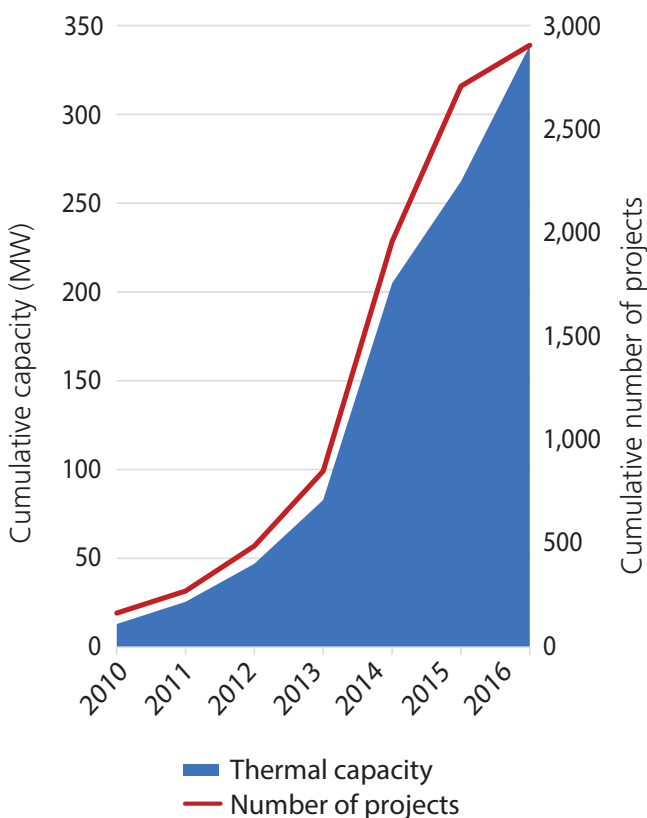
Analysis

Since 2014, the number of large biomass projects (over 1 MW) has doubled to eight, with a further 17 new projects just under 1 MW. The majority of these were installed in 2016. Over a quarter of all biomass projects in Wales are over 100 kW in capacity and this scale of boiler represents over three quarters of the installed capacity. The largest project installed since 2014 is a 20 MW industrial plant in Ceredigion.

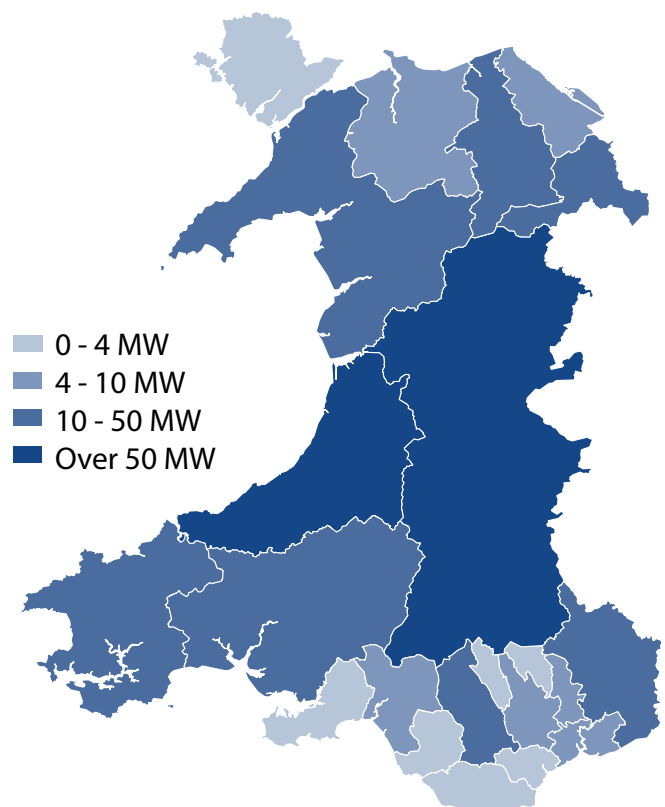
Small scale deployment (up to 20 kW) remains limited, with approximately 400 installations in total in Wales. Just under a third of these were commissioned in 2015. However, growth dropped in 2016, when only 27 small scale boilers were commissioned, in response to RHI reductions.

Deployment is highest in areas with the greatest proportion of off gas buildings. Powys has the highest number of projects and greatest installed capacity with 849 projects, totalling 104 MW.

Biomass heat deployment over time



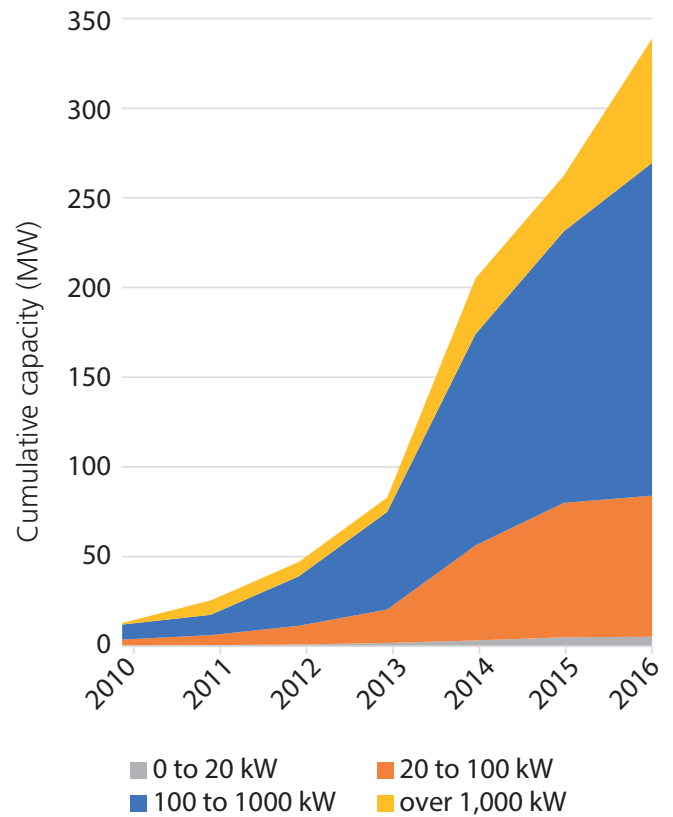
Geographic distribution of biomass



Future

The decarbonisation of heat remains a Welsh and UK government priority. There can be sustainability challenges with sourcing large quantities of biomass, with carbon savings depending partially on the distance the fuel is transported. However, there is a potential long-term role for small scale biomass projects or CHP fuelled district heating where sustainable feedstocks or waste biomass can be sourced locally. The UK government perceives biomass as a transition technology in advance of the electrification of heat and as a result it continues to offer subsidy support under the RHI, provided sustainability criteria are met. However, cuts to the available subsidy have significantly reduced current deployment rates, particularly affecting smaller scale projects.

Biomass heat deployment by scale



Case study: Portmeirion district heat

A 1 MW rated district biomass heat network based in the village of Portmeirion, Gwynedd, was installed and completed in 2016.

The woodchip boilers help supply heating to houses, hotels, and shops as well as Castell Deudraeth and the village swimming pool. The district heating network required 3.5 km of trenching within the popular tourist village.

Biomass electricity, CHP and waste

In Wales, there are 24 projects within the biomass electricity, CHP and waste category, with a total capacity of 137 MWe and 91 MWth. 14 of these projects were installed since 2014, the majority of which were small scale biomass projects, as well as the 30 MWe Cardiff energy from waste plant. This sector generates around 1,328 GWh.

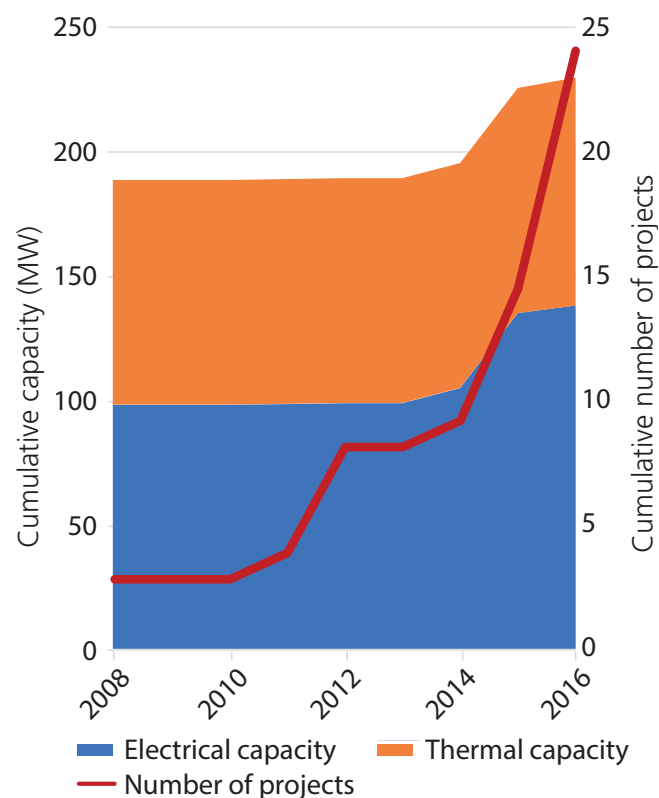
Technologies within this category include electricity generation from biomass, biomass CHP plants, biomass gasification plants, the co-firing of biomass at coal fired power stations and energy from waste plants.

Analysis

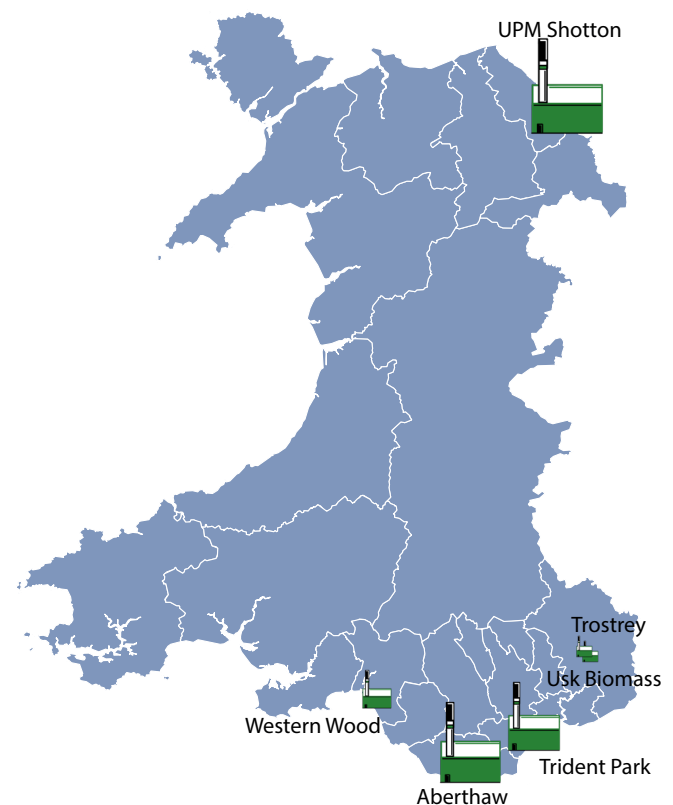
There are 22 biomass CHP, biomass electricity or biomass gasification plants. This includes the 25 MWe, 90 MWth CHP plant at Shotton Paper Mill, which uses its own waste processed into pellets to fuel the plant. There is an estimated 55 MW of capacity at the Aberthaw power station that is fuelled by co-fired biomass.

There is currently one energy from waste plant in Wales. At 30 MWe export capacity, the Cardiff Trident Park facility has been operational since 2015 and handles 350,000 tonnes of non-recyclable waste per year, diverting 95 per cent of South Wales' residual waste away from landfill.

Biomass electricity, CHP and waste deployment over time



Geographic distribution of biomass electricity, CHP and waste projects



Over half of the waste, 172,000 tonnes, comes from five councils that make up the Project Green (Prosiect Gwyrdd) partnership: Cardiff, Newport, Monmouthshire, Vale of Glamorgan and Caerphilly with the remainder coming from businesses.



Case study: Cardiff Energy Recovery Facility

At 30 MW, this is the largest energy recovery facility in Wales treating waste from local authority and local business contracts. The facility handles 350,000 tonnes of waste per year, (plus 75,000 tonnes under newly acquired planning permission) which cannot be practically recycled or composted per year. The site diverts 95 per cent of South Wales' residual waste away from landfill.

Future

There continues to be questions about the sustainability of sourcing and using biomass in large scale electricity production and co-firing of biomass at Aberthaw is expected to conclude in 2017.

Biomass CHP can provide efficient onsite energy production where there is sufficient heat requirement. Growth is likely to continue at a similar pace as industrial users recognise the opportunity of using their own waste as an energy resource, as is the case at Shotton Paper Mill's CHP plant.

There is significant debate about the future availability of the waste resource for UK energy production, particularly with the over-capacity already in EU plants providing a viable export option. Despite this, there are two further large-scale incineration projects in the pipeline in Wales. Wheelabrator Parc Adfer is under construction and will be a 16.6 MWe export facility in Flintshire. A planning application is being prepared for Buttington Quarry energy recovery facility in Powys, a proposed 9 MWe project.

To date, few advanced thermal treatment projects have been successful in the UK, with technology issues causing financial failures. However, if the technology develops, advanced thermal treatment offers significant potential for smaller scale plants that process commercial waste or fill in gaps between areas served by large scale plants.

An advanced thermal treatment of waste site is under construction in Hirwaun, near Aberdare, which will process around 10 per cent of the waste that arises in South East Wales. The developer Enviroparks was the only Welsh company to receive a Contract for Difference agreement from the UK government in March 2015; the contract is worth £150m. The project completed phase 1 in 2016 and is now in phase 2 of construction. There are also plans by CoGen and Lockheed Martin for a 15 MW gasification plant in the Cardiff area, with construction planned for 2018.

Heat pumps

Wales has approximately 41 MWth of air, ground and water heat pump capacity in 3,760 installations. They currently deliver the equivalent heat for approximately 0.5 per cent of Welsh homes.

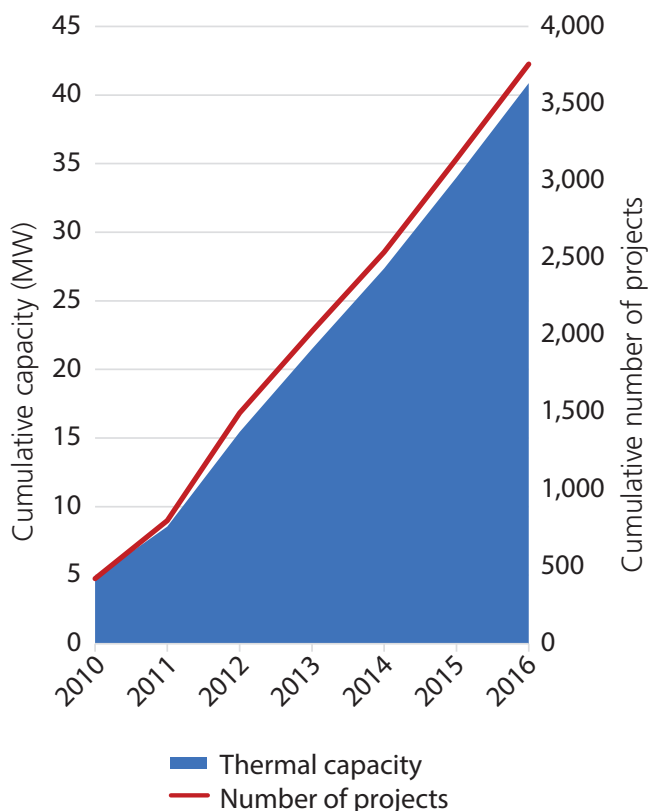
Analysis

Heat pump installations have experienced a steady increase since 2010 of between 500 and 700 installations per year, with an average size of 10 kW.

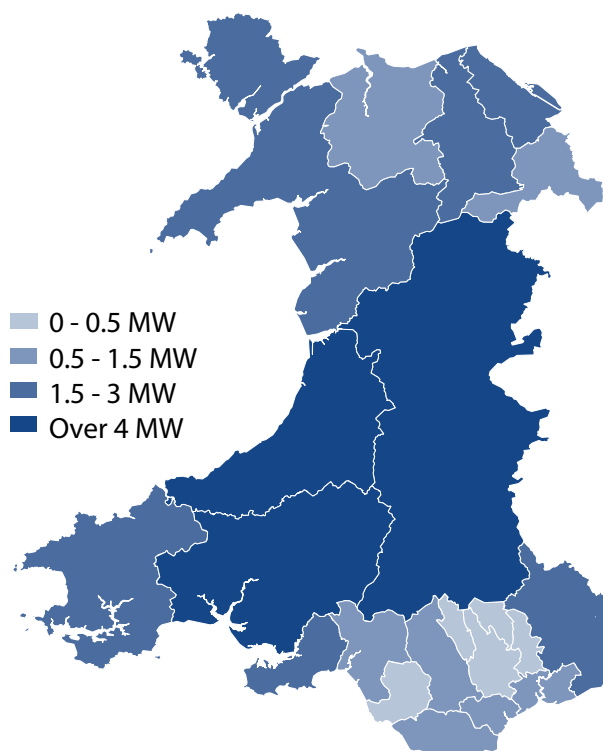
65 per cent of the installations are air source heat pumps and the rest are predominantly ground source. There are only a few water source projects in Wales. 93 per cent of the installations are small scale (less than 20 kW) with the vast majority of these serving domestic properties. Only five projects are above 100 kW. The largest project installed since 2014 is a 260 kW ground source heat pump on a farm in Denbighshire.

It is estimated that 80 per cent of all heat pump installations are associated with off-gas properties. Deployment is, therefore, highest in local authority areas with the largest off-gas areas. Powys has the highest number of installations, with 625 heat pumps providing 6.2 MWth and are installed in 1.1 per cent of homes. Carmarthenshire and Ceredigion have the next highest with 350 and 463 respectively, providing 4.4 and 4.2 MWth. Carmarthenshire has some larger scale heat pump projects, including a water source heat pump in the National Botanic Garden of Wales.

Heat pump deployment over time



Geographic distribution of heat pumps

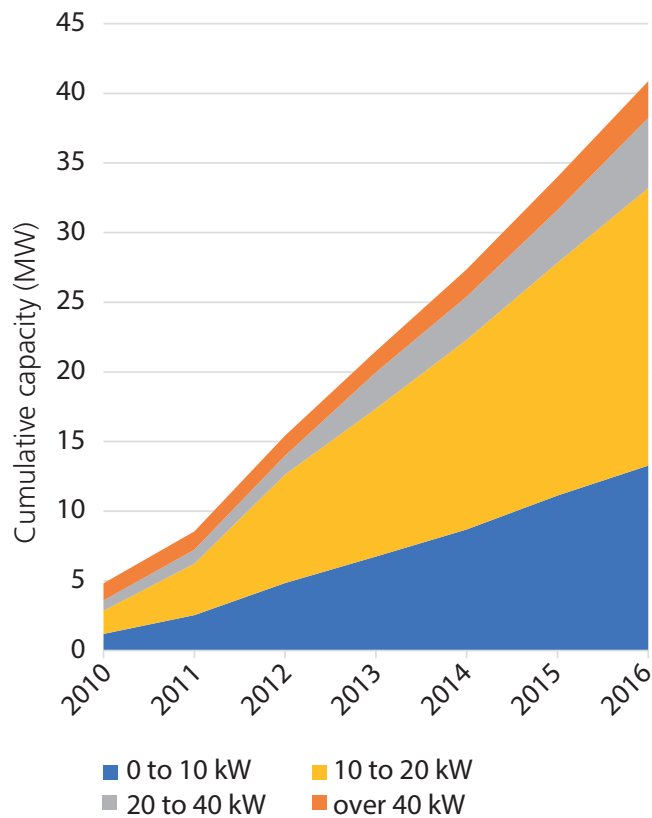


Future

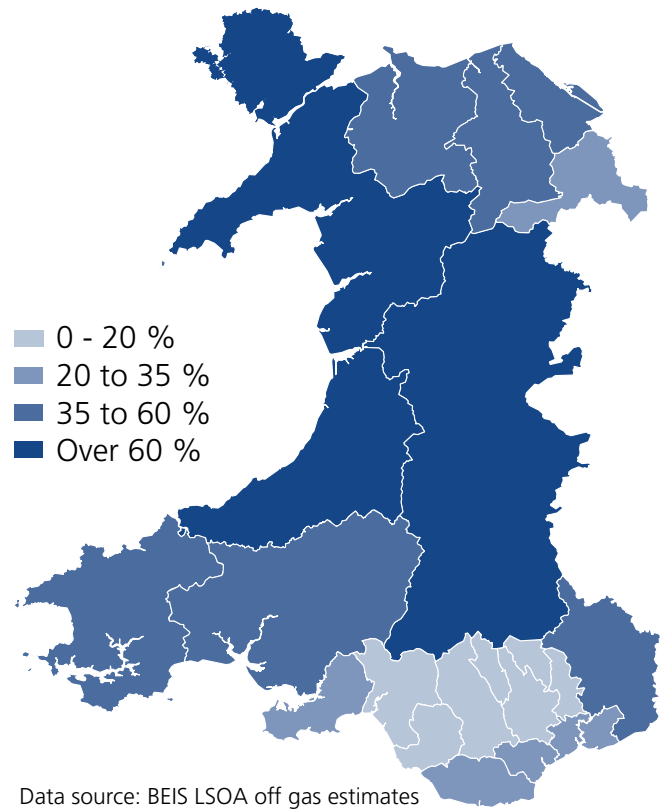
With a high proportion of off-gas properties, Wales has a significant potential for heat pump deployment. However, installation in existing properties can be costly even in off-gas grid areas and disruptive for householders. Heat pumps are also most effective in energy efficient homes and can be unsuitable in poorly insulated houses.

The uplifted tariffs for the RHI implemented in September 2017 should increase uptake, particularly for air-source heat pumps, for which tariffs increased from 7.63 p/kWh to 10.18 p/kWh. However, the changes also impose heat demand limits that restrict RHI payments for larger schemes and are likely, therefore, to affect commercial scale projects.

Heat pumps deployment by scale



Off-gas households in Wales



Hydropower

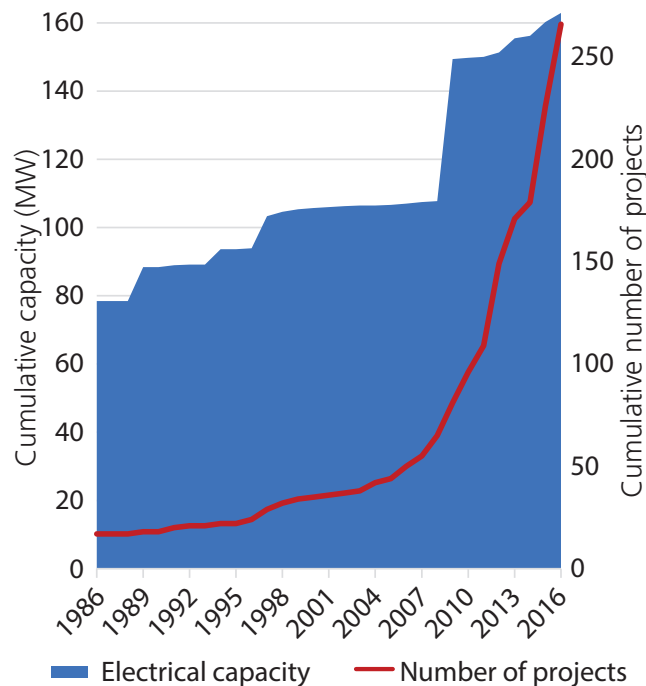
There is 163 MW of installed hydropower in Wales from 275 projects. Generating around 300 GWh annually, hydropower represents 4 per cent of all renewable electricity generation in Wales.

Analysis

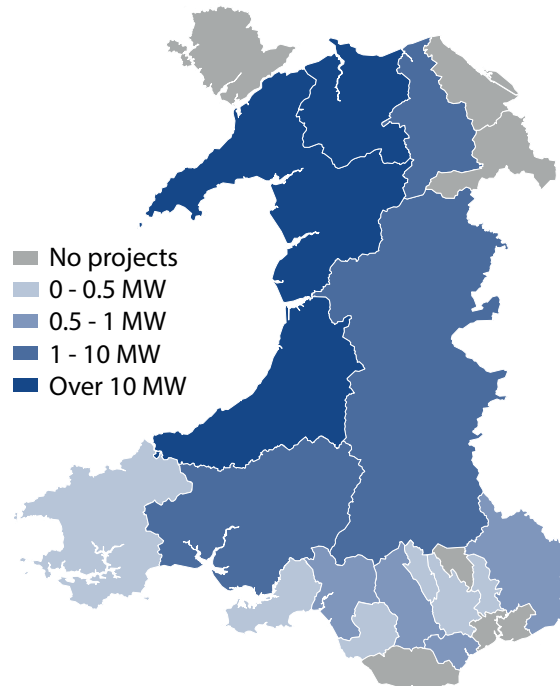
Nearly half of all hydropower capacity in Wales was installed before the 1970s. Of the capacity added since 2000, the 41 MW Rheidol Power Station was commissioned in 2009 and the remaining 23 MW has been installed through numerous small projects less than 1 MW.

The number of new projects installed has fallen as FIT subsidies were cut in 2015/16. In 2015, there were 41 new hydropower projects commissioned under 100 kW and 35 in 2016.

Deployment of hydropower over time



Geographic distribution of hydropower



Future

Hydropower is a well established renewable technology providing a predictable source of energy. There are many potential sites in Wales, particularly in North Wales. Those already developed are often community or land owner led developments, where good site conditions are aligned with an owner who is keen and has the necessary finances.

Natural Resources Wales, who are responsible for the management of water in Wales, have seen a significant drop in abstraction licence applications.

See page 35 for information on pumped hydropower storage in Wales.

Landfill gas

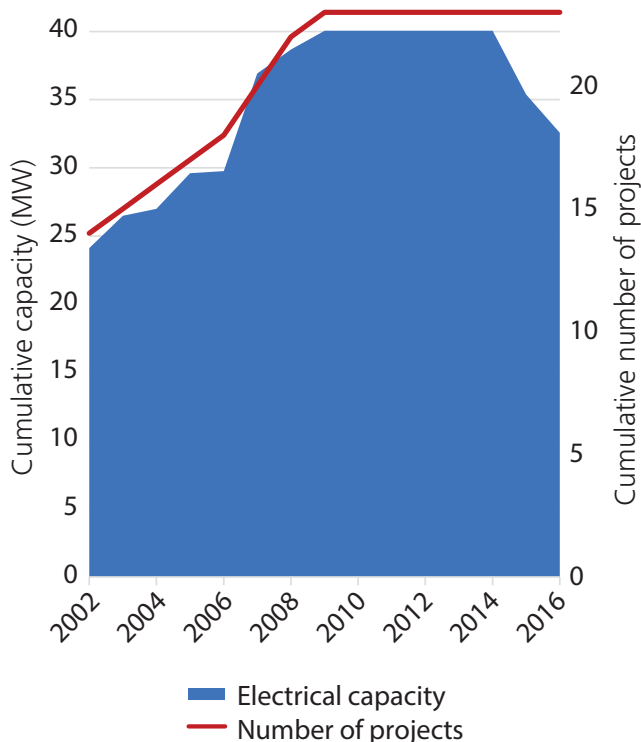
There is 32.6 MW of capacity from 23 landfill gas projects in Wales, generating electricity for nearly 40,000 Welsh households. This capacity has declined from a peak of around 40 MW in 2014, as waste is diverted to other waste management processes and existing deposited waste degases. The number of projects has not changed since 2009.

Analysis

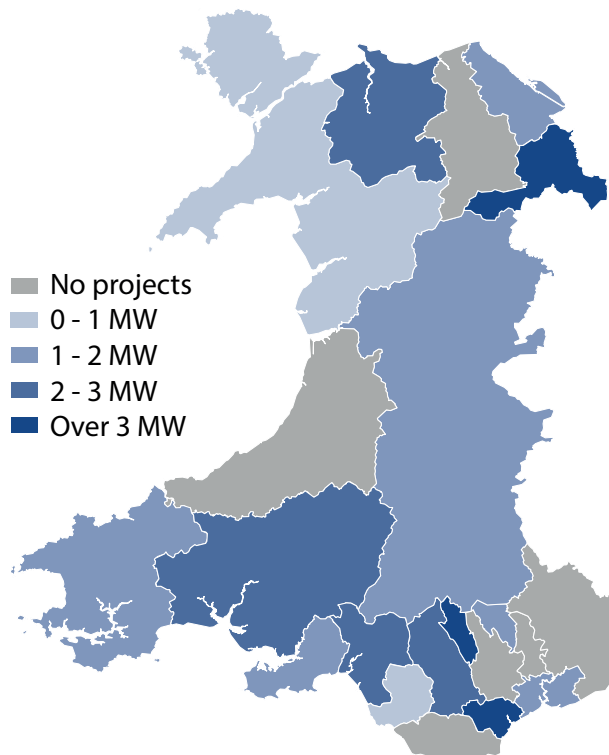
Landfill gas output grew consistently between 1994 and 2009 as landfill sites captured value by generating electricity from the gas produced by the deposited waste. Landfill gas capture continues to be a useful method to divert methane, a greenhouse gas that is significantly more potent than carbon dioxide, from entering the atmosphere.

Landfill gas projects are spread fairly evenly across Wales with one or two projects in most areas. Only Wrexham has more than this with three projects. Project sizes are small and vary from around 200 kW up to approximately 3 MW. Merthyr Tydfil currently has the highest capacity with over 6 MW from its two project sites.

Deployment of landfill gas over time



Geographic distribution of landfill gas



Future

Landfill gas will play a decreasing role in energy generation as landfill sites close, and waste is increasingly diverted to material recovery and energy from waste plants. However, in the near term, gas will continue to be produced from existing waste deposits and generators will be moved around within sites leading to variations in year-on-year production.

Nuclear

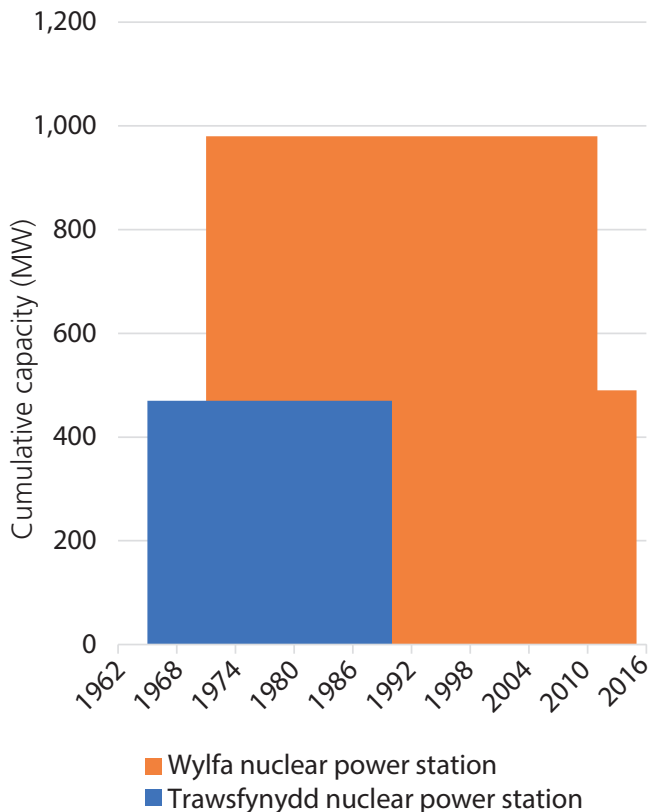
Wales currently has no nuclear generation. The last operational reactor at the Wylfa nuclear power station on the Isle of Anglesey stopped generating in 2015 after 50 years of operation.

Analysis and future

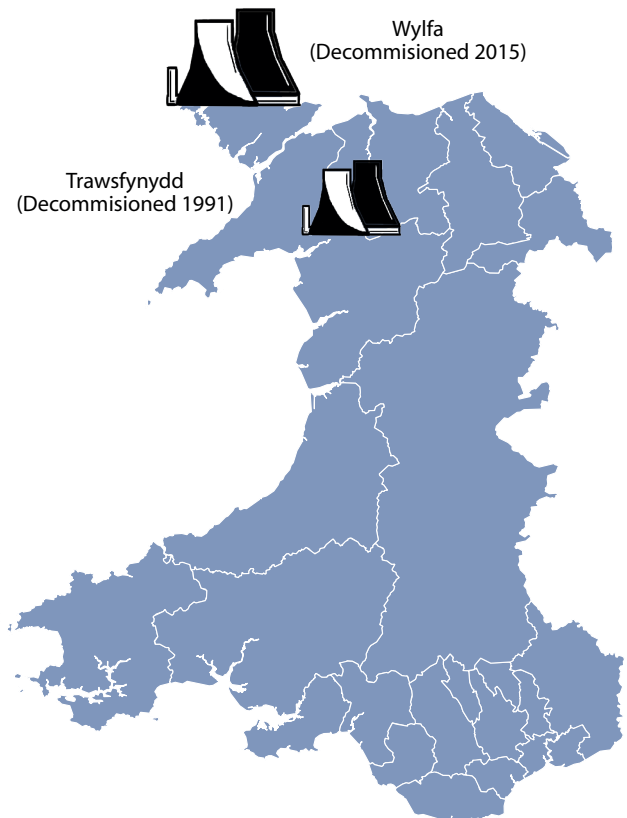
Planning for a new nuclear station at Wylfa by Horizon Nuclear is in advanced stages and it is expected that a Development Consent Order application will be submitted by the end of 2017.

Horizon hopes to start generating power at the 2.7 GW double reactor site by 2025. However, the project relies upon reaching an acceptable strike price for the electricity generated with the UK government. There is pressure to agree a price well below that of Hinkley Point C's £92.50 per MWh. Further pressure will have been added by the offshore wind winning bids in the 2017 Contracts for Difference auction that achieved a price of £57.50 per MWh.

Deployment of nuclear over time



Geographic distribution of nuclear



Offshore wind

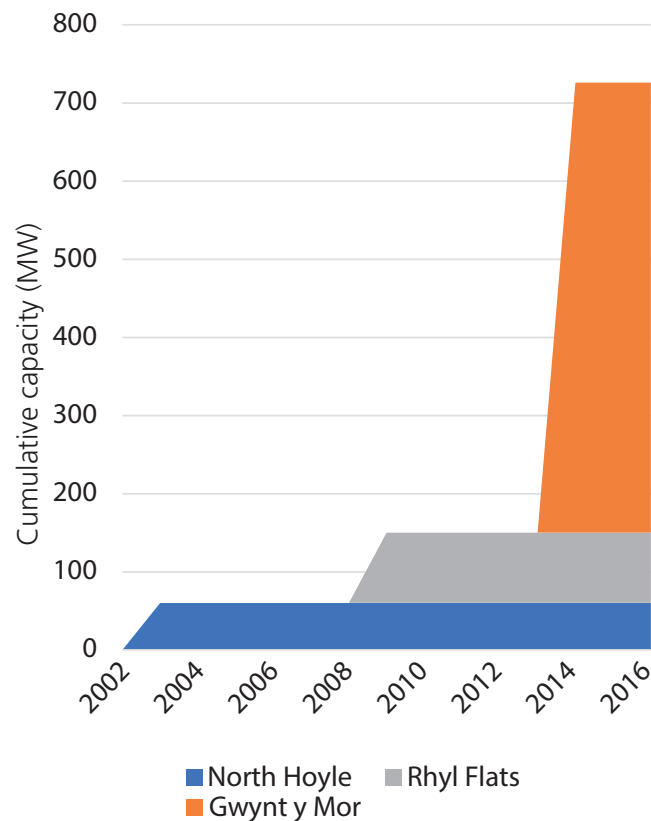
Wales has 726 MW of offshore wind installed from three projects, generating 34 per cent of all renewable electricity generation in Wales. Two of these projects were developed under the first leasing round from The Crown Estate and the third, Gwynt y Môr, under Round 2.

Analysis

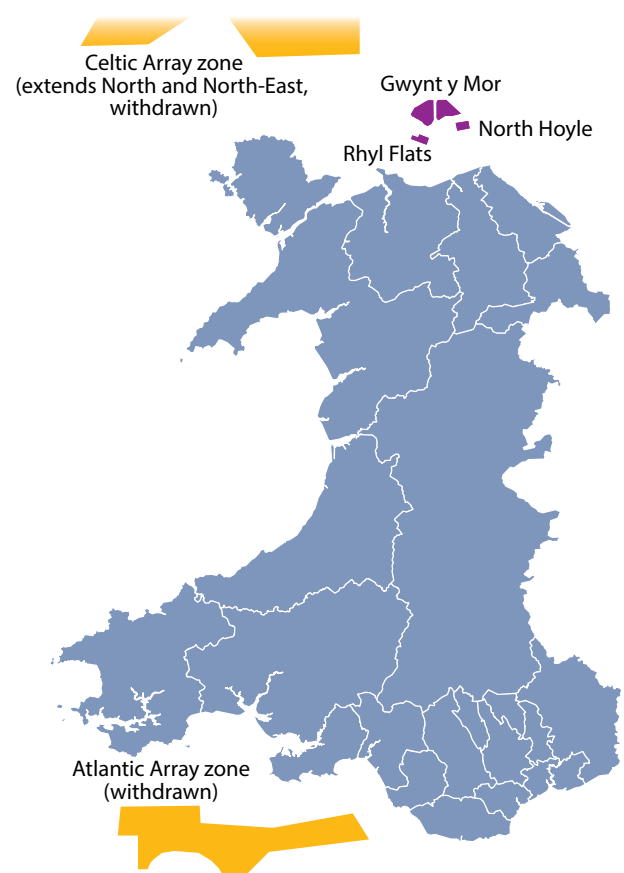
Gwynt y Môr, the most recently installed offshore wind farm, was commissioned in 2015 adding a huge 576 MW to the existing 150 MW. All three projects are located off the North Wales coast, in Liverpool Bay. Wales was an early adopter of offshore wind; North Hoyle was only the second offshore wind project to be commissioned in the UK, back in 2003. Gwynt y Môr remains the second largest offshore wind farm in the UK.

The pipeline of new offshore projects has, however, been reduced by the cancellation of the Atlantic Array project in the Bristol channel, and the Celtic Array in the Irish Sea.

Deployment of offshore wind over time



Geographic distribution of offshore wind



Future

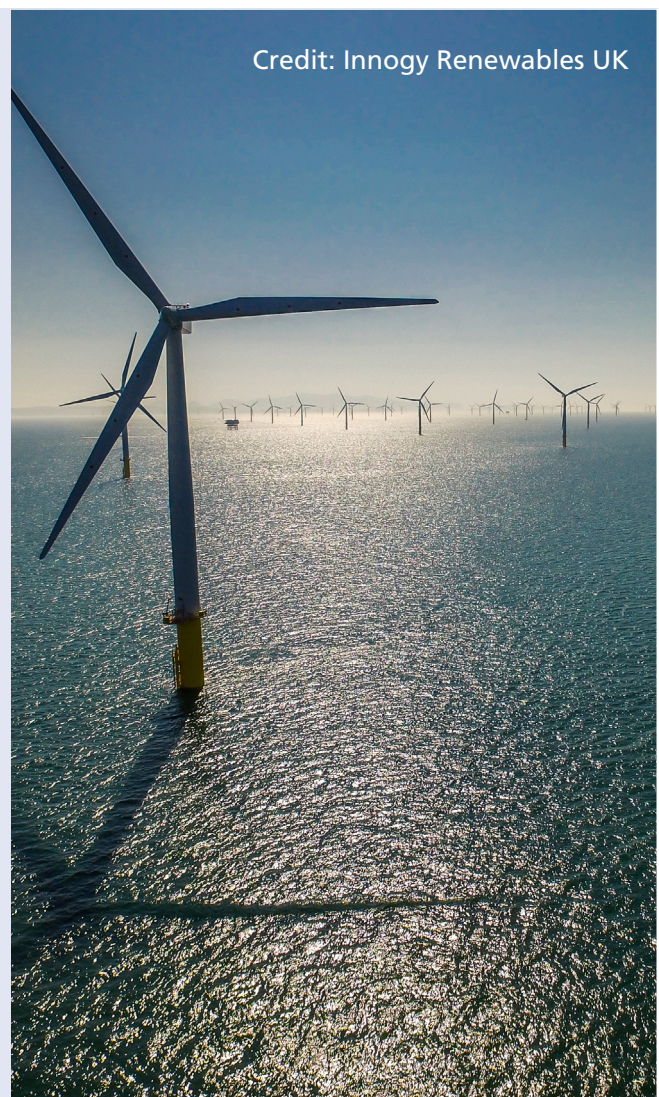
The cost of offshore wind has been falling over recent years. The most recent example of this was in the Contracts for Difference auction announced in September 2017, with three projects being successful in bidding for strike prices that were 50 per cent lower than those offered in the first auction round (2015). These projects were awarded strike prices of £57.50/MWh (for delivery in 2022/23) and £74.74/MWh (for delivery in 2021/22). Given the relatively low costs and the ability to build and generate at a large scale, offshore wind is likely to feature strongly in the UK future energy strategy, which will lead to offshore wind projects being developed once again. As this happens, Wales has the opportunity to expand its offshore wind portfolio. Developing new projects on the western seaboard will have added energy system benefits, helping to balance wind generation across the UK.

Case study: Gwynt y Môr

Gwynt y Môr is the world's second largest offshore wind farm. During the construction of Gwynt y Môr, £660 million was spent with companies based in the UK with over £90 million being spent within Wales. Around 700 jobs were created in Wales during the two year construction period and 100 new long term, skilled engineering jobs have been created for the operations and maintenance of Gwynt y Môr. The team are based at the Port of Mostyn.

Gwynt y Môr also delivers an annual community investment fund of £768,000 - worth over £19 million over the project's lifetime. Thanks to Gwynt y Môr Community Fund, £195,598 of match funding has been secured.

The wind farm has the potential to generate enough renewable energy to power the equivalent annual needs of approximately 400,000 average households.



Credit: Innogy Renewables UK

Onshore wind

Onshore wind deployment has grown significantly in Wales in recent years. By the end of 2016, Wales had 920 MW of onshore wind capacity, capable of generating over 2.3 TWh and powering the equivalent of 39 per cent of Welsh homes.

A few large projects contributed to the significant 2016 increase of nearly 300 MW, predominantly from the 228 MW Pen y Cymoedd wind farm, the largest wind farm in England and Wales. The 2015 capacity increase was 30 MW.

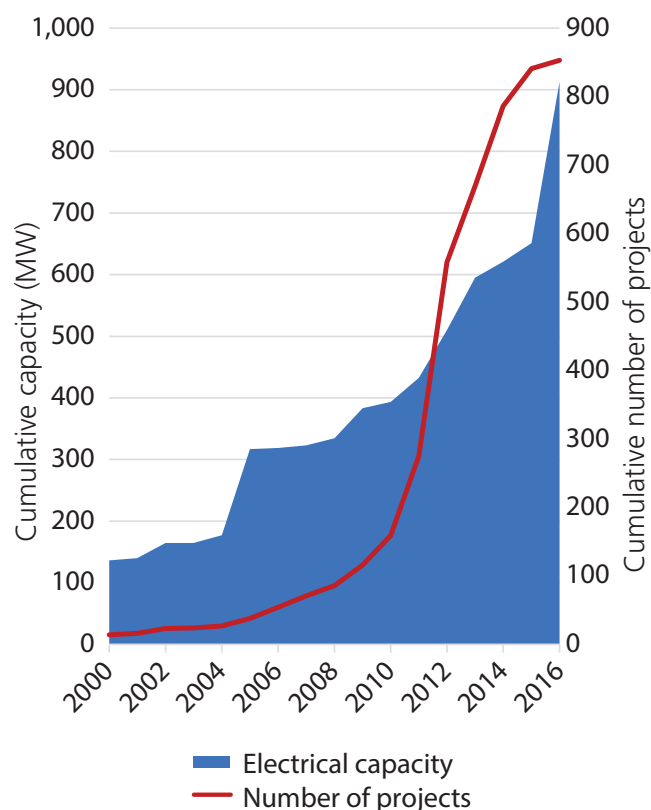
Analysis

In 2015, the 22.5 MW Mynydd Bwlfa wind farm was commissioned along with 57 small projects, of which only one was above 500 kW. In 2016, the Pen y Cymoedd Wind Farm was joined by a 24.6 MW Tirgwynt farm in Powys and ten smaller projects.

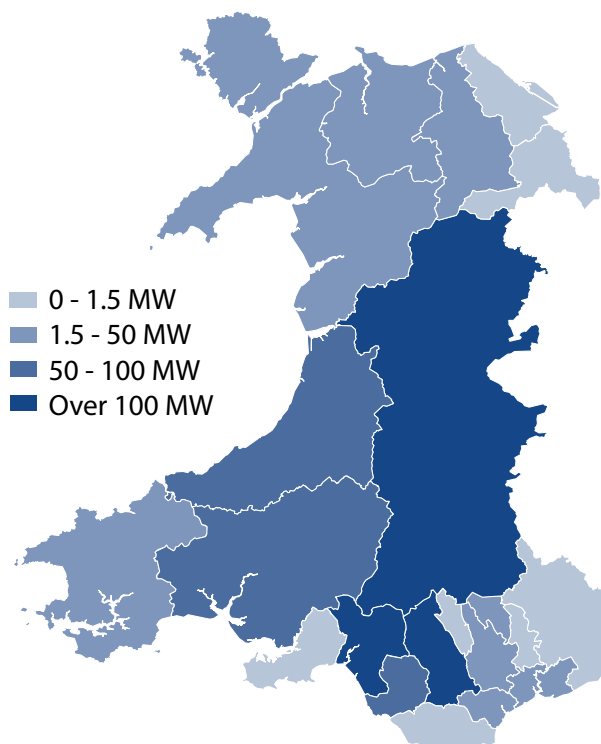
The reduction in the installation rate of small scale project numbers is mainly due to cuts to the FIT, with four projects under 500 kW developed in 2016, compared to 262 in 2012.

At the end of 2016, Powys had the largest number of onshore wind projects in Wales at 164. With the second highest total capacity at nearly 151 MW, Powys' wind turbines generate 355 GWh, enough to power the equivalent of 87,000 homes each year.

Deployment of onshore wind over time



Geographic distribution of onshore wind



The local authorities of Neath Port Talbot and Rhondda Cynon Taf have 10 and 9 projects respectively but, in 2016 due to sharing the Pen y Cymoedd project, have moved up to having the first and third highest capacity of onshore wind at 204 MW and 169 MW respectively.

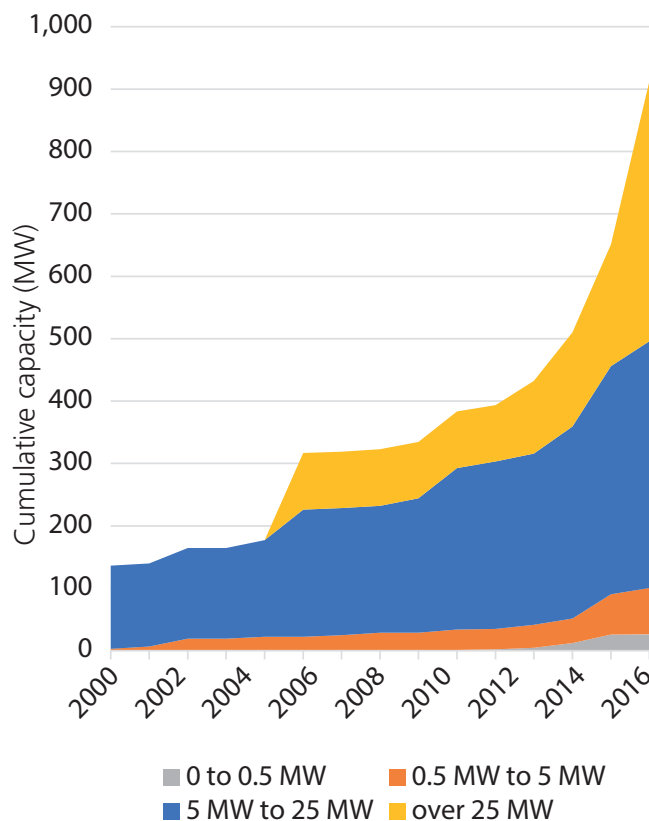
Future

With the Renewables Obligation closed for new large onshore wind projects from March 2016, projects currently being constructed are large wind farms that are eligible for subsidy grace periods such as the Garreg Lwyd Hill 33 MW farm in Powys commissioned in 2017, or schemes with energy used on or near site using private wires.

In Wales, the TAN 8 planning policy continues to encourage large developments in Strategic Search Areas (SSAs). Brechfa West 57 MW wind farm in SSA G and Mynydd Y Gwair 48 MW wind farm in SSA E both started construction in 2017. However, further capacity growth may be limited by pressure on the distribution network both in and outside of the SSAs.

Global onshore wind costs have fallen dramatically in recent years and this trend is set to continue. Falling costs mean that large scale onshore wind projects on the best sites are likely to be viable without subsidy in the near future. With the planning system in England currently impassable for most onshore wind projects, developers are looking to Wales and Scotland for sites. This represents a significant opportunity for Wales to attract onshore wind development, where the Welsh Government's aim for new developments to have shared ownership reflects the drive to ensure communities benefit significantly from these developments.

Deployment of onshore wind by scale



Case study: Pen y Cymoedd

This 228 MW, 76 turbine development within Rhondda Cynon Taf and Neath Port Talbot is the largest wind farm in England and Wales.

The wind farm was commissioned in October 2016, and powers the equivalent of 188,000 homes, corresponding to circa 15 per cent of Welsh homes.

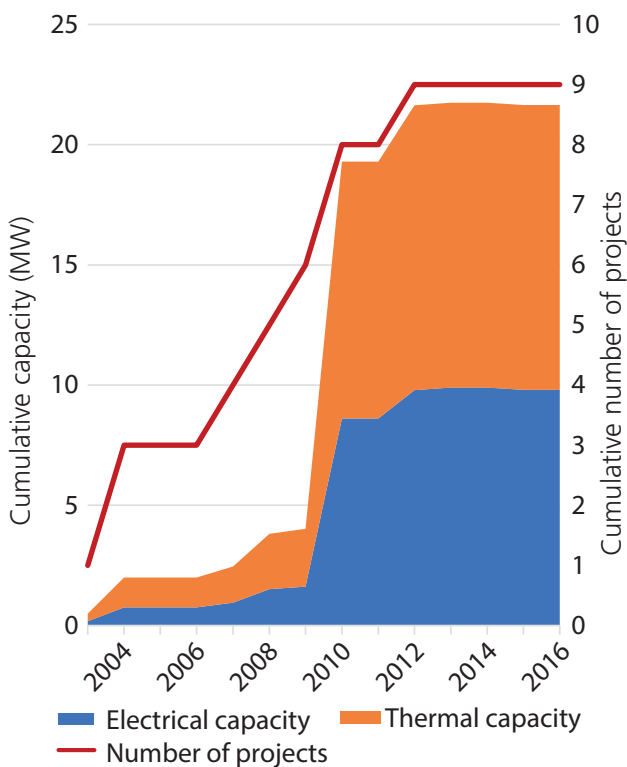
Sewage gas

There are nine sewage gas installations in Wales, all providing both heat and electricity with 12 MWth and 10 MWe in total, powering the equivalent of 2 per cent of Welsh homes. The most recent sewage gas project to be commissioned in Wales was in Five Fords in Wrexham in 2012. The site added the capacity to produce biomethane for injection into the gas grid in 2015.

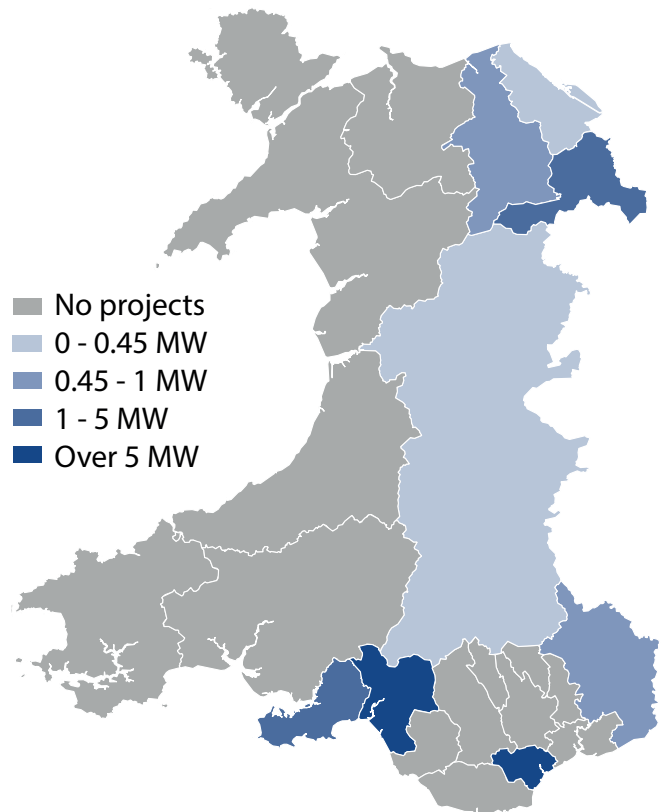
Analysis

Only eight out of 22 local authorities are home to sewage gas plants, the location of which is determined by the water companies' energy strategy and the availability of sufficiently large sewage processing plants. Of the nine sewage gas projects, two provide 70 per cent of the capacity, both commissioned in 2010. The largest is the 8 MW Cardiff East advanced digestion plant. The Afan advanced digestion plant in Neath Port Talbot has a total installed capacity of 6 MW.

Deployment of sewage gas over time



Geographic distribution of sewage gas



Future

Energy generation capacity from sewage gas is fairly limited at present in Wales. In future, if water companies' investment priorities further emphasise decarbonisation and cutting energy costs, there is the potential for both overall capacity growth and for more efficient energy recovery technologies to be deployed. In recent years, new technology has been developed enabling sewage plants to produce biomethane for injection into the gas grid, for example at the Dŵr Cymru Welsh Water Five Fords site.

Solar PV

Wales has 850 MW of solar PV capacity from a total of 54,575 installations. Over 440 MW, around half of the total capacity, was added in the last two years. Solar PV generates on average 737 GWh per year, providing enough electricity to power the equivalent of 14 per cent of Welsh households.

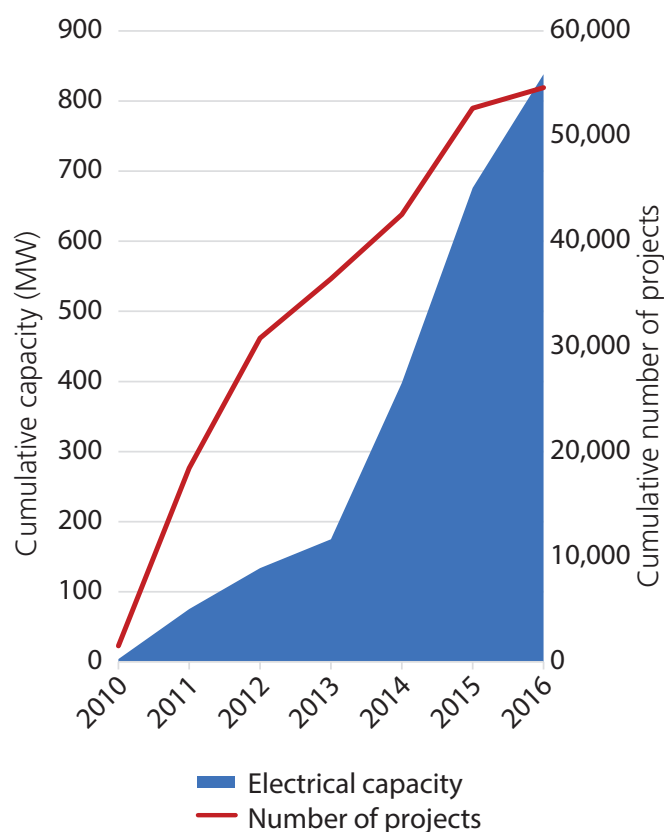
Analysis

The majority of PV projects in Wales are small rooftop solar PV, which make up 97 per cent of all solar PV installations. Due to reductions in the FIT, the deployment of solar PV projects has slowed considerably from over 10,000 new projects in 2015, totalling 278 MW, to under 2,000 in 2016 totalling 162 MW.

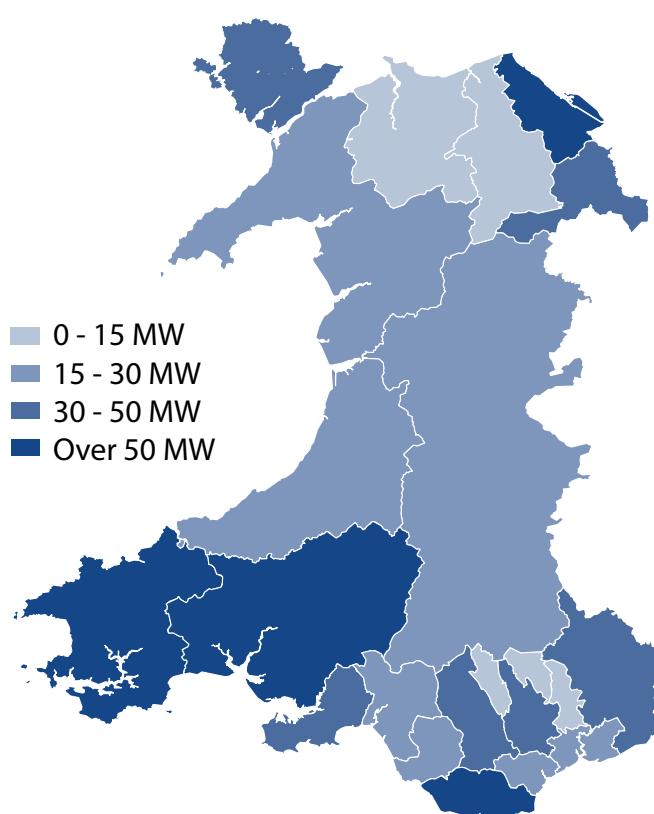
Over the same period, the average size of an installation has doubled in size, due to a shift towards larger scale solar PV parks. Wales now has two solar PV projects over 25 MW: a 36 MW park in Pembrokeshire and the UK's largest, the 72 MW Shotwick solar park in Flintshire, commissioned in 2016.

The Welsh local authority area with the highest capacity of solar PV is Pembrokeshire with 183 MW from 3,509 installations, followed by Carmarthenshire with 100 MW from 4,156 projects. Wrexham has the highest number of solar PV installations at 4,517, largely as a result of a programme of 3,000 installations on social housing in 2012.

Deployment of solar PV over time



Geographic distribution of solar PV



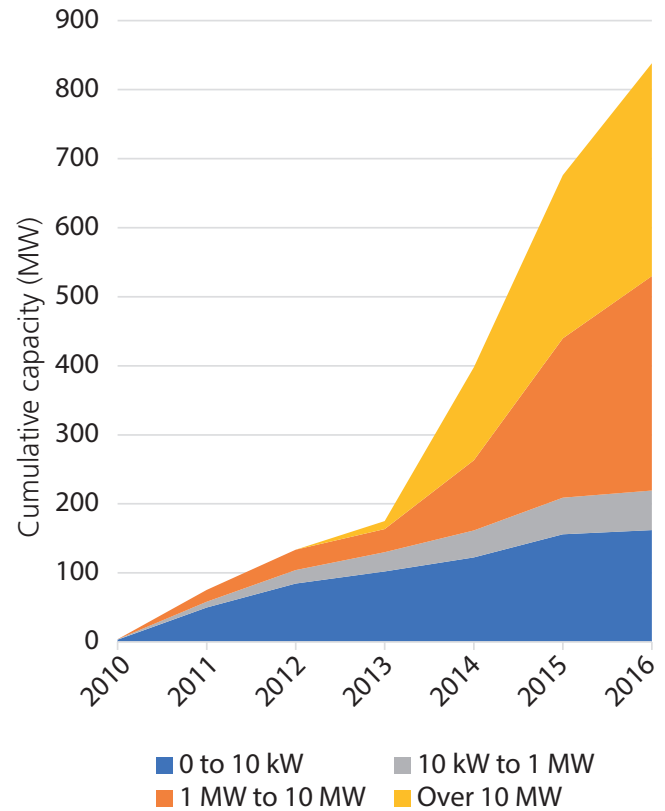
Future

The coastline of Wales has been an increasingly attractive place for solar PV deployment, thanks to its high levels of irradiance, availability of network connections and positive planning environments. Unlike onshore wind, the deployment of solar PV has been less impacted by planning constraints, with planning lead times typically six months and a relatively high success rate (circa 84 per cent).

As the numbers in Wales reflect, since the beginning of 2015, the UK's PV industry has been impacted by a drastically reduced FIT for small roof-top systems and the removal of the Renewables Obligation for larger ground-mounted solar farms.

However, solar PV costs are falling and lower prices have already made low subsidy rooftop solar attractive where households or businesses can maximise self consumption. For large scale ground mounted projects, subsidy-free development is becoming a reality, with the construction of the first subsidy free scheme in England in 2017.

Deployment of solar PV by scale



Case study: Shotwick Solar Park

Shotwick Solar Park is the largest solar park in the UK at 72.2 MW. It has a private wire connecting it directly to Shotton Paper Mill, offsetting roughly one third of their annual electricity demand and saving 22,500 tonnes of carbon per year. It also has a grid export capacity of 50 MW. The site was developed by British Solar Renewables, We-Link Energy and Compton Group and is now owned by Foresight Group.

Solar thermal

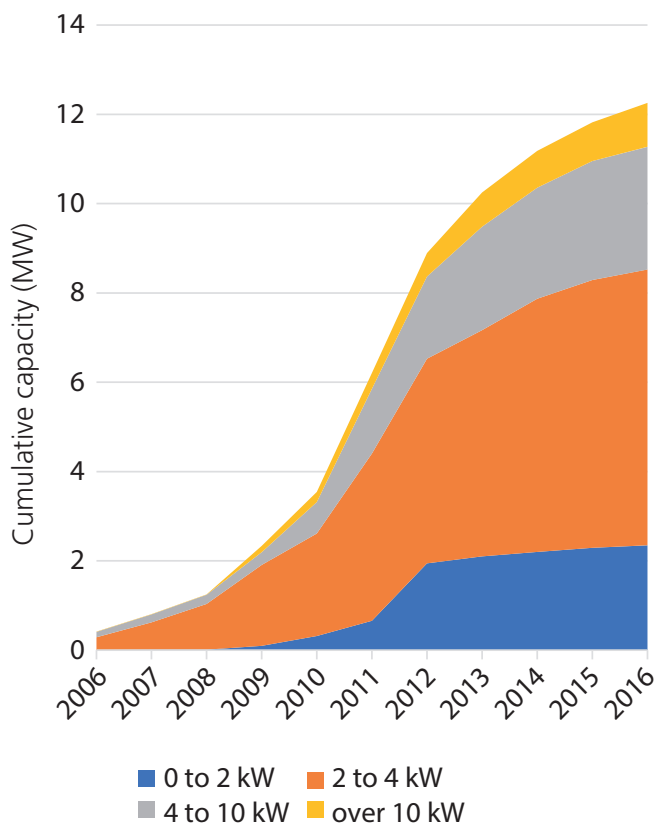
There is 12.3 MW of solar thermal capacity installed in Wales from 4,473 projects. 218 new systems were installed in 2015 and 122 in 2016.

Analysis

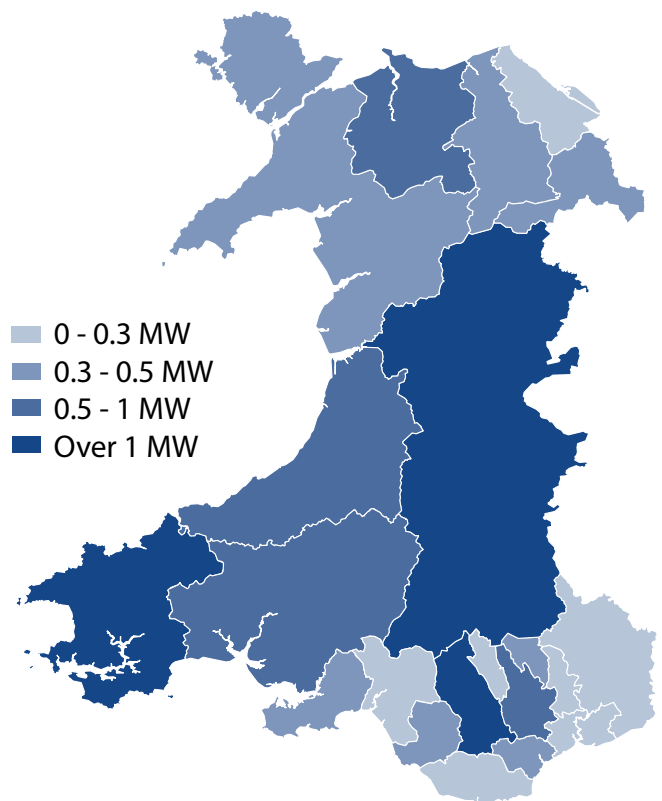
The rate of deployment of solar thermal projects has tailed off since its peak between 2010 and 2012, particularly for domestic projects. Larger scale and commercial level solar thermal systems have been installed at a more consistent rate and now provide around 16 per cent of the installed capacity. However, 94 per cent of all projects remain at a small household scale of under 5 kW.

Areas with the highest project numbers and installed capacity are off-gas grid areas of Powys, Rhondda Cynon Taf and Pembrokeshire.

Deployment of solar thermal by scale



Geographic distribution of solar thermal



Future

Changes to the RHI in September 2017 retained a tariff for solar thermal, despite previous suggestions this might be removed. However, cost reductions in solar PV have not been matched by those in solar thermal and demand for roof-mounted systems has shifted towards solar PV, which can provide more flexible energy and requires less maintenance.

Fossil fuels

Fossil fuel electricity generation

There is just under 8 GW of fossil fuel electricity generation capacity in Wales, which can be divided into large scale power stations, smaller scale 'peaking plant' generators and CHP projects.

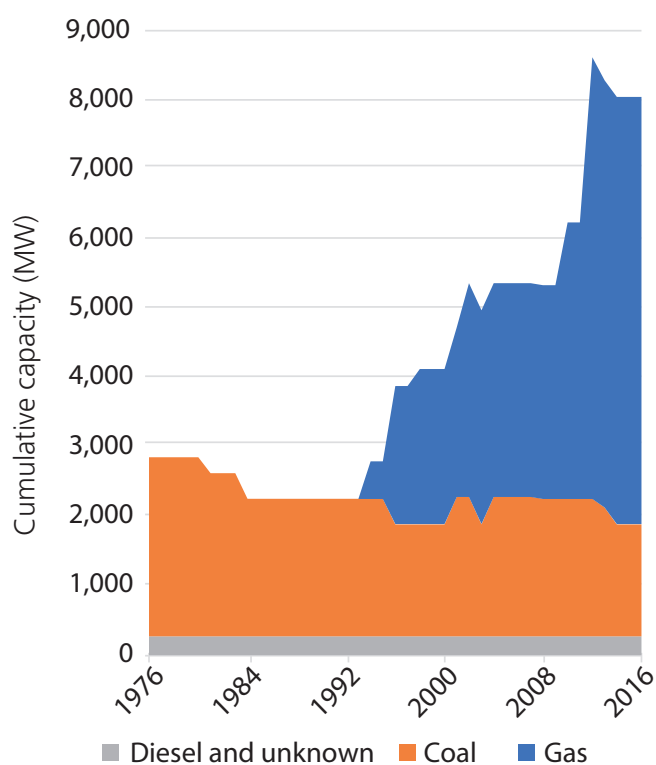
Large scale generation, with a total capacity of 7.35 GW, is currently provided by six Combined Cycle Gas Turbines (CCGT) power stations, of which the largest is in Pembroke, and a single currently operating coal fired power station at Aberthaw B.

Analysis

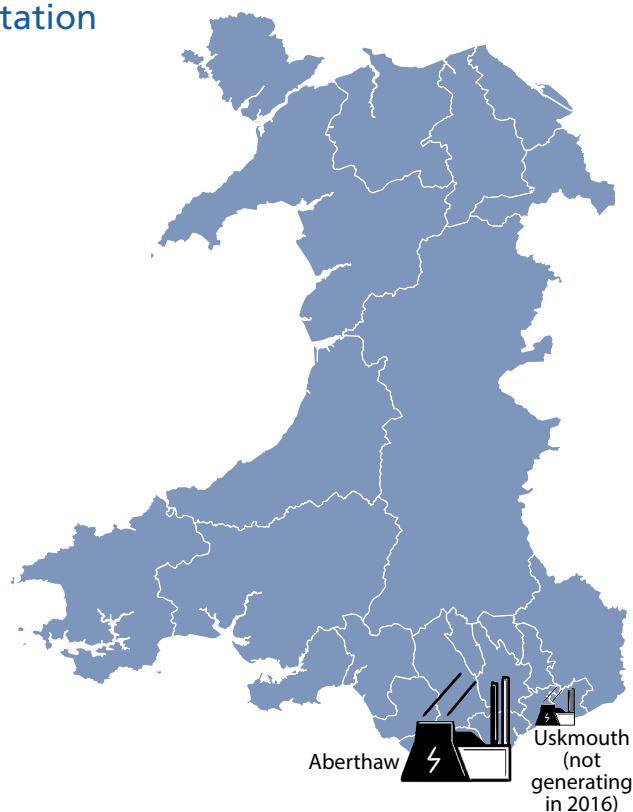
Fossil fuel electricity generation and capacity in Wales has shifted away from coal fired power stations, to less carbon intensive gas fired power stations. This shift began in the mid 1990s during the 'dash for gas', when a combination of technological development, economic issues and regulatory changes encouraged newly privatised power companies to build gas power stations.

There is over 550 MW of smaller scale Open Cycle Gas Turbines (OCGT), gas reciprocating engines and diesel generators connected to the distribution network in Wales. Often referred to as 'peaking plant', this class of generation technology has a higher unit cost of energy compared to CCGT, but is designed to generate for short periods to take advantage of price peaks in the energy market and revenues that can be earned by avoiding peak network charges.

Fossil fuel electricity generation capacity



Location of Aberthaw coal power station



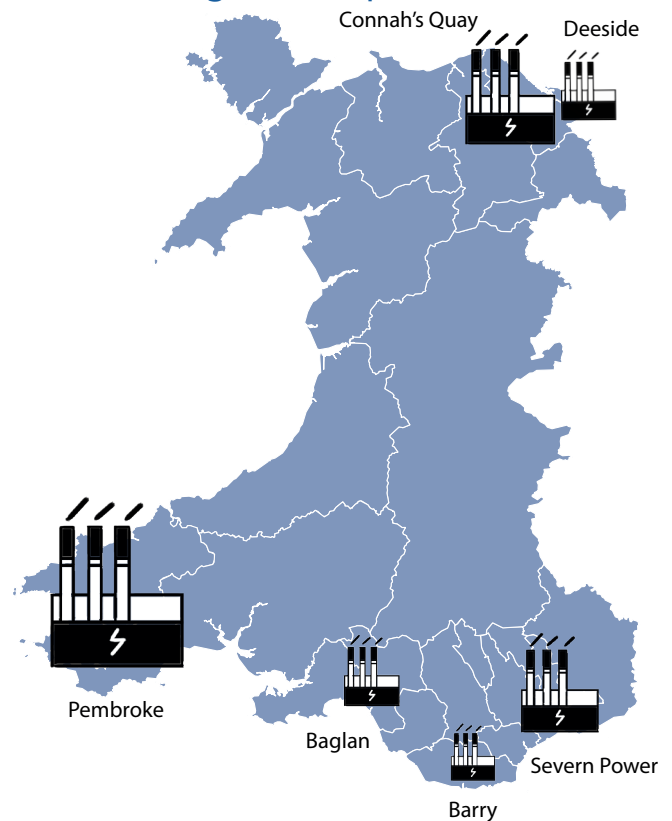
Future

The Welsh Government is establishing a regulatory framework for decarbonisation, including five year carbon budgets and interim targets, in addition to the existing 2020 and 2050 targets. As a result, fossil fuel generation will need to be reduced.

Coal generation is expected to further reduce and be phased out of the UK electricity system by 2025. Recently the owners of Aberthaw B have switched a small portion of their feedstock to biomass, and from April 2017 will only generate electricity when needed, such as in the winter months.

Storage and other flexibility services will become an important part of the UK energy system. However, in the near term, there is likely to be a requirement for gas generation to continue to provide peak power to meet periods of high demand and variable supply. It remains to be seen whether this balancing capability will be provided by new large scale CCGT power stations or by an expansion of smaller scale peaking plant. Carbon Capture and Storage (CCS) technology could reduce the carbon impact of fossil fuel generation; however, to date this technology is unproven.

Location of gas CCGT power stations



The sources of data for this category include DUKES' power station data and Wales' two distribution network operators. Small back up and on-site fossil fuel electricity generators, which may be located on farms or industrial and commercial properties, are likely to be underestimated within the data. While these small generators would increase the number of projects within this category, their impact on the total capacity and generation trends would be minimal.

Storage

Storage

The 360 MW Ffestiniog power station in Gwynedd opened in 1963, and the 1.7 GW Dinorwig pumped hydro plant commissioned in 1984. Together, these pumped hydro projects provide essential electricity storage to the UK electricity network.

Analysis

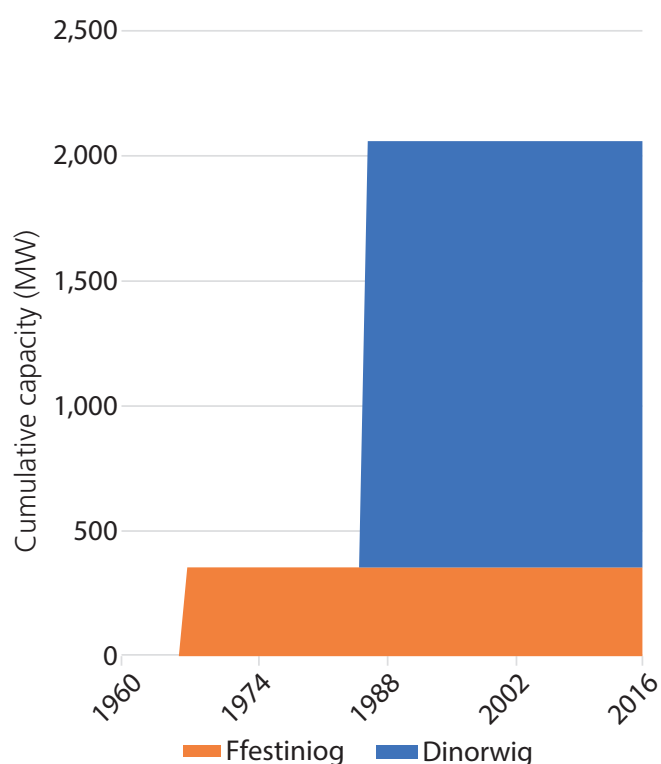
Energy storage, in the form of pumped hydro, has been a feature of the Welsh energy landscape since the 1960s and in March 2017, planning was approved for a new 99 MW pumped storage facility at Glyn Rhonwy, Snowdonia. Construction on this site is expected to start in 2018.

Wales currently has no large-scale battery storage projects connected to its electricity network, although there are advanced plans to develop a 22 MW / 33 MWh battery storage facility next to the Pen y Cymoedd wind farm. Construction is expected to start in 2017.

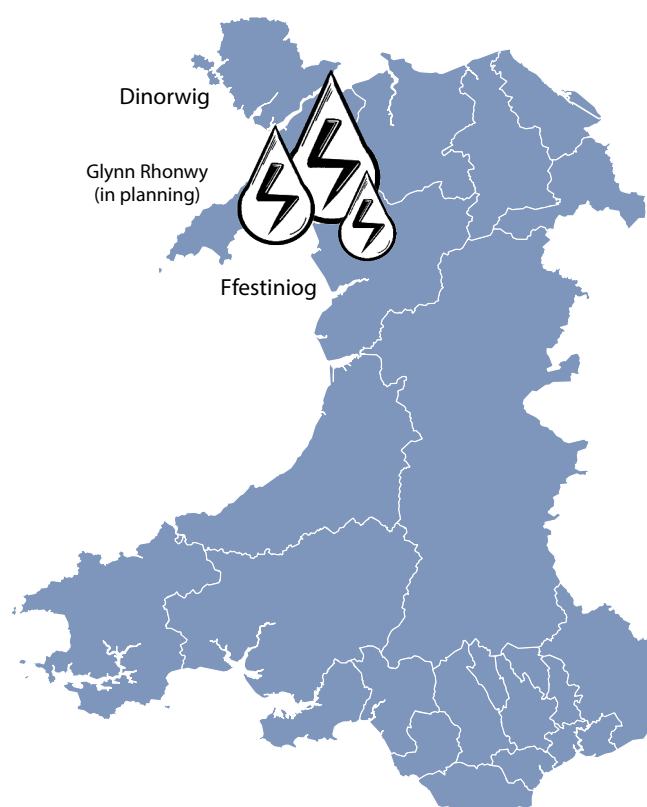
Western Power Distribution will, in 2017, begin trialing a 50 kW (210 kWh) Tesla battery storage system in Cardiff for its ability to provide network services and avoid network charges.

A survey of seven of the leading small-scale battery installers suggests that, as of September 2017, there have been at least 50 domestic storage installations, totalling around 500 kWh of storage capacity across Wales, plus a small number of larger installations at business premises.

Deployment of pumped hydropower storage over time



Geographic distribution of hydropower storage



Future

Energy storage is expected to play an increased role in the Welsh energy mix, as it can provide the flexibility required to support high levels of intermittent renewables in the energy system. Costs have been falling at a dramatic rate and are expected to continue to fall. A number of battery developers were successful in bidding into the Capacity Market and other auctions to provide grid services.

In the medium term, it is expected that many new and existing wind farm and PV projects will incorporate battery storage. Batteries could also displace diesel generators as the preferred solution to provide a backup power supply for public sector, commercial and industrial sites.

The investment market for very large scale pumped hydro, compressed air and other capital-intensive storage technologies will continue to be challenging. Without support in the form of a subsidy or long-term revenue guarantee, these projects will be difficult to finance.



Case study: Dinorwig Power Station

Situated in Snowdonia National Park, Dinorwig is one of the largest pumped hydroelectric plants in Europe with a maximum power output of 1,728 MW.

In March 2017, planning consent was given to a 99 MW pumped storage project near Dinorwig, called Glyn Rhonwy, which would be the first grid-scale pumped storage facility built in Britain for over 30 years.



Case study: Pen y Cymoedd storage

This 228 MW wind farm, the largest in Wales and England, is to be joined by a 22 MW energy storage facility. The Lithium-ion batteries will provide the generation and demand services for the National Grid, which are vital to keep the grid supply stable. Operations are due to begin in 2018, and when completed the technology will be able to respond to grid demands in under a second.

Reference pages

Data tables

Local authority	Totals					Renewables							
	Renewables			Fossil fuels		AD			Biomass heat		Biomass CHP and waste		
	Number of projects	Capacity (MW _e)	Capacity (MW _{th})	Number of projects	Capacity (MW _e)	Number of projects	Capacity (MW _e)	Capacity (MW _{th})	Number of projects	Capacity (MW _{th})	Number of projects	Capacity (MW _e)	Capacity (MW _{th})
Blaenau Gwent	1,021	13.5	2.6	2	32.0	-	-	-	6	2.0	-	-	-
Bridgend	2,539	100.9	3.6	4	25.2	1	3.2	-	28	2.8	-	-	-
Caerphilly	2,965	54.1	5.4	1	0.1	2	1.5	-	35	4.3	-	-	-
Cardiff	3,494	56.6	10.2	2	10.0	-	-	-	22	3.3	1	30.0	-
Carmarthenshire	5,266	189.0	29.0	1	10.0	1	0.0	-	346	23.8	-	-	-
Ceredigion	3,208	185.3	58.0	2	10.3	5	0.6	0.5	245	52.3	2	2.2	0.2
Conwy	1,799	62.1	9.7	3	2.0	4	-	0.7	111	6.8	-	-	-
Denbighshire	2,229	42.6	19.8	2	1.2	6	1.0	2.2	176	14.0	-	-	-
Flintshire	3,386	115.2	99.5	3	1,901	1	-	0.1	122	7.2	1	25.0	90.0
Gwynedd	3,009	93.6	17.7	1	0.1	2	1.5	0.2	200	13.6	-	-	-
Isle of Anglesey	2,173	72.6	5.8	1	0.1	1	1.2	-	53	2.8	-	-	-
Merthyr Tydfil	734	9.3	2.1	2	41.8	-	-	-	11	1.9	-	-	-
Monmouthshire	4,077	45.9	18.6	1	0.0	1	-	0.1	165	15.2	2	9.5	-
Neath Port Talbot	1,864	250.6	13.9	6	598.5	-	-	-	77	9.8	1	14.0	-
Newport	2,201	31.3	6.6	5	904.7	1	0.5	-	26	5.8	1	0.0	0.1
Pembrokeshire	4,703	204.5	20.9	5	2,331	3	0.0	0.2	230	15.8	1	0.0	0.1
Powys	6,222	183.6	115.3	4	0.7	19	3.4	3.2	849	104.0	5	0.5	0.2
Rhondda Cynon Taf	3,944	205.7	13.9	8	71.9	2	1.0	1.3	56	10.0	-	-	-
Swansea	3,097	44.8	6.6	2	44.4	-	-	-	71	3.6	-	-	-
Torfaen	2,054	11.4	5.4	2	0.4	-	-	-	18	4.4	4	0.4	0.6
Vale of Glamorgan	2,172	114.7	4.0	5	1,892	2	1.0	-	40	3.2	1	55.0	-
Wrexham	4,815	38.7	35.1	5	24.5	2	0.2	0.4	71	32.2	1	0.3	-
Offshore	3	726.0	-	-	-	-	-	-	-	-	-	-	-
Unknown	46	1.7	0.2	5	29.9	-	-	-	-	-	4	0.2	0.2
Total	67,021	2,854	503.7	72	7,931	53	15.0	8.7	2,958	338.7	24	137.2	91.3

Data tables

Local authority	Renewables												
	Heat pumps		Hydropower		Landfill gas		Offshore wind		Onshore wind		Sewage gas		
	Number of projects	Capacity (MW _{th})	Number of projects	Capacity (MW _e)	Number of projects	Capacity (MW _e)	Number of projects	Capacity (MW _e)	Number of projects	Capacity (MW _e)	Number of projects	Capacity (MW _{th})	
Blaenau Gwent	14	0.1	-	-	1	1.6	-	-	4	1.5	-	-	-
Bridgend	28	0.4	5	0.0	1	0.3	-	-	14	70.9	-	-	-
Caerphilly	40	0.5	1	0.0	-	-	-	-	15	6.2	-	-	-
Cardiff	67	0.9	1	0.4	2	3.3	-	-	5	2.4	2	4.4	5.7
Carmarthenshire	364	4.4	13	4.7	1	2.0	-	-	127	82.7	-	-	-
Ceredigion	464	4.2	23	55.6	-	-	-	-	90	96.8	-	-	-
Conwy	93	1.3	26	35.5	1	2.0	-	-	36	19.6	-	-	-
Denbighshire	251	2.9	16	1.3	-	-	-	-	40	32.9	1	0.2	0.3
Flintshire	163	1.8	-	-	2	1.9	-	-	26	0.3	1	0.2	0.2
Gwynedd	317	3.4	75	56.4	1	0.1	-	-	62	6.1	-	-	-
Isle of Anglesey	203	2.7	-	-	1	0.4	-	-	60	39.8	-	-	-
Merthyr Tydfil	14	0.2	1	0.1	2	6.3	-	-	2	0.5	-	-	-
Monmouthshire	247	2.7	7	0.2	-	-	-	-	25	0.5	1	0.2	0.3
Neath Port Talbot	75	0.7	12	0.5	2	2.5	-	-	10	204.1	1	3.0	3.3
Newport	44	0.6	-	-	1	1.0	-	-	11	13.7	-	-	-
Pembrokeshire	310	3.5	8	0.1	1	1.5	-	-	138	19.6	-	-	-
Powys	647	6.1	48	7.2	1	2.0	-	-	164	150.6	1	0.1	0.1
Rhondda Cynon Taf	89	1.1	3	0.2	2	2.6	-	-	9	169.2	-	-	-
Swansea	140	1.7	1	0.0	1	1.2	-	-	6	1.5	1	0.6	0.8
Torfaen	28	0.4	1	0.0	-	-	-	-	4	0.0	-	-	-
Vale of Glamorgan	53	0.7	-	-	-	-	-	-	7	0.6	-	-	-
Wrexham	109	1.1	-	-	3	3.7	-	-	12	0.7	1	1.2	1.2
Offshore	-	-	-	-	-	-	3	726.0	-	-	-	-	-
Unknown	-	-	35	0.9	-	-	-	-	-	-	-	-	-
Total	3,760	40.9	276	163.1	23	32.6	3	726.0	867	920.2	9	9.8	11.8

Data tables

Local authority	Renewables				Fossil fuels						Pumped hydropower storage	
	Solar PV		Solar thermal		Coal		Diesel and unknown		Gas			
	Number of projects	Capacity (MW _e)	Number of projects	Capacity (MW _{th})	Number of projects	Capacity (MW _e)	Number of projects	Capacity (MW _e)	Number of projects	Capacity (MW _e)	Number of projects	Capacity (MW _e)
Blaenau Gwent	706	10.4	290	0.5	-	-	-	-	2	32.0	-	-
Bridgend	2,367	26.4	95	0.5	-	-	1	12.5	3	12.7	-	-
Caerphilly	2,528	46.5	344	0.7	-	-	-	-	1	0.1	-	-
Cardiff	3,294	16.0	100	0.3	-	-	-	-	2	10.0	-	-
Carmarthenshire	4,156	99.6	258	0.8	-	-	-	-	1	10.0	-	-
Ceredigion	2,086	29.8	293	0.8	-	-	1	10.3	1	0.1	-	-
Conwy	1,272	5.1	256	1.0	-	-	-	-	3	2.0	-	-
Denbighshire	1,610	7.2	129	0.3	-	-	-	-	2	1.2	-	-
Flintshire	2,994	87.8	76	0.2	-	-	-	-	3	1,901	-	-
Gwynedd	2,188	29.6	164	0.5	-	-	-	-	1	0.1	2	2,088
Isle of Anglesey	1,687	31.2	168	0.4	-	-	-	-	1	0.1	-	-
Merthyr Tydfil	641	2.4	63	0.0	-	-	1	21.2	1	20.6	-	-
Monmouthshire	3,530	35.6	99	0.3	-	-	-	-	1	0.0	-	-
Neath Port Talbot	1,650	26.5	36	0.1	-	-	2	41.2	4	557.3	-	-
Newport	2,083	16.0	34	0.2	-	-	-	-	5	904.7	-	-
Pembrokeshire	3,509	183.2	503	1.4	-	-	-	-	5	2,331	-	-
Powys	3,840	19.8	648	1.7	-	-	-	-	4	0.7	-	-
Rhondda Cynon Taf	3,244	32.8	539	1.5	-	-	1	21.2	7	50.7	-	-
Swansea	2,699	41.6	178	0.5	-	-	2	44.4			-	-
Torfaen	1,982	10.9	17	0.0	-	-	-	-	2	0.4	-	-
Vale of Glamorgan	1,985	58.1	84	0.1	1	1,586	1	51.0	3	255.0	-	-
Wrexham	4,517	32.6	99	0.3	-	-	-	-	5	24.5	-	-
Offshore	-	-	-	-	-	-	-	-			-	-
Unknown	7	0.6	-	-	-	-	1	0.2	4	29.7	-	-
Total	54,575	849.7	4,473	12.3	1	1,586	10	202	61	6,143	2	2,088

Methodology

Methodology

Regen was commissioned by the Welsh Government to produce a database of energy generation projects in Wales; identify the extent to which projects are owned by Welsh individuals, organisations and communities; and analyse the data to produce a report on progress.

The research method developed by Regen to produce a detailed picture of energy generation across Wales includes:

- identifying, collating, cleansing and cross-referencing records from existing datasets;
- verifying and analysing the data to ensure a robust national overview and locally specific data where available;
- verifying the data with stakeholders and industry where appropriate;
- researching ownership details, including referencing to Companies House to identify projects with local ownership.

The key sources of data used in the study include:

- Ofgem Feed-in Tariff data
- Renewables Obligation register
- Renewable Heat Incentive and Renewable Heat Premium Payment data
- Western Power Distribution connections data
- SP Energy Networks connections data
- Gemserv MCS data
- Renewable Energy Planning Database
- Contact with utilities
- Contact with installers and industry organisations
- A survey of small scale storage installers.
- BEIS energy statistics

Regen

Regen is an independent not for profit that uses its expertise to work with industry, communities and the public sector to revolutionise the way we generate, supply and use energy.

For more information, visit www.regensw.co.uk





Abbreviations and definitions



Abbreviation	Explanation
Capacity	How much a project can generate at maximum output.
Capacity factor	All generation has a capacity factor of less than 100 per cent, as it does not run all the time. For example, the capacity factor for offshore wind in Wales is evaluated to be 38 per cent.
kW	Kilowatt - a unit of power (capacity)
kWh	Kilowatt hour - a unit of energy (demand or generation)
kWe	Kilowatt of electrical capacity
kWth	Kilowatt of thermal capacity
CO ₂	Carbon dioxide emissions (in metric tonnes)
RHI	Renewable Heat Incentive (a subsidy scheme for heat generating technologies)
FIT	Feed-in Tariff (a subsidy scheme for electricity generating technologies)
CHP	Combined Heat and Power
CCGT	Combined Cycle Gas Turbine
OCGT	Open Cycle Gas Turbine
Solar PV	Solar photovoltaic panels

Orders of magnitude	Explanation
W	1 watts = 1 watt
kW	1,000 watts = 1 kilowatt
MW	1,000,000 watts = 1 megawatt
GW	1,000,000,000 watts = 1 gigawatt
TW	1,000,000,000,000 watts = 1 terawatt

A note on power and energy

Power (capacity) × Time = Energy (e.g. demand and generation)


 50 Watts
 ×
 
 20 hours
 = 1,000 Wh (1 kWh) of demand


 1,000 kilowatts (1 MW)
 ×
 
 1 hour
 = 1,000 kWh (or 1 MWh) of generation

