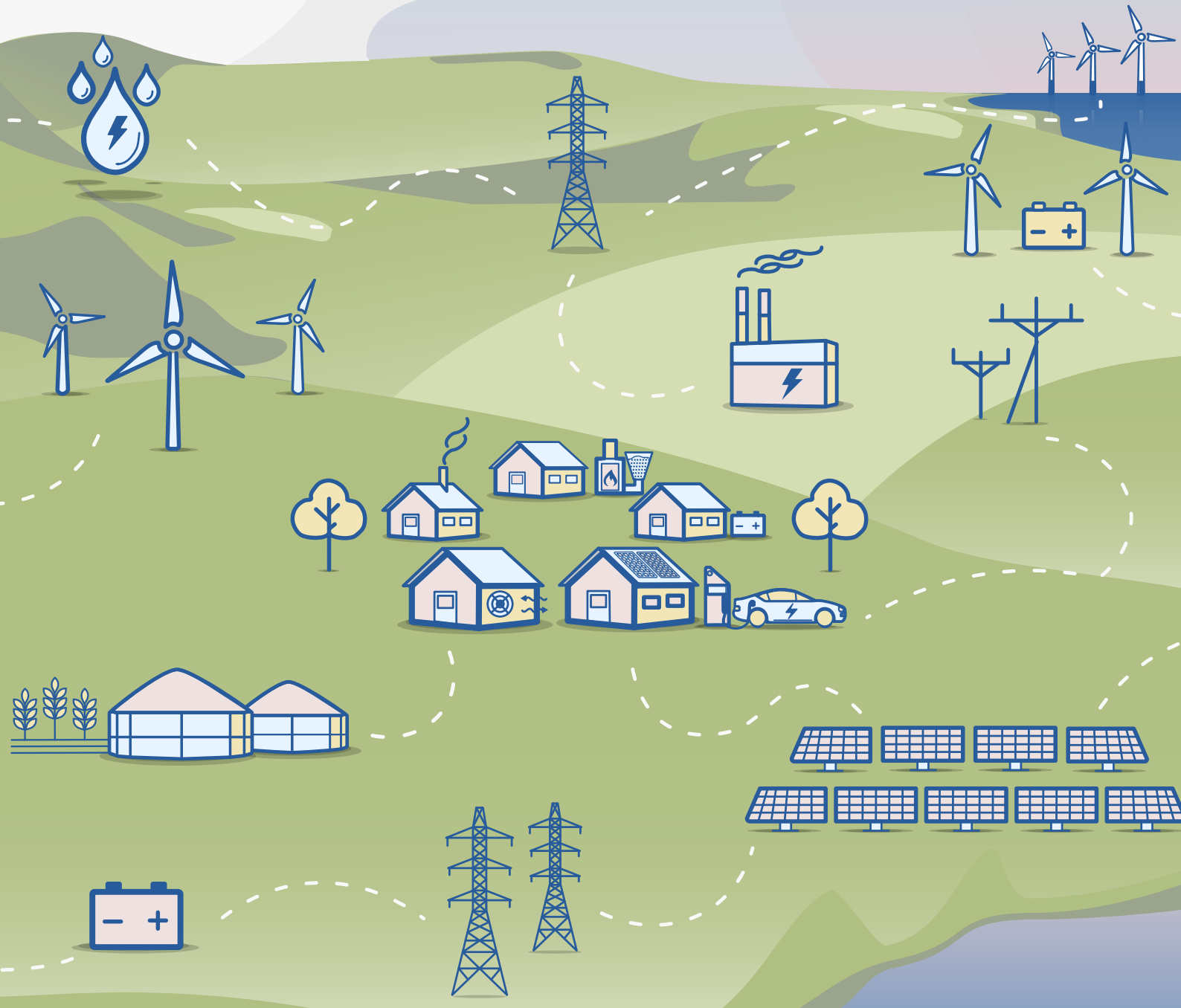
Energy Generation in Wales

2018

Llywodraeth Cymru
Welsh Government



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regen transforming energy

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Introduction

The Energy Generation in Wales 2018 report sets out the current energy generation capacity of Wales and analyses how it has changed over time.

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 previous Energy Generation in Wales reports, produced from 2014 onwards, and looks at the growth of renewable energy in 2018, reviewing the growth prospects of each technology.

Energy generation deployment is broken down into the 22 local authority areas in Wales. This allows analysis of the local factors, including natural resources, local policies and other demographic elements, which may influence the deployment of different technologies.

To illustrate the range of different technologies and scales of deployment in Wales, the report includes case studies of some of the energy projects that have recently commissioned in Wales.

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

This report

- Breaks down Welsh electricity and renewable heat generation by technology, capacity and local authority area to the end of 2018.
- Estimates 50% of electricity consumption comes from renewable sources.
- Estimates 778 MW of installed renewable energy 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).

Ministerial foreword

Decarbonising energy is driving a global shift in the energy world and is key to Wales achieving our carbon budgets. There is a huge opportunity to use our own natural resources to provide low carbon energy which will retain value within the local economy. This is why we view investment in renewable energy as a core strength of our strategy for the Welsh economy.

Traditionally, the provision of power, heating and transport fuel has been separate and centralised. Energy generation and delivery are now becoming more distributed in the communities where the energy is used. The boundaries between the systems are becoming blurred.

Soon, we might expect electric vehicle batteries to transfer electricity from workplace solar charging to homes to supply them during the evening peak demand. Heating may be from hybrid heat pump and gas boiler systems that decide whether electricity or gas is the fuel that will place least demand on the system at that time. This is what is increasingly described as a 'multi-vector' energy system.

To ensure Wales is at the forefront of a low carbon, multi-vector energy system, we have seen a number of significant milestones reached since publication of last year's Energy Generation in Wales study. In March we published 'Prosperity for All: a Low Carbon Wales', our first plan on how we intend to meet our first carbon budget and set the foundations for future action. We have also scaled up our ambition. In April, the Welsh Government declared a Climate Emergency. This was followed on 1 May by the National Assembly for Wales becoming the first parliament in the world to pass a Climate Emergency.

In June we accepted the advice of the UK Committee on Climate Change, committing to putting higher emissions reductions target of 95% into law. In recognition of the climate emergency, Welsh Government announced its ambition to work with UKCCC and other stakeholders to understand what is involved in developing a more ambitious net zero target for Wales, potentially going further than UK Government or any other UK administration.

Welsh Government continues to set a supportive policy framework to bring forward energy projects. Through the Welsh Government Energy Service we provide support to the public sector and communities to help them deliver renewable energy projects.

A new version of Planning Policy Wales was published last December. It sets out a clear approach

to energy, including an energy hierarchy that underpins the decarbonisation targets with specific requirements for Local Authorities to set renewable energy targets and spatial allocations for renewable energy projects within their Local Development Plans. The recently published draft National Development Framework (NDF) sets a clear vison for more renewable energy by identifying priority areas for the development of large scale solar and onshore wind.

The Energy Generation in Wales study provides a complete picture of energy generation in Wales and a consistent measure against the energy targets I set in 2017. Our target is for Welsh renewables to generate electricity equal to 70% of Wales' consumption by 2030. I am pleased to announce renewable generation equal to 50% of electricity consumption in Wales in 2018. We now have 778 MW of renewable energy capacity in local ownership, against our target of 1 GW by 2030. We expect all new energy projects to include an element of local ownership.

In 2018, we saw the commissioning of Wales's third largest wind farm, Brechfa West, in Carmarthenshire. Brechfa's 28 turbines are sited on the Welsh Government woodland estate and will provide a community benefit fund in excess of £11 million over the wind farm's operational life. The Welcome to Our Woods community organisation and its partners completed the build of a 27 kW hydropower development near Treherbert, Rhondda Cynon Taf. The community aim to use revenue from the scheme to reduce fuel poverty within the area.

Reducing our reliance on fossil fuels and continuing to develop and support renewable energy, with local ownership, will help us achieve our low carbon vision and maximise the value to Wales.

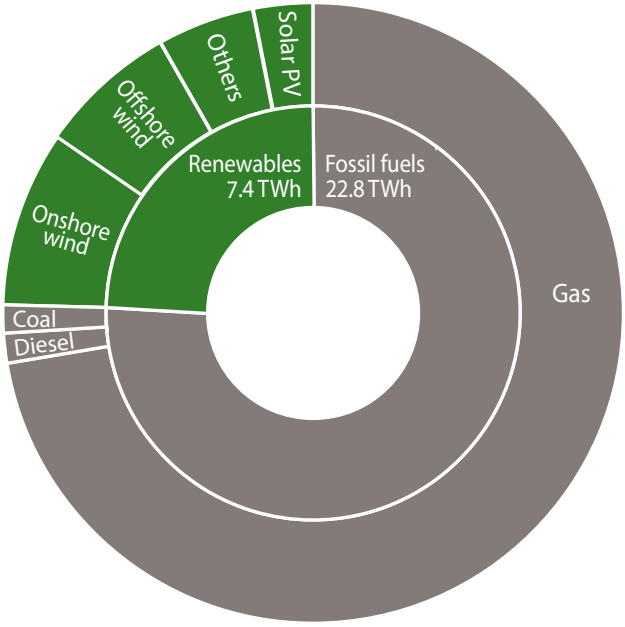
Lesley Griffiths AM

Minister for Environment, Energy and Rural Affairs

Electricity generation in Wales

Wales generated an estimated 30.2 TWh of electricity in 2018, while consuming approximately 14.9 TWh[1]. This means that Wales generates twice as much electricity as it consumes and is a net exporter of electricity to England, Ireland and the wider European electricity network.

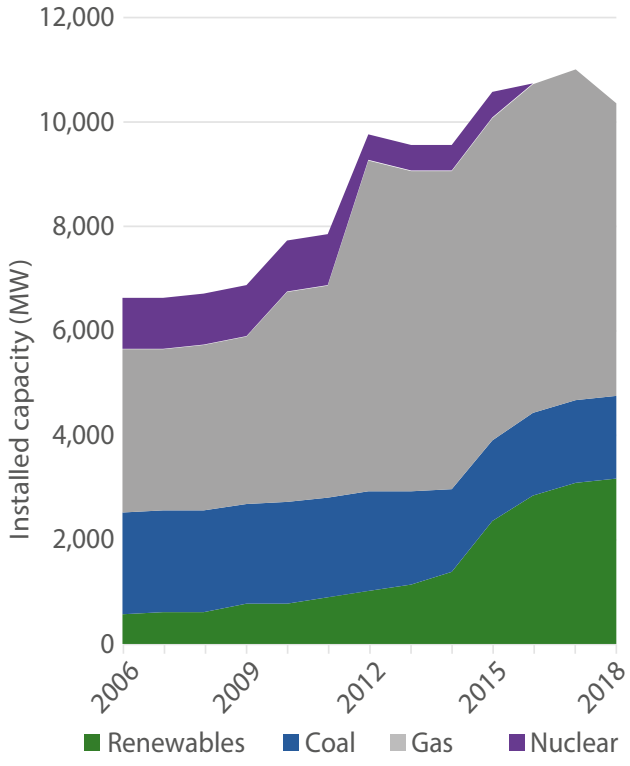
Wales' electricity generation



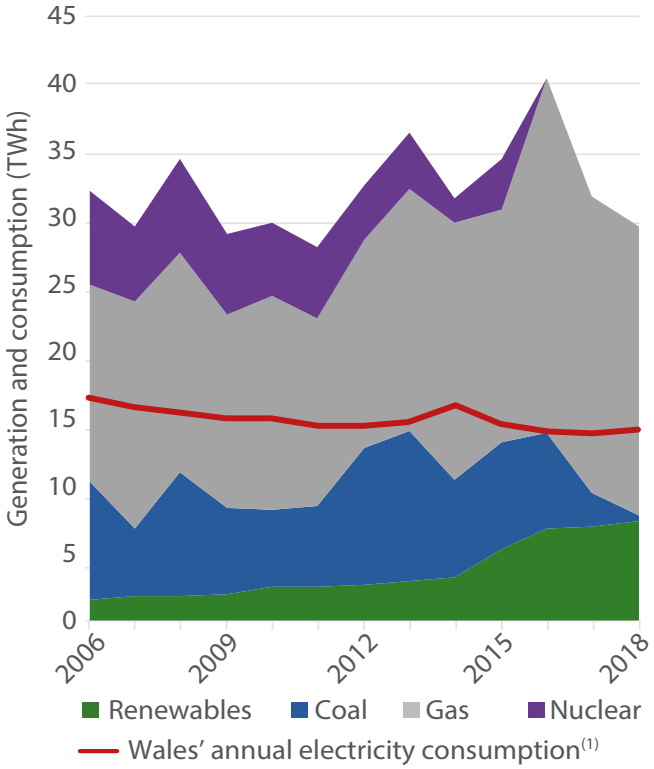
Of all electricity generated in Wales, 25% is from renewable sources, up from 22% in 2017. Total electricity generation in Wales has reduced by nearly 11% since 2017. This reduction is largely due to an 83% reduction in generation from coal fired power stations, while generation from gas fired power stations has also reduced by 3%.

Wales consumes around 91 TWh of energy per year[2]. Electricity consumption represents about 16% of this total consumption; the remaining 76.1 TWh is associated with transport, heating and industry.

Electricity capacity trends



Electricity generation trends



Electricity generation in Wales

- Electricity generation from fossil fuel sources reduced by 11% between 2017 and 2018. This reduction is predominantly due to an 83% reduction in Aberthaw's generation since 2017. The power station is due to close in March 2020.
- There are no nuclear power stations currently operating in Wales. Plans for a new nuclear plant on the existing Wylfa site are currently suspended. Opportunities for new nuclear at Trawsfynydd using small modular reactors or advanced modular reactors continue to be investigated.
- An estimated 7.4 TWh of renewable electricity was generated in Wales in 2018, up from 7.1 TWh the previous year. This represents 25% of all electricity generation in Wales.
- In 2018, an additional 126 MW of new renewable electricity capacity was installed, continuing 2017's trend of a significant slowdown in installation rates compared to 2015 and 2016.
- In 2018, there were 55,791 renewable electricity projects in Wales, up by 985 since the previous year.

Technologies	Number of projects	Electrical capacity (MW)	Estimated electricity generation (GWh)
Fossil fuels	**92**	**7,580**	**22,759**
Coal	1	1,586	439
Diesel	13	134	468
Gas	78	5,860	21,852
Storage	**209**	**2,088**	**-**
Battery storage	207	29.1 (MWh)	-
Pumped hydro	2	2,088	-
Renewables	**55,791***	**3,213**	**7,426**

* Please note these figures are for renewable electricity and so exclude renewable heat projects.

CASE STUDY - BRECHFA FOREST WEST

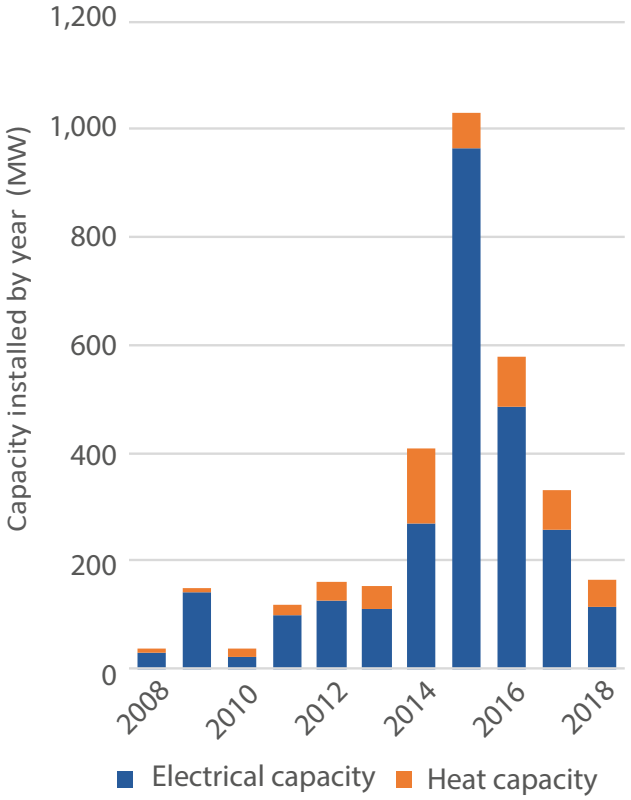
This 57.4 MW onshore wind project, sited on Welsh Government woodland estate, is located north of Carmarthen and was commissioned in January 2018 by Innogy Renewables. The wind farm is expected to generate enough electricity each year to meet the needs of 38,800 Welsh households. Innogy has launched the Brechfa Forest West Wind Farm Community Investment Fund, which is expected to be worth £11 million over the lifetime of the wind farm (up to 25 years), providing an opportunity for the local community and the wider region to benefit.


Credit: Innogy

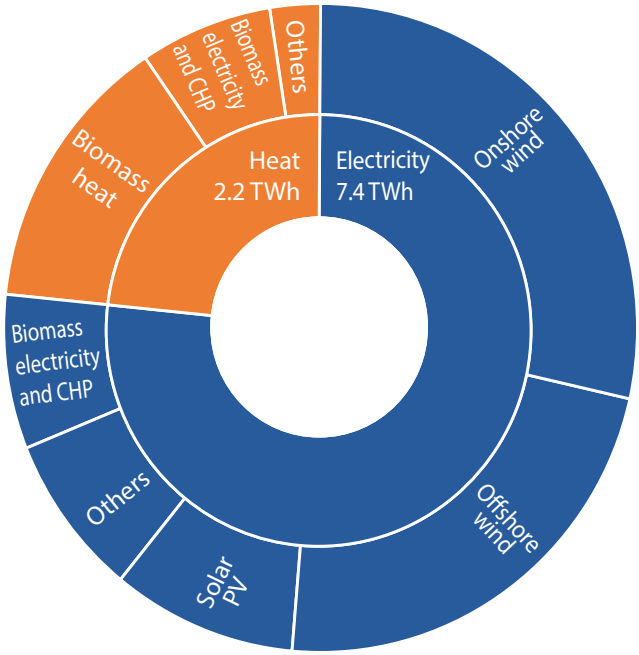
Renewable energy in Wales

166 MW of renewable energy capacity was commissioned in 2018 in Wales, bringing the total capacity to 3,864 MW from 68,728 projects. 2018 continued the trend of slowing renewable energy installation rates for the third consecutive year with a 4% increase in capacity, compared to 9% in 2017 and 21% in 2016. Renewable electricity technologies experienced a more pronounced reduction in installation rates compared to renewable heat technologies.

Wales' renewable energy capacity installation



Renewable electricity and heat generation



Renewable electricity in Wales

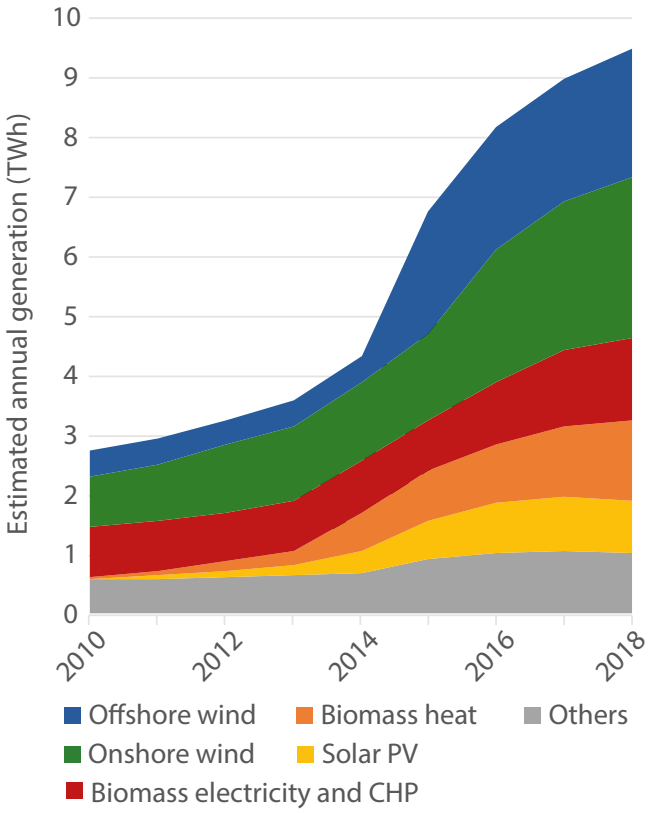
- Only three renewable electricity projects of over one megawatt were commissioned in 2018: two onshore wind farms and one biomass gasification plant.
- Solar PV projects make up 30% of Welsh renewable electricity capacity; however, a lower capacity factor than other generation technologies means that they provide only 12% of generation.
- The largest renewable electricity project to commission in 2018 was the 57.4 MW Brechfa Forest West Wind Farm.
- Approximately two-thirds of renewable electricity generated in Wales came from wind, with 30% from the three offshore projects along the Welsh coast and around 37% from about 1.1 GW of onshore wind capacity.

Renewable energy technologies	Number of projects	Electricity		Heat	
		Capacity (MW)	Estimated generation (GWh)	Capacity (MW)	Estimated generation (GWh)
Anaerobic digestion	45	19	100	8	48
Biomass heat	3,345	-	-	443	1,359
Biomass electricity and CHP	48	131	756	119	658
Energy from waste	1	30	125	-	-
Heat pump	4,928	-	-	56	108
Hydropower	364	182	389	-	-
Landfill gas	24	31	117	-	-
Offshore wind	3	726	2,200	-	-
Onshore wind	740	1,106	2,779	-	-
Sewage gas	6	9	34	11	68
Solar PV	54,560	978	925	-	-
Solar thermal	4,664	-	-	13	8
Total	68,728	3,213	7,426	651	2,249

Renewable heat in Wales

- There is 651 MW of renewable heat capacity in Wales, with 51 MW of new heat capacity added in 2018. There are just under 13,000 renewable heat projects across Wales.
- The number of new installations was lower in 2018 than 2017, with around 1,645 new installations in 2018 compared with 1,966 the previous year.
- Production of renewable heat was approximately 2.2 TWh in 2018, which is equivalent to 13% of estimated Welsh domestic heat demand.
- Heat pumps make up the largest proportion of heat projects in Wales with 4,928 projects, with solar thermal close behind with 4,664 projects.
- Biomass saw the largest increase in renewable heat capacity of any technology, with 45 MW of new projects installed in 2018; however, this increase was 17 MW less than in 2017.

Renewable energy generation in Wales



Progress towards targets

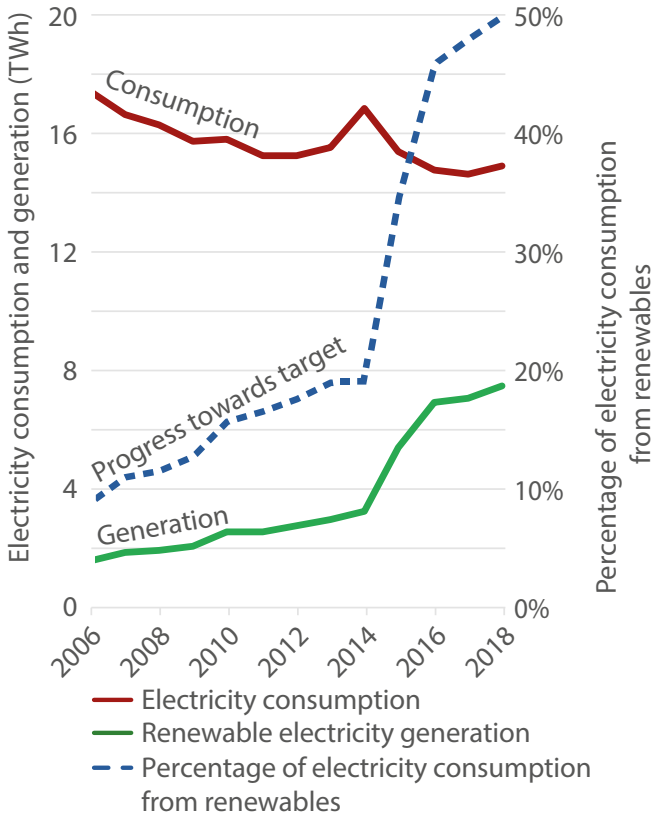
In 2017, the Welsh Government announced a target of meeting 70% of Wales' electricity demand from Welsh renewable electricity sources by 2030. This year, Wales reached the milestone of 50% of electricity consumption being generated by renewable energy, up from 19% in 2014 and 48% in 2017.

The long-term trend of progress towards this target has historically been a combination of both decreasing electricity consumption and increasing renewable electricity generation. Since 2005, electricity consumption has decreased by 18% while renewable electricity generation has increased by over 500%. However, in recent years the decrease in electricity consumption has slowed and renewable energy installation rates have been significantly cut as a result of reductions in support, including the closure of the Feed-in Tariff and Renewables Obligation and the lack of Pot 1 Contract for Difference auctions. Progress towards the target has therefore also slowed.

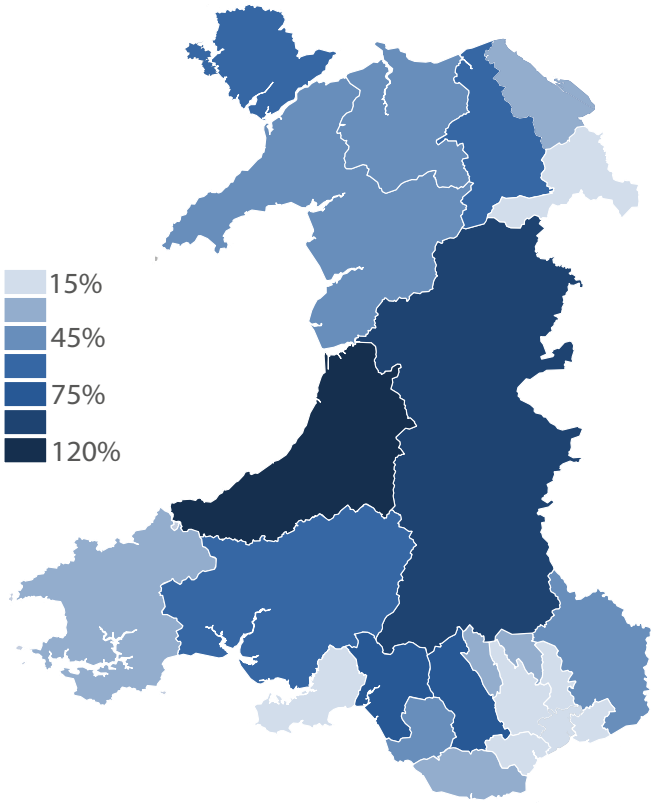
The 2% additional progress achieved towards the target in 2018 is attributable to an increase in renewable electricity generation. Increased renewable generation is predominantly due to an increase in wind generation, as well as a smaller increase in biomass electricity/CHP generation.

There remain significant challenges to meeting the 70% target by 2030, notably the lack of available price support for renewable generation, as well as network constraints and network unavailability in some areas restricting the ability for new projects to connect.

Growth in the percentage of electricity consumption from renewable sources in Wales



Percentage of electricity consumption in each local authority area met by local renewable electricity generation



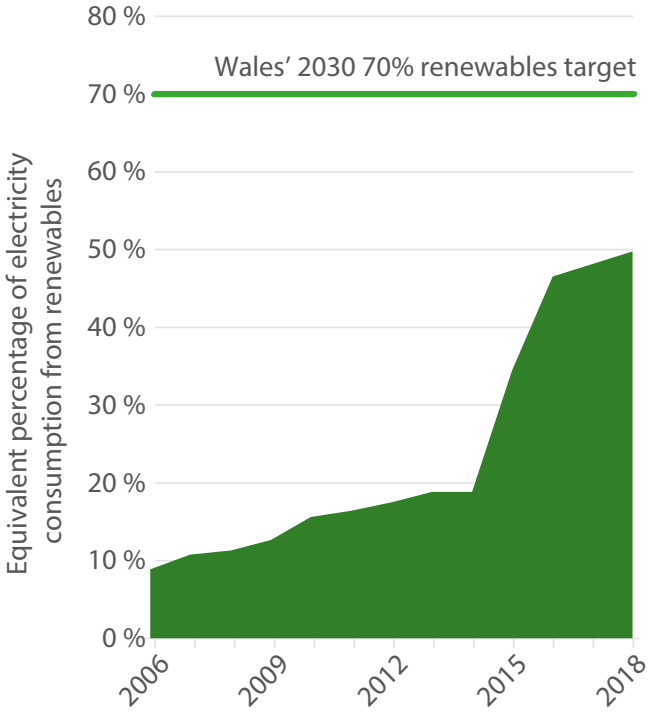
In March 2019 the Welsh Government published 'Prosperity for All: a Low Carbon Wales'. The plan details how Wales intends to meet the first carbon budget and sets the foundations for future action.

In April, the Welsh Government declared a Climate Emergency and this was followed on 1 May by the National Assembly for Wales becoming the first parliament in the world to pass a Climate Emergency. Welsh Ministers have accepted the UK Committee on Climate Change's advice on Wales' contribution to achieving net zero emissions in the UK by 2050. The Welsh Government announced its ambition to work with UKCCC and other stakeholders to understand what is involved in developing a more ambitious net zero target for Wales.

Prosperity for All plan on the power sector target

> The aim of the policies and proposals for the first carbon budget and subsequent carbon budgets will be to work together to transition our power system away from fossil fuels to a low carbon system at a scale and rate that maximises their contribution to the well-being goals.
>
> The move to cleaner, low carbon generation also provides other benefits to society. For instance, a decentralised system contributes to protecting householders and businesses from high energy costs by locating generation near to demand, improving the resilience and flexibility of our energy system and keeping more economic benefit within local communities.
>
> Therefore, the move away from fossil fuels combustion to a more low carbon electricity system contributes significantly to all our wellbeing goals. For instance, our Well-being Matrix tool identified how the local ownership element of our renewable energy policy provides strong benefits in relation to all the well-being goals.

Growth in the percentage of electricity from renewable sources in Wales



- Renewable electricity generation in Wales has increased by over 500% since 2005.
- Electricity consumption has fallen by 18% since 2005.
- Approximately 71% of the increase in renewable electricity generation in the last five years has been due to large-scale onshore and offshore wind.
- The ceasing of co-firing biomass at Aberthaw and the decommissioning of other biomass electricity and energy from waste plants has contributed to the recent slowdown in the installation rate of renewable energy capacity.

The local picture

Of the Welsh local authority areas, Carmarthenshire experienced the greatest renewable energy capacity growth in 2018, due largely to the commissioning of Brechfa Forest West Wind Farm. Denbighshire followed, with a more moderate increase. Three-quarters of Welsh local authority areas saw capacity increases of less than 5 MW.

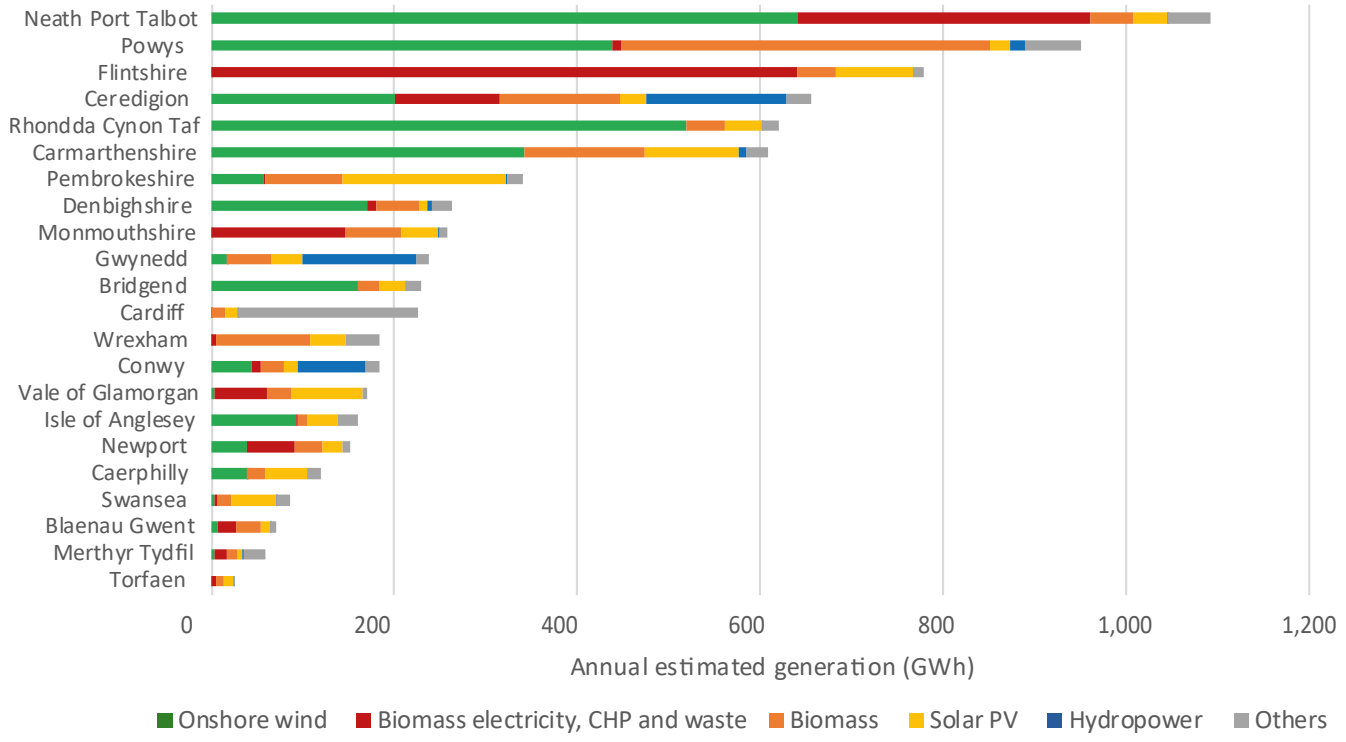
Powys is the local authority area with the greatest installed renewable energy capacity, with 369 MW. However, Neath Port Talbot still has the highest renewable energy generation, with an estimated 1,092 GWh.

Ceredigion has the highest percentage of its electricity consumption met by renewable electricity generation. This is due to a combination of its low electricity consumption and its diverse and relatively high amount of renewable energy, including hydropower, onshore wind and biomass electricity and CHP.

Top five local authority areas by percentage of electricity consumption met by renewables

Local authority area	%
Ceredigion	117
Powys	86
Rhondda Cynon Taf	74
Neath Port Talbot	74
Denbighshire	53

Renewable energy generation by local authority area



Local authority area	Renewable heat and electricity			Fossil fuel electricity		
	Number of projects	Total capacity (MW)	Estimated generation (GWh)	Number of projects	Electrical capacity (MW)	Estimated generation (GWh)*
Blaenau Gwent	939	28	70	4	69	-
Bridgend	2,587	109	230	5	25	-
Caerphilly	2,905	75	119	2	19	-
Cardiff	3,480	64	225	5	33	-
Carmarthenshire	5,598	310	610	2	11	-
Ceredigion	3,462	258	656	3	10	-
Conwy	1,975	85	183	3	2	-
Denbighshire	2,186	107	263	2	1	-
Flintshire	3,584	223	780	2	1,386	-
Gwynedd	3,131	124	238	1	0	-
Isle of Anglesey	2,103	86	160	1	0	-
Merthyr Tydfil	747	21	59	3	42	-
Monmouthshire	4,193	93	258	2	0	-
Neath Port Talbot	1,909	351	1,092	6	614	-
Newport	2,238	61	152	7	897	-
Pembrokeshire	5,051	250	340	7	2,331	-
Powys	6,706	369	951	4	1	-
Rhondda Cynon Taf	3,862	255	621	9	73	-
Swansea	2,987	64	87	4	85	-
Torfaen	1,979	15	25	5	0	-
Vale of Glamorgan	2,262	104	171	9	1,936	-
Wrexham	4,835	85	184	6	44	-
Offshore	3	726	2,200	-	-	-
Unknown	2	0	1	-	-	
Total	68,724	3,864	9,675	92	7,580	22,759

* Not disclosed due to confidentiality

CASE STUDY - RADYR WEIR

The Radyr Weir hydro scheme uses the current of the River Taff to produce up to 360 kW of electricity. The scheme has two Archimedes screw turbines, each 10 m long, which generate enough energy to power approximately 550 homes each year. It was commissioned at the end of 2015 and is owned by Cardiff Council. The project, therefore, contributes to both Cardiff Council's aspiration to lower its environmental impacts and the Welsh Government's goal of 1 GW of renewable electricity being locally owned by 2030.

Credit: Cardiff Council

Locally owned renewable energy

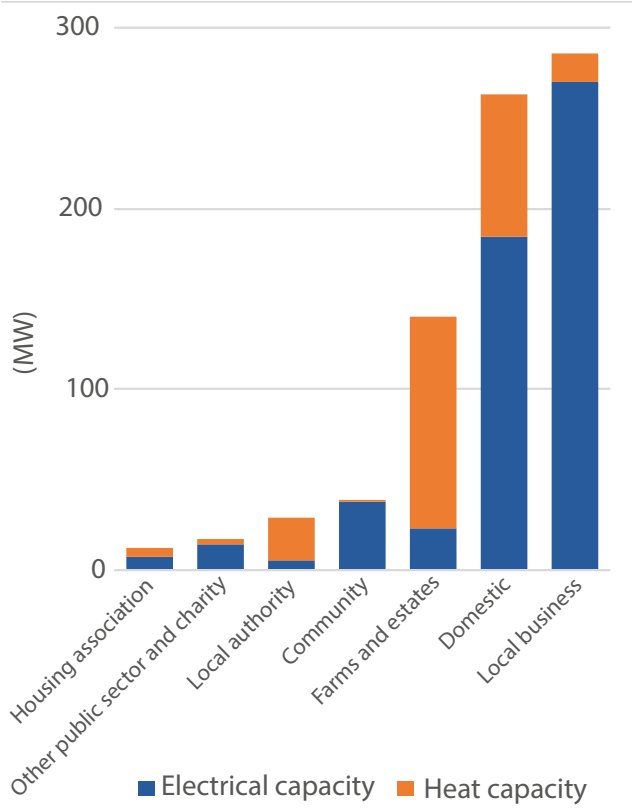
The Welsh Government has set a target that at least 1 GW of renewable energy capacity should be locally owned by 2030. There is also an expectation for all new energy projects in Wales to have at least an element of local ownership from 2020.

Locally owned renewable electricity capacity increased by 11 MW to 540 MW in 2018. Locally generated heat capacity increased by 22 MW to 243 MW, representing a 10% increase on the previous year. Wales has therefore reached 783 MW of locally owned capacity, 78% of the way towards the 1 GW target. Solar PV projects make up just under half of locally owned electricity capacity in Wales.

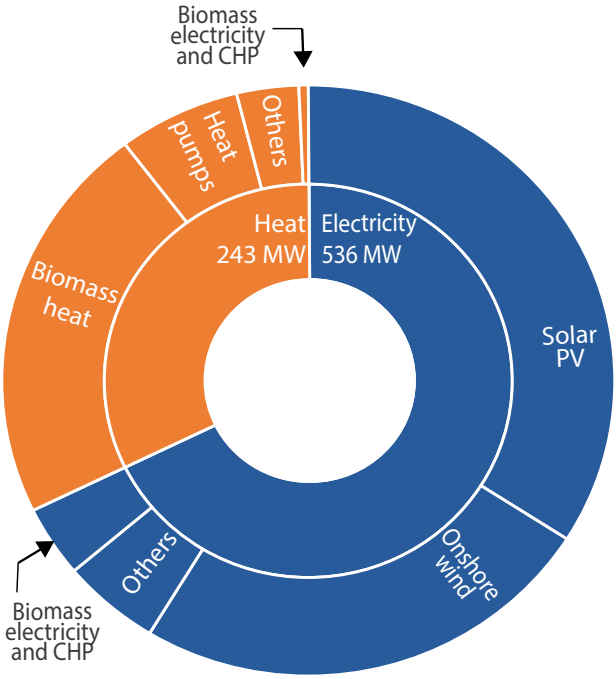
Biomass remains the technology that makes up the largest proportion of locally owned renewable heat capacity, with 75% of locally owned renewable heat capacity installed in 2018 coming from biomass projects.

There are around 64,600 locally owned renewable energy projects in Wales, 94% of all renewable energy projects in Wales. Over 83% of all locally owned renewable energy projects are solar PV projects. In 2018, 1,566 new locally owned renewable energy projects were installed, 906 of which were solar PV projects and 485 were heat pumps.

Locally owned renewable electricity and heat capacity by ownership type



Locally owned renewable energy generation by technology



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[3], 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 number of projects	Capacity (MWe)	Capacity (MWth)	Estimated generation (GWh)
Community	174	37	1	50
Domestic	56,909	184	78	360
Farms and estates	775	23	117	456
Housing association	5,687	7	5	11
Local authority	300	13	3	33
Local business	379	270	16	826
Other public sector and charity	413	5	23	75
Total	64,637	540	243	1,812

Fossil fuels

The ownership of fossil fuel electricity projects has not fully been assessed, as there are no appropriate datasets available for analysis. It is estimated that at least 19%, or approximately 1.5 GW of gas and coal electricity generation capacity is locally owned. This is predominantly attributable to two large-scale gas plants that are owned by the Welsh-based power producer Calon Energy. It is expected that a higher proportion of small-scale fossil fuel generators would be locally owned.

CASE STUDY - RHIWFELIN FACH FARM

To the west of Rhiwfelin Fach Farm, Llantrisant, a single 850 kW wind turbine was commissioned in August 2018. Developed by the Wales-based wind developer Infinite Renewables for The Royal Mint, the turbine is designed to resemble a giant daffodil. All energy generated by the turbine is consumed on site, supplying 10% of the Royal Mint's electricity demand. Owned by a public sector organisation, The Royal Mint's daffodil wind turbine contributes towards Wales' local ownership target.

Credit: Infinite Renewables

Low carbon technologies

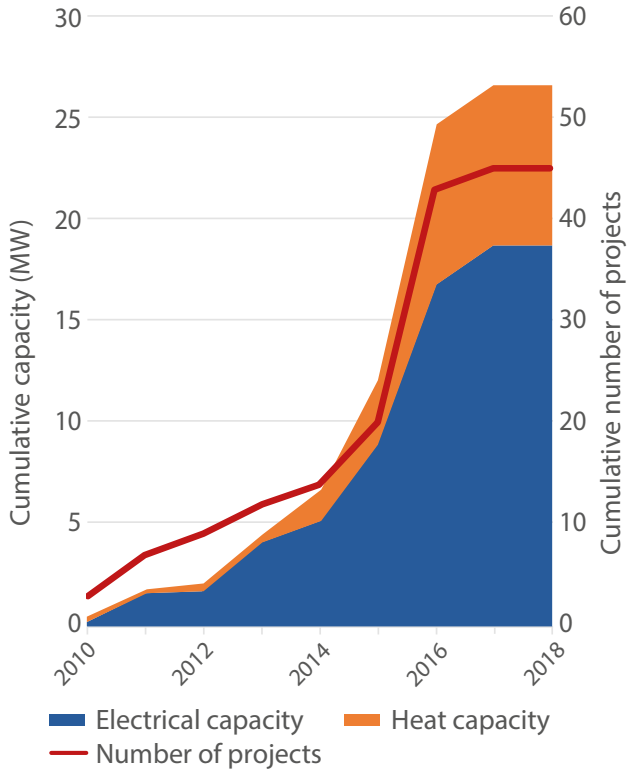
Anaerobic digestion

There are 45 anaerobic digestion (AD) projects installed in Wales, totalling 27 MW of electrical and thermal capacity. No new anaerobic digestion AD projects have been identified as commissioning in 2018.

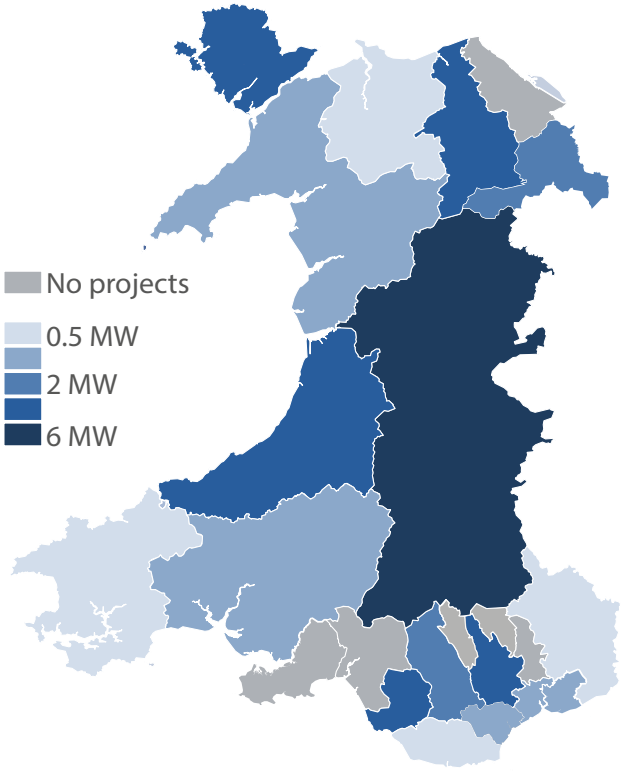
Analysis

The 27 MW of AD capacity in Wales is made up of 19 MW of electrical capacity and 8 MW of thermal capacity. 16 of the 22 local authority areas host one or more AD plants. Around a quarter of the AD plants are in Powys and account for 6 MW of total capacity. Deployment rates of AD have halted since subsidy tariff rate cuts in 2017, before which there was a period of high growth; between 2014 and 2016, the number of AD projects in Wales trebled.

AD deployment over time



Geographic distribution of AD



Future

In 2018, the Renewable Heat Incentive tariffs for AD and Renewable Transport Fuels Obligation rates were both increased. Together with new rules to allow the claiming of both payments for biomethane, these increases have the potential to revitalise the AD market. However, the requirement for at least 50% of AD feedstock to be from waste in order to receive Renewable Heat Incentive support may limit project development. Wales has been successful in reducing the amount of food waste produced. In 2017, Wales' household waste was around 9% lower than the rest of the UK and is expected to continue decreasing. Wales' Low Carbon Development Plan discusses plans to continue supporting the generation of renewable energy from AD.

Biomass heat

Biomass heat projects represent over two-thirds of all renewable heat capacity in Wales, with a total thermal capacity of 443 MW from 3,345 projects. There were 135 new projects commissioned in 2018, adding 45 MW of capacity.

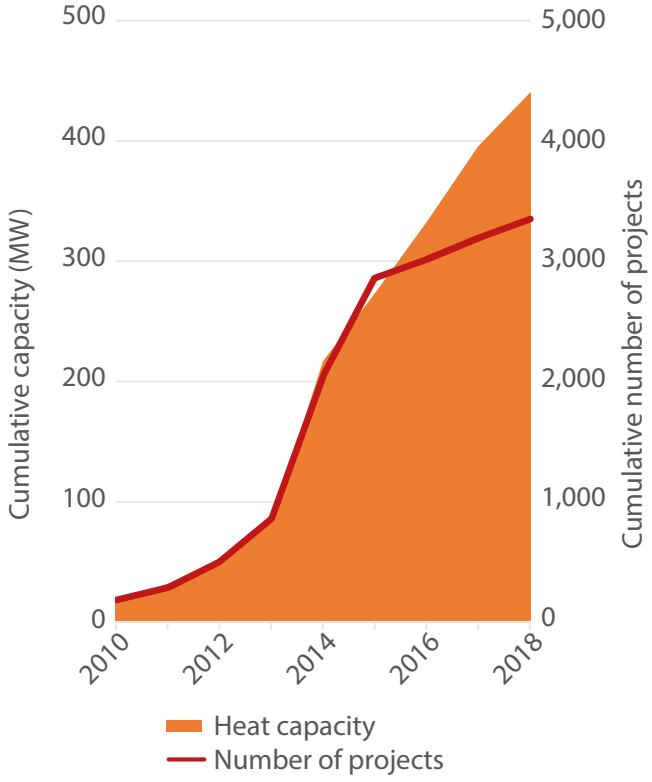
Analysis

There are five biomass heat projects with a capacity over 1 MW in Wales, the largest of which remains the 23 MW solid biomass boiler at a wood manufacturing plant in Wrexham, commissioned in 2014. The most recent project, commissioned in 2018, is a 1.25 MW solid biomass boiler in Rhondda Cynon Taf. These five projects make up 12% of Wales' biomass thermal capacity.

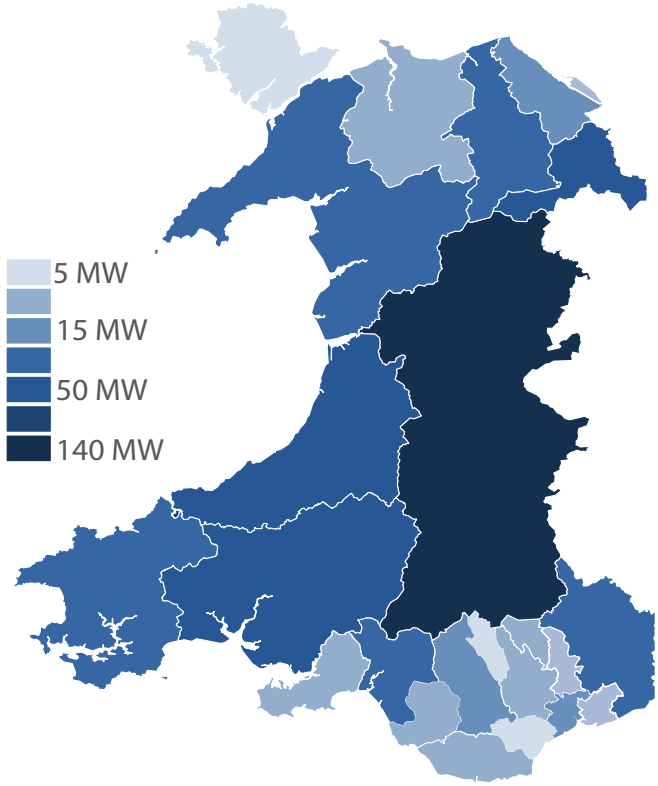
Powys is the local authority area with the highest biomass deployment, with a total thermal capacity of just under 132 MW across 928 projects, representing just over a quarter of all biomass heat projects in Wales. Ceredigion and Carmarthenshire are the local authority areas with the next highest capacities, with each hosting around 43 MW.

Biomass heat projects in Wales generated 1,360 GWh of heat, enough to meet the equivalent heat demand of approximately 108,000 homes. However, the deployment of biomass boilers in domestic properties (excluding log burners) is limited, with installations in less than 0.1% of Welsh homes. In 2018, 68% of new installations were in non-domestic properties.

Biomass heat deployment over time



Geographic distribution of biomass

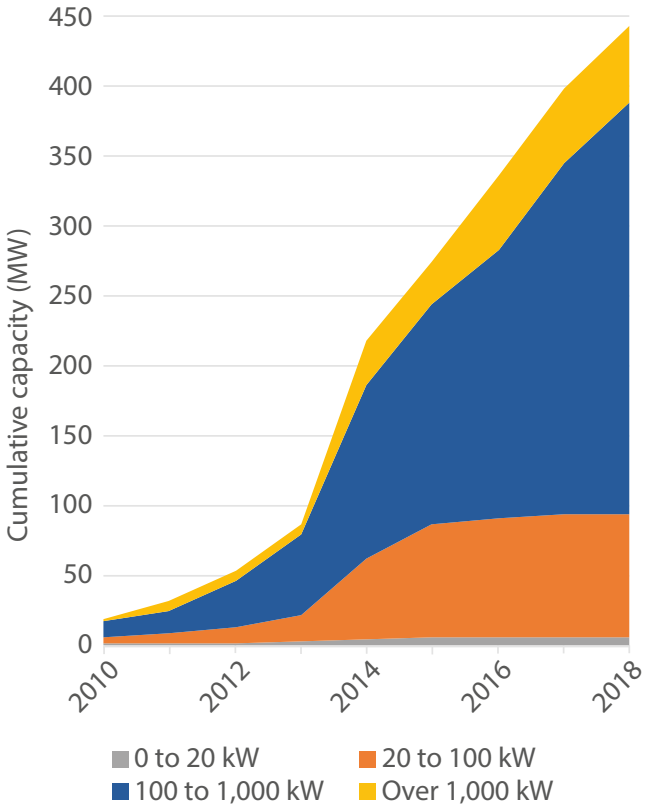


Future

There is considerable uncertainty around pathways for decarbonising heat in the UK. This includes debate over the role for biomass, for which there can be sustainability challenges, particularly when carbon savings depend partially on the distance that biomass is transported. In addition, there can be challenges for biomass use regarding potential local air quality impacts. Evidence on the impact of biomass to local air quality will be considered as part of the work of the Clean Air Plan for Wales, which the Welsh Government will be consulting on later this year.

Despite these challenges, there is a potential long-term role for small-scale biomass projects or biomass-fuelled CHP 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 continues to offer support under the Renewable Heat Incentive, provided sustainability criteria are met. However, tariff cuts have reduced current deployment rates, particularly affecting smaller scale projects, and the Renewable Heat Incentive is due to conclude for new projects in 2021.

Biomass heat deployment by project scale



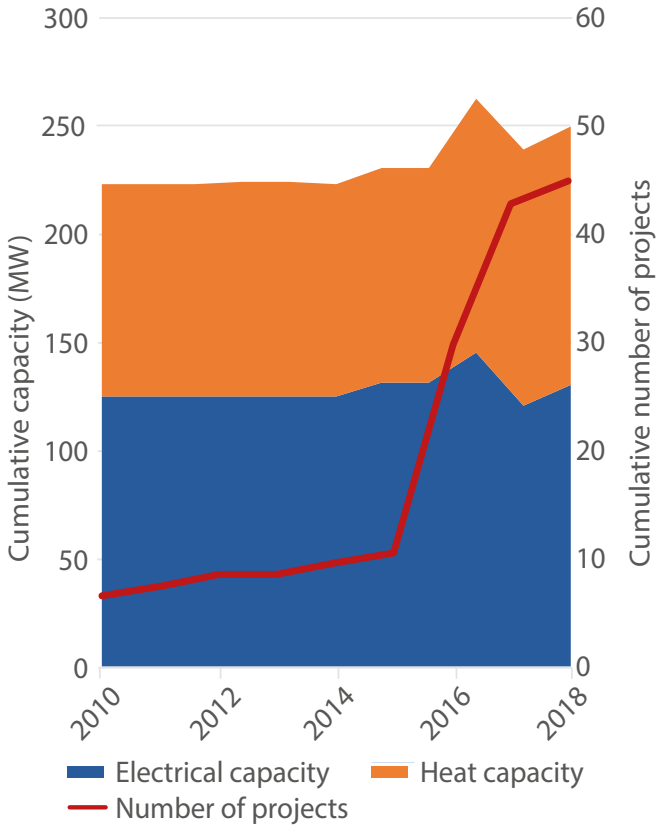
Biomass electricity and CHP

Technologies within this category include electricity from biomass (including waste wood), biomass CHP plants and biomass gasification plants. There are currently 48 operating projects in Wales of these types, with a total electrical capacity of 131 MWe and thermal capacity of 119 MWth. In 2018, four projects were commissioned, with a total capacity of 10.7 MWe. The biggest was the 10 MWe waste-wood fired gasification plant at Barry Docks in The Vale of Glamorgan.

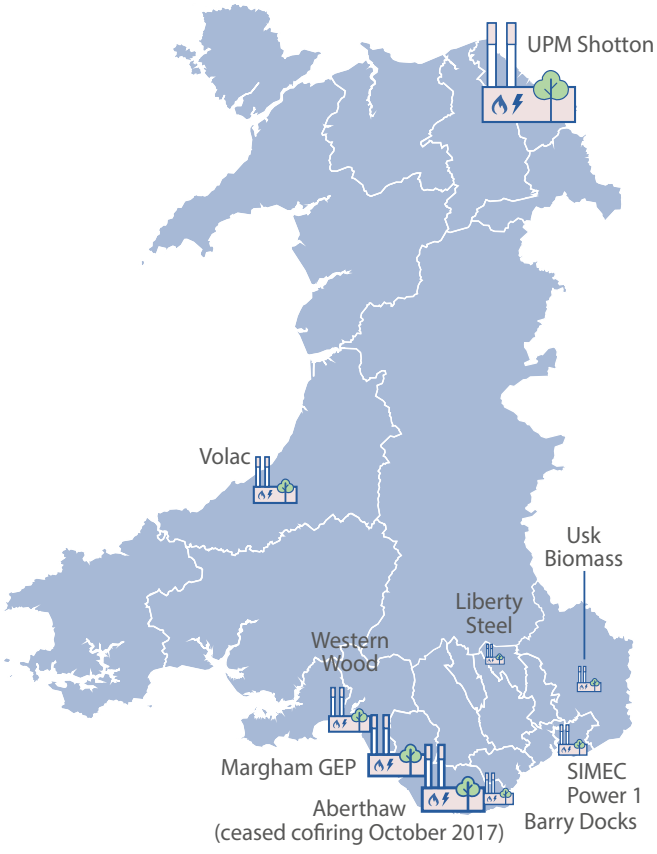
Analysis

The development of new biomass electricity and CHP in Wales has reduced significantly in recent years, from 20 new projects in 2016 to 4 in 2018. The overall electrical capacity of this category increased by 8% in 2018, following a small decrease in 2017. At 41.8 MWe, the Margam Green Energy Plant in Neath Port Talbot, commissioned in 2017, is the largest plant in this category to be installed in recent years. The CHP plant at Shotton Paper Mill in Flintshire remains the project with the highest total capacity at 115 MW, due to having the highest thermal capacity at 90 MWth combined with an electrical capacity of 25 MWe.

Biomass electricity and CHP deployment over time



Geographic distribution of biomass electricity and CHP projects



Powys is the local authority area with the largest number of biomass electricity/CHP projects, with nine small-scale plants totalling 0.91 MWe and 0.97 MWth. Neath Port Talbot is the local authority area with the highest biomass electrical capacity due to the 41.8 MWe Margam Green Energy Plant.

Future

The planned phase-out of coal in the UK's energy mix previously led to an increase in biomass co-firing in coal-fired power stations and a surge of interest in biomass electricity generating plants. However, in recent years this trend has slowed, as a result of the UK Government tightening regulations regarding biomass electricity. For example, to obtain a Contract for Difference for a new biomass project, the emissions' limit ($kgCO_2$ emitted per MWh generated) is over six times lower than it was previously under the Renewables Obligation. The UK's 2019 Clean Air Strategy has a considerable focus on biomass, and includes proposals to remove coal-to-biomass conversions from future Contract for Difference auctions. Despite this, a small number of new biomass electricity plants are in development, aiming to meet the tighter emissions limits and focussing on revenues from the sale of power rather than receipt of incentive payments.

Energy from waste

This section includes energy from waste plants that generate energy from municipal or commercial waste and excludes wood-waste only plants (considered in the biomass electricity chapter on page 19). Anaerobic digestion is considered as a separate technology on page 16. Only one energy from waste plant is now in operation in Wales, with a total electrical capacity of 30 MW.

Analysis

The only energy from waste project in operation is the 30 MW Trident Park energy recovery facility in Cardiff, owned and operated by Viridor. Commissioned in 2015, Trident Park has the capacity to handle 425,000 tonnes of municipal waste a year and diverts at least 95% of residual waste produced in South Wales. The 5 MW Swansea Crymlym Burrows waste incinerator in Neath Port Talbot has been decommissioned.

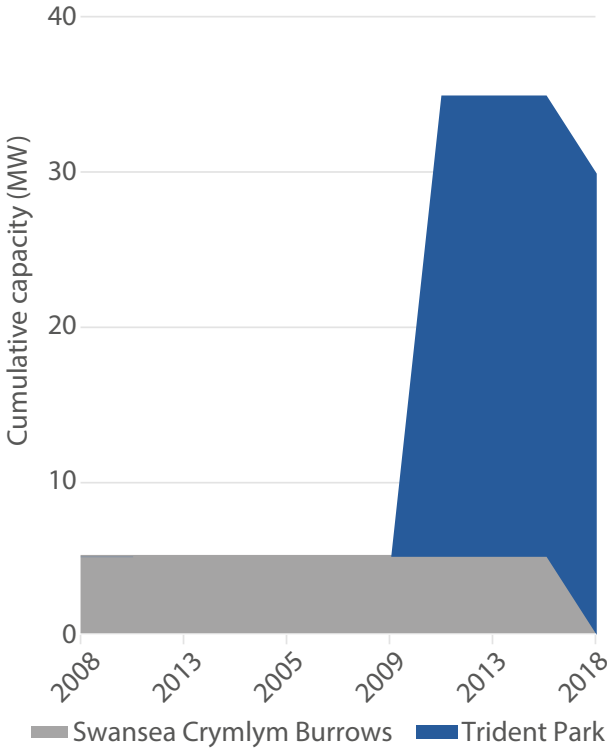
Future

There is debate around the availability of waste resource for energy generation in the UK, both as progress is made towards a zero-waste economy and thanks to the current ability for the UK to export waste at low cost to take advantage of excess incineration capacity in Europe. However, there remains significant activity in Wales to develop new energy from waste plants in the near term. For example, the 16 MW Wheelabrator Parc Adfer incineration facility is under construction in Flintshire and is expected to be completed by the end of 2019.

Advanced Thermal Treatment plants use gasification or pyrolysis to generate energy from waste. In the UK, Advanced Thermal Treatment plants have tended to fail in the development phase due to technology issues, resulting in financial losses. If these issues can be overcome, Advanced Thermal Treatment plants could become more widespread, taking advantage of more localised commercial waste streams and gaps in municipal processing provision.

In Wales, several Advanced Thermal Treatment projects are publicly under development, including one which won Contracts for Difference agreements: the 20 MW Enviroparks' Hirwaun plant.

Energy from waste deployment over time



Heat pumps

Wales has 56 MW of air, ground and water source heat pumps across 4,928 installations. 488 new projects were commissioned in 2018, adding 5.5 MW of thermal capacity. Heat pump installations currently produce 108 GWh of heat, the equivalent of 0.6% of estimated domestic heat demand in Wales.

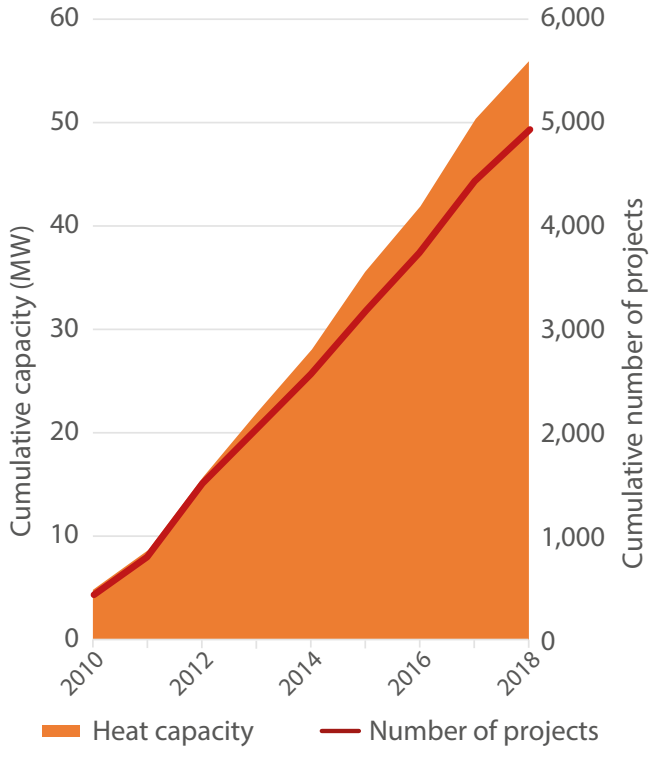
Analysis

In 2018, the heat pump installation rate in Wales fell slightly below the recent annual average, with 488 new installations; this is the lowest number of new projects since 2011. The majority of new installations were air source heat pumps, with 403 new projects falling under that category. These now make up 72% of all heat pumps in Wales. However, the largest heat pump installed in 2018 was a 173 kW water source heat pump in Powys.

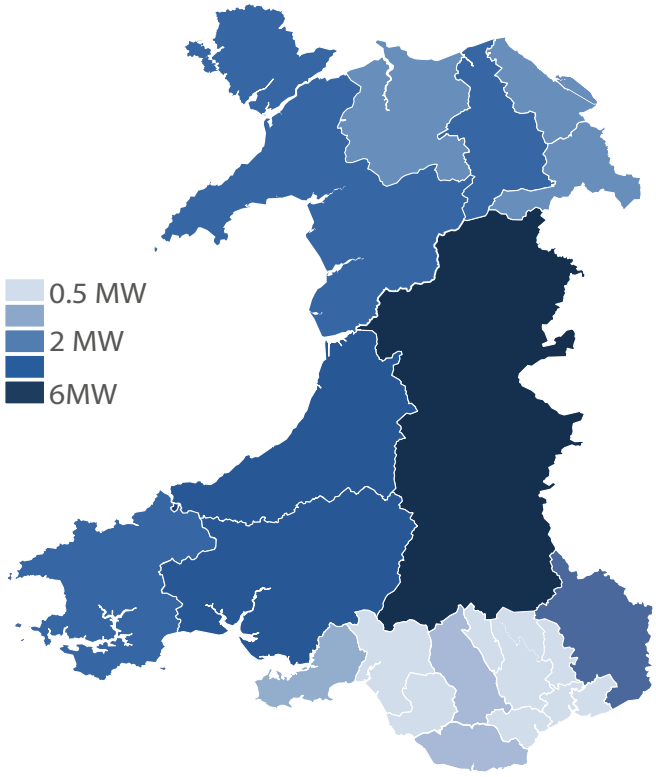
The deployment rate of installations over 45 kW in capacity fell in 2018, with only five projects compared to seven in 2017. The majority of new installations are small-scale heat pumps below 10 kW capacity.

Powys is the local authority area with the highest number of heat pumps, with a total of 882 projects, giving it the highest thermal capacity of 9.7 MW. In 2018, Ceredigion saw the greatest growth in installed capacity and projects, with 0.87 MW being installed across 116 projects.

Heat pump deployment over time



Geographic distribution of heat pumps

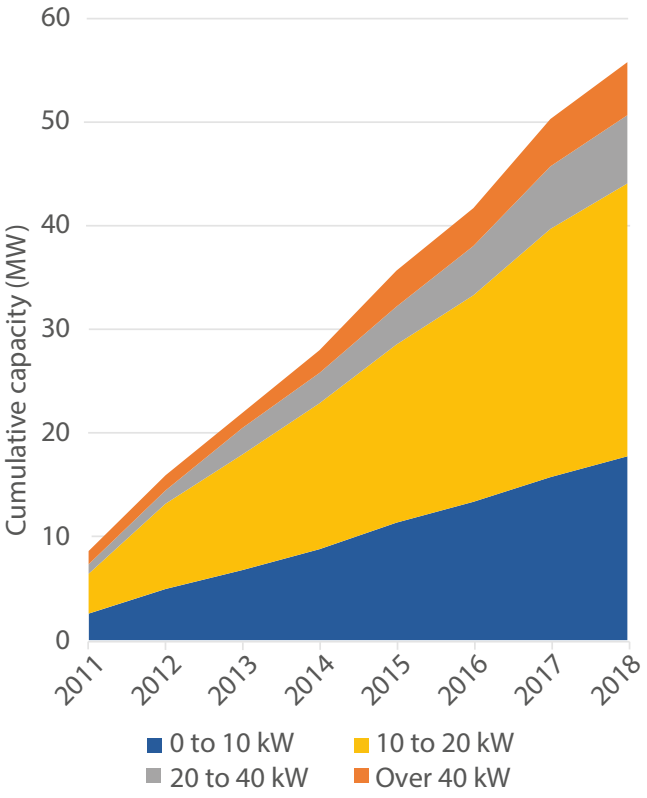


Future

Heat pumps are described in the Committee on Climate Change net zero report as being a no-regret option to put the UK on track to meet its decarbonisation commitments, and in the 'Decarbonising Welsh Housing' report as being a potential solution for decarbonising off-gas homes. However, the installation rate of heat pumps remains low. Heat pumps have a higher upfront cost than most conventional heating systems and are most effective in energy efficient homes, so the widespread deployment of heat pumps is only likely alongside widespread uptake of energy efficiency measures. The Prosperity for All: A Low Carbon Wales Report discusses energy efficiency stimuli and support which will be explored in 2019.

Strategic decisions about the role of hybrid heat pumps, and in the longer term hydrogen heating, will also affect the uptake rates of heat pumps and other renewable heating technologies.

Heat pump deployment by project scale



CASE STUDY: BRIDGEND MINE WATER HEAT PUMP WITH DISTRICT HEATING

A feasibility study for a heat pump system that extracts heat from mine water is underway in Bridgend. Local mine water is being considered as a suitable heat source due its consistent temperature of over 20°C. Welsh Government and European funding has been awarded to develop the technology that would be required to pump the mine water to the surface and upgrade it to a usable temperature. It would then be used to heat 300 homes, community buildings and a primary school, in the fifth most deprived ward in Wales. There is the potential for the technology to be deployed at more sites across Wales.

Hydropower

Wales has 182 MW of hydropower capacity from 364 projects. Hydropower generates approximately 367 GWh of power annually, enough to power the equivalent of 104,000 Welsh homes. The largest project commissioned in 2018 was the 550 kW Bryn Cowlyd Water Treatment Works Hydroturbine in Conwy.

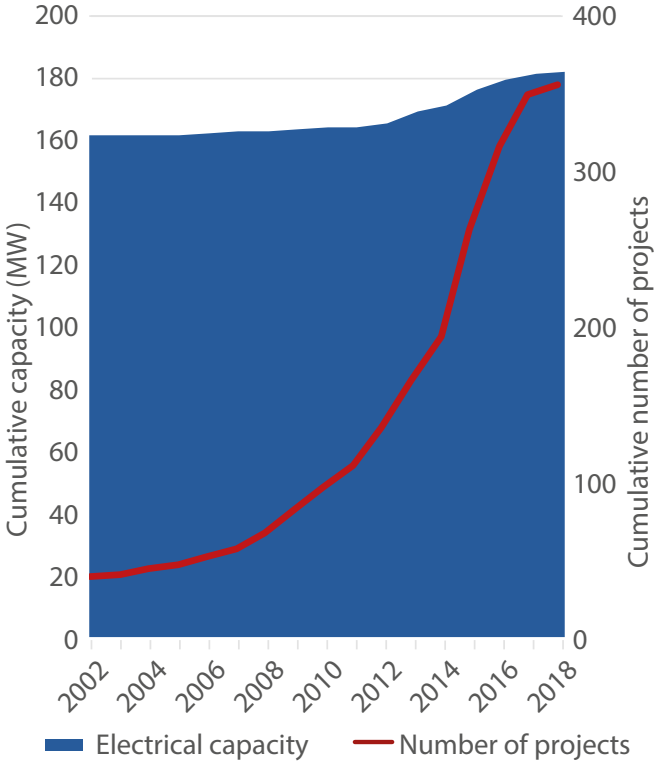
Analysis

There were only six new projects commissioned in 2018, less than 10% of the deployment rate of 2015 when installation rates peaked at 70 new projects. Total installed hydropower capacity increased by less than 1% between 2017 and 2018.

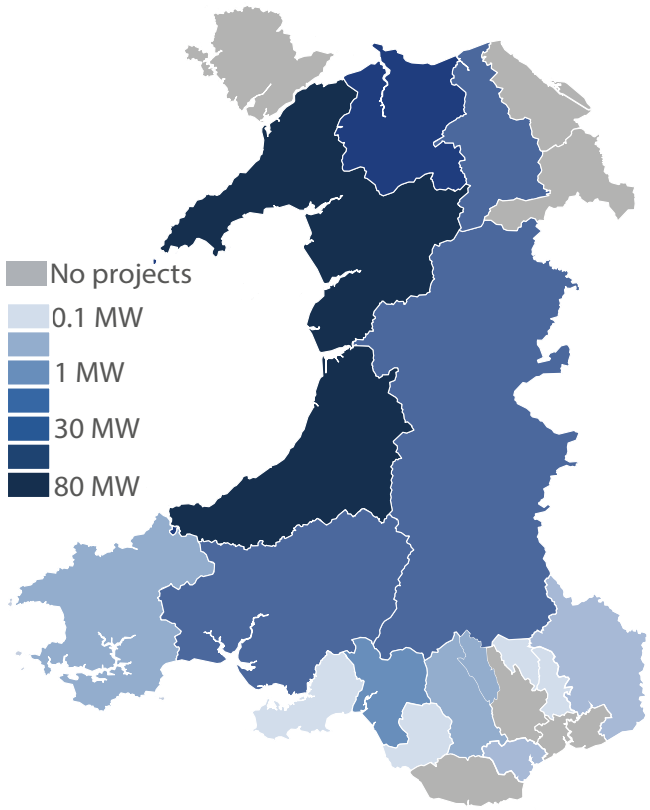
Nearly 80% of the installed capacity in 2018 is due to the 550 kW Bryn Cowlyd project in Conwy, the first project over 500 kW that has commissioned since 2014. No hydropower project over 700 kW has been commissioned in the last 20 years. The largest hydropower project in Wales, Rheidol Power Station, is in Ceredigion, commissioned in 1964 and has a capacity of approximately 56 MW.

Gwynedd remains the local authority area with the greatest number of hydropower projects in Wales, with 141 projects totalling 59 MW. However, due to hosting Rheidol Power Station, Ceredigion has the greatest hydropower capacity with just under 71 MW across 28 projects.

Deployment of hydropower over time



Geographic distribution of hydropower



Future

Prior to its closure in March 2019, the Feed-in Tariff supported steady growth in small- and medium-scale hydropower deployment in Wales. With the closure of the Feed-in Tariff, the closure of the Renewables Obligation in 2017, and hydropower not presently being eligible for Contracts for Difference, there is now no existing or planned tariff support for hydropower.

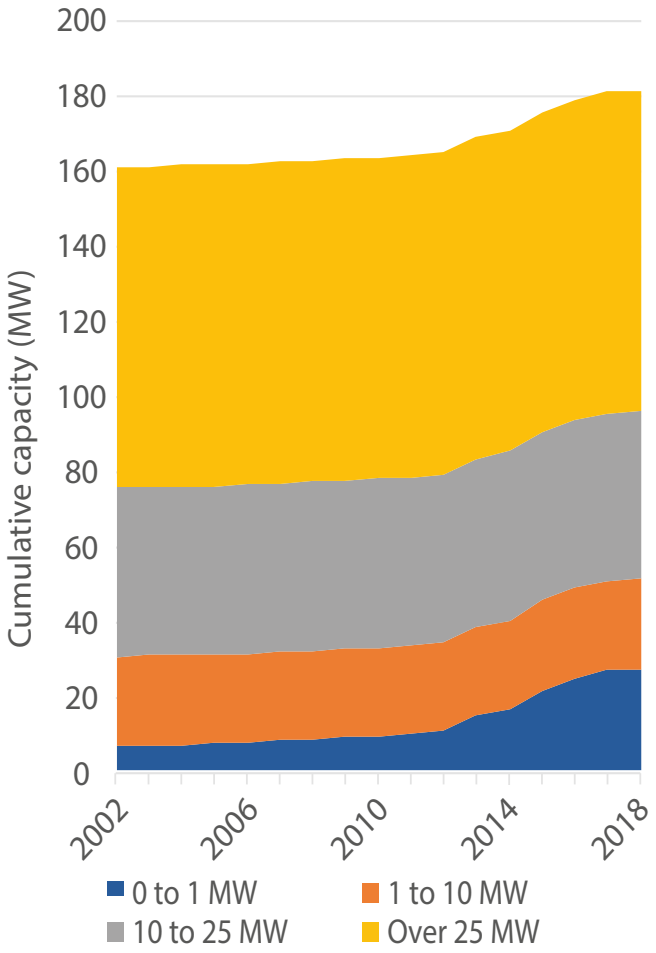
The Feed-in Tariff supports 274 hydropower projects in Wales, 75% of all hydropower projects. These projects total nearly 15 MW in capacity, which represents most of the hydropower capacity installed in the last 15 years.

Hydropower is a mature and proven technology that can provide a predictable source of energy. However, the relatively high upfront cost and a lack of cost reduction potential is likely to limit future growth without support.

The 2017 revaluation of business rates also impacted the sector, with many schemes seeing a large increase in their rateable value. The Welsh Government is providing grant support to the sector for payment of business rates.

In the near term the deployment rate is likely to remain low, with sites being developed only where conditions are optimal, for example where there is the potential to supply the electricity to a local user or users, or where a long-term approach to capital payback is adopted.

Hydropower deployment by project scale



Landfill gas

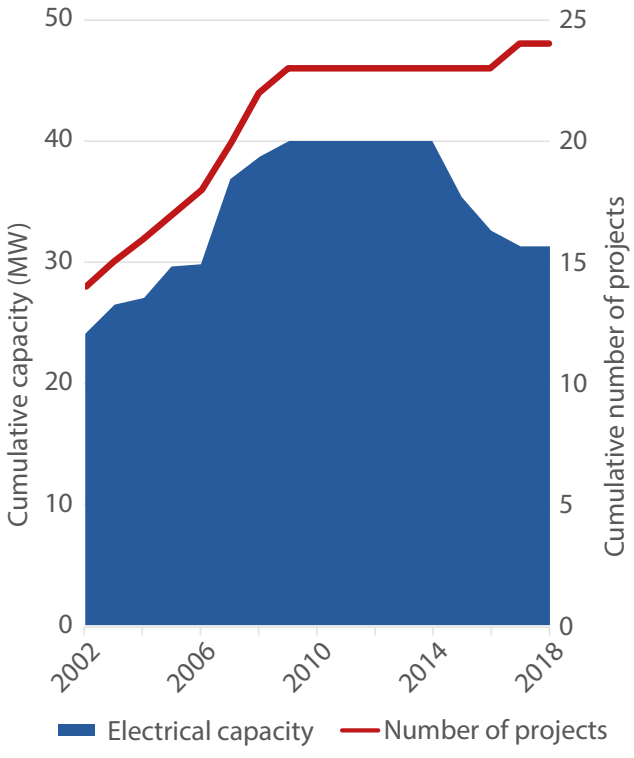
There are 24 landfill gas projects in Wales with a total capacity of 31.4 MW. There was no change between 2017 and 2018 in the number and total capacity of landfill gas powered generation plants.

Analysis

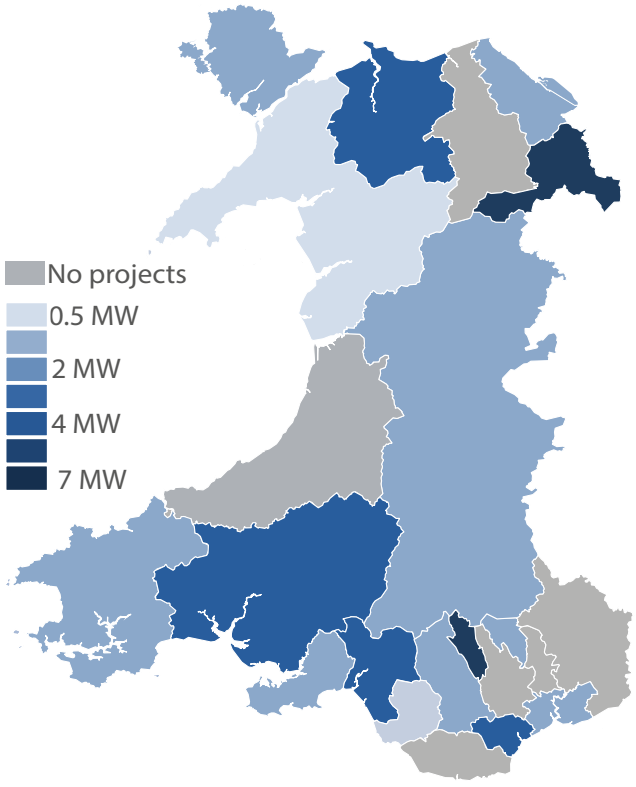
Landfill gas in Wales generated 117 GWh of electricity in 2018, enough to power the equivalent of approximately 33,000 Welsh homes. However, the amount of generation from landfill gas has been decreasing each year from a peak in 2014. This is due to waste increasingly being diverted away from landfill, particularly organic waste, and so the amount of methane gas captured from decomposing waste is decreasing.

There remains a spread of landfill gas projects across the local authority areas in Wales. Merthyr Tydfil has the greatest capacity with 6.3 MW, including the 4.3 MW Trecatti 2, the largest landfill gas site in Wales. Wrexham has the highest number of projects and second largest capacity in Wales, with three projects and a total of 4.4 MW capacity.

Deployment of landfill gas over time



Geographic distribution of landfill gas



Future

Wales now recycles 63% of its municipal waste, up from 5% in the 1990s. This transformation has been the result of Wales' ambitious waste reduction targets, high rates of recycling collection and well-developed reprocessing infrastructure.

Wales now has an ambition for zero waste to be sent to landfill by 2025. As a result, there will be a reduced role for landfill gas generation as the amount of organic waste in landfill sites reduces.

Nuclear

Wales currently has no nuclear power generation. Horizon Nuclear Power has been negotiating with the UK Government to develop plans for a new 2.9 GW nuclear power station at Wylfa Newydd on Anglesey. The Welsh Government is working to secure a lasting legacy for Wales from the project if it goes ahead.

Analysis and future

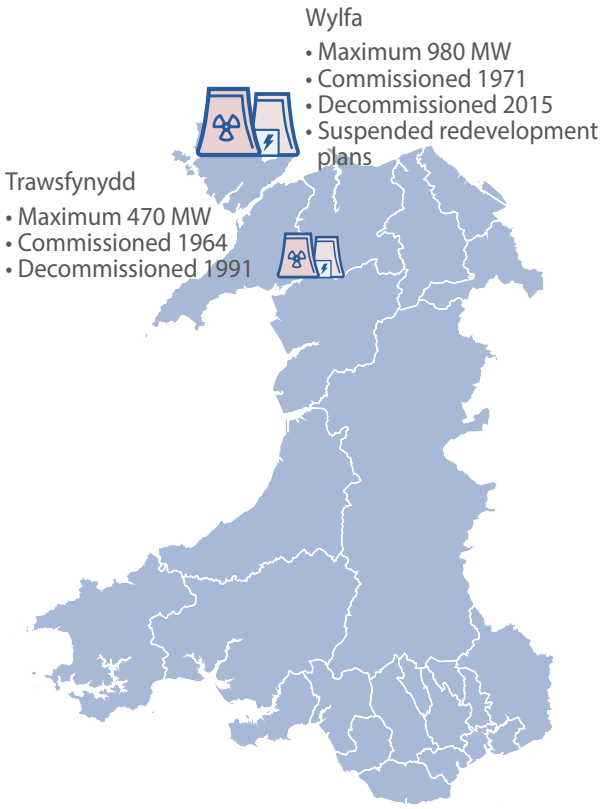
For over 50 years, nuclear power was generated in Wales at the Wylfa and Trawsfynydd sites. The Trawsfynydd site in Gwynedd operated for 26 years until 1991, while Wylfa on Anglesey finally ceased operation in December 2015 after 44 years of operation.

Since 2009, plans have been developed by Horizon Nuclear Power, a UK subsidiary of the Japanese company Hitachi, for a 2.7 GW new nuclear power station on an adjacent 'Wylfa Newydd' site. Hitachi's Advanced Boiler Water Reactor received its UK license from the Office for Nuclear Regulation in December 2017 and the company submitted a Development Consent Order application to the Planning Inspectorate in October 2018. However, in January this year, the company announced a suspension for Wylfa Newydd due to insufficient progress being made in the negotiations around project financing.

In July 2019, the UK Government launched a consultation on the adoption of a new Regulated Asset Base (RAB) model which could provide an alternative future funding model for nuclear new build projects. This may have potential to help revive the Wylfa Newydd project and the Welsh Government remains in regular dialogue with Horizon regarding future development options for the site.

The Trawsfynydd nuclear power station is currently undergoing decommissioning. The former power station site is included in the Snowdonia Enterprise Zone established by the Welsh Government in 2012 and the Enterprise Zone's Board is actively promoting the site's re-use for the deployment of 'small' or 'advanced' modular reactors – conventionally regarded as reactors of up to 350 MW capacity. The site has already attracted significant interest from potential developers and substantial work has already been undertaken to de-risk the site. Currently, work is being undertaken to explore the potential for establishing a Development Company with a remit to redevelop the Trawsfynydd site and procure appropriate technology for eventual deployment.

Geographic distribution of nuclear



Onshore wind

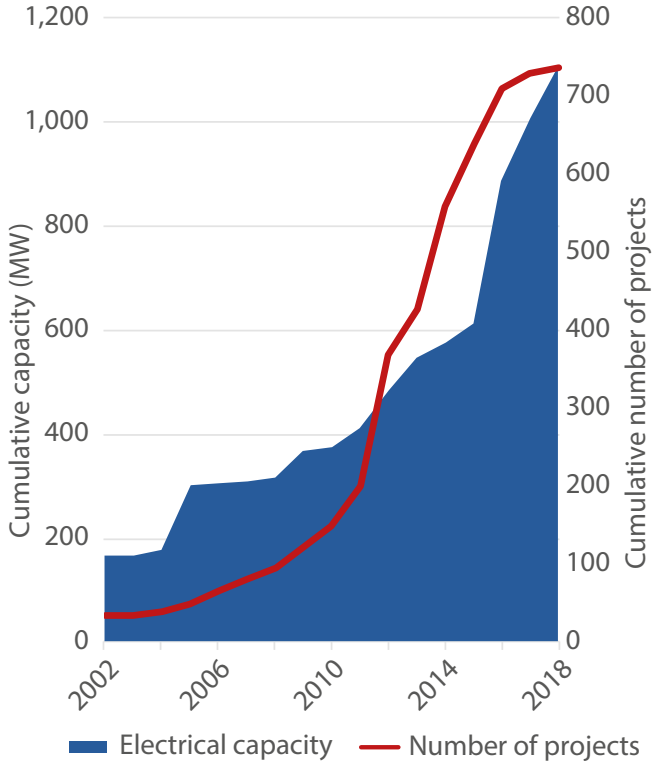
Welsh onshore wind capacity increased by nearly 100 MW in 2018 to 1.1 GW, generating enough electricity to power the equivalent of 55% of Welsh homes. The vast majority of new onshore wind capacity commissioned in 2018 was from two large-scale projects: the 57.4 MW Brechfa Forest West Wind Farm in Carmarthenshire and the 37.6 MW Brenig Wind Farm in Denbighshire.

Analysis

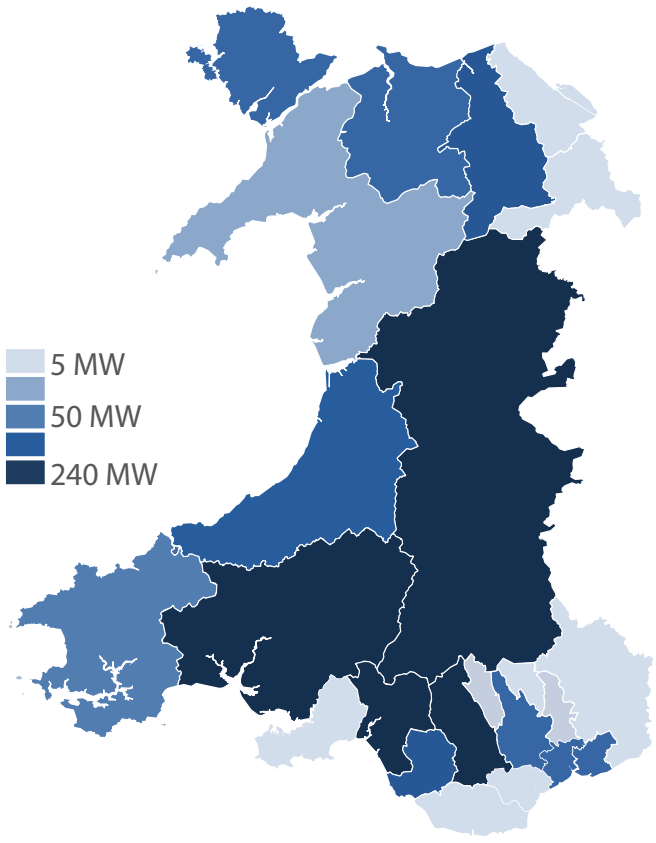
In addition to the two new large-scale onshore wind projects, six small-scale projects commissioned in 2018. These eight projects provide an additional 99 MW of new capacity, a similar increase in capacity to the previous year. This represents a 10% increase in total onshore wind capacity, but just a 1% increase in the overall number of projects. With only one project commissioned in 2018, the number of projects installed that were rated under 500 kW was at its lowest since 2004.

Neath Port Talbot remains the local authority area with the highest onshore wind capacity, with 230 MW from only 12 projects, mainly due to 138 MW of the 226 MW Pen y Cymoedd wind farm sited within the authority's area. A similar situation exists in Rhondda Cynon Taf, which hosts the remaining 90 MW of the Pen y Cymoedd wind farm and six other large-scale projects.

Deployment of onshore wind over time



Geographic distribution of onshore wind

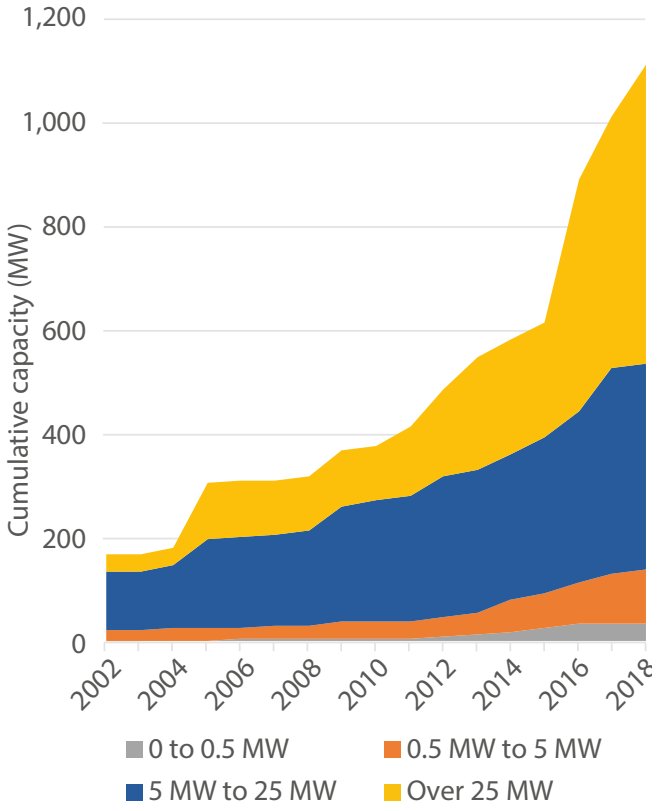


Future

With a supportive planning environment and strong wind resources, Wales has significant potential for further onshore wind development. The draft National Development Framework 2020-2040 sets out a positive approach, offering support in identified areas for appropriate development of largescale wind and solar, with a focus on maximising the local benefits that these projects can bring.

However, there is a disparity in Wales between the location of future developable onshore wind resources and suitable electricity network infrastructure. This represents a key barrier to further development of onshore wind in Wales. For example, in 2015, the 31.8 MW Llandinam wind farm in Powys received planning consent to repower with a smaller number of more efficient turbines within five years. In 2019, the developer applied for permission to extend the repowering timescale to 2025 to allow more time to find a solution to grid connection issues in the area.

Deployment of onshore wind by project scale



Support for new onshore wind projects is not currently available, with no Pot 1 auctions having taken place under Contracts for Difference since 2015. This has reduced the number of projects being planned; only two new planning applications for large-scale projects were submitted in 2018. However, onshore wind technology costs have fallen, with further reductions expected. As a result, the first UK subsidy-free projects are starting to be developed, with developers focussing on sites in Wales and Scotland. For example, Pant y Maen, a seven-turbine wind farm in Denbighshire, was granted planning permission in February 2018 and is being developed on a subsidy-free basis.

Several older onshore wind projects in Wales are approaching the end of their operational lives. For such projects, several options are available:

- Repowering of existing projects by using a smaller number of larger, more efficient wind turbines, helping to increase the amount of electricity generation from onshore wind in Wales.
- Some developers may choose to apply to extend the operational life of a project, rather than repowering. For example, in 2018, Bryn Titli wind farm in Powys was granted an eight-year extension to the operational life of the wind farm.
- Other sites may decommission entirely when the end of their planned life is reached.

Offshore wind

Wales has three offshore wind projects, totalling 726 MW. All three Welsh projects are located off the North Wales coast, in Liverpool Bay.

Analysis

Wales was an early adopter of offshore wind; North Hoyle (60 MW) and Rhyl Flats (90 MW) were both developed under the first offshore wind leasing round from The Crown Estate in 2003 and 2009 respectively. Gwynt y Môr was developed under Round 2 and commissioned in 2015, adding 576 MW to the existing 150 MW of offshore wind already installed in Welsh waters. Gwynt y Môr is currently one of the largest offshore wind farms in the UK.

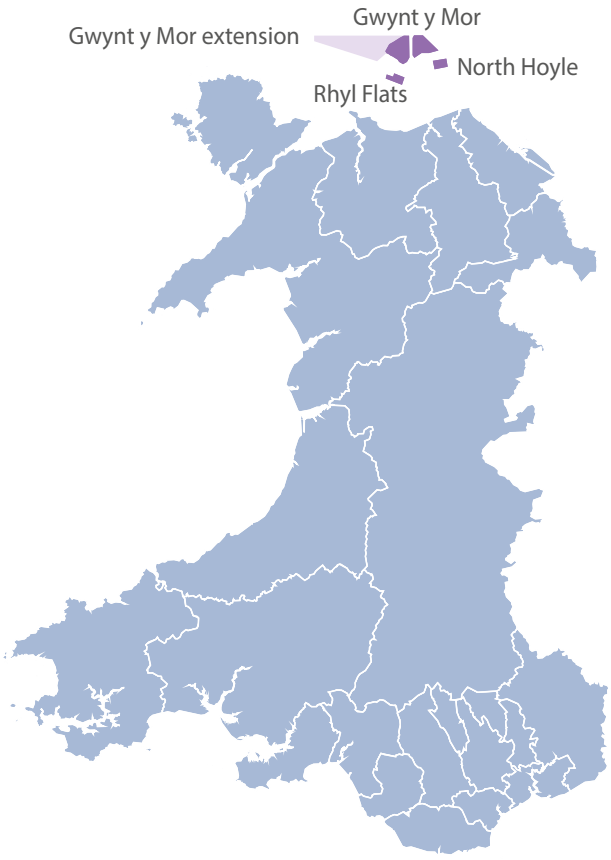
Future

In 2017, The Crown Estate proposed a round of extensions to existing operational wind farms, to which it received eight project applications. This included the Gwynt y Mor offshore wind farm, which applied for a possible extension of up to 576 MW. In August 2019, The Crown Estate confirmed that Gwynt y Mor was among seven projects that would progress to the award of development rights.

Over the past decade, the costs of offshore wind have rapidly declined and it continues to receive strong support from BEIS. A Sector Deal was also announced for offshore wind in March 2019. In the 2019 Contract for Difference auction, almost 5.5 GW of offshore wind projects were awarded strike prices that were significantly less than any awarded previously. Prices were £41.61/MWh for projects built to be in 2024/25 and £39.65/MWh for 2023/24. Meanwhile, in September 2019, The Crown Estate confirmed plans for a fourth seabed leasing round. The announcement confirmed that there will be the opportunity for applications to come forward for future offshore wind projects off Anglesey.

Wales is committed to developing sustainable marine energy generation. Wave and tidal stream technologies are being tested in Wales's two demonstration zones and these areas provide the ability for developers to test their developing and proven technologies. The Welsh Government considers these technologies to be part of the energy mix in Wales to provide a secure source of renewable energy.

Geographic distribution of offshore wind



Solar thermal

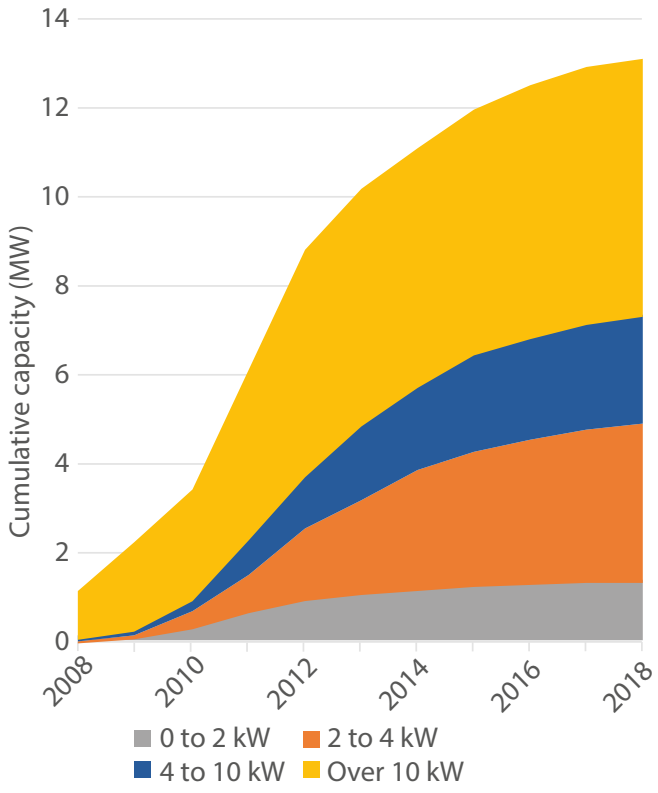
There is now over 13 MW of installed solar thermal capacity, from 4,664 projects. In 2018, 64 new projects were installed, adding 0.18 MW of capacity.

Analysis

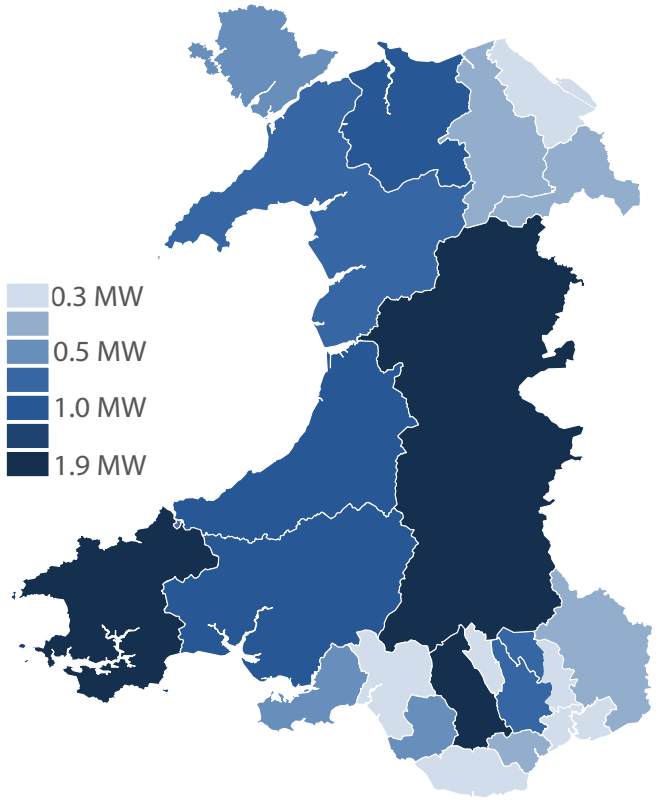
The rate of deployment of solar thermal projects continued to decrease in 2018. The number of new installations reduced by 42% in 2018 compared to 2017, with just 64 new projects being commissioned, the lowest number of new installations since 2005. Only one project greater than 10 kW was commissioned in 2018, which was in Denbighshire.

Powys is the local authority area with the greatest solar thermal capacity and the most projects, with 1.9 MW installed across 671 projects. The local authority areas with the highest number of solar thermal projects tend to be those with housing associations that have installed solar thermal on their housing. For example, Rhondda Cynon Taf has the second greatest number of installations in Wales, of which over 90% are related to social housing.

Deployment of solar thermal by project scale



Geographic distribution of solar thermal



Future

Solar thermal installations continue to be eligible for the Renewable Heat Incentive, which has budget allocated until March 2021. However, current tariff levels are proving insufficient to incentivise significant uptake.

Solar PV

Solar PV capacity in Wales totals 978 MW across 54,560 installations, an increase of 5 MW from last year. Solar PV generated an estimated 909 GWh in 2018, enough to power the equivalent of 18% of Welsh homes.

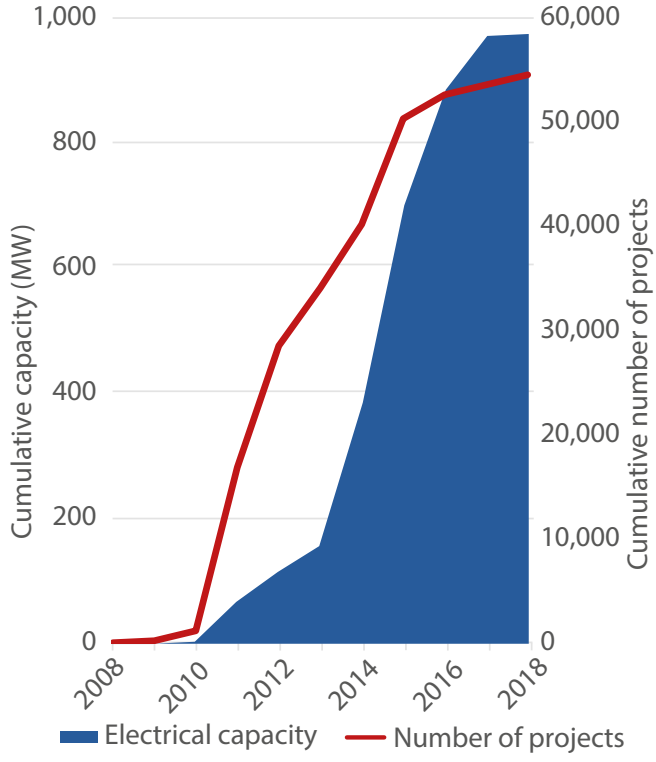
Analysis

The largest solar PV project to be commissioned in 2018 was a 250 kW commercial rooftop PV project in Flintshire. This is the lowest maximum project size in a decade, representing the challenging situation for large-scale solar PV across the country, as a result of the closure of the Feed-in Tariff and the Renewables Obligation and the lack of Pot 1 Contracts for Difference auctions.

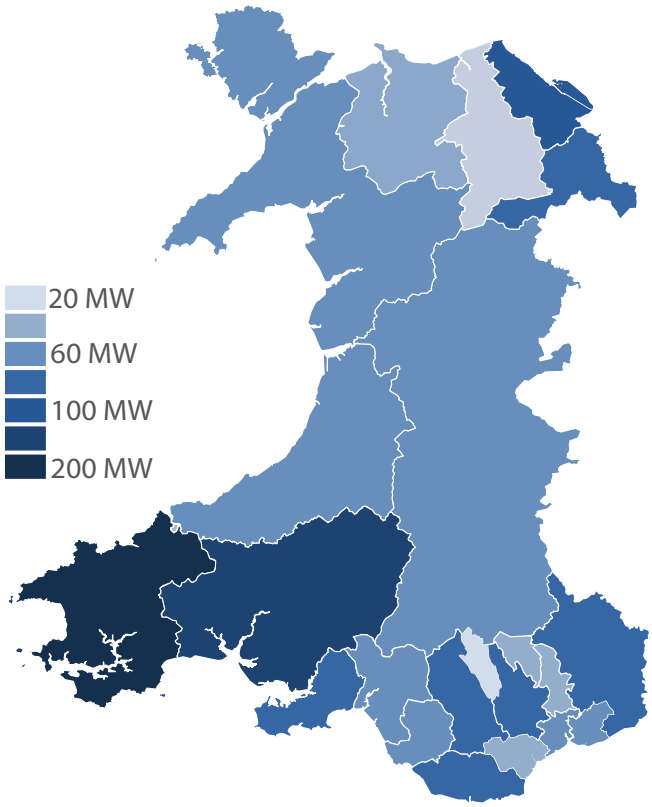
In 2018, the number of solar PV projects commissioned was similar to 2017, with 940 new projects commissioned in 2018 and 916 in the previous year. This represents a dramatic reduction in the installation rate of solar PV projects compared to 2016 and 2015, when over 2,200 and 10,000 were installed respectively.

Wales currently hosts the largest solar farm in the UK, the 72.2 MW Shotwick Solar Park in Flintshire, which commissioned in 2016. Pembrokeshire remains the Welsh local authority area with the highest capacity of solar PV, totalling 190 MW, followed by Carmarthenshire, totalling 108 MW.

Deployment of solar PV over time



Geographic distribution of solar PV



Future

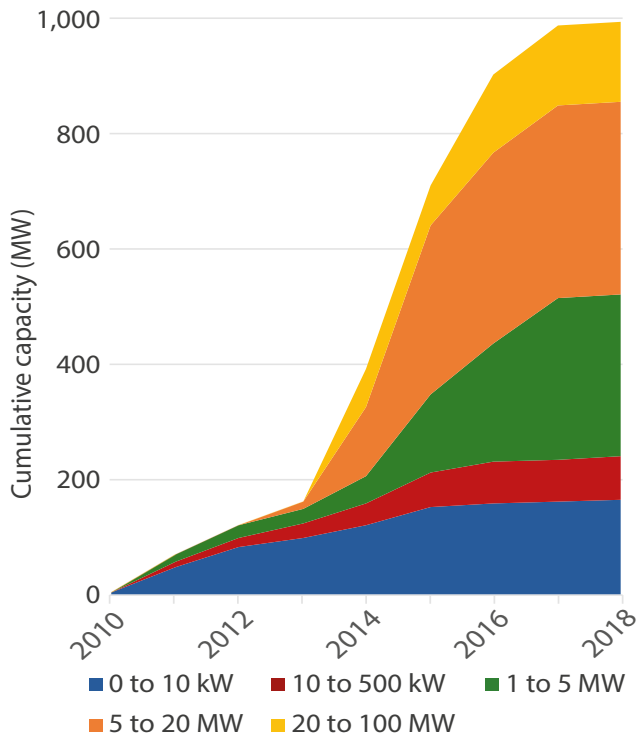
Solar PV deployment in Wales, as in the rest of the UK, has been affected by the end of the grace period for the Renewable Obligation in 2017, the cancellation of the Feed-in Tariff in 2019 and the absence of Pot 1 auctions under Contracts for Difference. In Wales, this has led to a 98% reduction in solar PV deployment rates. In the near term, some community schemes are still continuing to be developed, having pre-registered for the Feed-in Tariff. For example, Egni Co-op, a community renewable energy charity in South Wales, is looking to undertake the 'biggest rollout of rooftop solar in Welsh history'. They have applied to pre-register solar panels on 250 sites under the Feed-in Tariff (totalling 5 MW), with the projects to be installed between now and April 2020.

Following the Feed-in Tariff, the future of price support for solar PV is uncertain. The Smart Energy Guarantee, due to be introduced in January 2020, will mean that energy suppliers must provide a tariff for energy that is exported to the electricity grid. However, there are still uncertainties with the Smart Energy Guarantee, such as there being no minimum price that energy suppliers must pay.

As with onshore wind, the draft National Development Framework 2020-2040 sets out a positive approach for solar PV, offering support in identified areas for appropriate development of large-scale solar, with a focus on maximising the local benefits that these projects can bring.

Meanwhile, falling costs and innovation in solar PV design, finance and system integration have led to subsidy-free solar farms starting to be developed, with large-scale solar developers looking to private wire and power purchase agreements to make their projects viable. The 6 MW Llwyndyrus solar farm in Gwynedd is expected to be one of the first subsidy-free projects in Wales. In addition, Cardiff Council has received planning permission to turn the former Lamby Way landfill site into a solar farm.

Deployment of solar PV by project scale



CASE STUDY: CARDIFF CITY COUNCIL - SOLAR PV IN SCHOOLS

The Wales Funding Programme, administered by Salix, is working with the Welsh Government Energy Service to invite public sector organisations to apply for interest-free loans to finance energy efficiency and renewable energy installations. In 2018-19, Cardiff City Council secured finance to install solar PV across 10 schools, with a total renewable electricity generation capacity of approximately 300 kW. This promotes the continuation of solar PV installations despite subsidy cuts and contributes to the Welsh Government goal of 1 GW of locally owned renewable energy by 2030.

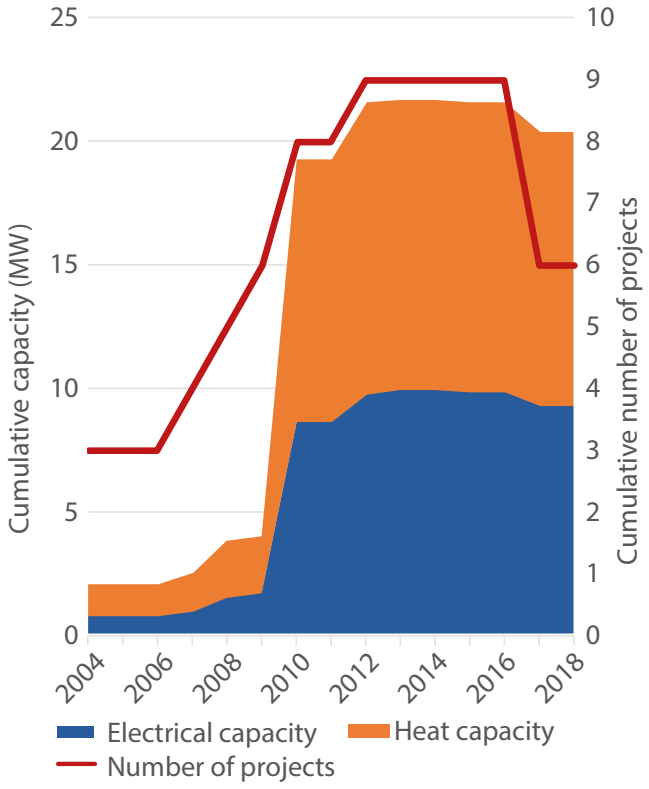
Sewage gas

There was no change in the number of sewage gas projects in Wales in 2018. There are six active sites providing a total of 11.2 MW of heat and 9.3 MW of electricity. The most recent sewage gas project to be commissioned remains the Five Fords plant in Wrexham, which opened in 2012 and injects up to 700 standard cubic metres per hour of biomethane into the gas grid.

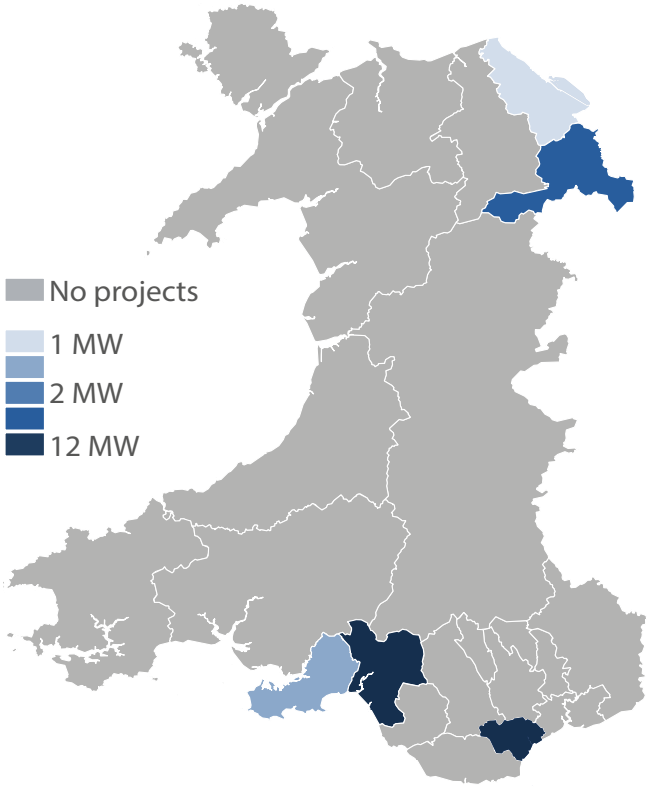
Analysis

The six active sewage gas plants in Wales are distributed among five local authority areas. Two projects commissioned in 2010, the Cardiff East plant at 4 MWe/5 MWth and the Afan CHP in Neath Port Talbot at 3 MWe/3.3 MWth, account for a third of the total capacity. Cardiff is the local authority area with the largest concentration of sewage gas generation, representing 49% of the total capacity in Wales.

Deployment of sewage gas over time



Geographic distribution of sewage gas



Future

Dwr Cymru Welsh Water is planning to close all its current sewage gas AD plants, to be succeeded by four Advanced Anaerobic Digestion hubs. Advanced Anaerobic Digestion plants are more efficient and produce a more refined gas than standard AD plants, enabling more energy to be recovered. Dwr Cymru Welsh Water also has ambitious plans to increase sustainable energy production, including aspirations to become energy neutral by 2050. There is also potentially a greater role for sewage gas plants to produce biomethane for injection in the gas grid.

Fossil fuels

Fossil fuel electricity generation

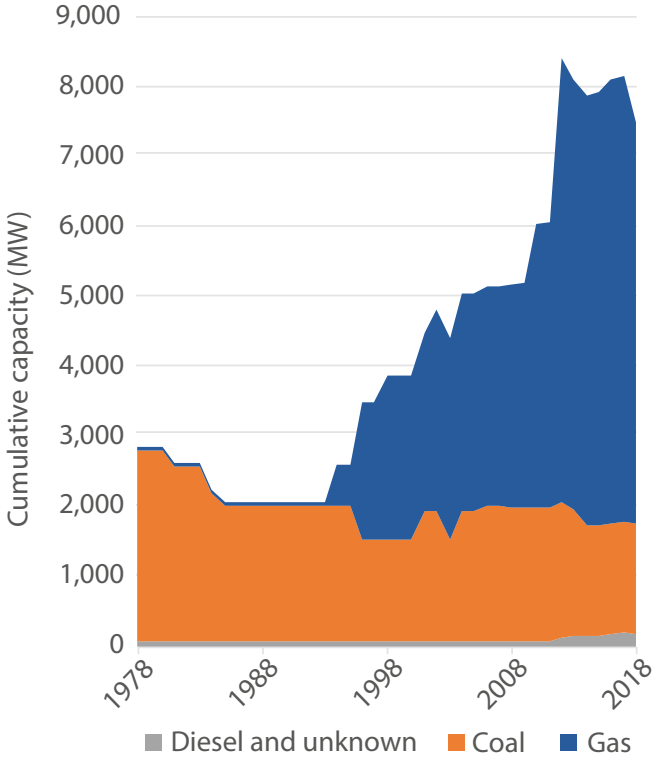
Fossil fuel generation in Wales has a total capacity of approximately 7.6 GW, including nearly 5.9 GW of gas power, 1.6 GW of coal and 0.1 GW of diesel. Deeside Power station, a Combined Cycle Gas Turbine (CCGT), has been decommissioned, reducing the capacity of fossil fuel electricity generation in Wales by 515 MW. In 2018, gas generation capacity was mainly made up of five large CCGT power stations:

- **Pembroke Power Station** – 2,269 MW (currently the largest gas power station in the UK)
- **Connah's Quay Power Station** – 1,380 MW
- **Severn Power** – 850 MW
- **Baglan Bay Power Station** – 520 MW
- **Barry Power station** – 235 MW (ceased operations in March 2019)

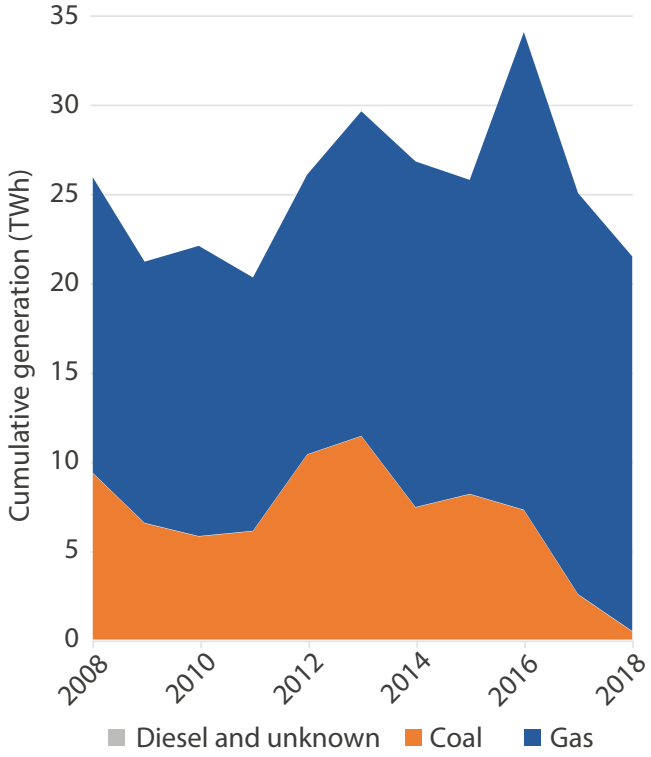
Analysis

Wales has around 740 MW of small-scale (<100 MW) fossil fuel electrical capacity, which includes diesel generators, CHP projects, open cycle gas turbines and gas reciprocating engine sites. Over the last decade there has been a greater need for smaller, decentralised power stations to provide flexibility services to the network, in order to replace decommissioned centralised power stations and to support the rapid increase in renewable energy generation.

Fossil fuel electricity capacity



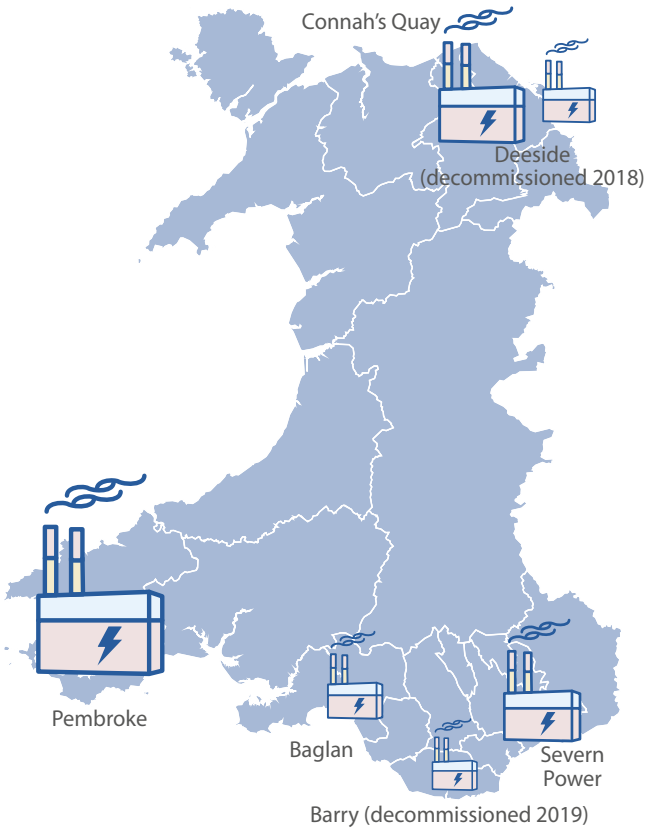
Fossil fuel electricity generation



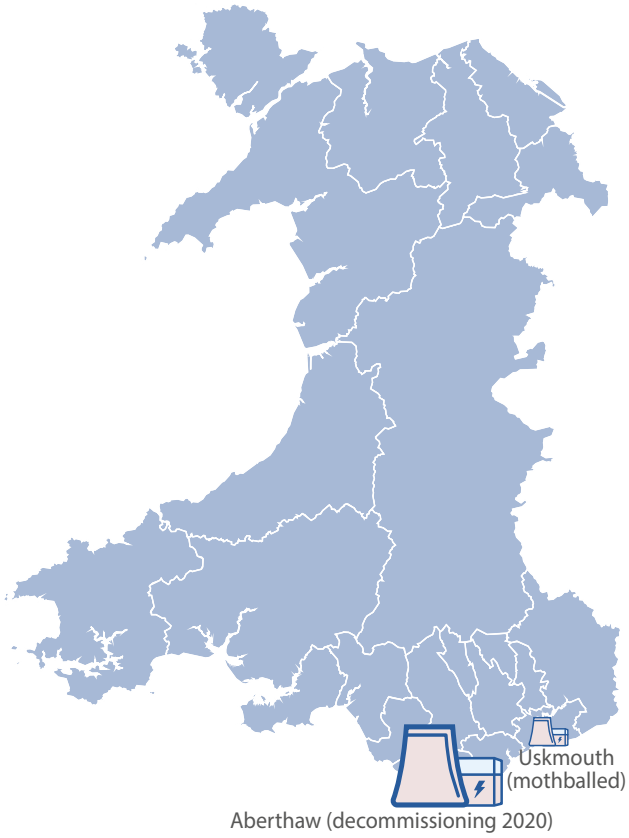
Many of these generating stations operate as 'peaking plants', designed to generate only during periods of peak electricity prices or in response to calls from the UK Electricity System Operator (National Grid ESO) or Distribution Network Operators.

In South Wales there is currently a constraint on the transmission electricity network, preventing controllable generation technologies (e.g. thermal generation, battery storage, fossil fuel and some biomass) from connecting to either the transmission or distribution networks until 2026. It is unclear whether the closure of Aberthaw Power Station in 2020 will help mitigate this constraint or expedite the solution to unlocking capacity sooner.

Geographical distribution of major gas plants in Wales



Geographical distribution of coal plants in Wales



Future

The Welsh Government has adopted the target recommended by the Committee on Climate Change to reduce carbon emissions from Wales by 95% by 2050. The Welsh Government has also declared an ambition to reach net zero by 2050 and will work with the UKCCC and other stakeholders to understand how this could be achieved.

Reducing carbon emissions from power generation is vital to the achievement of carbon targets; a future energy system powered solely by low carbon energy sources is needed. The proposed closure of Aberthaw Power Station in March 2020 will contribute towards Wales' carbon targets and will mean that power generation in Wales will be coal-free five years ahead of the UK's target of 2025. The reason for the closure is due to several market conditions, including increasing competition from gas power.

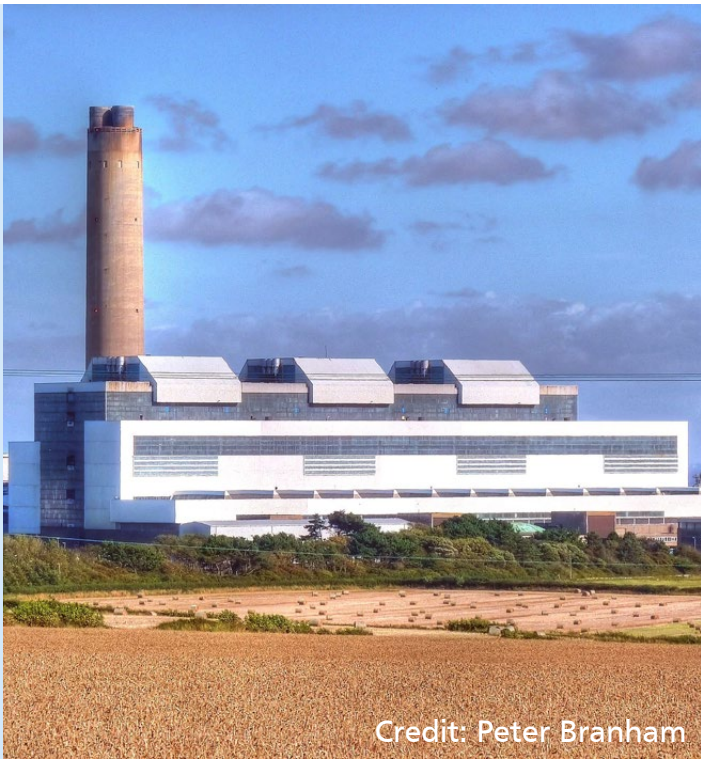
While several larger-scale fossil fuel power plants are closing, there is currently an increased interest in connecting smaller, distributed, flexible gas generation sites in Wales. These flexible gas generators are expected to continue to play a role in the wider electricity system, as variable low carbon generation capacity increases. To what extent and how often flexible gas generation will be called on to operate varies significantly under different future energy scenarios. However, reducing the carbon impacts of these gas generators will need to be considered if Wales' carbon reduction ambitions are to be achieved.

Diesel plant developers face several challenges to future development, including network constraints and the Medium Combustion Plant Directive, which prevents unabated large-scale diesel generators being developed and operated. The Welsh Government's decarbonisation objectives are likely to direct backup generator requirements towards less polluting options.

The sources of data for this category include DUKES power station data and Wales' two distribution network operators. Small backup 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- and medium-scale generators would increase the number of projects within this category, their impact on the total capacity and generation trends would be minimal, due to their size and infrequent use.

CASE STUDY - ABERTHAW POWER STATION

The 1,586 MW capacity Aberthaw Power Station was constructed in 1971 and is the last operating coal plant in Wales. The plant has gone through several changes over its lifetime, including a carbon capture pilot in 2013, 13 years co-firing with biomass from 2004 to 2017 and an environmental upgrade to make it one of the most efficient coal-fired plants in the UK. The power station is due to be decommissioned at the end of March 2020, due to adverse market conditions and the phase-out of coal ahead of the UK Government's 2025 ban on unabated coal power.


Credit: Peter Branham

Storage

Battery Storage

Two large-scale co-located battery projects were commissioned in 2018 in Wales: the 4 MW Cenin Renewables' Parc Stormy storage project in Bridgend and the 22 MW Pen y Cymoedd Energy Storage project in Neath Port Talbot.

Analysis

The 22 MW 'Battery@PyC' became operational in May 2018 at Pen y Cymoedd Wind Farm in Neath Port Talbot in South Wales. It was one of eight UK wide projects selected by National Grid to provide Enhanced Frequency Response (EFR) services to the network. The Parc Stormy 4 MW/4.8 MWh storage project came online in February 2018 and provides Firm Frequency Response (FFR) to the National Grid. Five network-connected, small-scale batteries (<100 kW) have been connected to the grid as of the end of 2018.

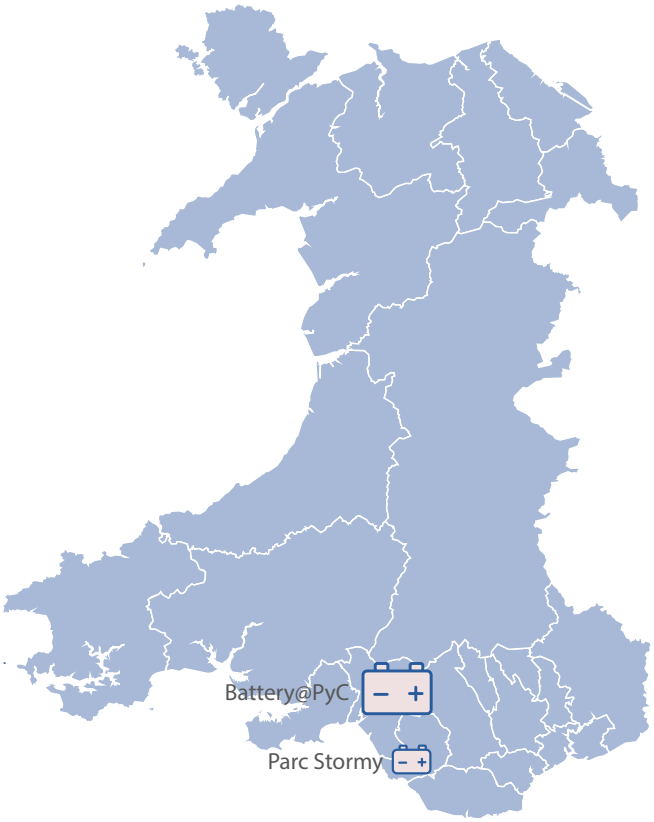
A survey of ten of the leading small-scale battery installers in Wales suggests that, to date, there have been at least 200 domestic and small-scale commercial battery storage installations in Wales, comprising around 2.7 MWh of storage. This represents an increase of 1.8 MWh since 2017.

Future

There is continued interest in developing new battery storage projects across the UK, with a pipeline of around 5-6 GW applying to connect to the distribution and transmission networks, though it is uncertain how many will go on to be installed. Battery storage projects face several challenges to their development, including saturated markets, reducing market values, regulatory changes and planned reforms around paying for the electricity network. Several business models for battery storage will be impacted by Ofgem's Targeted Charging Review, how BEIS define storage in policy and licencing (i.e. whether storage is defined as generation or its own asset class) and business rates for companies that install batteries.

The Welsh Government's Innovative Housing Programme fund has supported schemes that are incorporating storage into homes and will be evaluating the performance and benefits to the user and the network. Pobl Housing Association and Tirion Homes are building 225 homes in

Geographical distribution of large-scale battery storage projects



Parc Eirin, Tonyrefail, which will include ground source heat pumps, photovoltaics, energy storage and smart electric vehicle charging.

Only six battery storage projects in Wales have secured planning consent in recent years, and only three projects have secured Capacity Agreements in the UK Capacity Market auctions to date. The limited development in Wales is partially due to the constraint on the National Grid transmission network in South Wales until 2026, preventing new battery storage projects above 1 MW from connecting, due to its asset classification. This notwithstanding, battery storage technology can bring value to networks through providing flexibility services to network operators and could even seek to mitigate constraints if storage is co-located and co-operated alongside variable renewable generation.

With the closure of Barry Power Station (230 MW gas CCGT site) in 2019 and proposed closure of Aberthaw Power Station in 2020, there is a possibility that this restriction could be lifted earlier than 2026.

CASE STUDY: PEN Y CYMOEDD 'BATTERY@PYC' ENERGY STORAGE

The UK's largest battery co-located with an onshore wind farm, Vattenfall's 22 MW battery was commissioned in May 2018 at the 228 MW Pen y Cymoedd Wind Farm site in Neath Port Talbot. The battery provides balancing services to the National Grid; the wind farm and the battery storage facility share grid infrastructure so that the batteries can either be charged by the wind farm, or directly from the grid. The battery is one of eight projects that were selected by National Grid to provide Enhanced Frequency Response service to the electricity network.

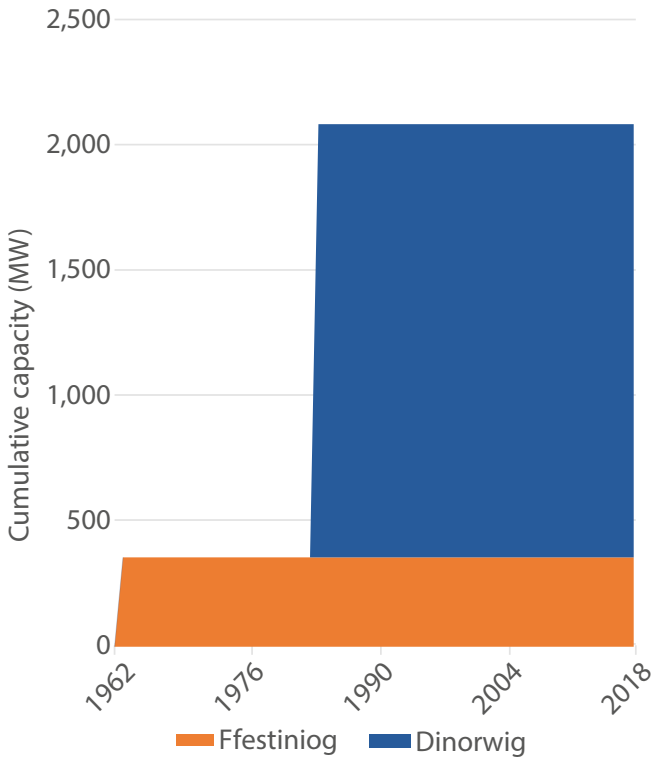
Pumped Hydropower Storage

The amount of pumped storage in 2018 in Wales totals 2,088 MW from two projects and remains unchanged from previous years. The operational projects are the 360 MW Ffestiniog pumped storage plant in Gwynedd, which opened in 1963, and the 1.7 GW Dinorwig pumped storage plant, which opened in 1984. Both provide essential services to the UK electricity network.

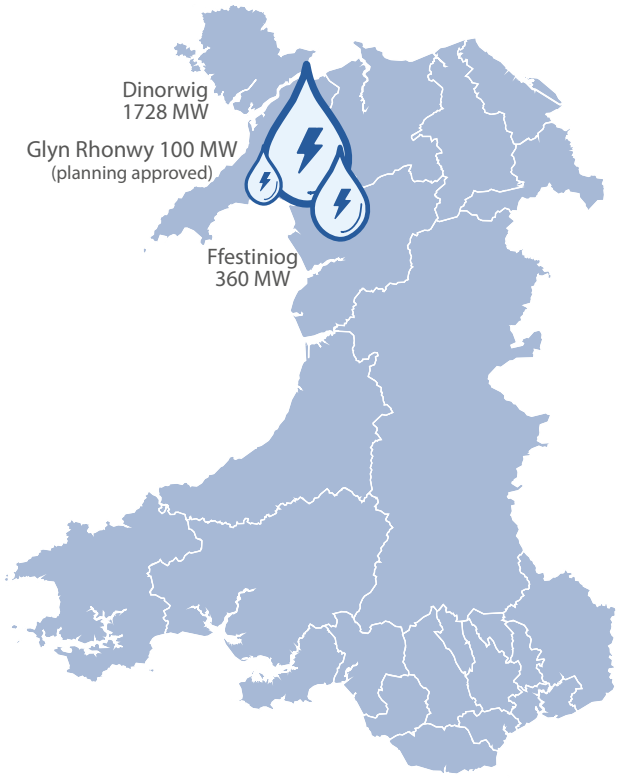
Analysis

Pumped hydropower has been a feature of the Welsh energy landscape since the 1960s and is an essential part of the UK's electricity network, helping to meet rapid changes in electricity demand. Both operational plants serve this purpose, but the Dinorwig power station runs on a Short-Term Operating Reserve (STOR) contract to meet rapid changes, while the Ffestiniog storage plant is used primarily to meet peak loads.

Deployment of pumped hydropower storage over time



Geographic distribution of hydropower storage



Future

Ffestiniog is currently undergoing refurbishment work, in which two of its four 90 MW generating units are being replaced to extend their operational life. It is possible the other two units will be replaced at a future date.

In March 2017, planning was approved for the new 100 MW Glyn Rhonwy pumped hydropower storage facility in the village of Llanberis, Snowdonia. The station proposes to use abandoned slate quarries as reservoirs.

Reference pages

Data tables

Local authority	Totals					Renewables							
	Renewables			Fossil fuels		AD			Biomass heat		Biomass electricity and CHP		
	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	939	18.4	9.4	4	68.8	-	-	-	14	8.8	1	3.6	-
Bridgend	2,587	100.2	9.1	5	25.2	1	2.8	-	34	7.8	-	0.0	-
Caerphilly	2,905	67.1	8.0	2	19.2	2	1.9	0.5	43	6.3	1	0.1	-
Cardiff	3,480	52.4	11.9	5	33.3	1	1.8	-	21	4.9	1	0.1	-
Carmarthenshire	5,598	260.0	49.9	2	10.6	2	0.5	0.2	475	42.7	-	0.0	-
Ceredigion	3,462	190.2	68.1	3	10.3	4	1.3	1.3	244	43.1	4	3.3	17.4
Conwy	1,975	72.2	12.5	3	2.0	3	-	0.4	121	8.5	5	1.4	0.3
Denbighshire	2,186	86.0	20.9	2	1.2	3	1.3	1.3	169	15.5	5	1.5	0.4
Flintshire	3,588	116.1	107.0	2	1,386	-	-	-	141	13.9	1	25.0	90.0
Gwynedd	3,131	102.6	20.9	1	0.1	2	0.5	0.2	215	16.0	1	0.1	-
Isle of Anglesey	2,103	78.6	7.4	1	0.1	2	1.9	0.2	59	3.3	1	0.1	0.1
Merthyr Tydfil	747	15.7	5.3	3	42.3	-	-	-	14	3.4	1	1.0	1.5
Monmouthshire	4,193	62.6	30.5	2	0.1	2	0.4	0.1	183	19.6	4	18.0	7.1
Neath Port Talbot	1,909	331.4	19.8	6	613.5	-	-	-	87	15.5	2	55.8	-
Newport	2,238	49.6	11.4	7	896.7	2	0.5	0.1	39	10.4	2	9.0	0.1
Pembrokeshire	5,051	216.3	34.0	7	2,331	2	0.0	0.1	275	27.2	2	0.1	0.1
Powys	6,706	222.2	146.3	4	0.7	12	3.7	2.2	928	131.7	9	0.9	1.0
Rhondda Cynon Taf	3,862	238.0	17.4	9	73.2	1	1.2	0.7	59	13.9	-	0.0	-
Swansea	2,987	55.5	8.5	4	84.6	-	-	-	54	5.0	1	0.6	-
Torfaen	1,979	11.3	3.8	5	0.5	-	-	-	20	2.9	1	0.4	0.5
Vale of Glamorgan	2,262	94.1	10.2	9	1,936	1	0.5	-	61	9.0	2	10.1	-
Wrexham	4,835	46.6	38.1	6	44.5	5	0.4	0.7	89	33.8	2	0.3	0.5
Offshore	3	726.0	0.0	0	-	-	-	-	-	-	-	0.0	-
Unknown	2	0.1	0.0	0	-	-	-	-	-	-	2	0.1	0.0
Total	68,728	3,213	651	92	7,580	45	18.7	7.9	3,345	443.3	48	131.3	119.1

Data tables

Local authority	Renewables											
	Energy from waste		Heat pumps		Hydropower		Landfill gas		Offshore wind		Onshore wind	
	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	-	0.0	17	0.1	1	0.0	1	1.6	-	-	7	2.9
Bridgend	-	0.0	104	0.9	3	0.0	1	0.3	-	-	15	67.7
Caerphilly	-	-	45	0.5	0	-	-	-	-	-	20	16.4
Cardiff	1	30	56	0.9	1	0.4	2	2.3	-	-	3	0.1
Carmarthenshire	-	-	492	6.0	14	4.7	1	2.0	-	-	113	145.1
Ceredigion	-	-	623	5.3	28	70.9	-	-	-	-	76	84.7
Conwy	-	-	175	2.3	32	34.9	1	2.0	-	-	39	18.6
Denbighshire	-	-	233	3.4	19	2.3	-	-	-	-	38	72.0
Flintshire	-	-	239	2.6	0	-	2	1.3	-	-	16	0.1
Gwynedd	-	-	376	4.2	141	59.2	2	0.2	-	-	36	6.9
Isle of Anglesey	-	-	255	3.3	0	-	1	0.9	-	-	49	39.4
Merthyr Tydfil	-	-	26	0.4	4	0.2	2	6.3	-	-	4	1.5
Monmouthshire	-	-	298	3.4	11	0.2	-	-	-	-	10	0.3
Neath Port Talbot	-	-	93	0.9	11	0.6	2	3.4	-	-	12	230.1
Newport	-	-	48	0.7	0	-	1	1.0	-	-	11	16.1
Pembrokeshire	-	-	425	4.9	14	0.5	1	1.5	-	-	148	24.5
Powys	-	-	882	9.7	78	7.9	1	2.0	-	-	117	185.2
Rhondda Cynon Taf	-	-	99	1.2	4	0.2	2	1.1	-	-	12	193.0
Swansea	-	-	173	2.3	2	0.1	1	0.9	-	-	4	1.4
Torfaen	-	-	26	0.3	1	0.0	-	-	-	-	3	0.0
Vale of Glamorgan	-	-	80	1.0	0	-	-	-	-	-	6	1.1
Wrexham	-	-	163	1.7	0	-	3	4.4	-	-	1	0.0
Offshore	-	-	-	-	0	-	-	-	3	726.0	0	0.0
Unknown	-	-	-	-	0	-	-	-	-	-	0	0.0
Total	1	30	4,928	56.0	364	182.1	24	31.4	3	726.0	740	1,106.9

Data tables

Local authority	Renewables							Fossil fuels					
	Sewage gas			Solar PV		Solar thermal		Coal		Diesel and unknown		Gas	
	Number of projects	Capacity (MW_e)	Capacity (MW_{th})	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)
Blaenau Gwent	-	-	-	608	10.2	290	0.5	-	-	1	16.0	3	52.8
Bridgend	-	-	-	2,328	29.3	101	0.5	-	-	-	-	5	25.2
Caerphilly	-	-	-	2,449	48.8	345	0.7	-	-	1	19.0	1	0.1
Cardiff	2	4.4	5.7	3,300	13.3	92	0.4	-	-	1	0.7	4	32.7
Carmarthenshire	-	-	-	4,212	107.7	289	0.9	-	-	-	-	2	10.6
Ceredigion	-	-	-	2,137	30.1	346	1.0	-	-	2	10.3	1	0.1
Conwy	-	-	-	1,349	15.4	250	0.9	-	-	-	-	3	2.0
Denbighshire	-	-	-	1,578	8.9	141	0.4	-	-	-	-	2	1.2
Flintshire	1	0.2	0.2	3,104	89.4	84	0.2	-	-	-	-	2	1,386
Gwynedd	-	-	-	2,192	35.7	166	0.5	-	-	-	-	1	0.1
Isle of Anglesey	-	-	-	1,553	36.3	183	0.5	-	-	-	-	1	0.1
Merthyr Tydfil	-	-	-	629	6.7	67	0.0	-	-	1	21.2	2	21.1
Monmouthshire	-	-	-	3,573	43.7	112	0.3	-	-	1	0.1	1	0.0
Neath Port Talbot	1	3.0	3.3	1,662	38.6	39	0.1	-	-	1	21.2	5	592.3
Newport	-	-	-	2,101	23.0	34	0.1	-	-	-	-	7	896.7
Pembrokeshire	-	-	-	3,634	189.7	550	1.7	-	-	-	-	7	2,331
Powys	-	-	-	4,008	22.5	671	1.9	-	-	-	-	4	0.7
Rhondda Cynon Taf	-	-	-	3,140	42.6	545	1.6	-	-	1	21.2	8	52.0
Swansea	1	0.6	0.8	2,603	51.9	148	0.4	-	-	2	23.6	2	60.9
Torfaen	-	-	-	1,910	10.9	18	0.1	-	-	-	-	5	0.5
Vale of Glamorgan	-	-	-	2,025	82.5	87	0.1	1	1,586	2	0.2	6	350.0
Wrexham	1	1.2	1.2	4,465	40.3	106	0.3	-	-	-	-	6	44.5
Offshore	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	6	9.3	11.2	54,560	977.5	4,664	13.2	1	1,586.0	13	133.6	78	5,860.3

Methodology

Regen was commissioned by the Welsh Government to produce a database of energy generation projects in Wales; to identify the extent to which projects are owned by Welsh individuals, organisations and communities; and to 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 it is 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
- Renewable Energy Guarantees of Origin 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, installers and industry organisations
- A survey of small-scale storage installers
- BEIS energy statistics

Assumptions and references

Assumption	Source
Estimated Welsh domestic heat demand	Evaluated using BEIS Regional and Local Authority Gas Consumption Statistics (2017).
Local authority and Welsh electricity consumption	BEIS Regional and Local Authority Electricity Consumption Statistics (2017). See Note 1 for more information.
Fossil fuel electricity generation	Researched by Regen through a survey of major power plants. Actual generation from plants was collected from plants representing 95% of the major electricity generating fossil fuel capacity in Wales.
Number of homes	StatsWales Dwelling stock estimates.
Capacity factors	Evaluated from a three year average of DUKES regional capacity factors and other industry established values.

Notes

(1) The 2018 electricity consumption figure for Wales is not yet published. The published figure for Wales' 2017 electricity consumption is used for this report's 2018 calculations, with the knowledge that the 2017 and 2018 UK total electricity consumption that have been published by DUKES remains approximately constant (<0.05% variance).

(2) The figure for Wales' total energy consumption is the most recently published BEIS total final energy consumption data for 2016. As explained in the BEIS Sub-National Consumption Statistics methodology, this consumption data excludes autogeneration and some very large energy users for confidentiality reasons.

(3) Community And Locally Owned Renewable Energy In Scotland At June 2016, Energy Saving Trust, 2016

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Abbreviations and definitions

Abbreviation	Explanation
Generation	The energy produced by generators such as wind farms or gas-fired power plants.
Consumption	The final use of energy, either as electrical demand, heat demand, or both.
Autogeneration	Electricity generation that is produced onsite (usually in an industrial setting) and wholly consumed onsite, therefore, not exported to the electricity network.
Capacity	How much power a project can generate at maximum output.
Capacity factor	The proportion of time an energy generation project will generate for, relative to its maximum capacity. For example, the capacity factor for offshore wind in Wales is evaluated to be 33%.
MW	Megawatt - a unit of power (capacity).
MWh	Megawatt hour - a unit of energy (demand or generation).
MWe	Megawatt of electrical capacity.
MWth	Megawatt of thermal capacity.
CHP	Combined Heat and Power.
Solar PV	Solar photovoltaic panels.

Orders of magnitude	Explanation
W	1 watt = 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) **X** **Time** **=** **Energy (e.g. demand and generation)**

50 watts

X

20 hours

= 1,000 Wh or 1 kWh (of demand)

1,000,000 watts (1 MW)

X

1 hour

= 1,000,000 Wh or 1 MWh (of generation)