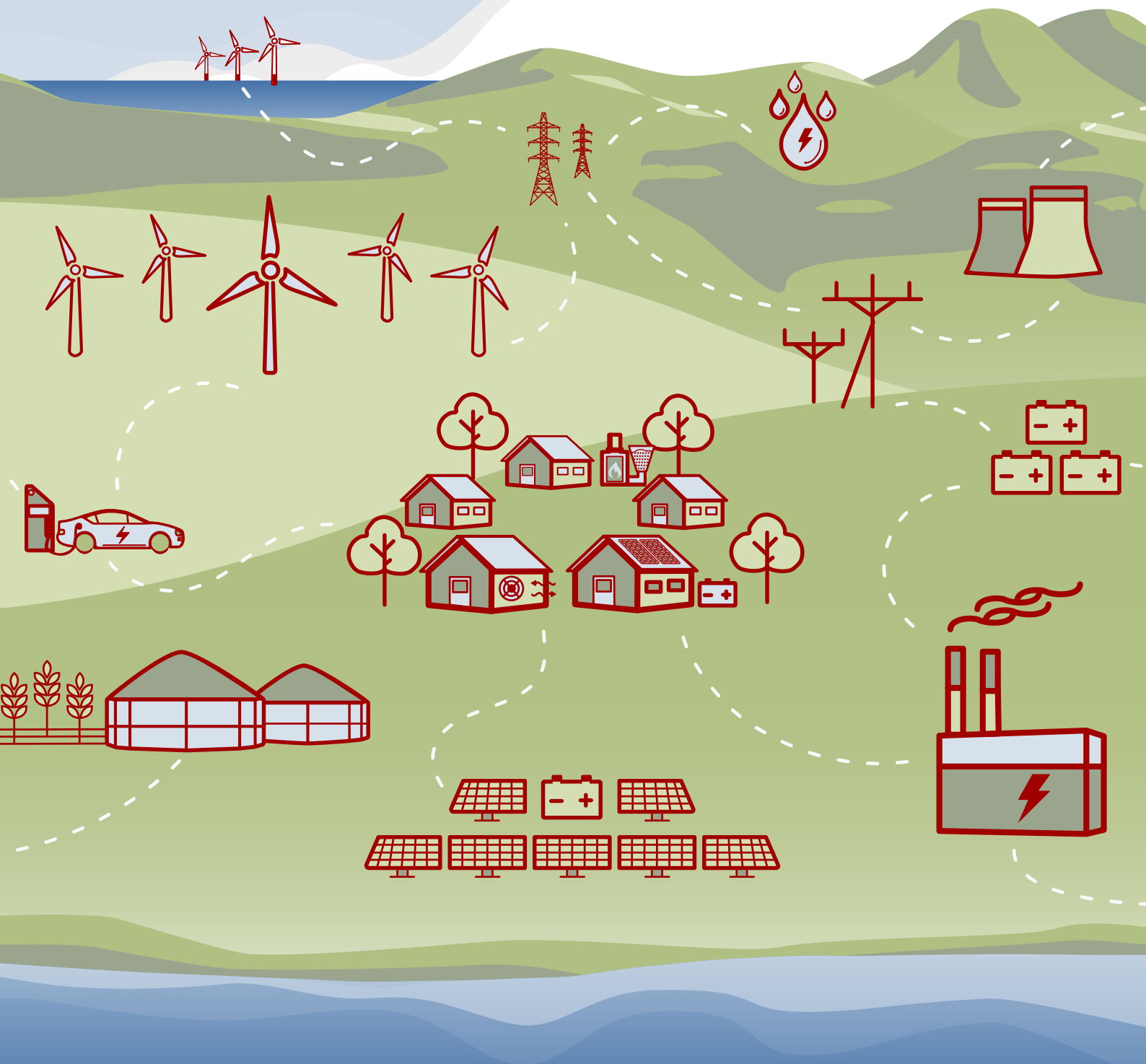


Energy Generation in Wales 2017



Llywodraeth Cymru
Welsh Government



Cover illustration: Regen

Written and produced by Regen
for the Welsh Government



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Ministerial foreword



I recently set our first two carbon budgets for Wales and interim targets for 2020, 2030 and 2040. This is a significant milestone in terms of providing clarity and certainty for government, business and stakeholders with regard to Wales' pathway to a low-carbon society.

The energy system is undergoing significant change, with generation and delivery becoming more distributed in the communities and regions where the energy is used. We also anticipate this transition increasing the interaction between previously separate uses of energy, connecting power, transport and heat networks in new and different ways.

As these different energy vectors decarbonise, there is a continuing role for renewable energy deployment. The renewable energy targets I set last year demonstrate Wales' ambition to develop and support current and new forms of renewable energy.

Welsh Government has set a supportive policy, regulatory and support framework in Wales, which continues to be successful in bringing forward energy projects both at the local and the large scale. Gower Regeneration's 1 MW solar farm at Dunvant is Wales' first community owned solar farm. The Garreg Llwyd Hill wind farm in Radnorshire can provide electricity for the equivalent of approximately 26,000 homes and provides a significant community benefit fund.

We are actively supporting projects through our Welsh Government Energy Service. One of our objectives is to drive more locally owned energy developments to retain more benefits from generation in Wales. We have an expectation for all new developments to have an element of local ownership from 2020. We published a call for evidence on this topic earlier this year.

The Energy Local Club in Bethesda is a great example of how smart technology has enabled people to use renewable electricity at the place it is generated. More such innovative solutions are needed to deliver the low-carbon energy transition. New technology will help us better manage our energy use at home and at work, integrate different technologies and enable local matching of demand and supply.

I commissioned the Energy Generation in Wales study to provide a complete picture of energy generation in Wales. The study also allows us to chart progress against our renewable energy targets. Our target is to generate the equivalent of 70% of the electricity we use from renewables by 2030. I am pleased to announce renewable generation equal to 48% of electricity consumption in Wales in 2017. We now have 750MW of renewable energy capacity in local ownership, against our target of 1 GW by 2030.

We need to continue to develop and support new forms of renewable energy to create a balanced multi-vector energy system. We will only capture the benefits to Wales from the low carbon transition by continuing to innovate and support the transition.

Lesley Griffiths

Cabinet Secretary for Energy, Planning and Rural Affairs

Introduction

The Energy Generation in Wales 2017 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 2017, reviewing 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 policies and other demographic factors, 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 were installed in 2017.

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 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 2017.
- Calculates 48% of electricity consumption comes from renewable sources.
- Estimates 751 MW of installed renewable energy capacity is locally owned.

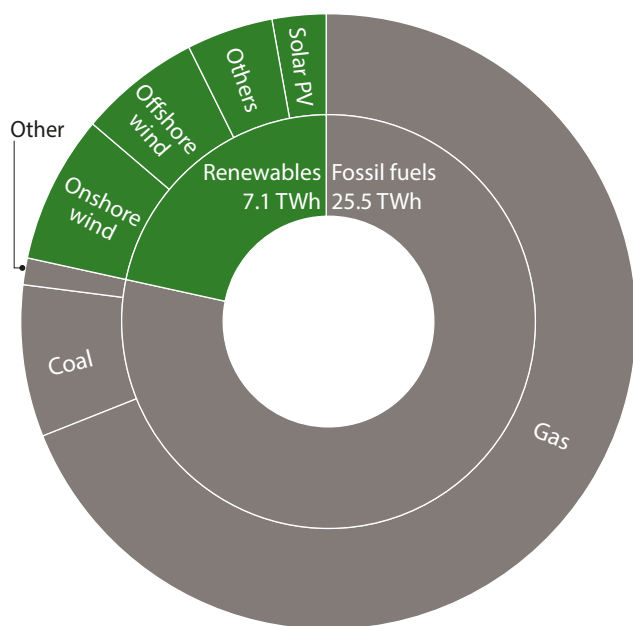
Technologies analysed

- 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).

Electricity generation in Wales

Wales uses around 89 TWh of energy per year – a figure that has reduced by around 18% since 2005. Electricity consumption accounts for approximately 14.6 TWh¹ of total energy consumption, with the remaining 84% of energy being used for heat and transport.

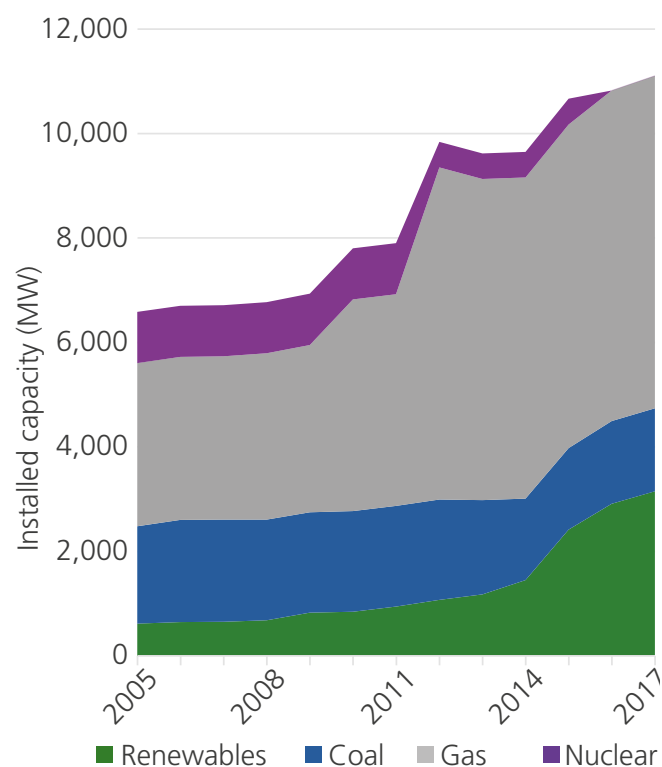
Wales' electricity generation



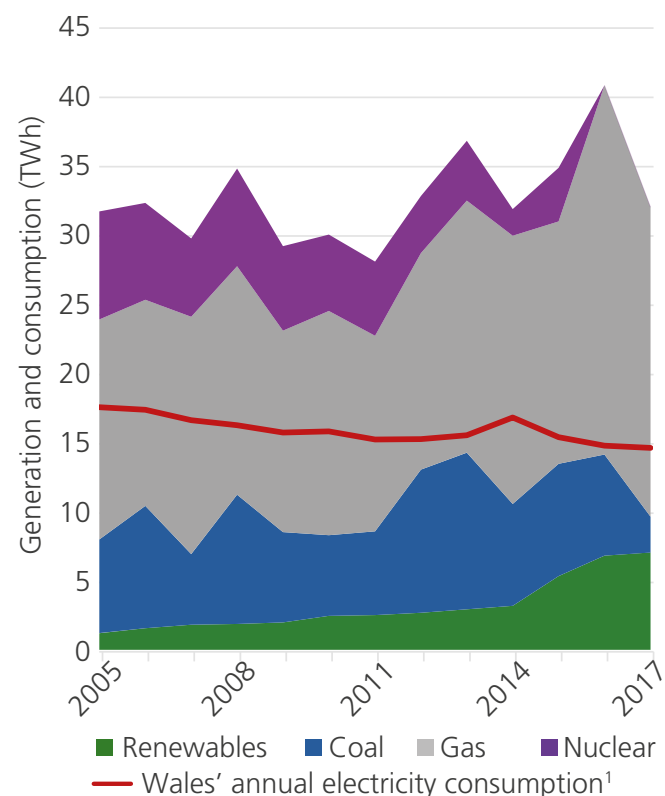
Wales generated an estimated 32.5 TWh of electricity in 2017, more than twice what it consumes. Wales is, therefore, a significant net exporter of electricity to England, Ireland, and the wider European network.

Approximately 22% of total electricity generated in Wales is from renewables. This generation is the equivalent of 48% of electricity consumed in Wales annually, a five percentage point increase compared to 2016.

Electricity capacity trends



Electricity generation trends



Electricity generation in Wales

- An estimated 25.5 TWh or 78% of Welsh electricity generation was from fossil fuel plants in 2017.
- Total electricity generation in Wales in 2017 was 32.5 TWh, compared to 40 TWh in 2016. A reduction in generation from coal and gas caused this overall drop in electricity generation.
- Six Combined Cycle Gas Turbine (CCGT) plants and one coal fired power station provide 92% of fossil fuel electricity generation. The remainder is made up of small-scale gas and diesel generators.
- There are no nuclear power stations currently generating in Wales, although there are plans for a new plant at Wylfa on Anglesey.
- Around 7.1 TWh of electricity generated in Wales is from renewables, up from 6.9 TWh in 2016. Renewables capacity increased in 2017, but the growth rate was significantly reduced compared with 2016.

Technologies	Number of projects	Electrical capacity (MW)	Estimated electricity generation (GWh)
Fossil fuels	84	8,002	25,480
Coal	1	1,586	2,588
Diesel	11	133	467
Gas	72	6,282	22,425
Storage	62	0.9	-
Battery storage	60	0.9	-
Pumped hydro	2	2,088	-
Renewables	67,056²	3,087	7,050

CASE STUDY - SPECIFIC'S ACTIVE CLASSROOM

The Active Classroom on the Bay Campus at Swansea University was designed as an energy positive building to demonstrate the 'buildings as power stations' concept that was developed by SPECIFIC Innovation and Knowledge Centre. The project makes use of integrated solar thermal cladding, solar PV roofing, and battery storage technology to generate, store and release energy. In 2017, it generated 1.6 times the amount of energy it consumed.

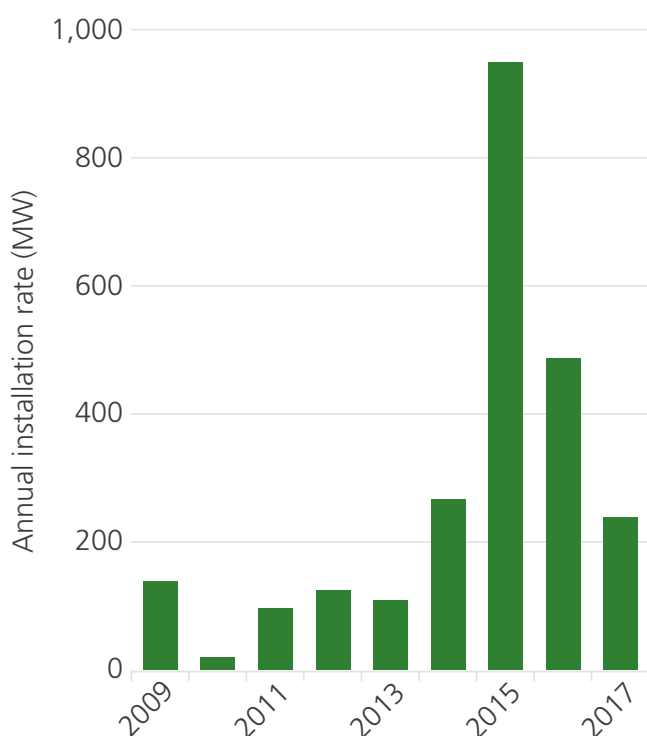
The Active Classroom project was led by SPECIFIC with several collaborative partners involved. Performance information is collected continuously from over 1000 data points, then processed by the team at SPECIFIC. Surplus power is used to charge electric vehicles and meet the baseload of neighbouring buildings. The building has won several awards including RICS Wales Project of the Year.



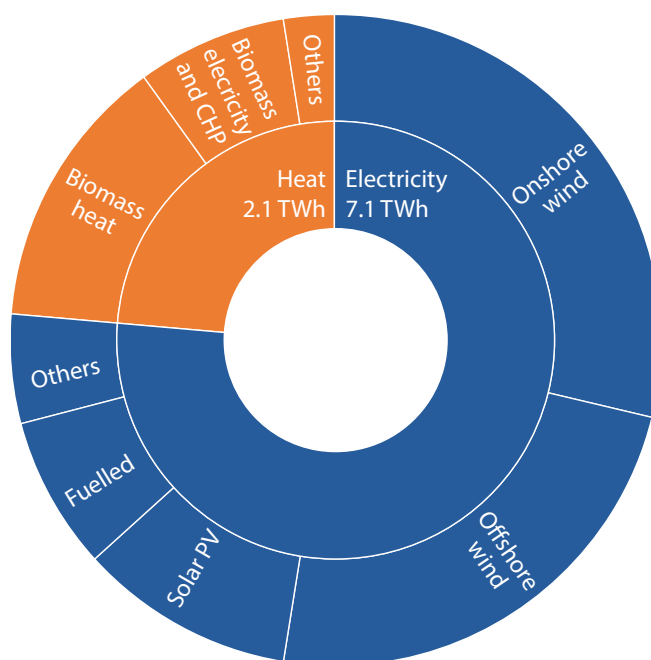
Renewable energy in Wales

Renewable energy capacity in Wales increased by 313 MW in 2017, reaching a total of 3,683 MW. Over 84% of this total capacity is from renewable electricity projects. The increase in renewable electricity capacity in 2017 was less than a quarter of 2015's capacity increase. Renewable heat capacity makes up the remaining 596 MW of renewable energy capacity, with an increase of 72 MW from 2016.

Wales' renewable electricity capacity installation rate



Renewable electricity and heat generation



Renewable electricity in Wales

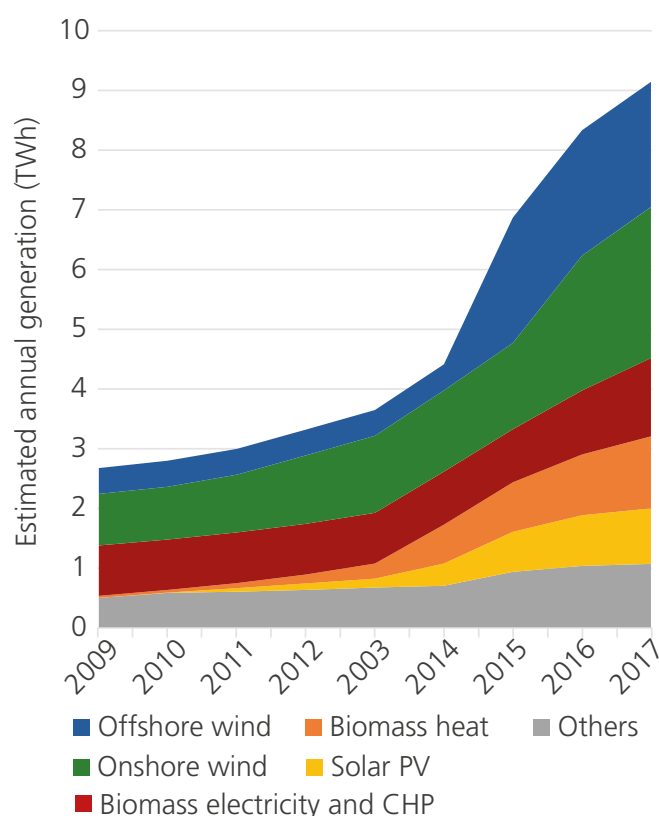
- There was a significant slowing of the renewable electricity installation rate in 2017, with a 8% increase in capacity, compared to a 21% increase the previous year.
- Aberthaw power station ceased co-firing biomass in October 2017, leading to a reduction in renewable generation of over 380 GWh compared to 2016.
- Approximately 65% of renewable electricity generated in Wales comes from wind, of which 30% is generated by the 726 MW of offshore wind projects off the Welsh coast and 35% by just over 1 GW of onshore wind.
- Whilst solar PV makes up 31% of installed renewable capacity, its lower capacity factor means that solar PV provides 13% of renewable electricity
- The largest renewable energy project commissioned in 2017 was a 40 MWe biomass electricity plant, Margam Green Energy Plant in Neath Port Talbot.

Renewable energy technologies	Number of projects	Electricity		Heat	
		Capacity (MW)	Estimated generation (GWh)	Capacity (MW)	Estimated generation (GWh)
Anaerobic digestion	46	19	109	8	52
Biomass	3,210	-	-	394	1,207
Energy from Waste	2	35	201	-	-
Biomass electricity and CHP	37	113	654	120	660
Heat pump	4,440	-	-	50	97
Hydropower	358	181	367	-	-
Landfill gas	24	31	128	-	-
Offshore wind	3	726	2,099	-	-
Onshore wind	730	1,002	2,531	-	-
Sewage gas	6	9	32	11	68
Solar PV	53,600	970	930	-	-
Solar thermal	4,600	-	-	13	8
Total	67,056²	3,087	7,050	596	2,092

Renewable heat in Wales

- There is 596 MW of renewable heat capacity in Wales, with 72 MW of new capacity added in 2017. There are over 12,000 renewable heat projects.
- The number of new heat installations in 2017 was higher than 2016, with 986 new projects in 2017 compared with 902 new projects in 2016.
- Wales produces approximately 2.1 TWh of useable renewable heat, equivalent to 10.5% of estimated Welsh domestic heat demand.
- Biomass accounts for the largest proportion of renewable heat capacity, with 66% of the total.
- Solar thermal makes up the largest proportion of renewable heat projects in Wales by number, with 4,600 heat pumps in operation.
- Biomass was the renewable heat technology that saw the largest increase in capacity in 2017, with an additional 62 MW installed.

Renewable energy generation in Wales



Progress towards targets

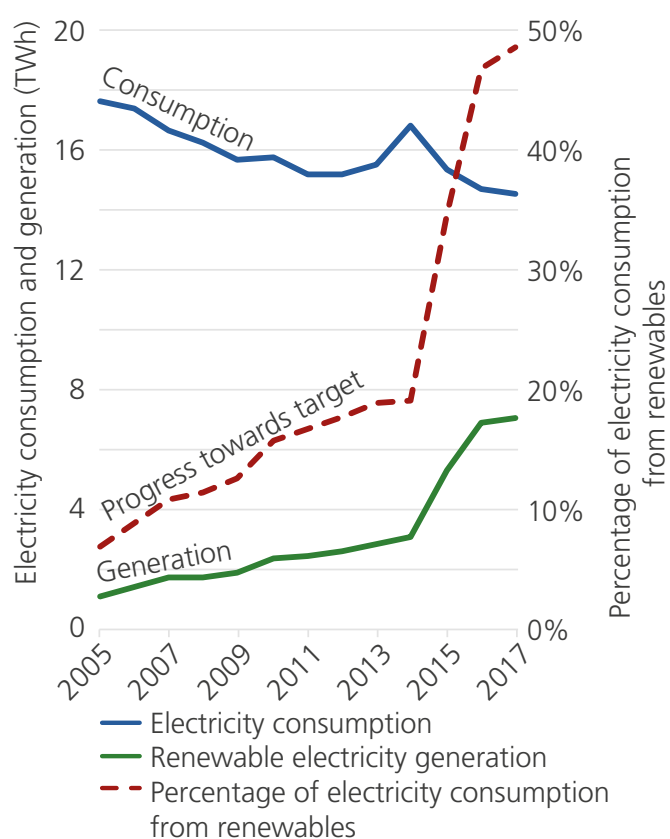
The Welsh Government has set a target of generating 70% of Wales' electricity consumption from renewable sources by 2030. Progress towards the target is due to both growing renewable electricity generation and falling electricity demand.

In 2017, the equivalent of 48% of electricity consumption in Wales was generated from renewable sources, compared with 43% in 2016. This is attributable to a 2% increase in renewable electricity generation coupled with a 1% decrease in demand.

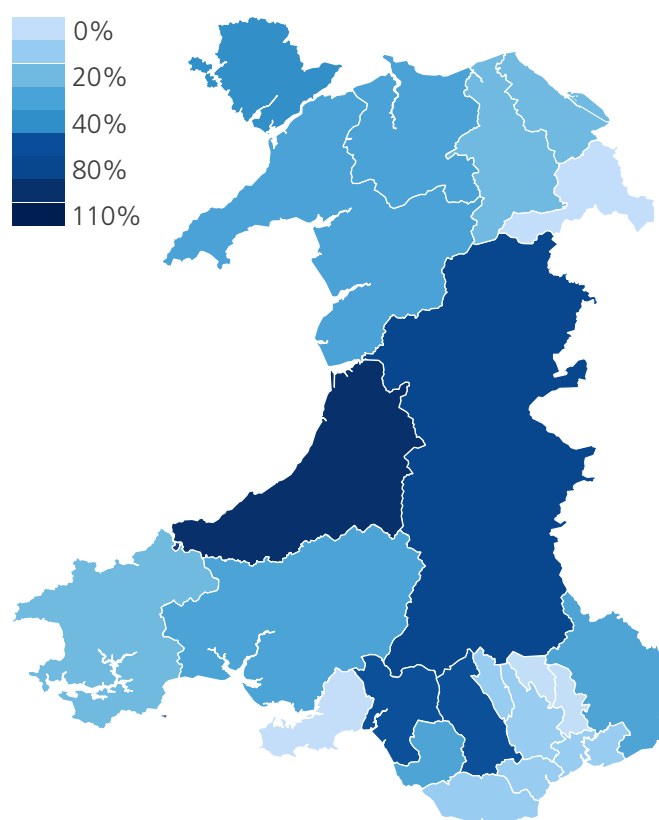
Since 2005, renewable electricity generation has increased by nearly 5 times or approximately 5.9 TWh. In this time, total electricity consumption has reduced by 18%, or approximately 3 TWh.

The decrease in electricity consumption is attributable to a 2.2 TWh reduction in industrial and commercial electrical consumption and a 0.6 TWh reduction in domestic electrical consumption.

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 September 2017, the Cabinet Secretary for the Environment, Lesley Griffiths announced renewable electricity and ownership targets for energy generation in Wales.

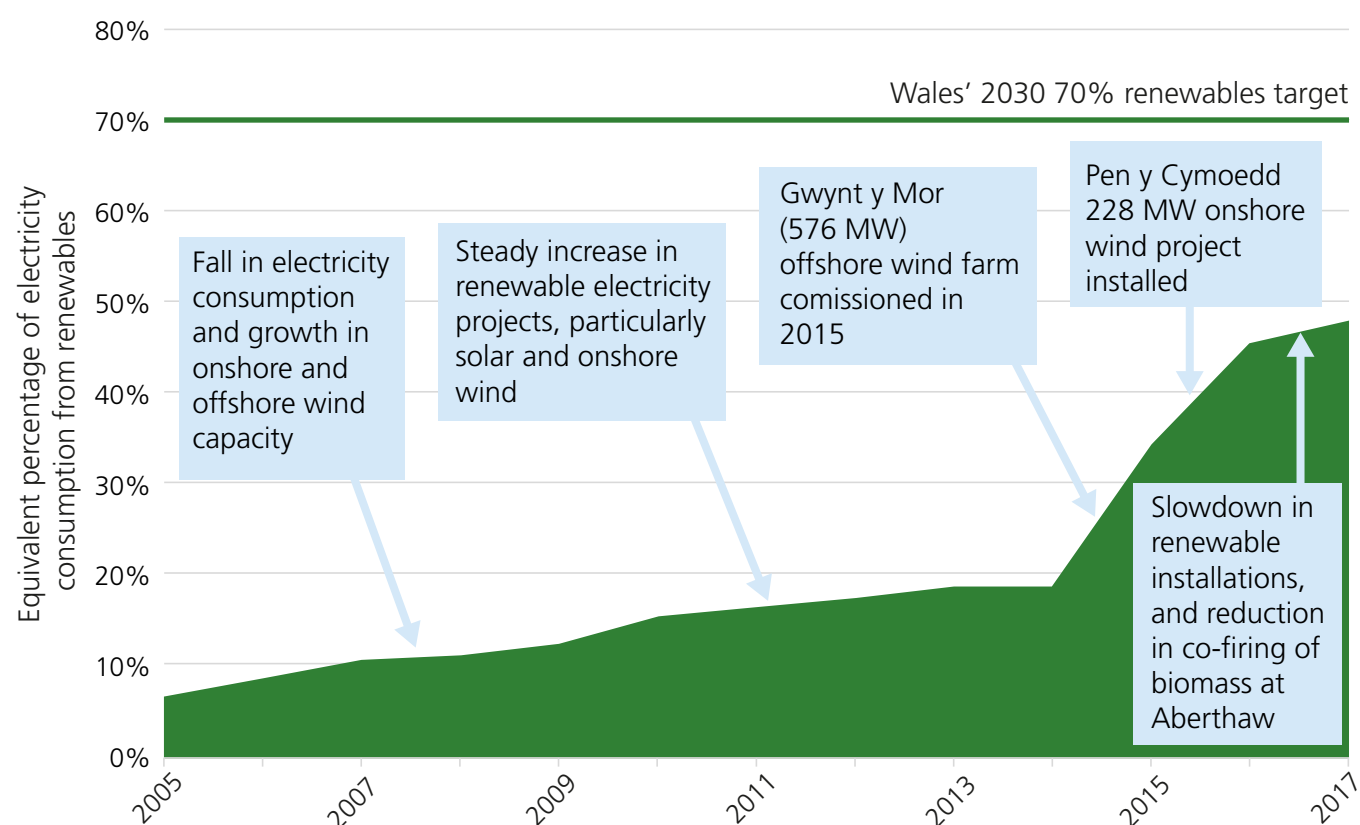
“Wales must be able to compete in global low carbon markets, particularly now we face a future outside the EU. The ability to meet our needs from clean energy is the foundation for a prosperous low carbon economy. This is why I am today announcing targets to focus action across the country and to capture the benefits for Wales.

Firstly, I am setting a target of Wales generating 70% of its electricity consumption from renewable energy by 2030. Secondly, I am setting a target for 1 GW of renewable electricity capacity in Wales to be locally owned by 2030. Finally, by 2020 I expect new renewable energy projects to have at least an element of local ownership.

I believe these are stretching but realistic targets which will help us to decarbonise our energy system, reduce long-term costs and deliver greater benefits to Wales.

Cabinet Secretary for Environment Lesley Griffiths, 28 September 2017

Growth in the percentage of electricity from renewable sources in Wales



The local picture

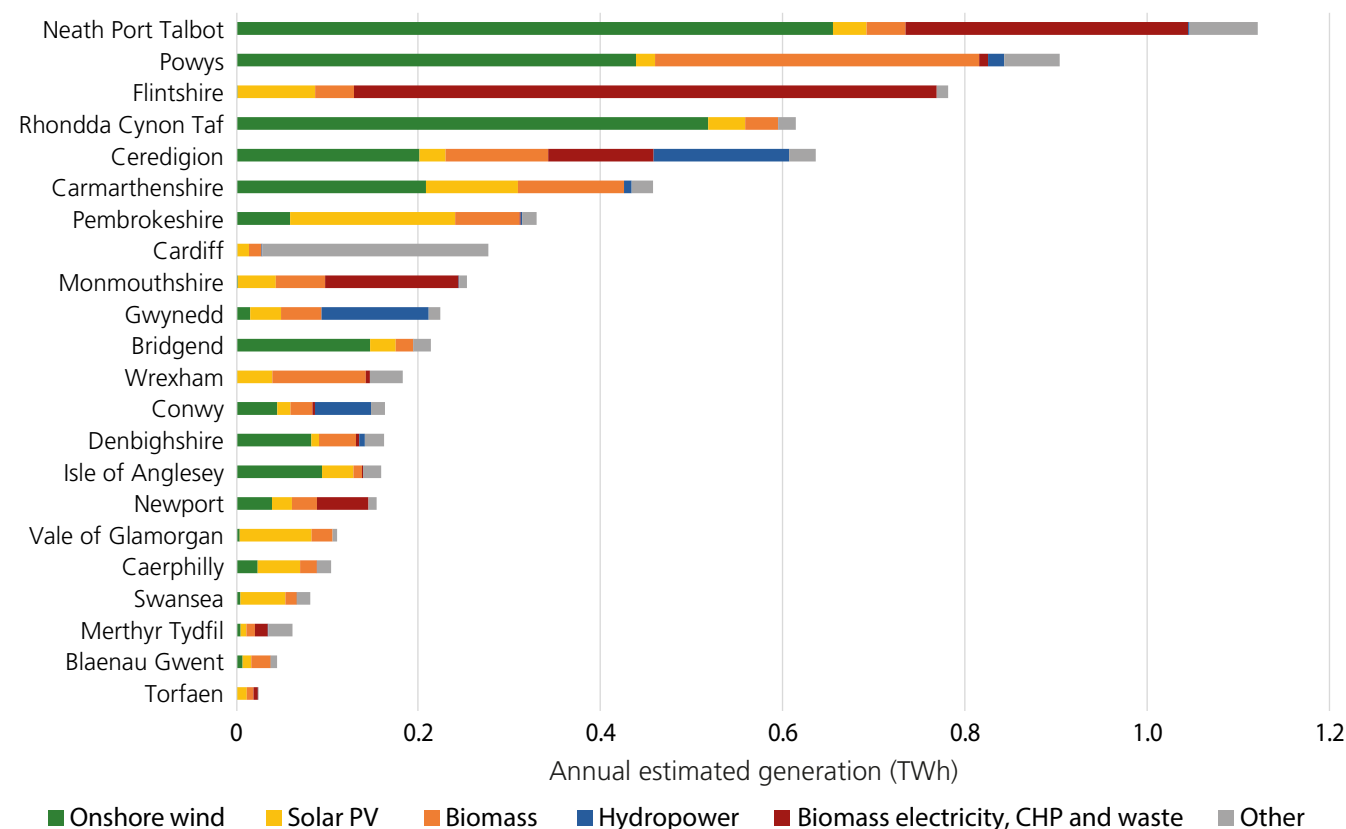
Renewable energy capacity growth was greatest in Neath Port Talbot in 2017, while Powys and Bridgend saw a modest increase in installed capacity. The majority of local authority areas saw very little growth in renewable energy generation during the year. The Vale of Glamorgan experienced a dramatic reduction in its renewable energy generation due to Aberthaw power station co-firing significantly less biomass with coal in 2017 compared to 2016.

Neath Port Talbot is the local authority area with the highest total installed renewable energy capacity with 358 MW and the greatest renewable energy generation with an estimated 1,122 GWh. A significant portion of 2017 renewable energy growth was concentrated here thanks to the commissioning of Margam wood fired power station and the Awel Aman Tawe, Lynfi Afan and Mynydd Brombil onshore wind projects.

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

Local authority	%
Ceredigion	119
Powys	88
Neath Port Talbot	77
Rhondda Cynon Taf	75
Isle of Anglesey	48

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	927	22	44	3	48	-
Bridgend	2554	102	213	5	25	-
Caerphilly	2870	68	103	2	19	-
Cardiff	3416	64	276	3	11	-
Carmarthenshire	5461	245	457	2	12	-
Ceredigion	3276	252	636	3	11	-
Conwy	1904	82	162	3	2	-
Denbighshire	2091	65	161	2	1	-
Flintshire	3511	222	781	3	1,901	-
Gwynedd	3034	120	223	1	0	-
Isle of Anglesey	2023	85	158	1	0	-
Merthyr Tydfil	739	21	61	3	43	-
Monmouthshire	4075	91	252	1	0	-
Neath Port Talbot	1874	358	1,122	5	594	-
Newport	2229	60	153	6	889	-
Pembrokeshire	4924	245	329	7	2,333	-
Powys	6478	351	904	4	1	-
Rhondda Cynon Taf	3794	252	614	8	72	-
Swansea	2907	62	80	4	85	-
Torfaen	1953	14	23	5	1	-
Vale of Glamorgan	2222	93	110	8	1,992	-
Wrexham	4789	83	182	5	24	-
Offshore	3	726	2,099	-	-	-
Unknown	2	0	1	-	-	-
Total	67,056²	3,683	9,142	84	8,064	25,480

* Not disclosed due to confidentiality

CASE STUDY - OAK GROVE SOLAR FARM

Oak Grove Solar Farm was installed on council-owned land in Crick, Monmouthshire in March 2017. Funding for the £4.5 million scheme was awarded to Monmouthshire County Council by Welsh Government's Invest to Save Green Growth programme, which supports public services to install energy efficiency and renewable energy projects. It represents an important step in the council's aim to diversify and improve the environment whilst also providing a sustainable source of income.

Energy generated by the farm feeds into the National Grid, whilst the same land can be used for animal grazing, hence enabling home-produced energy to be balanced with traditional food production. It has the capacity to generate enough electricity to supply around 14,000 homes and save over 2,000 tonnes of carbon dioxide per year by generating clean, renewable energy.

Locally owned renewable energy

The Welsh Government has set a target for 1 GW of renewable electricity capacity to be locally owned by 2030. In addition, there is an expectation for new renewable energy projects to have at least an element of local ownership by 2020.

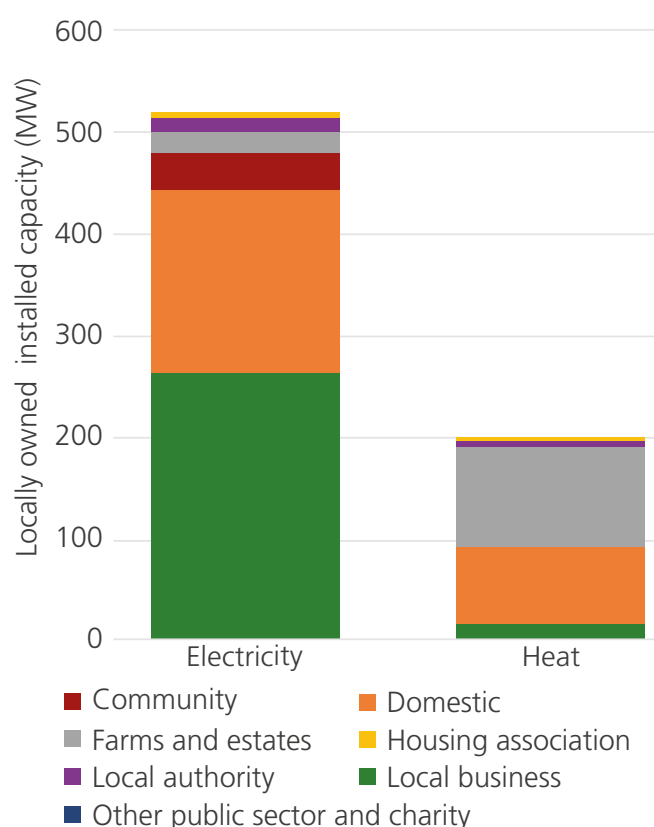
There is now 529 MW of locally owned renewable electricity, including 185 MW of onshore wind and 179 MW of solar PV. Locally owned renewable electricity capacity has increased by over 12% since 2016, thanks to the commissioning of several community and local business solar farms, and an extension at Pant y Wal Wind Farm.

There is also now 221 MW of renewable heat capacity that is locally owned, up 16% on 2016. Two thirds of all locally owned renewable heat capacity and generation is from biomass, which is largely thanks to the technology's uptake on farms and estates.

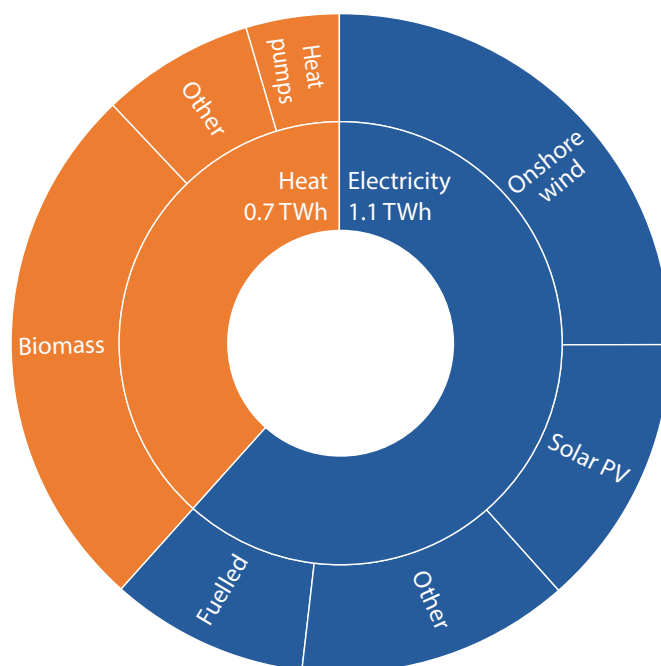
In total, there are over 63,000 locally owned renewable energy projects, largely made up of domestic rooftop solar PV projects. While these projects comprise just 20% of all renewable energy capacity in Wales, they make up 94% of all renewable energy projects.

The amount of renewable energy capacity that is owned by community groups in Wales increased this year, reaching 37 MWe and 0.5 MWth. This includes 10 renewable electricity projects over 1 MW, made up of nine solar farms and the Awel Aman Tawe community wind farm.

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*, 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 (MWh)
Community	168	37.0	0.5	50
Domestic	55,459	180.9	72.5	344
Farms and Estates	714	22.6	102.3	411
Housing Association	5,655	7.0	4.6	11
Local Authority	300	13.5	3.2	33
Local Business	364	264.0	15.7	822
Other public sector and charity	411	4.4	22.6	73
Total	63,071	529	221	1,743

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% of gas and coal electricity generation capacity is locally owned. It is expected that a higher proportion of small-scale fossil fuel generators would be locally owned.

CASE STUDY - AWEL AMAN Tawe COMMUNITY WIND FARM

The Awel Aman Tawe community-owned wind farm is in the Upper Amman and Swansea Valley in Neath Port Talbot. Following 18 years of planning, the 4.7 MW, two-turbine wind farm began operating in January 2017 and is the largest community-owned onshore wind project in Wales.

All profits from the project go back into local regeneration and to support the Awel Aman Tawe charity in tackling fuel poverty and developing other renewable projects. Estimated profits over the wind farm's lifetime are around £3 million. The project was developed with support from several partners including the Welsh Government's Ynni'r Fro programme and Local Energy Service.

* Community And Locally Owned Renewable Energy In Scotland At June 2016, Energy Saving Trust, 2016

Low carbon technologies

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Solar thermal	30
Solar PV	31
Sewage gas	33

Anaerobic digestion

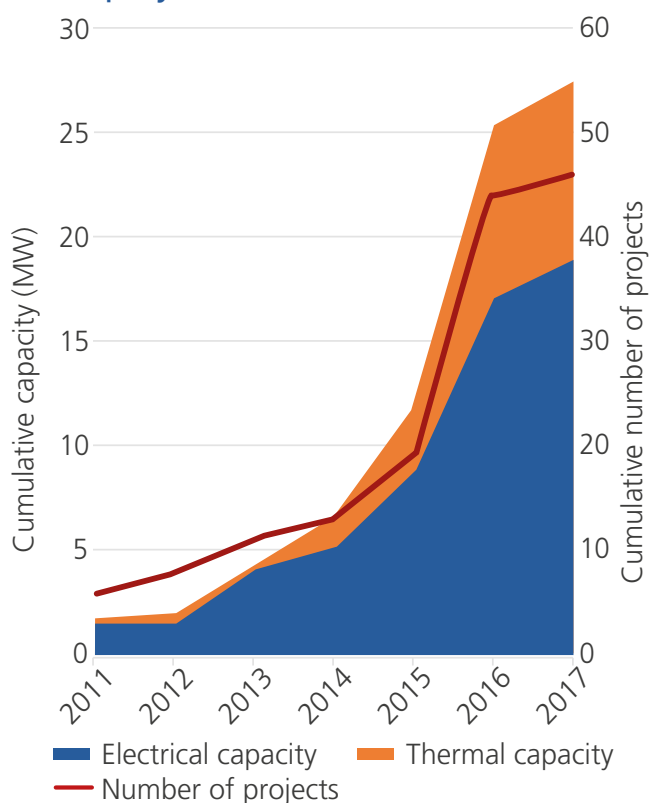
There is over 27 MW of anaerobic digestion (AD) capacity in Wales from 46 projects. There were just two new projects connected in 2017, totalling around 2 MW of capacity.

Analysis

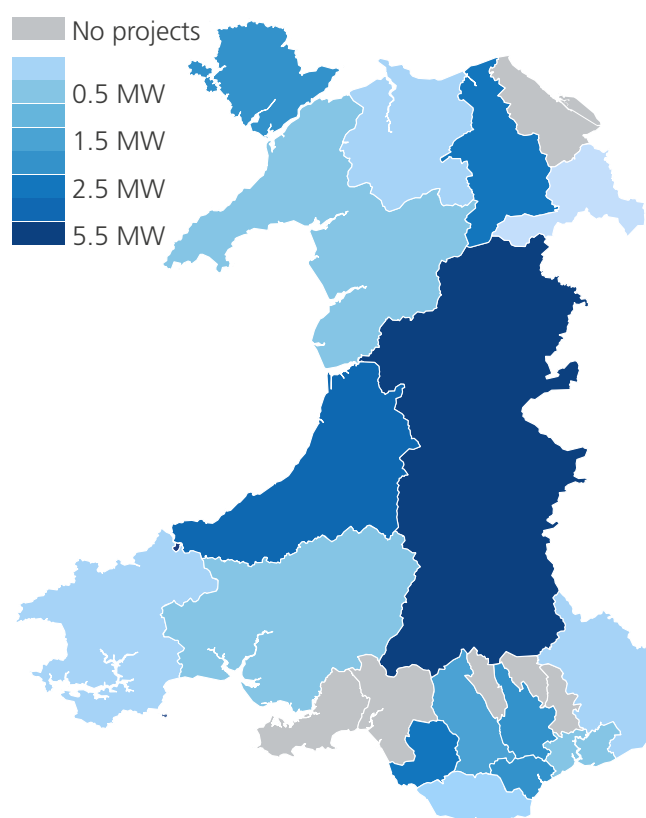
The 46 AD plants in Wales are distributed across nearly all the local authority areas. Around two thirds of the total capacity is electrical (18.9 MW) and one third is thermal (8.4 MW).

Following a period of relatively high growth from 2014 to 2016, the deployment rate slowed significantly in 2017 as a result of subsidy cuts. The two new projects installed in 2017 were both commissioned by April, with no further projects commissioned for the remainder of the year. The largest project commissioned in 2017 was the Tremorfa Food Recycling Plant in Cardiff, with an electrical capacity of 1.8 MW. The other project was an 82 kW on-farm project in Denbighshire.

AD deployment over time



Geographic distribution of AD



Future

In May 2018, RHI tariffs for heat and biomethane production from AD were reset upwards to 2016 levels; this is expected to provide a near term boost for the industry, although deployment caps will limit the number of projects that are built. Alongside the increased RHI tariffs, a requirement has been introduced for at least 50% of AD feedstock to be from waste (or residues) for a project to be eligible to receive RHI support, limiting the potential for using energy crops.

Biomass heat

Biomass heat projects in Wales have a total capacity of 394 MWth from 3,210 projects. In 2017, 179 new projects were commissioned, adding 62 MWth of capacity, continuing the trend from 2016 for slow but steady growth.

Analysis

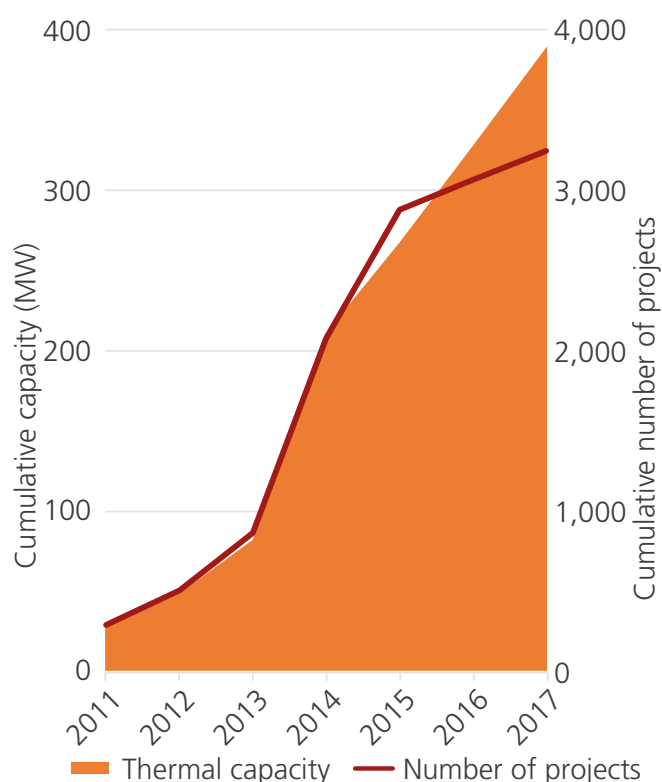
Currently, there are four biomass heat projects over 1 MW in Wales, the largest of which is a 23 MW solid biomass boiler at a wood manufacturing plant in Wrexham, installed in 2014. These four projects make up 13% of Wales' total thermal capacity from biomass heat.

In 2017, no new projects over 1 MW were installed; the majority (57%) of new projects commissioned were between 100 kW and 1 MW, with a further third between 20 to 100 kW. The growth of small-scale projects (less than 20 kW) was limited to just 15 new projects.

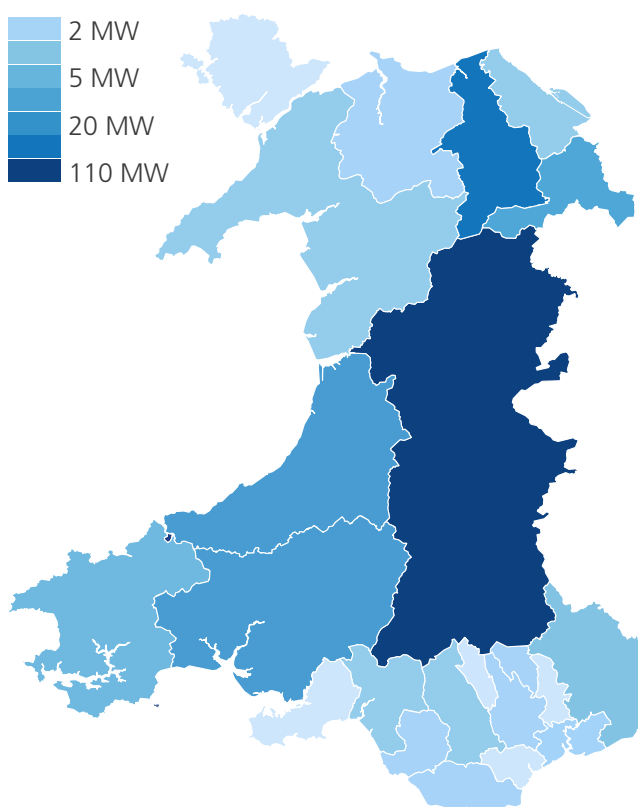
Despite lower growth in 2017, mid-scale projects between 20 and 100 kW are the dominant size in terms of numbers, making up 60% of all biomass heat installations in Wales, with the majority of these in non-domestic premises.

Welsh biomass heat projects generated approximately 1,207 GWh in 2017, enough to meet the equivalent heat demand of approximately 100,000 Welsh households. However, the deployment of biomass boilers in domestic properties (excluding log burners and boilers) is limited, with installations in less than 0.1% of Welsh homes. In 2017, 70% of new installations were in non-domestic properties.

Biomass heat deployment over time

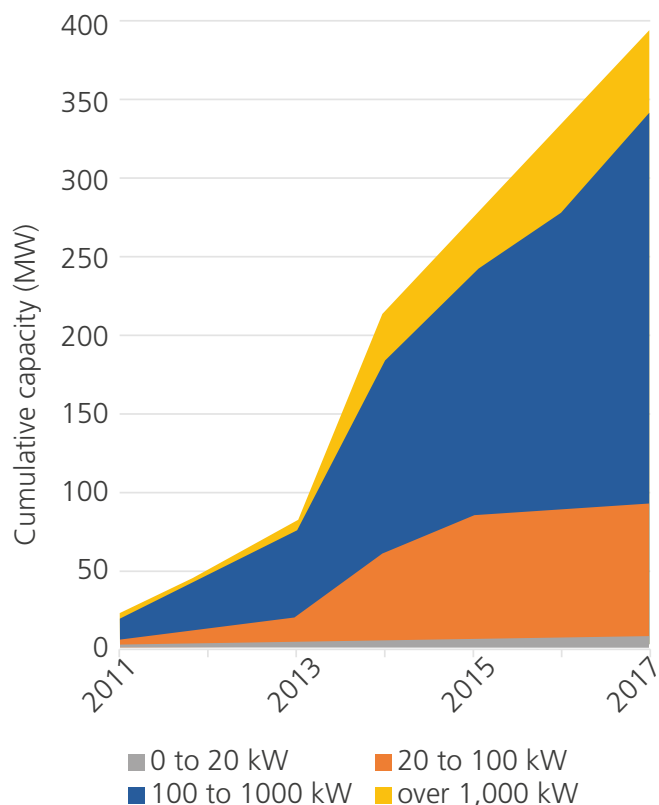


Geographic distribution of biomass



Powys is the local authority with the highest rate of biomass heat deployment, with 899 projects and 116 MWth of capacity, which is just over a quarter of all biomass heat projects. The local authority with the next highest capacity is Carmarthenshire, with 38 MWth across 455 projects. As might be expected, areas with a higher number of off-gas buildings in Wales see higher rates of deployment of biomass heat projects.

Biomass heat deployment by scale



Future

The decarbonisation of heat remains a Welsh and UK government priority, which will be addressed further within the Welsh Government's forthcoming Low Carbon Delivery Plan. 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. The RHI is due to conclude for new projects in 2021.

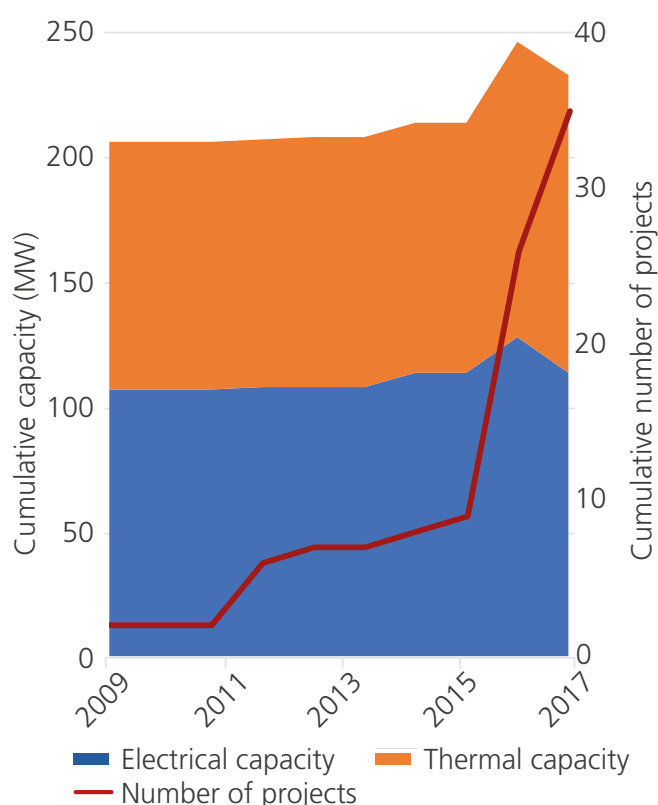
Biomass electricity and CHP

Technologies within this category include electricity generation from biomass, biomass CHP plants, biomass gasification plants, and the co-firing of biomass at coal-fired power stations. There are currently 37 projects in Wales that fall under this category, with a capacity totalling 113 MWe and 120 MWth. In 2017, 9 new projects were installed including the 40 MWe wood-fired Margam Green Energy Plant in Neath Port Talbot. The remaining new projects were biomass CHP projects totalling 0.65 MW.

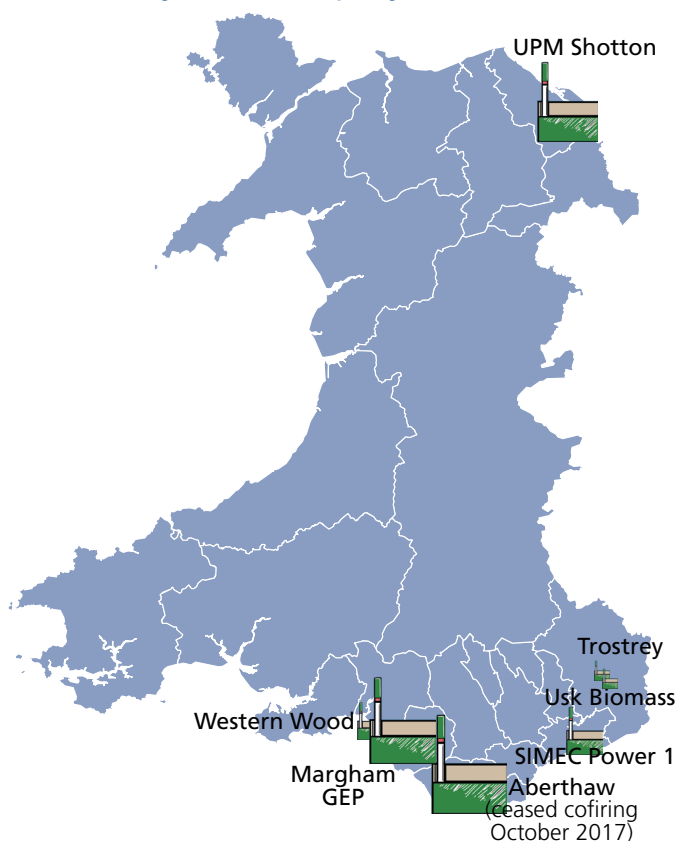
Analysis

Since 2014, there has been steady growth in the number and capacity of projects in this category, which now includes 37 biomass CHP, biomass electricity, or biomass gasification plants. The largest project in the category was the cofiring of biomass with coal at Aberthaw power station, however, this project ceased cofiring biomass in October 2017. The project with the largest thermal capacity remains a 90 MWth and 25 MWe CHP plant at Shotton Paper Mill in Flintshire, followed by a 7 MWth and 8.4 MWe biogas CHP engine at Magor Whitbread Brewery in Monmouthshire. Both sites use by-products of their production processes to fuel their generators, with the Shotton Mill plant using waste processed into pellets.

Biomass electricity and CHP deployment over time



Geographic distribution of biomass electricity and CHP projects



Powys has the greatest number of projects in this category, with seven projects totalling 0.97 MWth and 0.77 MWe. Flintshire has the highest thermal capacity in this category, due to the Shotton Mill plant, despite this being the only project in the area. The Vale of Glamorgan had the highest electrical capacity due to co-firing at Aberthaw power station, until it ceased co-firing biomass in October 2017. At the end of 2017, Neath Port Talbot had the highest electrical capacity at 54 MWe.

CASE STUDY - MARGAM GREEN ENERGY PLANT

The 40 MWe wood-fired power station in Neath Port Talbot was commissioned in 2017. The project generates electricity equivalent to 17% of Neath Port Talbot total annual electricity demand and uses an estimated 300,000 tonnes of waste wood per year from nearby regions. A local community fund and local employment opportunities are critical parts of the multi-million-pound investment in the project.



Future

The progressive phase-out of coal as an energy source in the UK has seen an increased adoption of biomass as a source of fuel by some traditionally coal-fired power stations. Uskmouth coal has been mothballed since April 2017. Plans have been announced to convert the plant to use an end-of-waste energy pellet as fuel. In contrast, Aberthaw power station co-fired biomass from 2004 to mid-2017 at 55 MWe capacity, but since October 2017 has reverted to using coal only.

Wales has seen a recent surge in interest in new biomass electricity plants with three new mid and large scale plants being considered, ranging from 11.7 MWe biomass incineration project in Barry to a 350 MW project in Milford Haven. None of these projects have been successful in obtaining a CfD contract to date and developers are citing other revenue streams, such as the sale of power, as the financial driver for their developments.

Energy from waste

This section includes energy from waste plants that generate energy using municipal or commercial waste and excludes wood waste only plants. Two energy from waste plants exist in Wales, totalling a capacity of 35 MWe.

Analysis

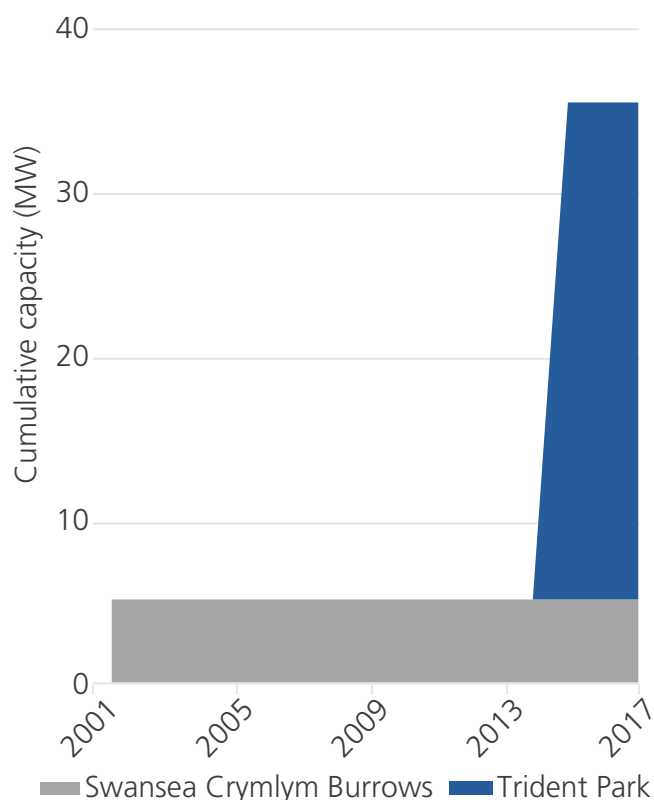
The largest and most recent energy from waste project to be commissioned was the 30 MWe Trident Park energy recovery facility in Cardiff, owned and operated by Viridor. Commissioned in 2015, Trident Park diverts 425,000 tonnes of municipal waste a year away from landfill, which equates to 95% of residual waste produced in South Wales. The 5 MWe Swansea Crymlym Burrows waste incinerator in Neath Port Talbot has been in operation since 2002. The plant processes household waste from both Neath Port Talbot and Bridgend and was briefly shut down in the first half of 2011.

Future

There is debate around the availability of the waste resource for energy production in the UK both as progress is made towards a zero waste economy and thanks to excess incineration capacity in Europe. However, there remains significant activity in Wales to develop new plants in the near term. For example, the 16.6 MWe Wheelabrator Parc Adfer incineration facility is under construction in Flintshire and expected to be completed in 2019, while a planning application for the proposed £80 million, 9 MWe Buttington Quarry energy recovery facility has been submitted to Powys County Council.

Advanced Thermal Treatment (ATT) plants use gasification or pyrolysis to generate energy from waste, rather than more straightforward but less efficient incineration plants. To date, ATT plants have tended to fail in the UK in the development phase due to technology issues and resulting financial failure. If these issues can be overcome, ATT plants could become more widespread, taking advantage of more localised commercial waste streams and gaps in municipal processing provision.

Energy from waste deployment over time



In Wales, two ATT projects are publicly under development: Enviroparks' Hirwaun plant, which has won a Contract for Difference agreement and is in its second phase of construction and a 15 MW gasification plant in Cardiff, which is in the design and contracting stage.

Heat pumps

Wales has just over 50 MW of air, ground, and water source heat pumps across 4,440 installations. They currently generate over 97 GWh of heat, the equivalent of 0.5% of estimated Welsh domestic heat demand.

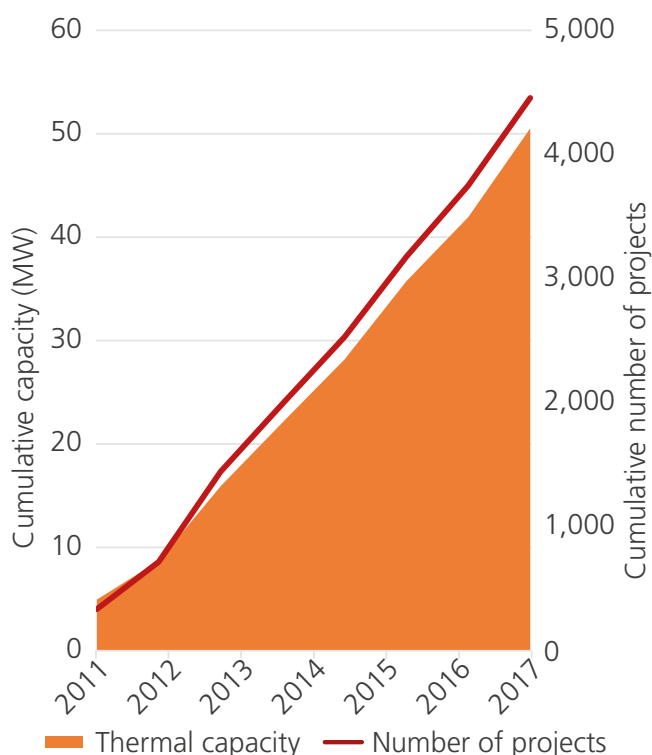
Analysis

Since 2010, there has been a steady increase in the number of heat pumps installed, with on average between 500 and 600 new heat pump installations each year. In 2017, the installation rate was slightly above the recent annual average, with 689 new installations, the highest number since 2012. The largest heat pump installed in 2017 was a 256 kW water source heat pump in Denbighshire. In 2017, there were nine heat pumps over 40 kW, compared with four in 2016.

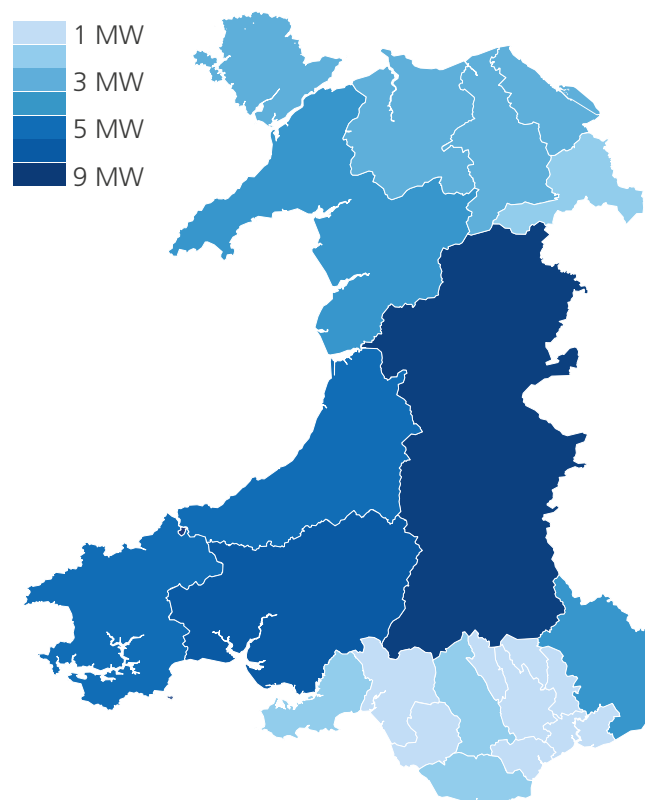
The majority of new installations in 2017 were air-source heat pumps and these now make up 67% of all heat pump installations in Wales. The rest are predominantly ground-source heat pumps, with five water-source heat pumps.

It is estimated that four out of five heat pumps currently installed are in off-gas properties. The local authorities with the largest off-gas areas, therefore, have seen overall greater levels of heat pump deployment. Powys is home to the highest number of installations and greatest capacity by a significant margin, with 8.8 MW of capacity across approximately 800 projects. Bridgend has seen the most growth in installed capacity and projects in 2017, having installed 75 new heat pumps in 2017 as a result of Project FREEDOM (see case study). Carmarthenshire has 36 projects above 20 kW, including a water-source heat pump in the National Botanic Garden of Wales.

Heat pump deployment over time



Geographic distribution of heat pumps

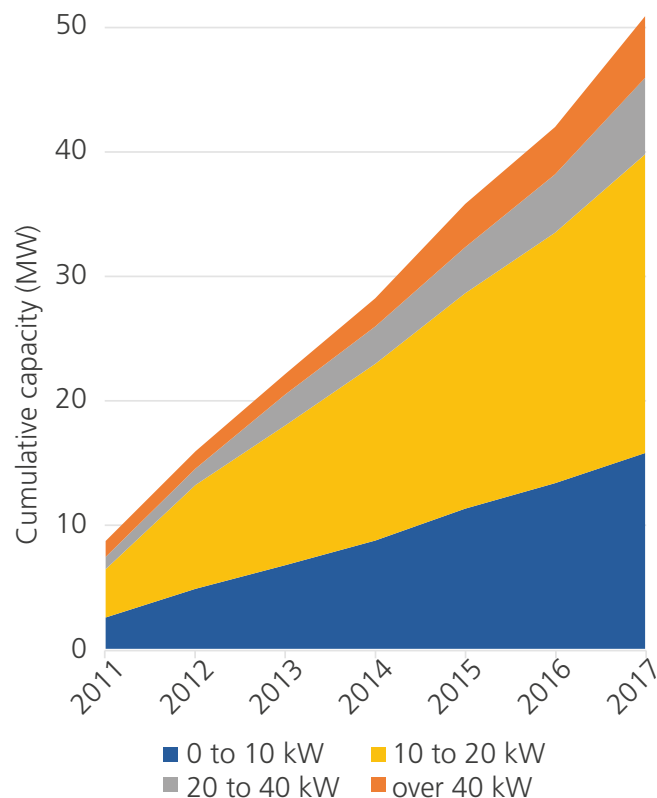


Future

Heat pumps are most effective in energy efficient homes and are more likely to be cost effective off the gas grid. Wales has a high proportion of off gas homes, but many of these have relatively poor energy efficiency ratings. As a result, widespread deployment of heat pumps is only likely alongside widespread uptake of energy efficiency measures.

The RHI tariffs for heat pumps were increased in September 2017 and this should have a short term impact to increase the deployment rate. In the longer term, higher deployment rates may result from (as yet unspecified) actions by the UK government to achieve its ambition “to phase out the installation of high carbon fossil fuel heating in new and existing off gas grid residential buildings during the 2020s.” In addition, the Welsh Government plans to address the decarbonisation of heat through its forthcoming Low Carbon Delivery Plan.

Heat pumps deployment by scale



CASE STUDY: WPD AND W&WU FREEDOM HEATING PROJECT

The Freedom Project has been managed by Western Power Distribution and Wales & West Utilities using funding from Ofgem’s Network Innovation Allowance. The project has researched the feasibility of using hybrid heating systems in homes to help meet near-zero heat-related CO2 emission targets by 2050. It retrofitted heat pumps to gas boiler heating systems in 75 homes in Bridgend alongside smart optimisation controls. The results from the trial participants demonstrated the ability of hybrid heating systems to achieve fuel arbitrage by switching between gas and electric loads, provide highly flexible demand response services, and provide consumer, carbon, and network benefits with an aggregated demand response control system. The project has evidenced the potential benefits that hybrid heating systems can provide to the whole integrated energy system and an affordable route to decarbonising domestic heating has now emerged.

Hydropower

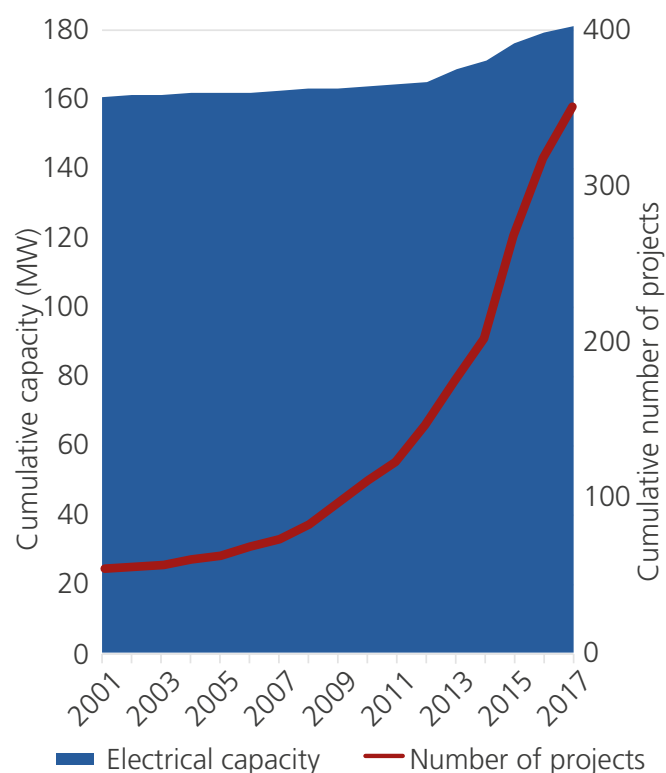
Wales has over 181 MW of hydropower capacity from 358 projects. Hydropower generates approximately 367 GWh of power annually, enough to power the equivalent of over 100,000 Welsh homes. The largest project commissioned in 2017 was the 250 kW Llys y Fran project in Pembrokeshire.

Analysis

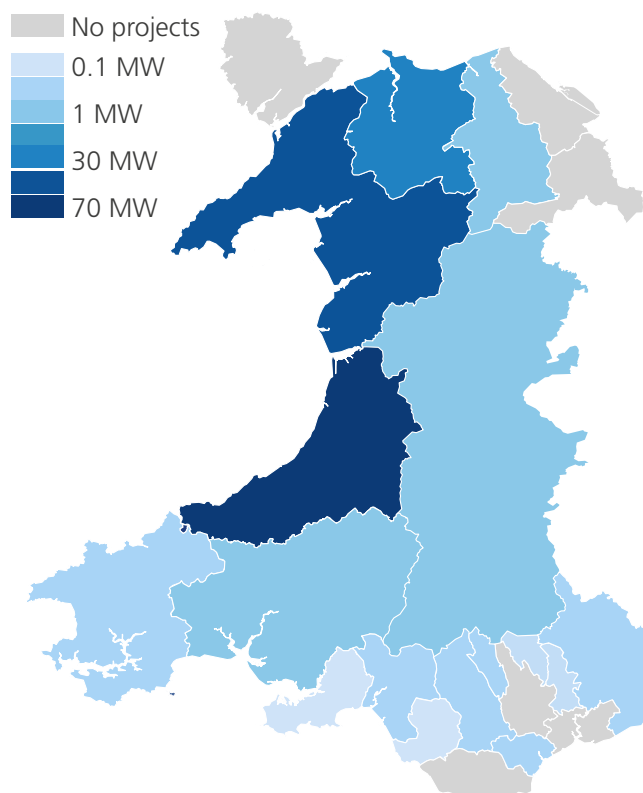
There were 34 new projects installed in 2017, an annual increase of 9%. However, the generally small size of these projects means that, in terms of capacity, this represented a 0.5% annual growth from 2016. This follows the trend for the last 10 years, where there have been no new projects over 1 MW in scale and the majority have been under 200 kW.

Gwynedd is the local authority with the highest number of hydropower projects in Wales, with 138 projects, representing 59 MW of capacity and generating the equivalent power over a year for approximately 33,000 Welsh homes. Ceredigion has the largest capacity of hydropower, with 71 MW across 28 projects.

Deployment of hydropower over time



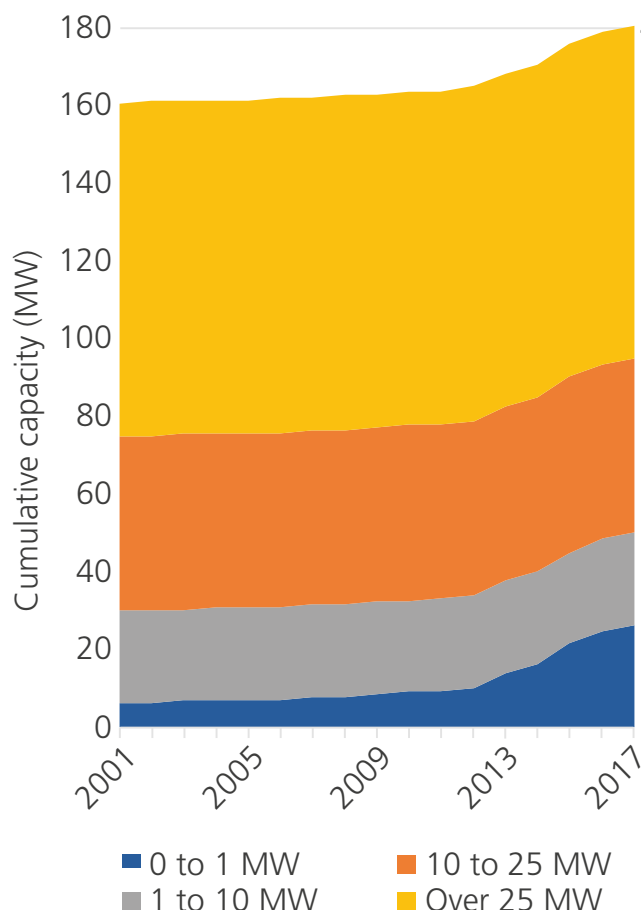
Geographic distribution of hydropower



Future

The Feed-in Tariff has supported steady growth in small and medium scale hydropower deployment in Wales. It is due to close for new projects in March 2019 with no replacement currently planned. Hydropower technology is mature and can provide a predictable source of energy. However, the relatively high upfront cost and lack of cost reduction potential is likely to limit future growth without subsidy support. In the near term, without subsidy support, the deployment rate is likely to drop, 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 scale



CASE STUDY: WELCOME TO OUR WOODS – COMMUNITY HYDROPOWER

The Welcome to Our Woods (WTOW) community organisation and its partners have developed a 27 kW high head hydropower development in Cwm Saebren, Teherbert, Rhondda Cynon Taf. The community aimed to reduce fuel poverty within the area by making use of natural local resources to create revenue for community use, as well as to demonstrate the capability of a small community organisation to deliver an ambitious generation project.

The project underwent a nine-year development process because of difficulties in securing the statutory permissions to build the project, due in part to an initial lack of confidence in the abilities of a community organisation. The project has successfully reached its completion with help from the Welsh Government's Local Energy service and is expected to generate 118,870 kWh per annum.

Landfill gas

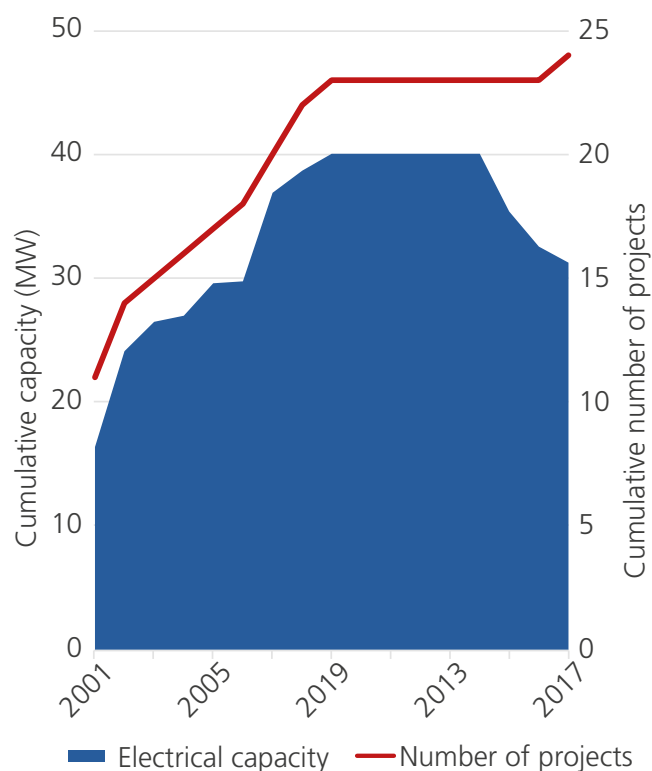
There are 24 landfill gas projects with a total capacity of 31.3 MW. Together they generate 128 GWh of electricity over a year, enough to power the equivalent of approximately 36,000 Welsh homes.

Analysis

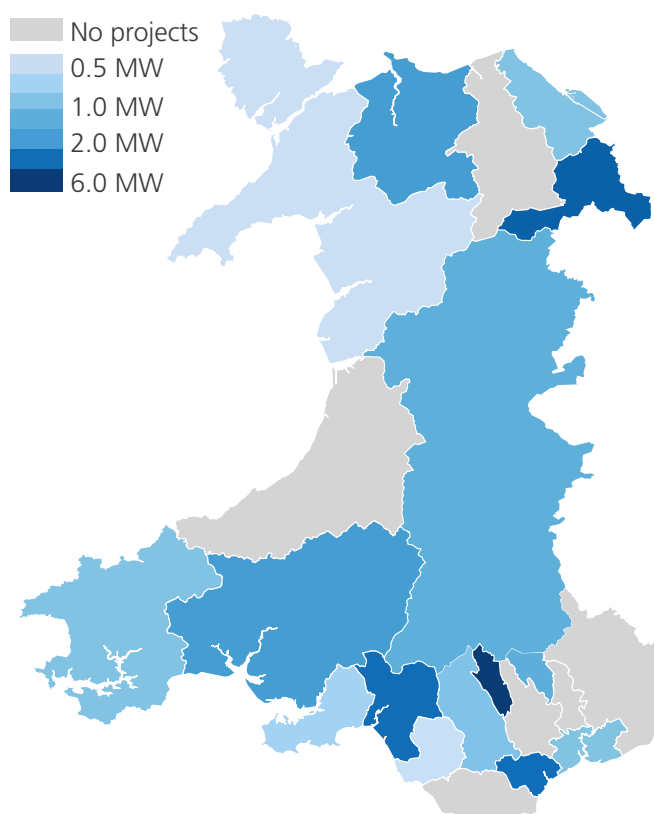
There was one new 50 kW project installed in 2017 at the Nant-y-Gwyddon landfill site, the first since 2009. However, the total capacity of landfill gas projects has continued to decline from a peak of 40 MW in 2014; the amount of methane gas captured from decomposing waste is decreasing due to greater proportions of organic waste being diverted away from landfill sites.

There remains a spread of landfill gas projects across the local authorities in Wales. Merthyr Tydfil has the largest capacity with 6.3 MW, including the 4.3 MW Trecatti 2, the largest site in Wales. Wrexham has the highest number of projects and second largest capacity in Wales, with three projects and a total of 3.7 MW capacity.

Deployment of landfill gas over time



Geographic distribution of landfill gas



Future

Wales has ambitious waste reduction targets, including to cut food waste by half by 2025 and to be a zero waste country by 2050. As a result, there will be a reduced role for landfill gas over the coming years as the amount of organic waste in landfill sites reduces.

Some waste companies are investigating the potential for using landfill gas sites to offer the peaking plant services that are required to balance demand and supply of electricity at certain times.

Nuclear

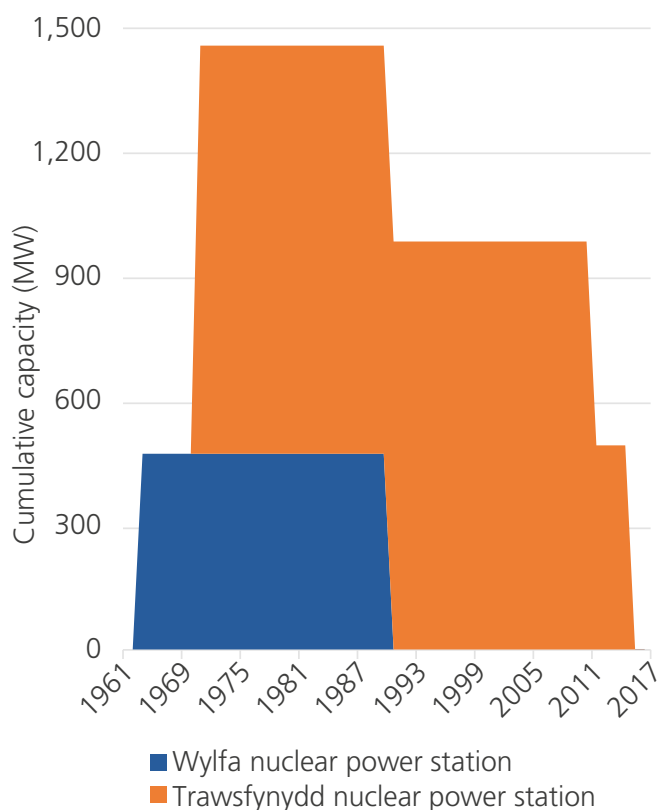
Wales currently has no nuclear power generation. Horizon Nuclear Power is negotiating with the UK Government to develop plans for a new 2.9 GW nuclear power station at Wylfa Newydd on Anglesey. The Welsh Government is working to secure a lasting legacy for Wales from the project if it goes ahead.

Analysis and future

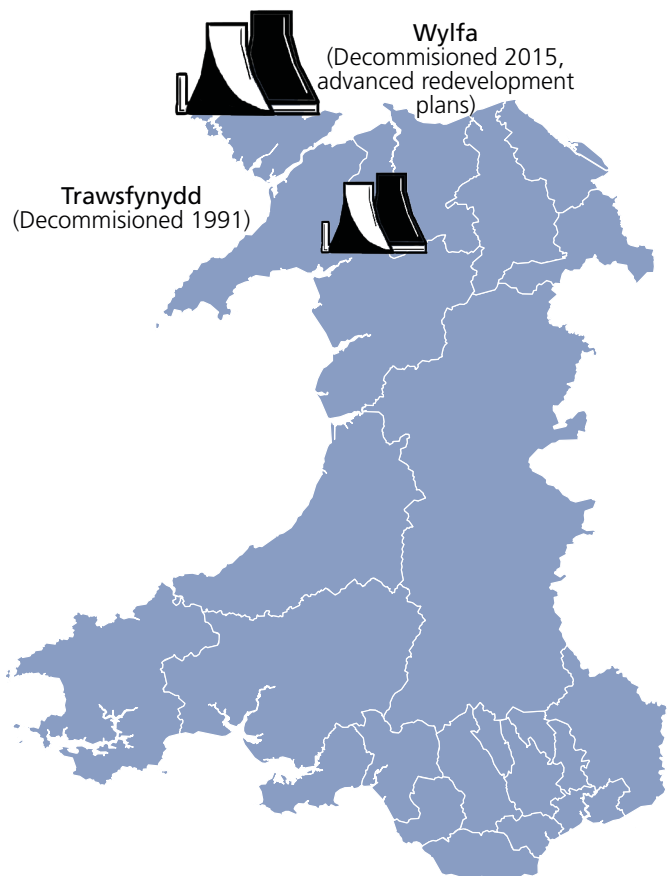
The last operating nuclear power station in Wales, Wylfa on Anglesey, was decommissioned in 2015 after 50 years of operation. There are now advanced plans for a new £15 billion nuclear power station named Wylfa Newydd on Anglesey in North Wales. The developers of the new 2.9 GW plant, Horizon Nuclear Power, are owned by the Japanese company Hitachi. An application for development consent has been made to the planning inspectorate. The UK government has signalled the intention to use public funds to provide a significant proportion of the investment required, a marked departure from other recent projects, such as Hinkley Point C.

The site of the decommissioned Trawsfynydd nuclear power station could be a location for one of a new generation of small modular reactors, putting Wales at the forefront of innovation in the nuclear industry.

Deployment of nuclear over time



Geographic distribution of nuclear



Onshore wind

Wales has over 1 GW of installed onshore wind capacity, generating enough electricity over a year to power the equivalent of 53% of Welsh homes. The largest onshore wind project installed in 2017 was 34 MW Garreg Lwyd Hill in Powys.

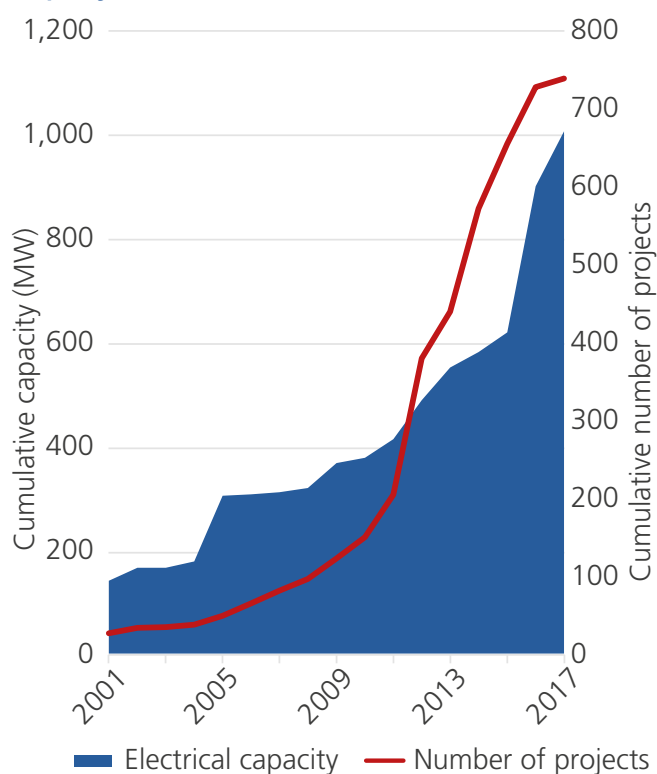
Analysis

There were 17 new onshore wind projects commissioned in 2017, adding 115 MW of capacity. This represents a 13% increase in capacity in 2017, a significant drop in the growth rate when compared with 2016, when capacity grew by 45%. However, the 2016 growth rate was particularly high, due largely to the commissioning of the largest onshore wind farm in Wales, the 228 MW Pen y Cymoedd wind farm. The 2017 annual capacity growth rate remains above the rate seen in preceding years, which was only 6% in 2015 and 4% in 2014.

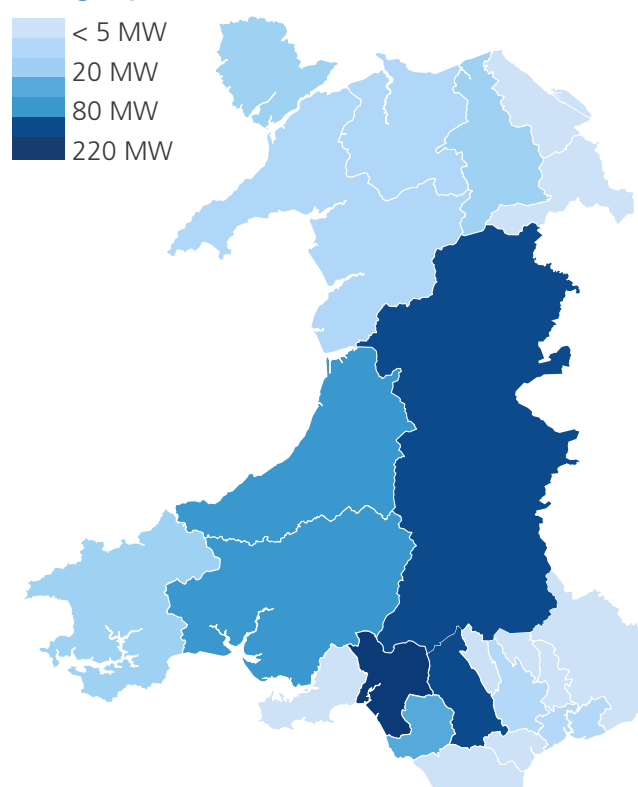
Approximately 85% of the new capacity was due to five large scale projects, ranging from 8 MW to 34 MW in size. The number of small and medium wind projects installed in 2017 was low, with only six projects that were 500 kW or under, compared with a high of 262 in 2012.

Neath Port Talbot has the highest onshore wind capacity of all the local authority areas in Wales with 236 MW, from only 11 projects, mainly due to the portion of Pen y Cymoedd wind farm that is within the authority area. Wind turbines in Neath Port Talbot can produce the equivalent energy annually for nearly half of the local authority area's total electricity consumption.

Deployment of onshore wind over time



Geographic distribution of onshore wind



Future

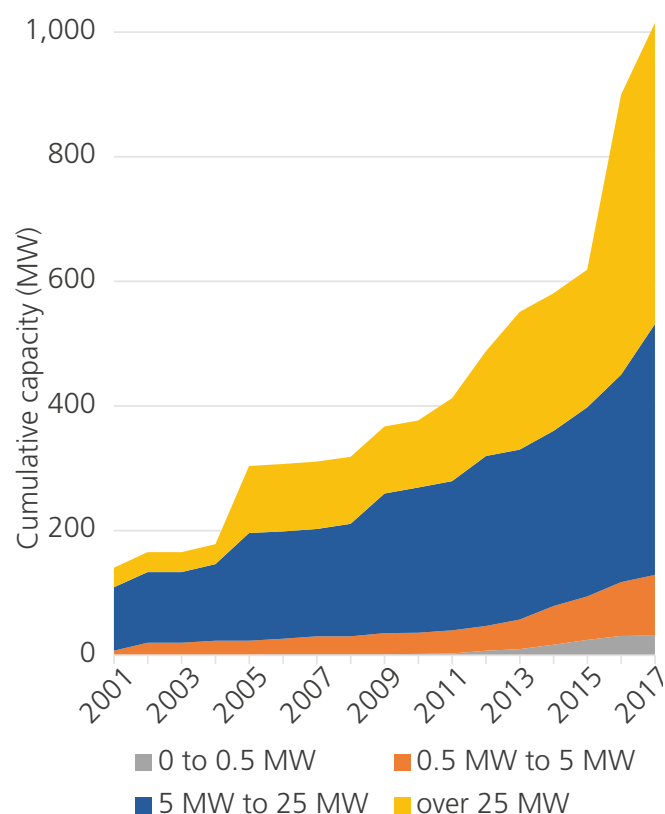
There is no subsidy support available for new large-scale (above 5 MW) onshore wind projects at present and limited support through the Feed-in Tariff for new smaller projects only available until the end of March 2019. However, costs have fallen considerably over the last few years as the technology has advanced and the first subsidy free projects are starting to be developed. For example, Pant y Maen, a seven turbine wind farm in Denbighshire, was granted planning permission in February 2018, and could be developed without subsidy by 2021.

Access to the electricity network is the key barrier to the future development of onshore wind in Wales, with the disparity between the location of the wind resource and existing demand and grid having an impact.

The repowering of existing projects by using a smaller number of larger, more efficient wind turbines will help increase the amount of electricity generation from onshore wind in Wales. The 31.8 MW Llandinam wind farm in Powys will soon be repowered with 42 turbines, replacing the 103 turbines that were installed in 1992. However, some developers may choose to apply to extend the operational life of a project, rather than repowering. For example, Bryn Titli wind farm, in Powys, has recently been granted an eight year extension to the operational life of the wind farm. Similarly, some sites may decommission entirely when the end of their planned life is reached.

High wind speeds, the positive planning environment, particularly compared to England, and a focus on local ownership is helping guide new onshore wind project development to Wales.

Deployment of onshore wind by scale



CASE STUDY: YNNI TEG, FAIR ENERGY

The 900 kW onshore wind community energy project installed near Carmarthen is expecting to generate enough electricity for 620 Welsh homes. With strong links to Community Energy Wales, this is a great example of a locally owned renewable energy project that contributes towards the 1 GW local ownership 2030 target. The Welsh Government's Local Energy scheme provided support, loan finance and grant funding to the project.

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) was only the second offshore wind project to be commissioned in the UK, back in 2003. The 90 MW Rhyl Flats was also developed under the first leasing round from The Crown Estate, commissioning in 2009.

Gwynt y Môr was developed under Round 2 and commissioned in 2015. It added 576 MW to the existing 150 MW of offshore wind already installed in Welsh waters. Gwynt y Môr is the second largest offshore wind farm in the UK.

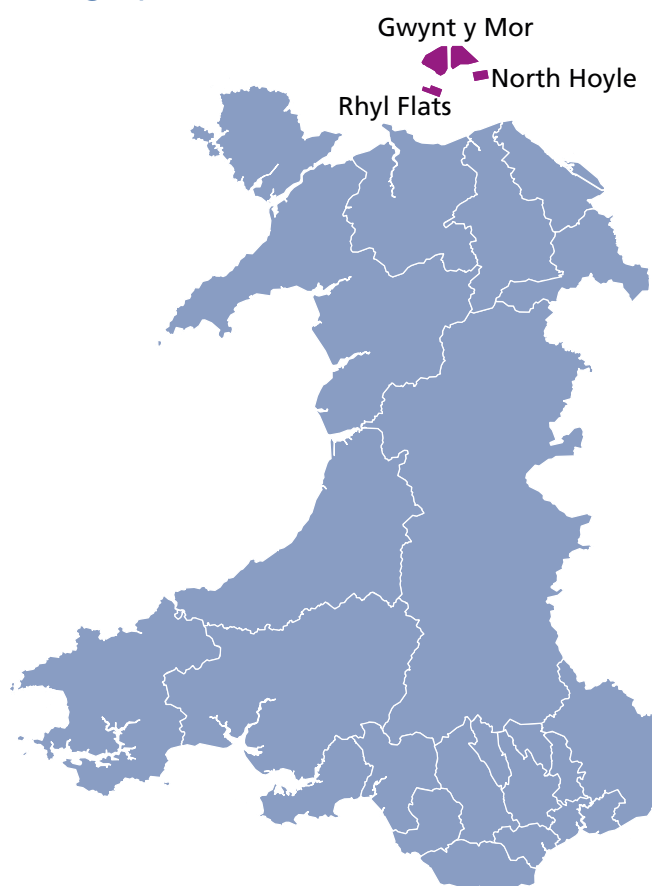
Future

The costs of offshore wind have been declining rapidly, with three projects being awarded strike prices in the September 2017 CfD auction that were 50% lower than those offered in the first auction round in 2015. However, these current development sites are focussed in the shallower waters in the North Sea. A balanced portfolio of sites around the UK that takes advantage of differing wind conditions would help to ensure greater security of supply for the UK. Floating wind technology offers a significant opportunity for innovation for which the Pembroke demonstration zone and the deeper waters of the outer Bristol Channel and Celtic Sea are prime sites for deployment.

The Welsh government has commissioned research to explore the potential for offshore wind in Wales. This research aims to undertake an initial evaluation of the case for offshore wind in Wales, the potential for increased offshore wind deployment, the associated economic benefits, and the key considerations for policy makers. In October, the Crown Estate announced a potential new leasing round for offshore wind (including an initial assessment for an extension to the Gwynt y Môr offshore wind farm of up to 576 MW). Meanwhile, BEIS

has confirmed that CfD auctions are scheduled every two years, with the next round due to take place in May 2019. There is a possibility that these three advances together could lead to new projects being investigated off the Welsh coast.

Geographic distribution of offshore wind



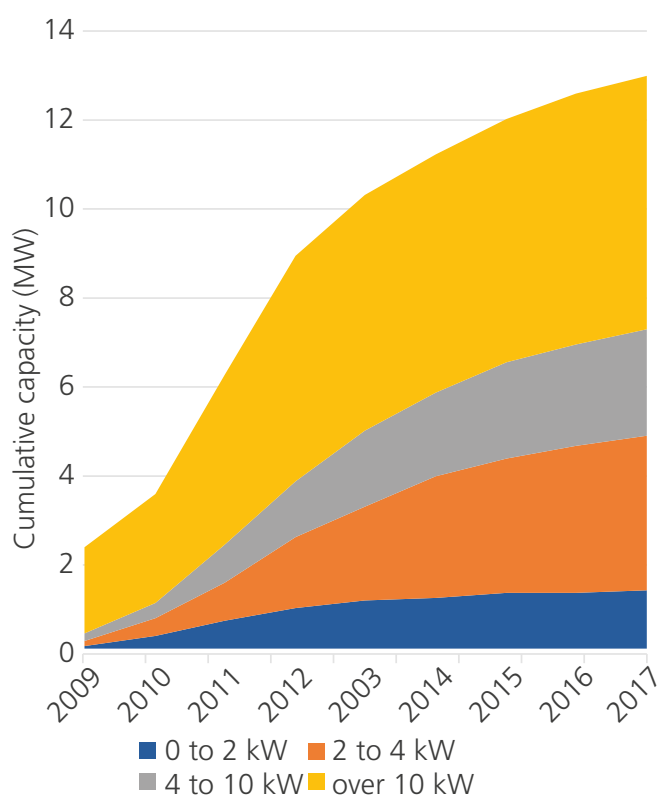
Solar thermal

There is 13 MW of solar thermal capacity installed across 4,600 projects in Wales. In 2017, 110 new projects were installed.

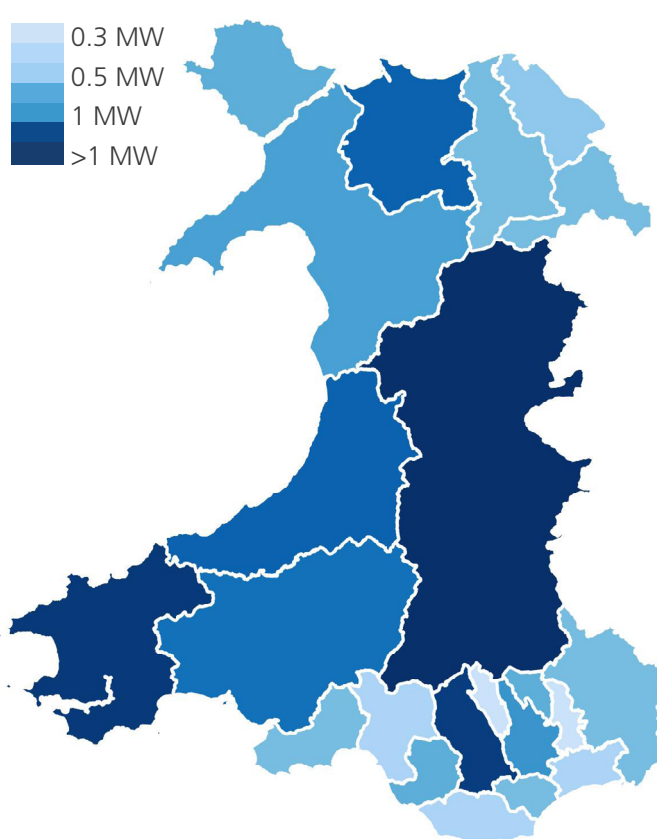
Analysis

The rate of deployment of solar thermal projects has continued to decrease after its peak between 2010 and 2012, with a further 21% decrease in the number of deployments in 2017 compared to 2016. The number of larger-scale (>10 kW) solar thermal installations decreased drastically after 2012, falling from 650 new installations in 2012 to just 13 new installations in 2013 and two in 2017.

Deployment of solar thermal by scale



Geographic distribution of solar thermal



Future

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

Solar PV

Solar PV capacity in Wales totals 970 MW across 53,600 installations, up from 888 MW and 52,704 installations in 2016. Solar PV generated an estimated 930 GWh in 2017, which is enough to power the equivalent of 19% of Welsh homes.

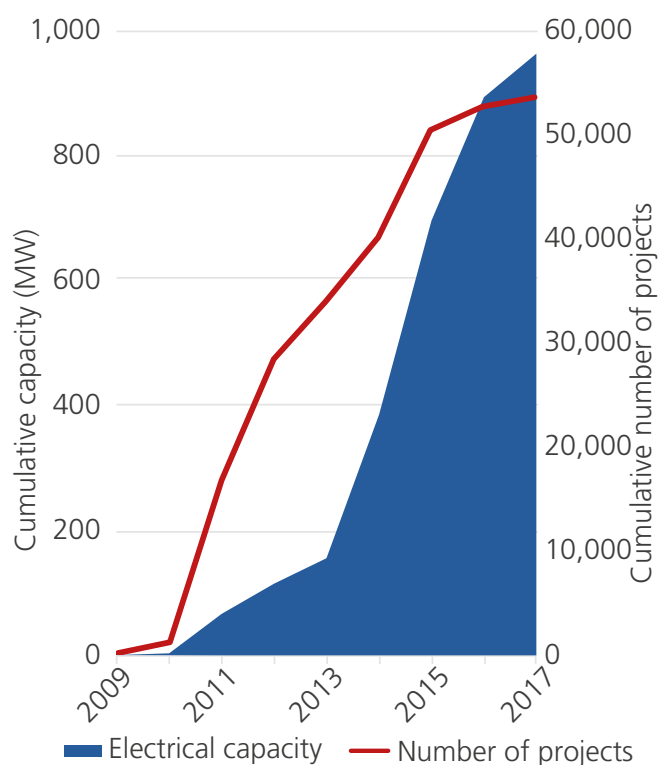
Analysis

The solar PV installation rate continued to fall in 2017, with 896 new projects, compared with over 2,200 in 2016 and over 10,000 in 2015. 92% of new installations in 2017 were small-scale (0-10 kW) rooftop solar PV installations. This scale of project accounts for 96% of all solar PV installations in Wales, but only 16% of total installed capacity.

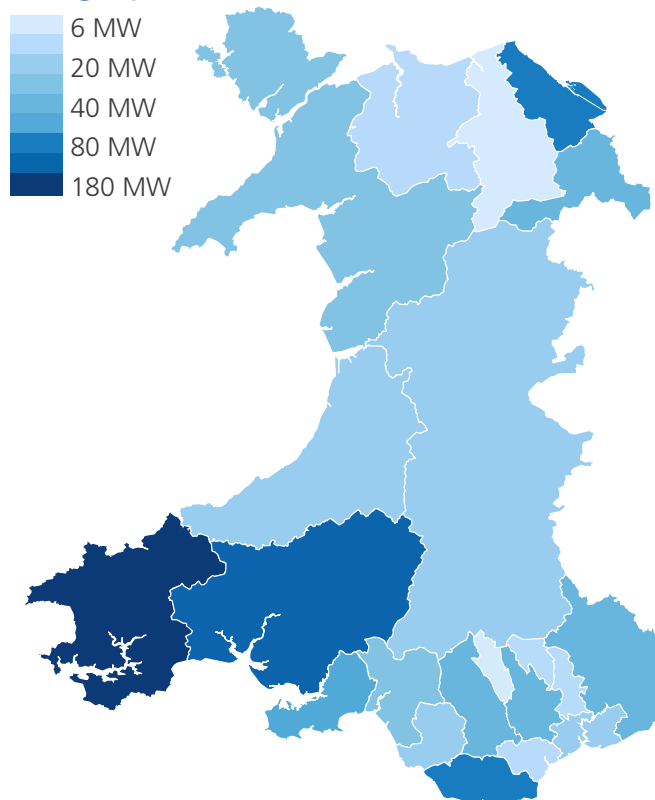
With no subsidy available for projects over 5 MW, the largest project installed in 2017 was the 4.97 MW Oak Grove Farm in Monmouthshire. 22 projects between 1 MW and 5 MW commissioned in 2017. These were built before the end of March 2017, taking advantage of the Renewables Obligation's grace period for this scale of project.

There are currently three solar PV projects above 25 MW in Wales; a 37.8 MW and a 28.9 MW solar park in Pembrokeshire, and the UK's largest solar farm, 72.2 MW Shotwick Solar Park in Flintshire, commissioned in 2016. Hosting two of the three largest solar farms, Pembrokeshire is the Welsh local authority area with the highest capacity of solar PV, totalling 189 MW.

Deployment of solar PV over time



Geographic distribution of solar PV

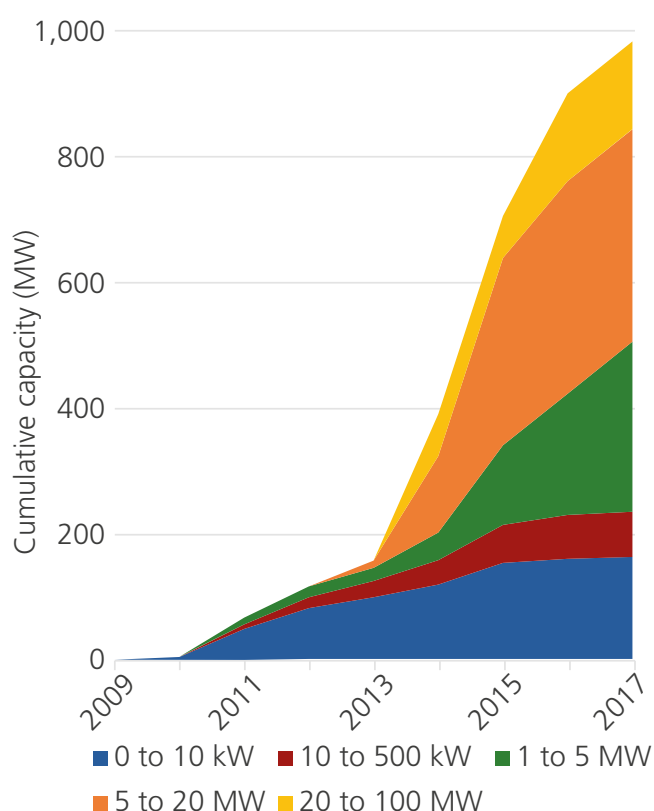


Future

Solar PV deployment in Wales, as in the rest of the UK, has been affected by cuts to the Feed-in Tariff and the ending of the Renewables Obligation. The ending of the grace period for the RO in March 2017 and the cancelling of the FiT from March 2019 will further reduce deployment. The solar industry is lobbying the UK government to provide some form of minimum price support for small scale solar after March 2019 and the Welsh Government and others are influencing the UK government to allow large scale solar to access the Contracts for Difference mechanism. The outcomes of these lobbies for price guarantee support will have an impact on the near term deployment rates.

Meanwhile, solar PV costs have fallen dramatically in recent years and the first subsidy free solar farm was built in England in 2017. Subsidy free projects are likely to become increasingly widespread as costs fall further and as innovative approaches to financing develop, for example through the Power Purchase Agreement market.

Deployment of solar PV by scale



CASE STUDY: SWANSEA COMMUNITY ENERGY AND ENTERPRISE SCHEME (SCEES)

The Swansea Community Energy and Enterprise Scheme (SCEES) was established in September 2015 by the City & Council of Swansea Council as a community-owned renewable energy company to develop community-owned solar projects in Swansea. The community group has installed 10 projects in and around the wards of Townhill and Penerry in Swansea, totalling 350 kW. The Welsh Government provided grant funding and technical support to the project via the Local Energy service.

SCEES has successfully raised £467,000 from a community share offer, with two-thirds of their investors coming from the Swansea area. Any surplus profits are intended to fund skills and enterprise in the poorest communities within Swansea, including renewable and energy efficiency projects, low carbon transport, energy awareness, and skills development, training, and tutoring.



Sewage gas

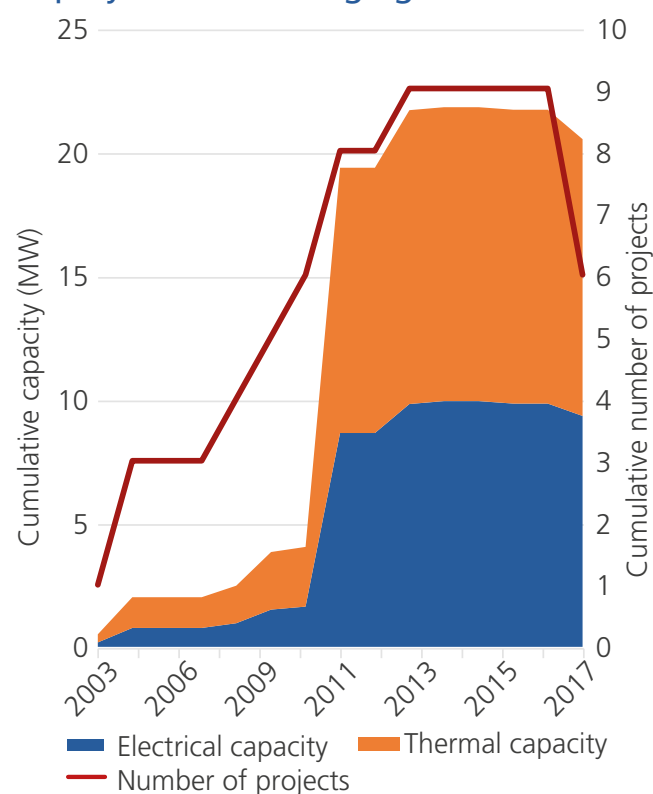
There are six active sewage gas projects in Wales, providing both heat and electricity, with a total capacity of 9.3 MWe and 11.2 MWth. The most recent sewage gas project to be commissioned remains the Five Fords plant in Wrexham, which opened in 2012 and also injects biomethane into the gas grid.

Analysis

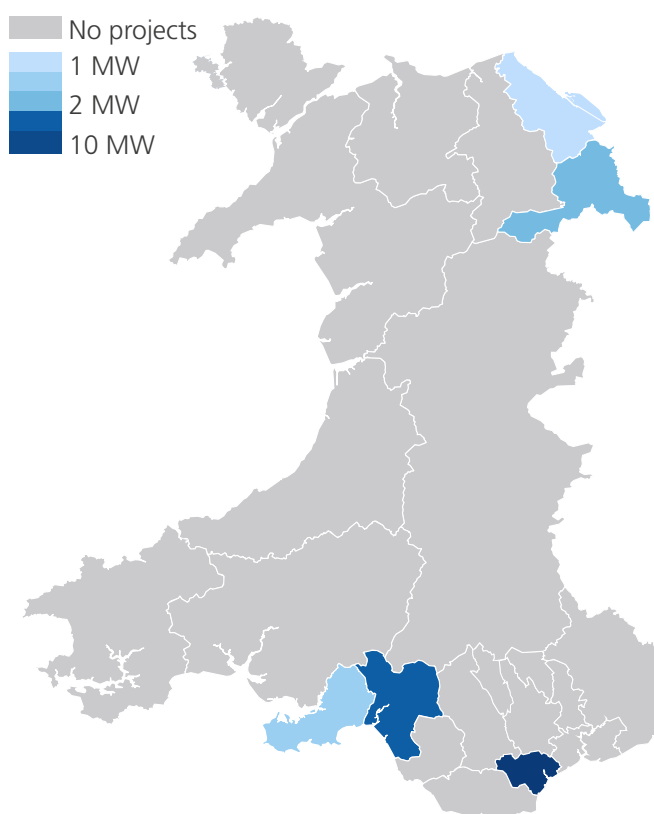
No new sewage gas installations were commissioned in 2017, while the Kinmel Bay CHP in Denbighshire, Newtown CHP in Powys and the Llanfoist CHP in Monmouthshire stopped generating in 2017.

Generation from sewage gas only occurs in five of the 22 local authorities in Wales. Two projects account for 75% of the total capacity, both commissioned in 2010. These are the Cardiff East plant at 4 MWe and 5 MWth and Afan CHP in Neath Port Talbot at 3 MWe and 3.3 MWth capacity.

Deployment of sewage gas over time



Geographic distribution of sewage gas



Future

The closure of three sewage gas sites in the past year is part of a plan by Dŵr Cymru Welsh Water to close all current AD satellite plants by 2020, as they move towards installing a smaller number of larger, more efficient Advanced Anaerobic Digestion (AAD) sites. Dŵr Cymru Welsh Water also has ambitious plans to increase sustainable energy production, including looking to become energy neutral by 2050. Alongside this, there is also a potentially greater role for sewage gas plants to produce biomethane for injection in the gas grid.

Fossil fuels

Fossil fuel electricity generation

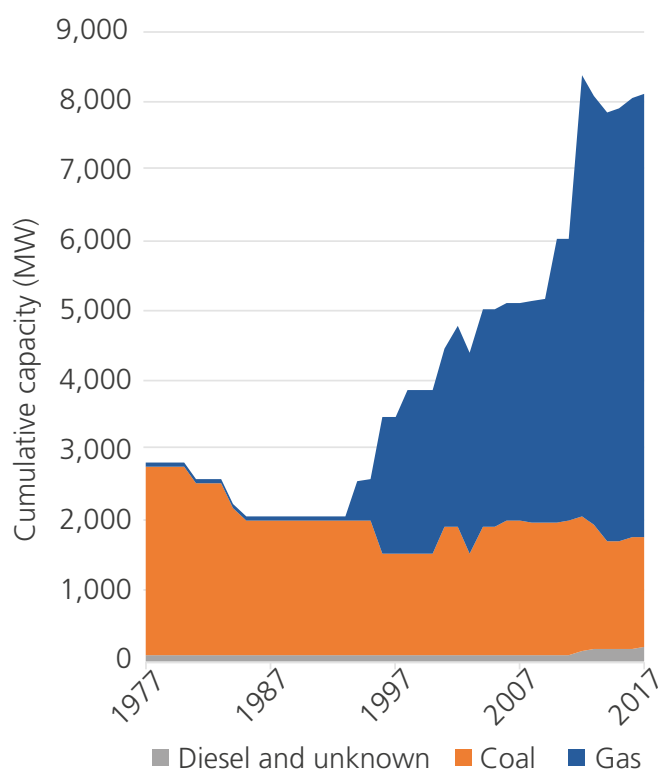
Fossil fuel electricity generation in Wales has a total capacity of just over 8 GW across multiple scales of power station, peaking plant and CHP projects. Generation by large scale plants is made up of six Combined Cycle Gas Turbine (CCGT) power stations and one coal-fired power station, Aberthaw B. The 2.2 GW Pembroke power station is the largest gas-fired power station in the UK.

Analysis

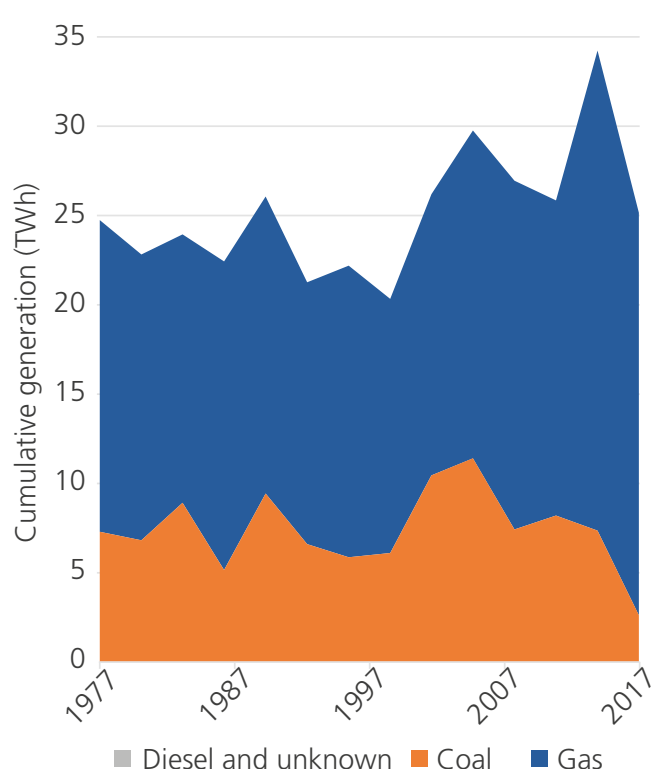
Due to competition from natural gas alongside the UK government's commitment to phasing out coal by 2025, the electrical capacity of coal-fired generation in Wales has gradually declined since 1971. Uskmouth B ceased baseload generation in 2013 and its current status since April 2017 is 'mothballed', with plans to convert it to use an end-of-waste energy pellet as fuel. The 1,586 MW Aberthaw B power station is the only coal-fired power station in Wales still in operation.

Wales has just over 700 MW of electrical capacity from small-scale (>100 MW) fossil fuel power stations, which includes diesel generators, small CHP projects, and small-scale Open Cycle Gas Turbines. The vast majority of these small-scale projects commissioned in the last decade; a greater need for flexible power to support the rapid expansion of renewable energy generation has led to an increased focus on smaller decentralised stations that can meet demand for flexibility, as opposed to traditional large-scale centralised stations. Many of these generating technologies operate as 'peaking plants', designed to generate during peak electricity demand periods.

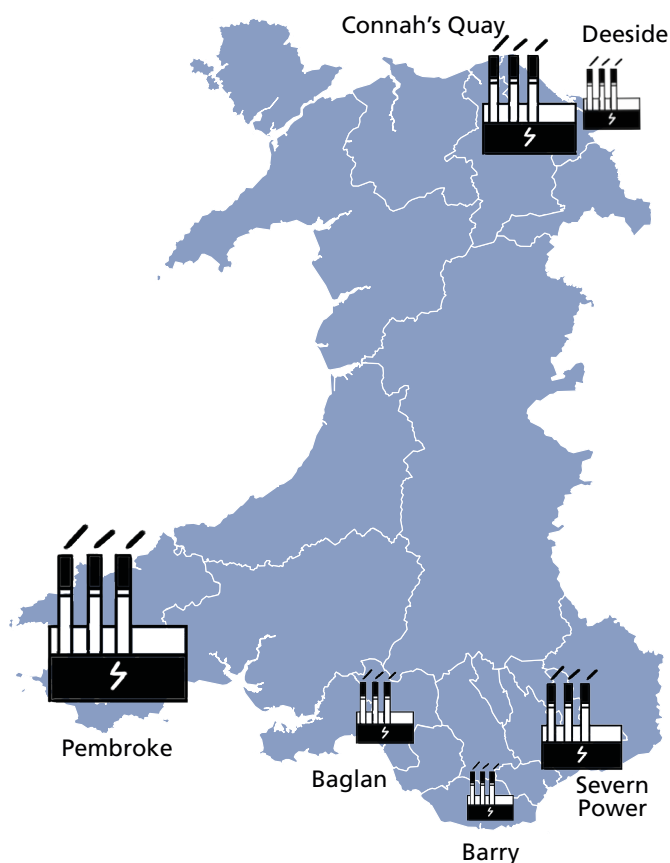
Fossil fuel electricity capacity



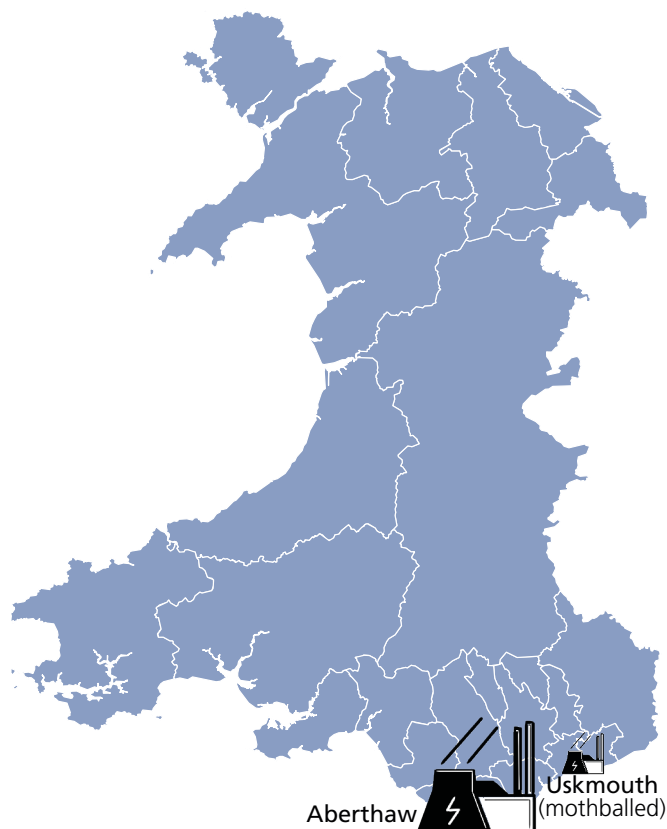
Fossil fuel electricity generation



Geographical distribution of major gas plants in Wales



Geographical distribution of coal plants in Wales



Future

The Welsh Government is committed to reducing fossil fuel generation to decarbonise energy generation in Wales. No new coal generation is expected in the future and Wales' only remaining coal power station, Aberthaw B now only generates electricity at peak times during the winter.

As the energy system decarbonises, gas generation is expected to continue to play a role in the energy mix, for example, providing peak power to meet periods of high demand and variable supply. The extent of this role and the likely scale of gas plant deployed varies under different future energy scenarios. Carbon Capture and Storage (CCS) technology could reduce the carbon impact of fossil fuel generation; however, to date this technology is unproven.

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 medium and small 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 small size and infrequent use.

Storage

Pumped hydropower storage.....	38
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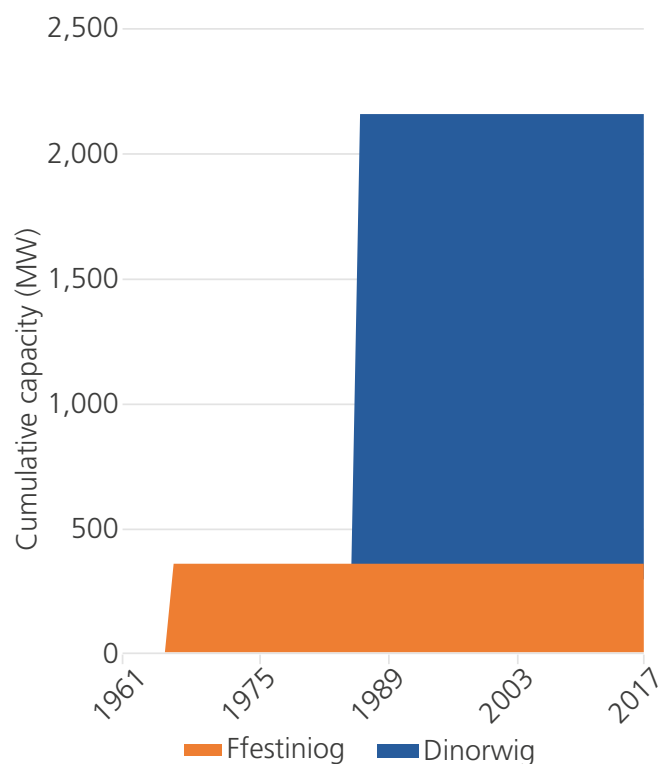
Pumped Hydropower Storage

Wales has 2,088 MW of pumped hydropower storage from two projects: the 360 MW Ffestiniog pumped storage plant in Gwynedd, which opened in 1963, and the 1,728 MW Dinorwig pumped storage plant, which opened in 1984. Both provide essential services to the UK electricity network.

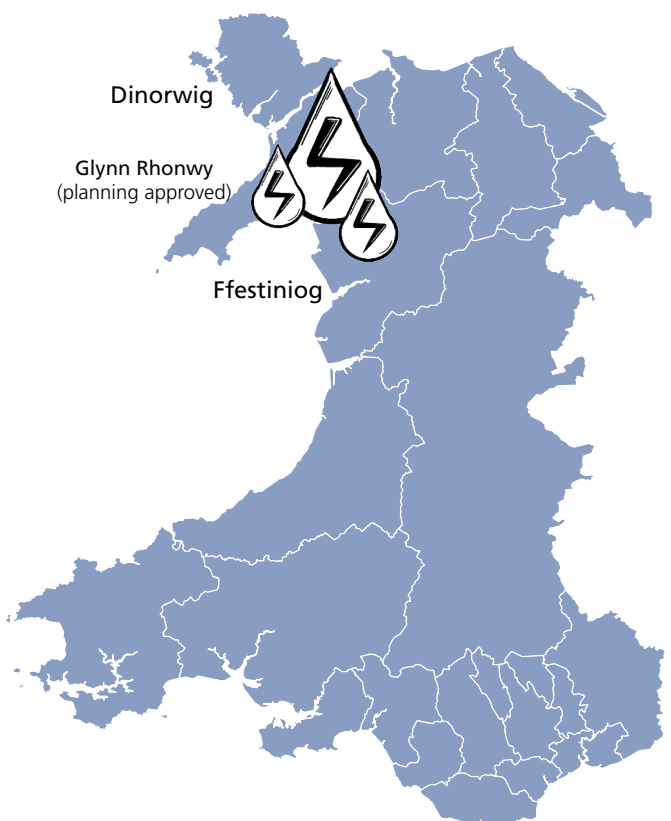
Analysis

Pumped hydropower was first considered in 1948 in Wales and has become a feature of the Welsh energy landscape since the 1960s in order to meet rapid changes in electricity demand. Both of the two currently-operating plants serve this purpose, but the Dinorwig power station runs on a Short Term Operating Reserve (STOR) contract to meet such 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

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 for the facility and is the first of its kind to be given consent as a Nationally Significant Infrastructure Project.

Battery Storage

There were no large-scale battery storage projects connected to the electricity network in Wales in 2017. Evidence on small-scale batteries shows limited but significant initial growth of this market in 2017/18.

Analysis

Two large scale co-located battery projects were connected in 2018. Both the 22 MW / 33 MWh co-located battery storage project at Pen Y Cymoedd windfarm, and the 4.3 MW / 4.8 MWh Parc Stormy battery storage facility, in Bridgend, completed construction and began operation in 2018. The business model of both projects is to provide frequency response services to National Grid, with the 'Battery@PyC' winning an Enhanced Frequency Response (EFR) contract and the Parc Stormy project winning a contract in the 2017/18 T1 Capacity Market auction.

A survey of ten of the leading small-scale battery installers suggests that, as of August 2018, there have been at least 60 domestic battery storage installations in Wales, comprising around 925 kWh of storage. This is a 64% increase from the approximated 565 kWh of domestic storage capacity from a survey of installers in September 2017.

Future

Energy storage has seen a significant amount of interest in the past 12 months, with many battery projects being active in UK flexibility services. In Wales, there has been more modest activity in these markets. Only two Welsh battery projects have secured contracts and one further 20 MW project is potentially being developed by FPC Industrial in Newport.

CASE STUDY

In August 2017, Western Power Distribution began trialling a 50 kW (210 kWh) Tesla battery storage system in Cardiff. The battery storage system stores electricity from solar PV. The project has shown the capability of using battery storage to avoid Triad peak demand penalties and to autonomously provide frequency response services in response to locally-measured frequency, with no overall impact on site energy supply.

In South Wales a National Grid embargo on new 'dispatchable generation' until 2026 is preventing new battery storage projects above 1 MW from connecting.

There is good potential to develop battery storage in Wales under a number of business models, such as:

- Co-locating batteries with existing and new renewable generation to access new sources of income or increase the value of the energy exported to the network
- Siting battery projects with commercial and industrial sites to avoid high cost periods
- Installing domestic batteries on homes with roof mounted solar PV to maximise the self-use of solar generation in homes

With tighter exhaust emission control requirements under EU legislation, there is also potential for longer duration battery storage to take on some of the network roles that diesel generators have historically undertaken.

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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	927	14	8	3	48	-	-	-	12	7	-	-	-	
Bridgend	2,554	94	8	5	25	1	3	-	31	6	-	-	-	
Caerphilly	2,870	60	8	2	19	2	2	1	42	6	1	0	-	
Cardiff	3,416	53	11	3	11	1	2	-	19	4	-	-	-	
Carmarthenshire	5,461	200	45	2	11	2	1	0	455	38	-	-	-	
Ceredigion	3,276	190	62	3	10	5	2	2	232	37	5	3	17	
Conwy	1,904	70	12	3	2	3	-	0	117	8	2	0	0	
Denbighshire	2,091	47	18	2	1	3	1	1	162	13	3	0	0	
Flintshire	3,511	115	107	3	1,901	-	-	-	141	14	1	25	90	
Gwynedd	3,034	101	19	1	0	2	0	0	207	14	-	-	-	
Isle of Anglesey	2,023	78	7	1	0	2	2	0	58	3	1	0	0	
Merthyr Tydfil	739	16	5	3	42	-	-	-	13	3	1	1	2	
Monmouthshire	4,075	62	28	1	0	2	0	0	175	18	4	18	7	
Neath Port Talbot	1,874	340	18	5	594	-	-	-	84	14	2	54	-	
Newport	2,229	50	10	6	889	2	0	0	37	9	3	9	1	
Pembrokeshire	4,924	216	29	7	2,331	2	0	0	263	23	2	0	0	
Powys	6,478	221	130	4	1	12	4	2	889	116	7	1	1	
Rhondda Cynon Taf	3,794	237	15	8	72	1	1	1	56	12	-	-	-	
Swansea	2,907	55	7	4	85	-	-	-	52	4	-	-	-	
Torfaen	1,953	11	3	5	0	-	-	-	18	2	1	0	1	
Vale of Glamorgan	2,222	84	9	8	1,936	1	1	-	59	8	-	-	-	
Wrexham	4,789	46	38	5	24	5	0	1	88	33	2	0	1	
Offshore	3	726	-	-	-	-	-	-	-	-	-	-	-	
Unknown	2	0	0	-	-	-	-	-	-	-	2	0	0	
Total	67,056	3,087	596	84	8,002	46	19	8	3,210	394	37	113	120	

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	-	-	16	0	1	0	1	2	-	-	6	2
Bridgend	-	-	96	1	3	0	1	0	-	-	14	62
Caerphilly	-	-	43	0	-	-	-	-	-	-	18	9
Cardiff	1	30	52	1	1	0	2	3	-	-	3	0
Carmarthenshire	-	-	445	6	14	5	1	2	-	-	112	88
Ceredigion	-	-	507	4	28	71	-	-	-	-	76	85
Conwy	-	-	154	2	30	34	1	2	-	-	39	19
Denbighshire	-	-	200	3	19	2	-	-	-	-	37	34
Flintshire	-	-	239	3	-	-	2	1	-	-	16	0
Gwynedd	-	-	350	4	138	59	2	0	-	-	35	6
Isle of Anglesey	-	-	224	3	-	-	1	0	-	-	48	39
Merthyr Tydfil	-	-	26	0	4	0	2	6	-	-	4	2
Monmouthshire	-	-	264	3	11	0	-	-	-	-	10	0
Neath Port Talbot	1	5	86	1	11	1	2	3	-	-	11	236
Newport	-	-	46	1	-	-	1	1	-	-	11	16
Pembrokeshire	-	-	374	4	14	1	1	2	-	-	148	24
Powys	-	-	819	9	78	8	1	2	-	-	117	185
Rhondda Cynon Taf	-	-	95	1	3	0	2	1	-	-	11	192
Swansea	-	-	152	2	2	0	1	1	-	-	4	1
Torfaen	-	-	22	0	1	0	-	-	-	-	3	0
Vale of Glamorgan	-	-	80	1	-	-	-	-	-	-	6	1
Wrexham	-	-	150	1	-	-	3	4	-	-	1	0
Offshore	-	-	-	-	-	-	-	-	3	726	-	-
Unknown	-	-	-	-	-	-	-	-	-	-	-	-
Total	2	35	4,440	50	358	181	24	31	3	726	730	1,002

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	-	-	-	601	10	290	1	-	-	1	16	2	32
Bridgend	-	-	-	2,307	29	101	0	-	-	-	-	5	25
Caerphilly	-	-	-	2,419	49	345	1	-	-	1	19	1	0
Cardiff	2	4	6	3,244	13	91	0	-	-	1	1	2	10
Carmarthenshire	-	-	-	4,152	105	280	1	-	-	-	-	2	11
Ceredigion	-	-	-	2,090	30	333	1	-	-	2	10	1	0
Conwy	-	-	-	1,308	15	250	1	-	-	-	-	3	2
Denbighshire	-	-	-	1,530	9	137	0	-	-	-	-	2	1
Flintshire	1	0	0	3,031	89	80	0	-	-	-	-	3	1,901
Gwynedd	-	-	-	2,137	35	163	1	-	-	-	-	1	0
Isle of Anglesey	-	-	-	1,509	36	180	0	-	-	-	-	1	0
Merthyr Tydfil	-	-	-	622	7	67	0	-	-	1	21	2	21
Monmouthshire	-	-	-	3,497	43	112	0	-	-	-	-	1	0
Neath Port Talbot	1	3	3	1,638	39	38	0	-	-	1	21	4	572
Newport	-	-	-	2,100	23	29	0	-	-	-	-	6	889
Pembrokeshire	-	-	-	3,581	189	539	2	-	-	-	-	7	2,331
Powys	-	-	-	3,889	22	666	2	-	-	-	-	4	1
Rhondda Cynon Taf	-	-	-	3,082	42	544	2	-	-	1	21	7	51
Swansea	1	1	1	2,551	52	144	0	-	-	2	24	2	61
Torfaen	-	-	-	1,890	11	18	0	-	-	-	-	5	0
Vale of Glamorgan	-	-	-	1,989	82	87	0	1	1,586	1	0	6	350
Wrexham	1	1	1	4,433	40	106	0	-	-	-	-	5	24
Offshore	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	6	9	11	53,600	970	4,600	13	1	1,586	11	133	72	6,282

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

Assumptions and references

Assumption	Source
Estimated Welsh domestic heat demand	Re-Energising Wales Project Work Package 1 – Half-Hourly Energy Demand Profiles For Wales For 2016, December 2017
Local authority and Welsh electricity consumption	Evaluated from BEIS Regional And Local Authority Electricity Consumption Statistics (2016) and scaled to 2017 based on UK electricity consumption trends
Fossil fuel electricity generation	Researched by Regen through a survey of major power plants. Actual generation from plants was collected from 93% of major electricity generating fossil fuel capacity in Wales.
Number of homes	Evaluated by Regen from 2011 Census data scaled to 2017 based on 2017 Welsh housing statistics.
Capacity factors	Evaluated from average DUKES regional capacity factors and other industry established values.

Notes

1. 2017's electricity consumption figure for Wales is not yet published. It is assumed Wales' 2017 electricity consumption will decrease between 2016 and 2017 in line with the UK wide trend.
2. New renewable energy projects were installed in 2017. However, if this total number of renewable energy projects is compared to the previous 2016 Energy Generation in Wales report, it is a reduction in the total number. This is due to errors in previous datasets issued by third parties, which included projects that have since been removed from the current datasets.

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 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%.
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)
AAD	Advanced anaerobic digestion
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 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)

