



Llywodraeth Cymru  
Welsh Government

# Energy Generation in Wales

2021



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# Ministerial foreword

**The current energy and cost-of-living crisis, combined with our climate and nature emergencies, demonstrates the importance of scaling up our ambitions to transition away from fossil fuels towards clean, renewable energy to meet net zero.**



**Julie James MS**

Minister for Climate  
Change

We continue to press forward with our vision for Wales to generate renewable energy to at least fully meet our energy needs and utilise surplus generation to tackle the nature and climate emergencies. This is seen in our steady progress addressing the recommendations that arose from our Renewable Energy Deep Dive, but more will need to be done to realise this just energy transition.

2021 saw the beginning of a return to pre-pandemic energy use with electricity generation increasing by 20% from the previous year to meet an uptick in demand. This meant several gas-fired power stations in Wales increased their outputs to pre-pandemic levels.

However, we are pleased the renewable sector kept pace, and we continue to generate the equivalent of approximately 55% of Wales' electricity consumption from renewable sources. This was largely led by solar PV and heat pumps, which saw significant increase in 2021, with five times more solar installed than in the previous year. More work will be needed to reach our target of 70% of our annual consumption met by renewables by 2030, but it is encouraging to read of the pipeline of projects, particularly in the offshore wind sector, which will boost Wales' renewable capacity in years to come. This pipeline will be benefited by the forthcoming Infrastructure Consent Bill which will help accelerate the consenting process.

We also pressed further towards our target of 1 GW of locally owned renewable electricity and heat capacity with a total of 897 MW of locally owned renewable capacity. The additional 5,500 locally owned renewable electricity and heat projects commissioned in Wales in 2021 helped us close in 90% of that goal ahead of 2030.

Despite these positive headlines, we recognise more work will be needed to reduce our dependence on fossil fuels and unleash the full potential of renewable technologies. We are working at all levels of government and with our stakeholders to achieve this and believe that together we can realise this vision and our efforts will be demonstrated in future editions of this report.

# Introduction

**The Energy Generation in Wales 2021 report sets out the energy generation capacity in Wales at the end of 2021 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, social 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 and fossil fuel electricity generation, as well as renewable heat and energy storage in Wales. It also looks at the development of renewable energy in 2021, reviewing the growth prospects of each technology. The analysis builds on prior publications:

- Previous Energy Generation in Wales reports.
- The first and second editions of the Energy Use in Wales reports, which set out how energy is used in Wales and how energy use has changed over time.

Energy generation deployment is broken down into the 22 local authority areas and four regions 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.

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

## **This report**

- Breaks down Welsh electricity and renewable heat generation and storage by technology, capacity and local authority area to the end of 2021.
- Estimates that an equivalent of 55% of Wales' electricity consumption comes from renewable sources.
- Estimates that 28% of total electricity generation in Wales comes from renewable sources.
- Estimates that 897 MW of installed renewable energy capacity is locally owned.

## **Technologies analysed**

- Renewable electricity and heat technologies.
- Electricity storage technologies.
- Fossil fuel electricity generation (generation from coal, gas and diesel).

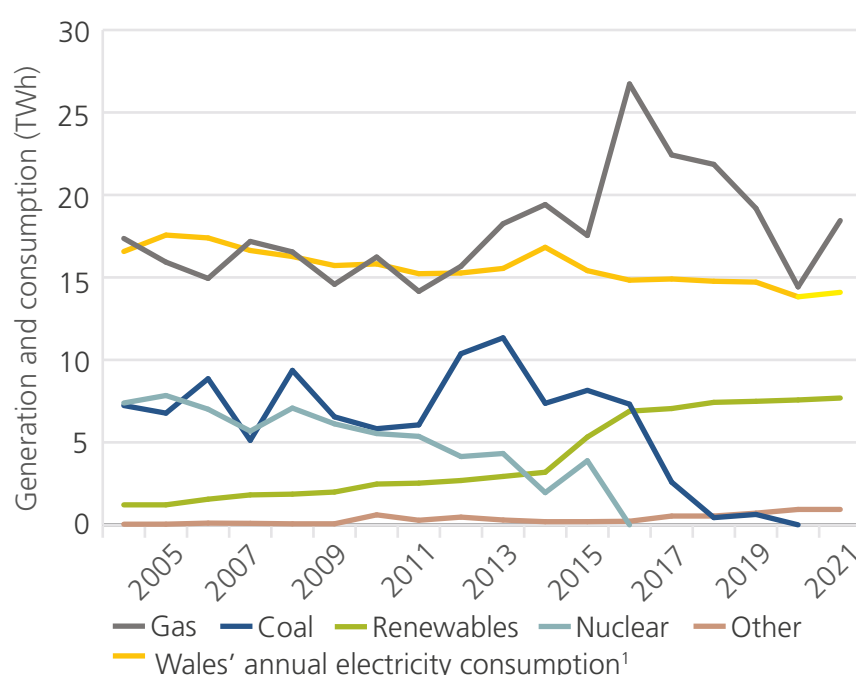
# Electricity generation in Wales

**Total electricity generation in Wales increased by nearly 20% in 2021 compared to 2020. The majority of this increase is a result of gas-fired power stations in Wales increasing their output back to pre-coronavirus (COVID-19) generation levels.**

Wales remains a net exporter of electricity, generating nearly twice as much electricity as it consumes on an annual basis. Wales generated a total of 27.1 TWh of electricity in 2021, 7.7 TWh of which came from renewables and 19.5 TWh from fossil fuels. Wales is estimated to have consumed in the order of 14 TWh<sup>1</sup> of electricity in 2021, up from 13.8 TWh the previous year.

## Electricity generation trends

Data source: (1,2)



With the exception of a 2016 to 2019 peak, electricity generation from gas has remained relatively constant in Wales

Electricity consumption has reduced by 13% since 2009

Renewable electricity generation has increased by over 600% since 2005, but has only increased by 12% since 2016

There is now no coal or nuclear capacity in Wales

An increase in electricity generation from gas in 2021 compared to 2020 has resulted in the estimated percentage of total electricity generation delivered by renewables decreasing from 33% to 28%, despite the absolute renewable generation figure increasing. 70% of all renewable electricity generation in Wales is from onshore and offshore wind, with most of the remainder from solar PV and biomass electricity generation.

Electricity consumption represents approximately 16% of Wales' estimated 92.8 TWh total energy consumption<sup>2</sup>.

<sup>1</sup> Welsh electricity consumption data for 2021 has not yet been published, so an estimate for 2021 has been produced. See [Assumptions](#) section for more information.

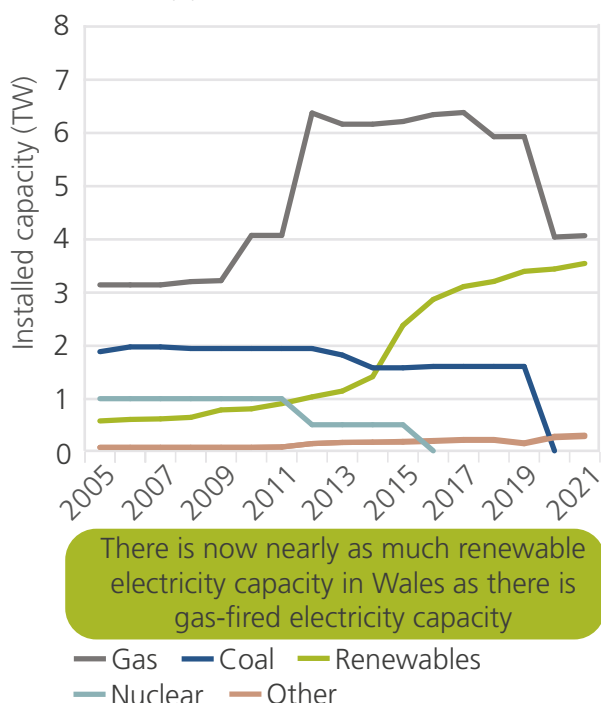
<sup>2</sup> BEIS, 2021; Sub-national total final energy consumption United Kingdom, 2019 [www.gov.uk/government/statistics/total-final-energy-consumption-at-regional-and-local-authority-level-2005-to-2019](https://www.gov.uk/government/statistics/total-final-energy-consumption-at-regional-and-local-authority-level-2005-to-2019)

## Electricity generation in Wales

- 116 MW of renewable electricity capacity was installed in 2021, meaning there is now 3,508 MW of renewable electricity capacity in Wales. Most of this new capacity is attributed to a single 75 MW solar farm, Llanwern Farm Solar Park in Newport.
- Renewable electricity generation in Wales has only increased by 9% over the last five years, compared to 140% in the preceding five years. Barriers to deployment (including securing a financially viable grid connection, gaining planning permission and lack of financial support) are being addressed as the Welsh Government implements the recommendations of the Renewable Energy Deep Dive<sup>3</sup>.
- 2021 was the second year in which no electricity generation from coal was exported to the grid in Wales and also the sixth year since nuclear generation in Wales reduced to zero.

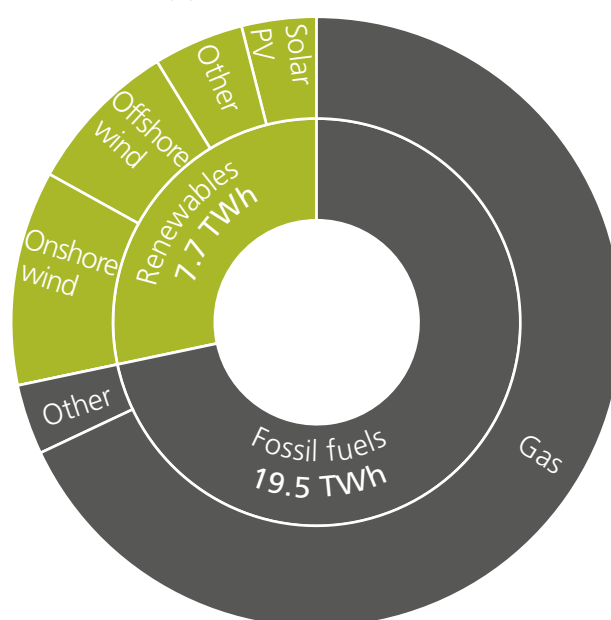
### Electricity capacity trends

Data source: (1)



### Electricity generation in Wales

Data source: (1)



### Electricity generation in Wales key statistics

Data source: (1)

Technologies	Number of projects	Electrical capacity (MW)	Estimated electricity generation (GWh)
<b>Fossil fuels</b>	<b>102</b>	<b>4,338</b>	<b>19,521</b>
Coal	0	0	0
Diesel	22	269	941
Energy from Waste	2	26	133
Gas	78	4,043	18,447
<b>Storage</b>	<b>5</b>	<b>2,114</b>	<b>n/a</b>
Commercial-scale battery storage	3	26.6	n/a
Pumped hydropower	2	2,088	n/a
Hydrogen	0	0	n/a
<b>Renewables (see page 6)</b>	<b>64,966</b>	<b>3,508</b>	<b>7,720</b>

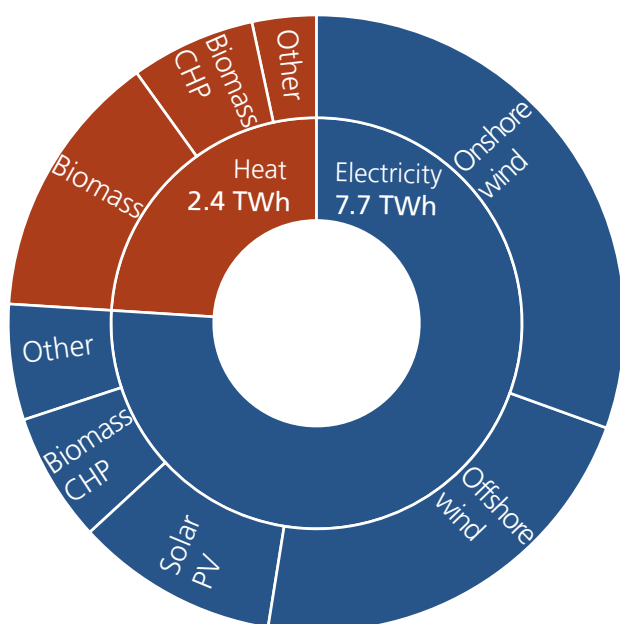
<sup>3</sup> Welsh Government, 2022; Renewable Energy Deep Dive Biannual Recommendations Update 1 [www.gov.wales/renewable-energy-deep-dive-biannual-recommendations-update-1](https://www.gov.wales/renewable-energy-deep-dive-biannual-recommendations-update-1)

# Renewable energy in Wales

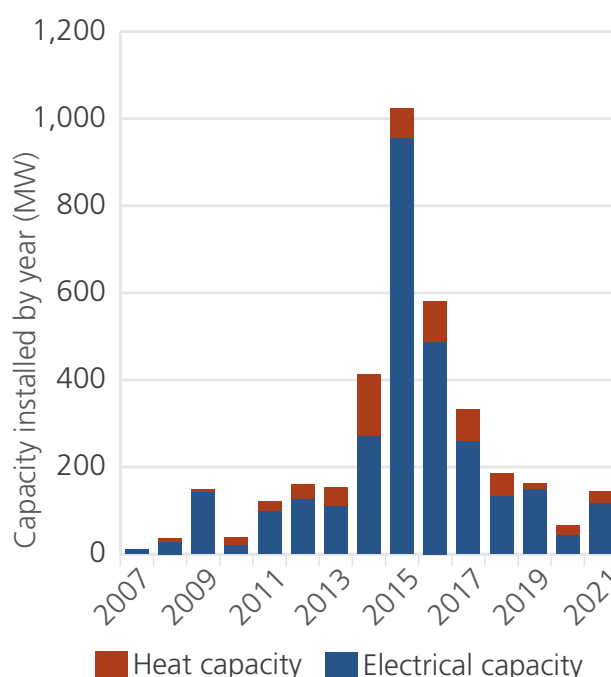
The total capacity of renewable energy projects installed in 2021 was more than double that installed in 2020. 116 MW of renewable electrical capacity and 29 MW of renewable heat capacity was installed in 2021, in comparison to a total capacity of 65 MW installed in 2020. However, 2021's installation rate remains the second lowest in the last decade and is nearly 90% lower than the 2015 peak, when more than 1 GW of renewable energy capacity was installed.

The majority (approximately 76%) of renewable energy capacity in Wales generates renewable electricity, while the remaining 24% produces renewable heat. However, energy consumption for heat (such as in homes, businesses and industry) in Wales is more than four times the consumption of electricity (such as for appliances, lighting and cooking powered by electricity)<sup>4</sup>.

## Renewable electricity and heat generation Data source: (1)



## Wales' annual renewable energy installation rate Data source: (1)



## Renewable electricity in Wales

- The largest renewable electricity project commissioned in Wales in 2021 was the Llanwern Farm Solar Park. At 75 MW, it is the largest solar farm in Wales and is the fifth largest renewable energy project in Wales.
- 2021 saw the smallest increase in onshore wind capacity since 2005, with 3.4 MW of new capacity commissioned. 97% of renewable electricity capacity installed in 2021 was solar PV.

<sup>4</sup> Welsh Government, 2022; Energy Use in Wales, Second Edition [www.gov.wales/sites/default/files/publications/2022-06/energy-use-wales-report.pdf](http://www.gov.wales/sites/default/files/publications/2022-06/energy-use-wales-report.pdf)

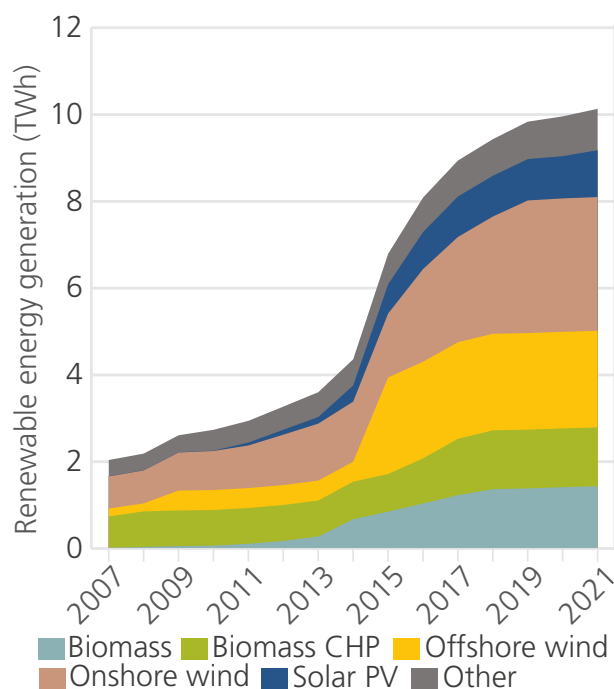


## Renewable heat in Wales

- 29 MW of renewable heat was commissioned in 2021, resulting in a total of 742 MW of renewable heat capacity installed in Wales.
- 63% of all renewable heat capacity is from biomass heat, followed by 16% from heat pumps.
- Production of renewable heat is estimated to be approximately 2.42 TWh in 2021, in comparison to 2.37 TWh generated in 2020.
- Approximately 94% of renewable heat projects commissioned in Wales in 2021 were heat pumps, from over 2,000 individual projects.

## Renewable energy generation in Wales

Data source: (1)



## Renewable energy in Wales key statistics

Data source: (1)

Renewable energy technologies	Number of projects	Electricity		Heat	
		Capacity (MW)	Estimated generation (GWh)	Capacity (MW)	Estimated generation (GWh)
Anaerobic digestion	47	19	100	8	50
Biomass heat	3,550	0	0	465	1,425
Biomass electricity and CHP	50	131	686	120	663
Energy from Waste	2	26	133	0	0
Heat pumps	11,171	0	0	122	199
Hydropower	376	170	338	0	0
Landfill gas	23	24	66	0	0
Offshore wind	3	726	2,226	0	0
Onshore wind	753	1,266	3,053	0	0
Sewage gas	5	12	43	14	83
Solar PV	63,707	1,134	1,075	0	0
Solar thermal	4,790	0	0	14	8
<b>Total</b>	<b>84,477</b>	<b>3,508</b>	<b>7,720</b>	<b>742</b>	<b>2,428</b>

# Progress towards targets

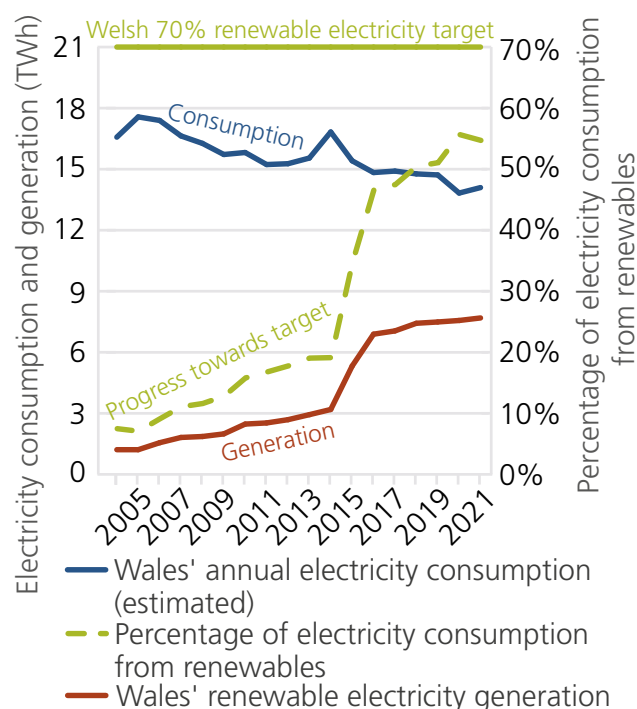
**The Welsh Government has a target for Wales to meet the equivalent of 70% of its electricity demand from Welsh renewable electricity sources by 2030. Electricity consumption in Wales is estimated to have increased at a faster rate than renewable electricity generation in Wales in 2021. As a result, the equivalent percentage of Welsh electricity consumption met by renewable electricity generation reduced from 56% in 2020 to 55% in 2021.**

Progress towards Wales' target is impacted in equal measure by electricity consumption and electricity generation. Both of these factors can vary between years as a result of both predictable and unforeseen events such as COVID-19. Consequently, progress towards the target is likely to be variable while the deployment of renewable electricity generation is slow.

The 70% renewable electricity target represents just an initial step in the development of renewable energy in Wales, as Wales' energy system transitions to net zero. The Renewable Energy Deep Dive set out the ambition for renewable energy generation in Wales "to at least fully meet our energy needs"<sup>5</sup>. However, with electricity consumption in Wales set to more than double if a net zero energy system is to be achieved by 2050<sup>6</sup>, the infrastructure required to achieve this ambition is a moving target.

As well as potentially rising electricity demand, the Welsh Government's Renewable Energy Deep Dive highlighted several barriers to deploying renewable generation at the pace required to meet ambitions – including securing a financially viable grid connection, gaining planning permission and lack of financial support. In addition to working to implement a number of recommendations from the Deep Dive to support the scale up of renewable deployment in Wales, in July 2022 the First Minister announced the introduction of a Bill on Infrastructure Consenting<sup>7</sup>, to simplify the process for agreeing major infrastructure projects.

## Growth in the percentage of electricity consumption from renewable sources in Wales Data source: (1,2)



<sup>5</sup> Welsh Government, 2022; Renewable Energy Deep Dive Biannual Recommendations Update 1 [www.gov.wales/renewable-energy-deep-dive-biannual-recommendations-update-1](http://www.gov.wales/renewable-energy-deep-dive-biannual-recommendations-update-1)

<sup>6</sup> Climate Change Committee, 2020; 6th Carbon Budget, 2020 [www.theccc.org.uk/publication/sixth-carbon-budget](http://www.theccc.org.uk/publication/sixth-carbon-budget)

<sup>7</sup> Welsh Government, 2022; Wales' green agenda [www.gov.wales/wales-green-agenda-first-minister-announces-welsh-governments-legislative-programme](http://www.gov.wales/wales-green-agenda-first-minister-announces-welsh-governments-legislative-programme)

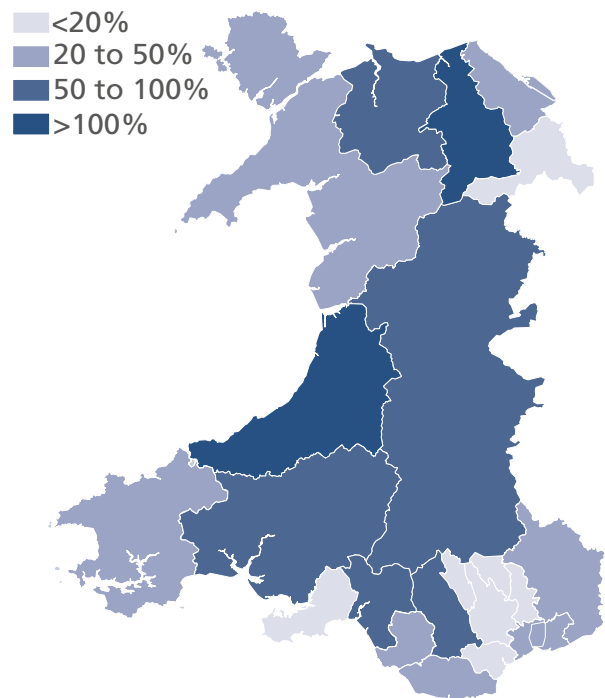
Two local authority areas are estimated to have generated more local renewable electricity than their total electricity consumption in 2021: Denbighshire and Ceredigion.

Although the Neath Port Talbot area generated the most renewable electricity of all local authority areas in Wales, it is also the second highest consumer of electricity and so only generates the equivalent of 75% of the electricity it consumes.

In contrast, Denbighshire is in the upper quartile of local authority areas for renewable electricity generation, and the lower quartile for electricity consumption. It is the combination of the two that leads it to have the highest equivalent percentage of its electricity consumption delivered by local renewable electricity generation.

### Equivalent percentage of electricity consumption delivered by local renewable generation

Data source: (1,3)



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

Data source: (1,3)

Local Authority Area	Equivalent percentage of local electricity consumption met by local renewable electricity generation
Denbighshire	110%
Ceredigion	109%
Powys	99%
Rhondda Cynon Taf	77%
Neath Port Talbot	75%

### Net zero and energy security

The recent surge in the global price of gas, combined with Russia's war in Ukraine, has resulted in huge increases in energy prices across the world, with the impact felt hardest by those who are least able to bear it. The Welsh Government is providing support to those in urgent need in the short term, while building a future energy system which insulates Wales from the worst of the impacts. Extending fossil fuel use will only result in problems in the longer term. Instead, Wales will improve energy efficiency and develop a renewables-based energy system fit for the future.

# Locally owned renewable energy

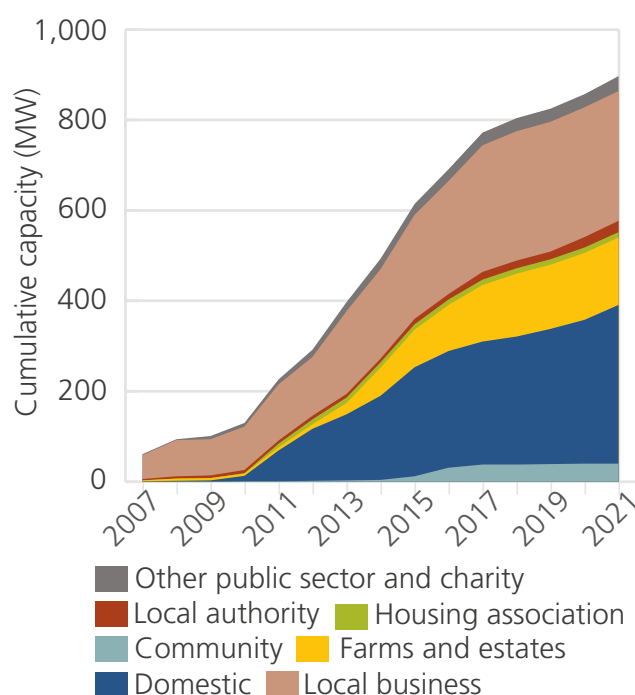
**Wales has achieved nearly 90% of its target of at least 1 GW of renewable energy capacity to be locally owned by 2030, representing an estimated 1.9 GWh of generation in 2021. All new energy developments are encouraged to have at least an element of local ownership. Furthermore, the Welsh Government has pledged to expand renewable energy generation by public bodies and community groups in Wales by over 100 MW by 2026.**

There is now 897 MW of locally owned renewable capacity, with over 40 MW of locally owned renewable energy capacity commissioned in 2021. This additional capacity consists of 18 MW of electrical capacity and 22 MW of heat capacity. Over 80% of this electrical and heat capacity was focused in the domestic sector, largely due to the installation of solar PV and heat pumps. Around 10% of the new locally owned capacity is attributable to the commissioning of a publicly owned solar farm on a landfill site in Swansea.

Over 5,500 locally owned renewable electricity and heat projects were commissioned in Wales in 2021, bringing the total to around 78,500. Over 90% of locally owned projects are domestic, including around 56,200 domestic solar PV projects and over 10,500 domestic heat pumps.

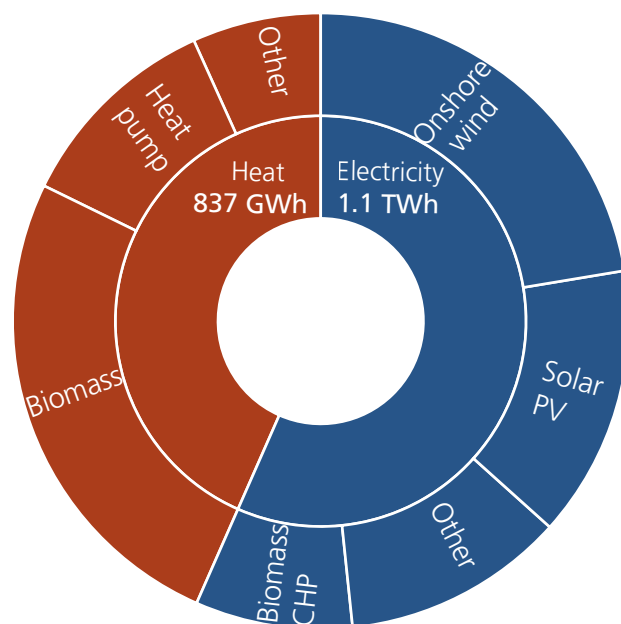
## Locally owned renewable capacity by ownership type

Data source: (1)



## Locally owned renewable energy generation by technology (GWh)

Data source: (1)



## Definition of ownership

The definition for 'locally owned' is set out in the Welsh Government's policy statement detailing local ownership of energy generation in Wales<sup>8</sup>. It covers energy installations that are located in Wales, 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. The Welsh Government has since published guidance<sup>9</sup> for developers, local stakeholders, and decision makers involved in Wales' energy sector on how to meet this target. The figures presented in this report are likely to be an underestimate, due to limitations in the source data.

## Locally owned renewable energy in Wales summary

Data source: (1)

Ownership category	Total number of projects	Capacity (MWe)	Capacity (MWth)	Estimated generation (GWh)
Community	198	40	1	54
Domestic	70,575	209	142	500
Farms and estates	798	23	126	444
Housing association	5,687	7	5	9
Local authority	303	22	3	40
Local business	394	271	16	797
Other public sector and charity	418	9	24	84
Total	78,373	581	316	1,928

## Fossil fuels

The ownership of fossil fuel electricity projects has not been fully assessed, as there are no appropriate datasets available for analysis. It is estimated that approximately 100 MW of gas, diesel and coal electricity generation capacity were locally owned in 2021, attributable to small-scale projects such as farm diesel generators. This is down from 1,500 MW in 2019, due to two large-scale gas plants that were owned by the Welsh-based power producer Calon Energy becoming dormant. Both of these plants may be repowered in the future. It is expected that a higher proportion of small-scale fossil fuel generators would be locally owned, often being associated with farms, businesses or public buildings as back-up generators for remote or essential services.

<sup>8</sup> Welsh Government, 2020; Policy Statement: local ownership of energy generation in Wales – benefitting Wales today and for future generation [www.gov.wales/sites/default/files/publications/2020-02/policy-statement-local-ownership-of-energy-generation-in-wales.pdf](http://www.gov.wales/sites/default/files/publications/2020-02/policy-statement-local-ownership-of-energy-generation-in-wales.pdf)

<sup>9</sup> Welsh Government, 2022; Local and shared ownership of energy projects: guidance [www.gov.wales/local-and-shared-ownership-energy-projects-guidance](http://www.gov.wales/local-and-shared-ownership-energy-projects-guidance)

# Renewable energy trends

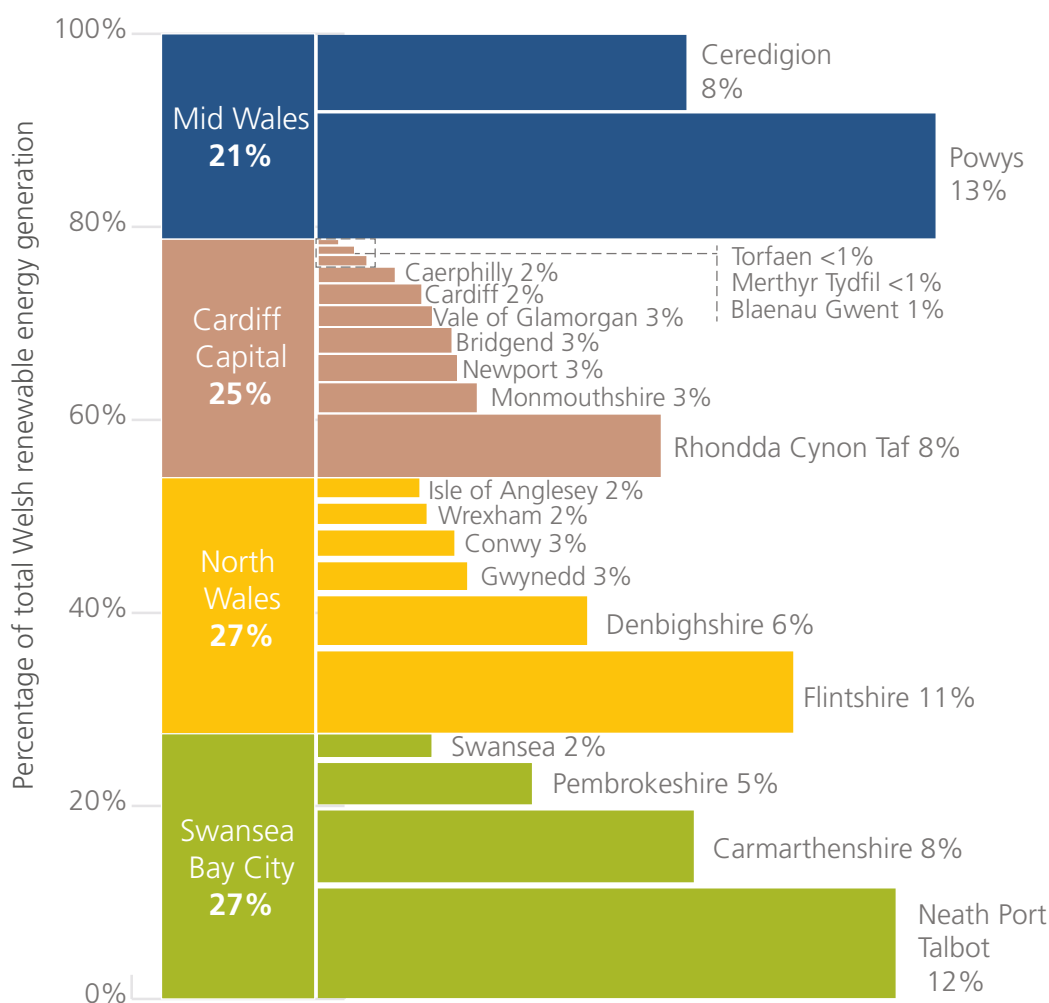
# Regional context

In 2021, the four Welsh regions contributed similar proportions of renewable energy generation. North Wales and the Swansea Bay City Region both represented an estimated 27% of total generation each, while the Cardiff Capital Region contributed 25% and Mid Wales 21%. Powys was the local authority area that generated the most from renewable technologies in 2021, with an estimated 1,019 GWh.



## Estimated annual renewable energy generation by region and local authority, 2020

Data source: (1)



## Local authority areas with the highest increase in renewable energy capacity in 2021

Data source: (1)

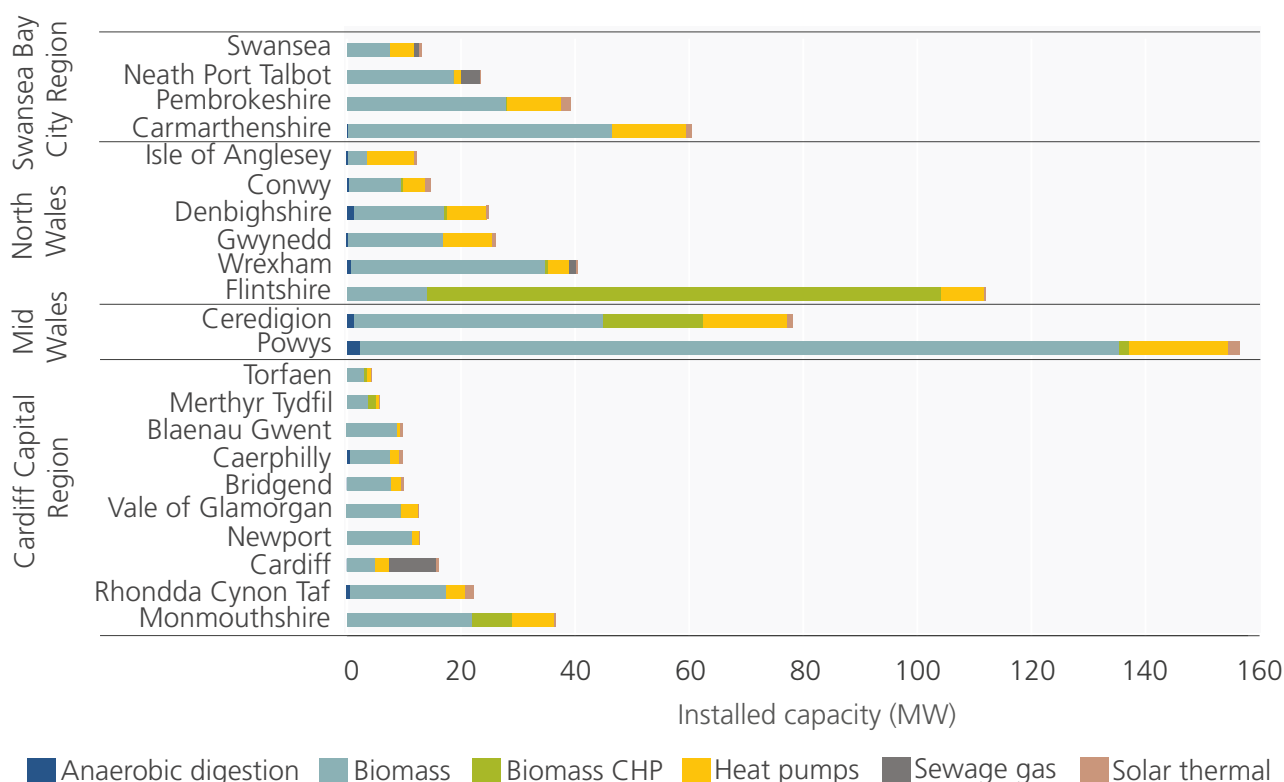
Local authority area	Region	Increase in renewable energy capacity (%)	Increase in renewable energy capacity (MW)
Newport	Cardiff Capital	118%	75.9
Swansea	Swansea Bay City	15%	15.2
Gwynedd	North Wales	7%	8.8

## Onshore capacity growth by local authority area

All 22 Welsh local authority areas saw an increase in their total renewable energy capacity in 2021, when compared to the previous year. However, only three of these authorities saw an increase of greater than 5%, with the remaining local authority areas having an average increase of 2%. Newport saw the largest increase in total renewable energy capacity, in both absolute capacity and percentage growth, with an increase of 118% between 2020 and 2021. 86% of this growth can be attributed to solar PV projects.

## Renewable heat capacity by local authority area

Data source: (1)



## Renewable heat capacity

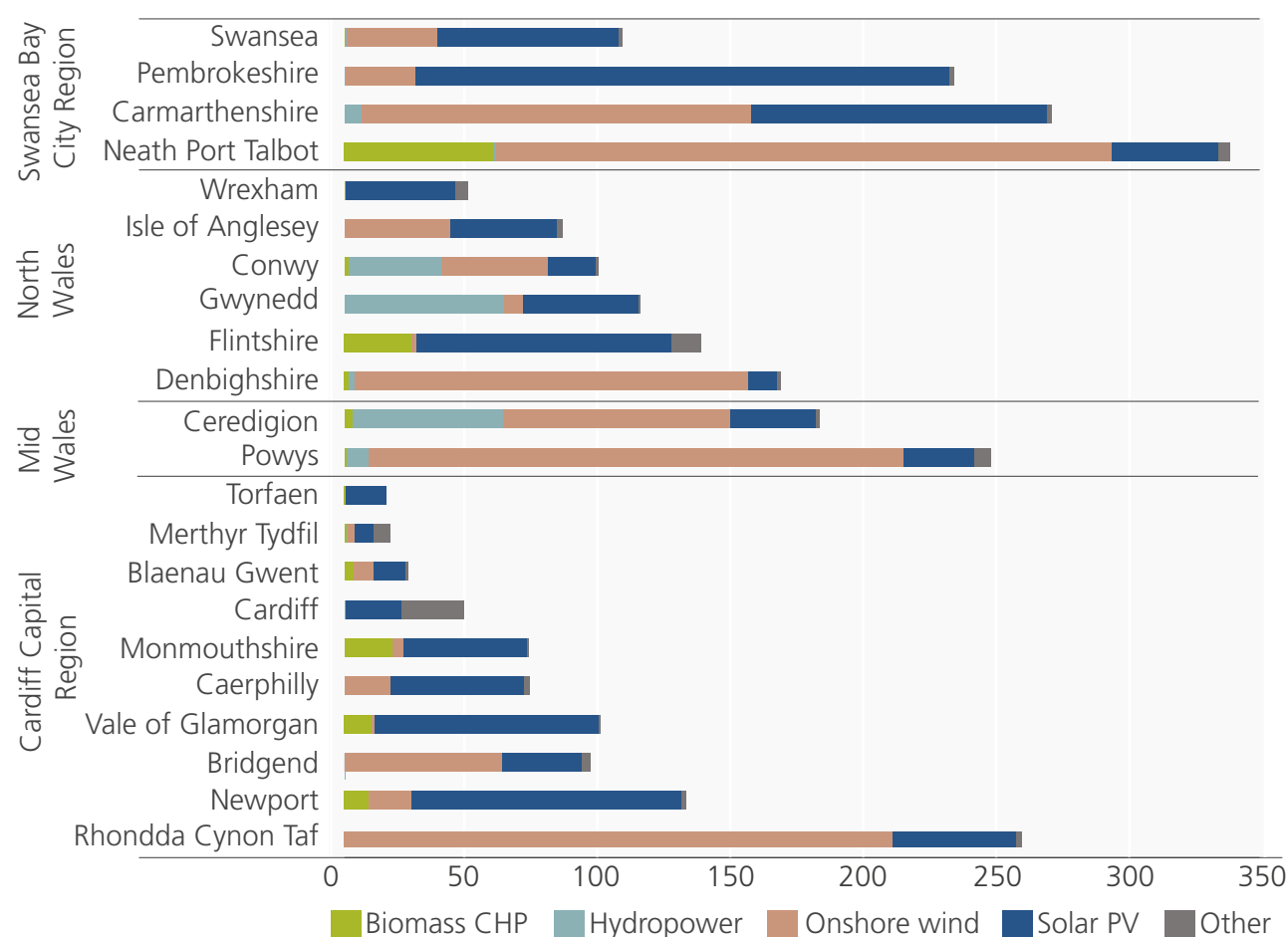
Mid Wales accounts for the greatest proportion of renewable heat capacity in Wales (32%), followed closely by North Wales (31%). The Cardiff Capital and Swansea Bay City regions represent 18% of renewable heat capacity each. The local authority areas of Powys and Flintshire have the greatest renewable heat capacity, representing 21% and 15% of total heat capacity in Wales respectively.



## Onshore renewable electricity capacity

Two-thirds of renewable electricity capacity in Wales comes from the Swansea Bay City and Cardiff Capital regions, which represent 33% (925 MW) and 29% (824 MW) respectively. North Wales accounts for 23% of the total electricity capacity, with 639 MW installed. This is followed by Mid Wales which, with a capacity of 419 MW, represents 15% of renewable electricity capacity in Wales. The local authority area with the greatest share of electricity capacity is Neath Port Talbot, with 330 MW, followed by Carmarthenshire (264 MW) and Powys (255 MW). In each case, onshore wind makes up the majority of this capacity, with 70%, 55% and 83% respectively.

### Onshore renewable electricity capacity by local authority area Data source: (1)



## Offshore wind in Wales

All three offshore wind sites currently in operation around Wales are situated off the north coast, meaning all electricity generated by this technology currently makes landfall in North Wales.

However, in the future, with the development of floating offshore wind technology in the Celtic Sea and at other sites across the Welsh seabed, such assets will be spread across a greater geographical area. This means generation will make landfall across a greater number of regions and nations, and as such, offshore wind has been viewed as a national asset in Wales, and any generation associated with this technology has not been grouped by region. The offshore wind sites currently in planning are expected to commission in the mid-2020s.

# Cardiff Capital Region

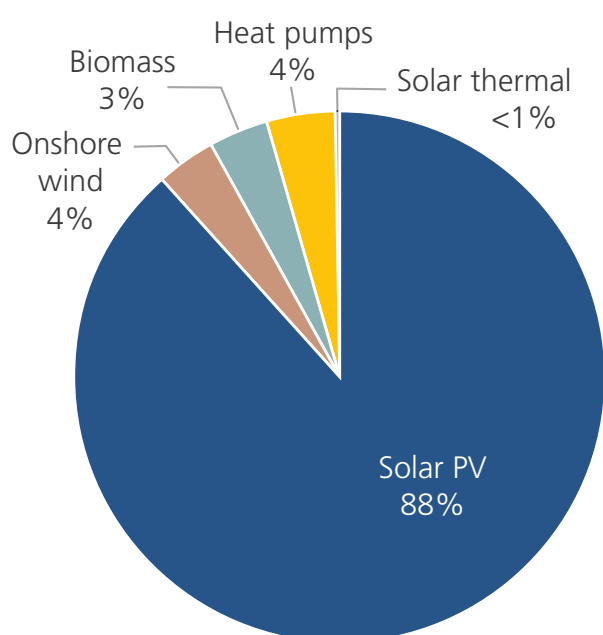
**A total of 1,494 new renewable projects were commissioned in the Cardiff Capital Region in 2021, representing an increase of 90.4 MW. Of this, the Llanwern solar PV project contributed 75 MW.**

Data source: (1)

Technology	Total Renewable heat and electricity			Commissioned in 2021	
	Number of projects	Total capacity (MW)	Estimated generation (GWh)	Number of projects	Total capacity (MW)
Anaerobic digestion	10	10	56	0	0
Biomass heat	516	95	291	12	3.2
Biomass electricity and CHP	14	51	271	0	0
Energy from Waste	1	15	78	0	0
Heat pumps	2,029	22	36	396	4.0
Hydropower	25	1	3	0	0
Landfill gas	9	12	34	0	0
Onshore wind	97	311	751	2	3.4
Sewage gas	2	15	77	0	0
Solar PV	25,050	411	390	1,076	80.7
Solar thermal	1,703	4	3	8	0.02
<b>Total</b>	<b>29,456</b>	<b>949</b>	<b>1,988</b>	<b>1,494</b>	<b>91</b>

## Percentage of renewable capacity commissioned in 2021, by technology

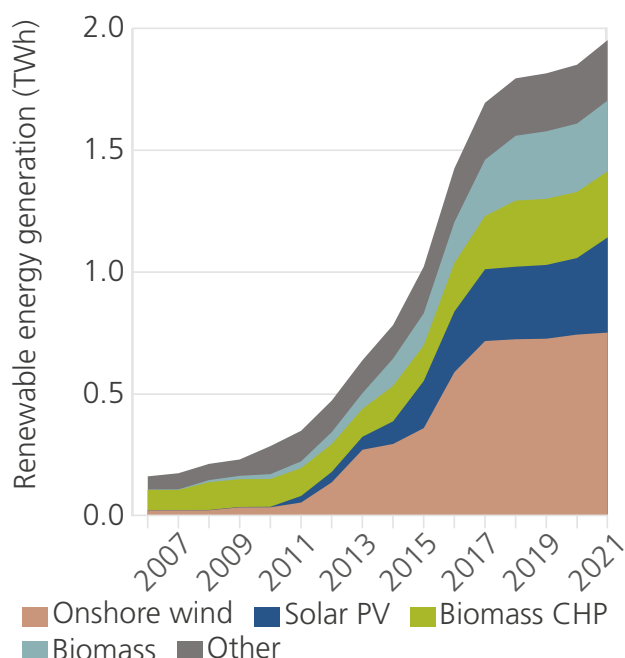
Data source: (1)



Solar PV contributed an estimated 88% of the Cardiff Capital Region's new renewable energy capacity in 2021, with a total of 81 MW commissioned. This is a considerable increase when compared to the previous three years, in which 3.2 MW was commissioned in 2018, 5.3 MW in 2019 and 12.1 MW in 2020.

In 2021, onshore wind was the most prolific technology and was responsible for producing an estimated 38% of the Cardiff Capital Region's renewable energy generation. Solar PV accounted for an estimated 20% of generation, with eight other technologies making up the remaining 42% of renewable generation in the region.

### Renewable energy generation in the Cardiff Capital Region Data source: (1)



### Largest projects in the Cardiff Capital Region commissioned in 2021, by capacity Data source: (1)

Project name	Local authority area	Technology	Capacity (MW)
Llanwern	Newport	Solar PV	75.0
Rassau Industrial Estate	Blaenau Gwent	Diesel	21.0
Tonyrefail Graig Fatha	Rhondda Cynon Taf	Onshore wind	2.5

### Llanwern Solar Farm

NextEnergy Capital energised a 75 MW solar farm within the Gwent Levels in 2021 – at the time thought to be the largest constructed solar PV plant in the UK. The 260 acres are spread across three separate parcels of land and provide farm diversification to seven local farm holdings<sup>10</sup>.

The project was approved as a Development of National Significance by the Welsh Government in 2018, and was constructed during COVID-19, employing over 200 workers on site during peak construction. The total investment was £43 million and it was developed under a subsidy free model. It provides the equivalent of an estimated 20,606 homes per year with clean energy. The site has a 40-year ecological management plan to target regeneration of Gwent Levels ecology, developed alongside Natural Resources Wales (NRW), Royal Society for the Protection of Birds and Newport Council. There is a focus on restoring the landscape for the benefit of rare birds, small mammals and invertebrates, such as the Shrill Carder Bee, Common Crane, Water Vole and Lapwing.

<sup>10</sup> Next Energy Capital, 2021; NextEnergy Capital Group continues to drive momentum in the UK [www.nextenergycapital.com/news/nextenergy-capital-group-continues-to-drive-momentum-in-the-uk-subsidy-free-solar-sector-as-it-announces-the-successful-construction-and-energisation-of-two-new-assets-totalling-115mw/](https://www.nextenergycapital.com/news/nextenergy-capital-group-continues-to-drive-momentum-in-the-uk-subsidy-free-solar-sector-as-it-announces-the-successful-construction-and-energisation-of-two-new-assets-totalling-115mw/)

# Swansea Bay City Region

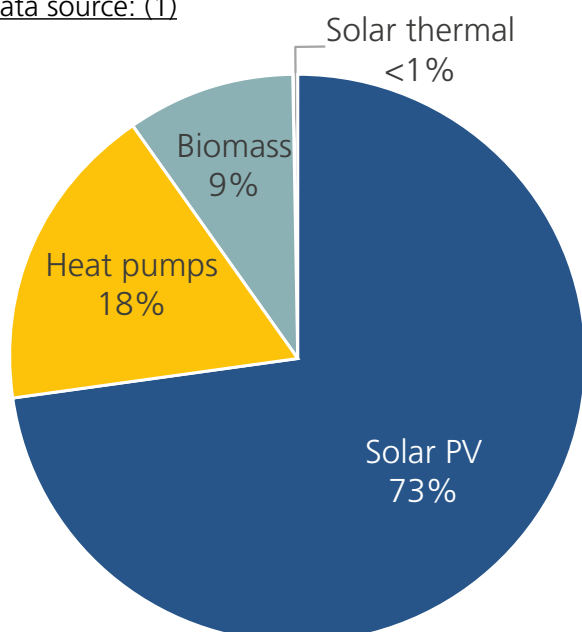
A total of 1,263 new renewable projects were commissioned in the Swansea Bay City Region in 2021, representing 23 MW of new renewable capacity in the region. Small-scale installations comprise much of this growth; only two projects were commissioned with an individual capacity of greater than 1 MW.

Data source: (1)

Technology	Total Renewable heat and electricity			Commissioned in 2021	
	Number of projects	Total capacity (MW)	Estimated generation (GWh)	Number of projects	Total capacity (MW)
Anaerobic digestion	4	1	4	0	0
Biomass heat	976	100	308	33	2.1
Biomass electricity and CHP	5	57	296	0	0
Heat pumps	2,524	28	46	369	4.0
Hydropower	40	8	15	0	0
Landfill gas	5	5	13	0	0
Onshore wind	280	435	1,050	0	0
Sewage gas	2	8	38	0	0
Solar PV	14,173	417	395	845	16.7
Solar thermal	1,076	3	2	16	0.04
<b>Total</b>	<b>19,085</b>	<b>1,062</b>	<b>2,167</b>	<b>1,263</b>	<b>23</b>

## Percentage of renewable capacity commissioned in 2021, by technology

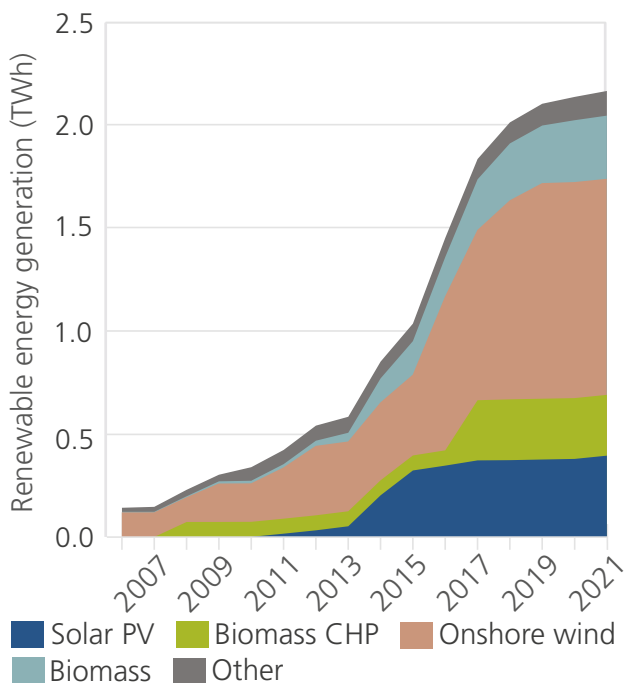
Data source: (1)



The deployment rate of renewable energy capacity for the Swansea Bay City Region has been declining from an annual peak of 202 MW commissioned in 2014, to 40 MW in 2019, 15 MW in 2020 and 22.9 MW in 2021. Solar PV represented an estimated 73% of the additional capacity commissioned in 2021, contributing 16.7 MW.

In 2021, onshore wind was responsible for an estimated 48% of the Swansea Bay City Region's renewable energy generation, making it the highest generating technology type in the region. Solar PV, biomass and biomass electricity and CHP form the next three highest generating technologies at 18%, 14% and 14% respectively.

### Renewable energy generation in the Swansea Bay City Region Data source: (1)



### Largest projects in the Swansea Bay City Region commissioned in 2021, by capacity Data source: (1)

Project name	Local authority area	Technology	Capacity (MW)
Afon Llan Solar Park	Swansea	Solar PV	9.2
Brynwhilach Solar Park	Swansea	Solar PV	4.0
Cerrigyrwyn Quarry	Carmarthenshire	Biomass	0.6

### Brynwhillach Solar Farm

This 4 MW solar farm in Swansea is the first solar farm in the UK to be owned by a health board, and is connected by a 3 km private wire to power Morriston Hospital in Swansea. The solar farm is comprised of 10,000 panels and cost £5.7 million to construct. It was built under the Wales funding programme loan scheme, set up to support public sector decarbonisation by 2030, and supported by the Welsh Government [Energy Service](#).

The solar farm began exporting in November 2021 and, as of March 2022, had saved £120,000 in electricity bills, even meeting 100% of the hospital's electricity demand on some days. 30,000 kWh of surplus energy has also been exported back to the grid, at a profit to the organisation<sup>11</sup>.

The project was developed by Vital Energi, who had previously worked with Swansea Bay University Health Board under the same government loan scheme, delivering a range of energy saving measures<sup>12</sup>.



<sup>11</sup> Welsh Government, 2022; Solar farm powers Morriston Hospital for 50 hours without back-up from the grid in winter months [www.gov.wales/solar-farm-powers-morriston-hospital-50-hours-without-back-grid-winter-months](http://www.gov.wales/solar-farm-powers-morriston-hospital-50-hours-without-back-grid-winter-months)

<sup>12</sup> Solar Power Portal, 2021; Private wire Brynwhillach solar farm linked with Welsh hospital goes live [www.solarpowerportal.co.uk/news/private\\_wire\\_brynwhillach\\_solar\\_farm\\_linked\\_with\\_welsh\\_hospital\\_goes\\_live](http://www.solarpowerportal.co.uk/news/private_wire_brynwhillach_solar_farm_linked_with_welsh_hospital_goes_live)

# Mid Wales

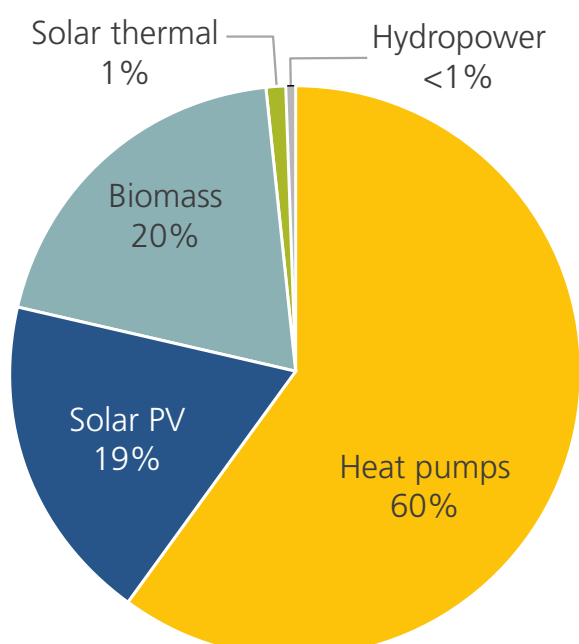
A total of 938 new renewable projects were commissioned in Mid Wales in 2021. These new projects represent a capacity increase of 8.5 MW and comprise mostly small-scale, domestic installations. 80% of this new capacity is thermal, with 6.8 MW of renewable heat and 1.6 MW of renewable electricity capacity developed in 2021.

Data source: (1)

Technology	Total Renewable heat and electricity			Commissioned in 2021	
	Number of projects	Total capacity (MW)	Estimated generation (GWh)	Number of projects	Total capacity (MW)
Anaerobic digestion	17	9	51	0	0
Biomass heat	1,249	177	542	32	1.6
Biomass electricity and CHP	14	24	129	0	0
Heat pumps	3,033	32	52	513	5.1
Hydropower	107	64	123	1	0.1
Landfill gas	1	2	6	0	0
Onshore wind	196	284	686	0	0
Solar PV	7,143	59	56	378	1.6
Solar thermal	1,045	3	2	14	0.04
<b>Total</b>	<b>12,805</b>	<b>653</b>	<b>1,645</b>	<b>938</b>	<b>8.4</b>

## Percentage of renewable capacity commissioned in 2021, by technology

Data source: (1)

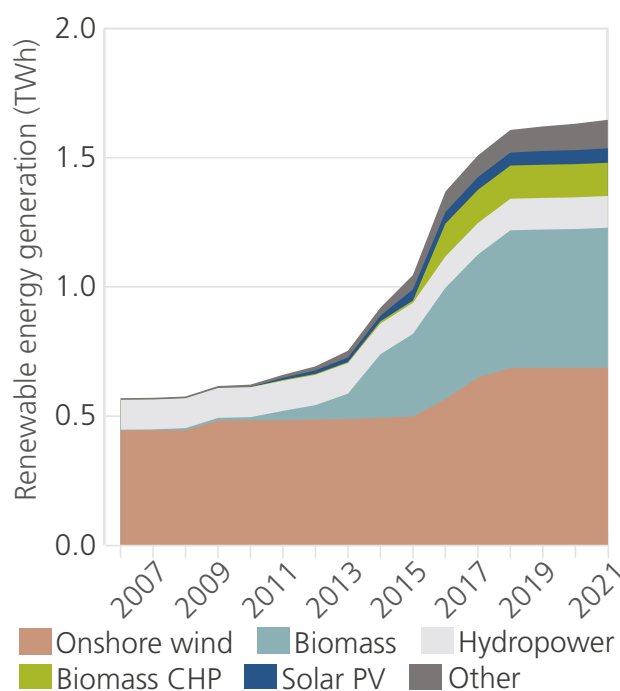


Heat pumps accounted for 60% of the increase in renewable energy capacity developed in 2021, with the majority of remainder coming from solar PV and biomass heat. The majority of new electrical capacity commissioned in Mid Wales in 2021 came from small-scale solar PV projects.

75% of renewable electricity generated in Mid Wales in 2021 came from onshore wind: almost 690 GWh. In comparison, the second greatest contribution was from hydropower, which generated an estimated 123 GWh in 2021, nearly six times less than onshore wind.

42% of renewable energy generation in Mid Wales in 2021 came from heat projects – the highest proportion of all four regions. Mid Wales has the lowest percentage of homes connected to the gas network in Wales (25% in Ceredigion and 45% in Powys)<sup>13</sup>, and moving off-grid homes away from oil, LPG and solid fuel-based heating systems is identified as a key priority in Mid Wales' 2020 Energy Strategy<sup>14</sup>. There are now over 3,000 heat pumps in operation in Mid Wales, the majority of which (96%) have been installed in domestic properties. Despite this, biomass accounts for three-quarters of the region's thermal capacity, producing 541 GWh of heat in 2021 in comparison to the 52 GWh produced by heat pumps.

## Renewable energy generation in the Mid Wales Region Data source: (1)



### Carno Wind Farm

Carno Wind Farm is located 4 km to the west of Carno Village in Powys<sup>15</sup>. The wind farm was constructed in two phases, with Phase I comprising 56 600 kW turbines, totalling 33.6 MW. Built in 1996, this site is owned and operated by Ventient Energy and, at the time of construction, was the largest onshore wind farm in Europe.

In 2009, Carno Phase II was developed by Amegni Ltd, which is a local company formed by farmers from Carno who have diversified their farming business into wind energy. They currently own and operate Carno II Wind Farm, one of the first windfarms of this scale to be locally owned in Wales. The site consists of 12 turbines with a total capacity of 15.6 MW.

In May 2022, plans for Carno Phase III, which will also be owned and operated by Amegni Ltd, were approved by Powys Council<sup>16</sup>. The plan consists of 13 turbines representing a combined capacity of 50 MW, as well as a new substation, control building, parking area and an underground cable<sup>17</sup>. Once operational, Phase III will bring the total capacity of the site to almost 100 MW.

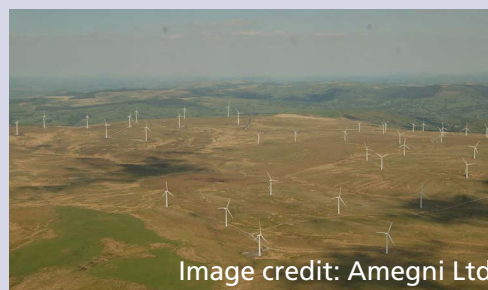


Image credit: Amegni Ltd

<sup>13</sup> BEIS, 2021; Sub-national estimates of properties not connected to the gas network [www.gov.uk/government/statistics/sub-national-estimates-of-households-not-connected-to-the-gas-network](http://www.gov.uk/government/statistics/sub-national-estimates-of-households-not-connected-to-the-gas-network)

<sup>14</sup> Welsh Government, 2020; Mid Wales Energy Strategy [www.gov.wales/sites/default/files/publications/2021-11/regional-energy-strategy-mid-wales.pdf](http://www.gov.wales/sites/default/files/publications/2021-11/regional-energy-strategy-mid-wales.pdf)

<sup>15</sup> Carno wind farm, 2022; [www.carnowindfarm.co.uk](http://www.carnowindfarm.co.uk)

<sup>16</sup> PES, 2022; Green light for Carno 3 Wind Farm [www.pes.eu.com/press-releases/green-light-for-carno-3-wind-farm](http://www.pes.eu.com/press-releases/green-light-for-carno-3-wind-farm)

<sup>17</sup> Power transformer news, 2022; New Carno 3 substation approved [www.powertransformernews.com/2022/05/19/new-carno-3-substation-approved](http://www.powertransformernews.com/2022/05/19/new-carno-3-substation-approved)



# North Wales

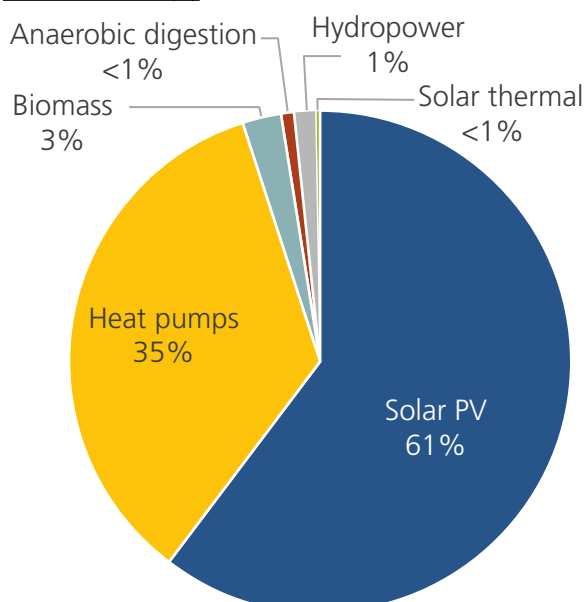
A total of 2,426 new renewable projects were commissioned in North Wales in 2021, the highest number of all four regions. Seven projects were commissioned with an individual capacity of greater than 1 MW – most notably, the Llwyndyrus Solar PV Farm and the Flint Landfill Solar PV Farm, which contributed 6 MW and 1.8 MW respectively.

Data source: (1)

Technology	Total Renewable heat and electricity			Commissioned in 2021	
	Number of projects	Total capacity (MW)	Estimated generation (GWh)	Number of projects	Total capacity (MW)
Anaerobic digestion	16	7	39	1	0.2
Biomass heat	809	93	285	5	0.6
Biomass electricity and CHP	15	120	652	0	0
Energy from Waste	1	11	55	0	0
Heat pumps	3,585	39	64	795	7.8
Hydropower	201	97	197	6	0.3
Landfill gas	8	5	14	0	0
Onshore wind	181	235	567	0	0
Sewage gas	1	2	11	0	0
Solar PV	17,318	248	235	1,603	13.7
Solar thermal	966	3	2	16	0.05
<b>Total</b>	<b>23,101</b>	<b>860</b>	<b>2,121</b>	<b>2,426</b>	<b>23</b>

## Percentage of renewable capacity commissioned in 2021, by technology

Data source: (1)

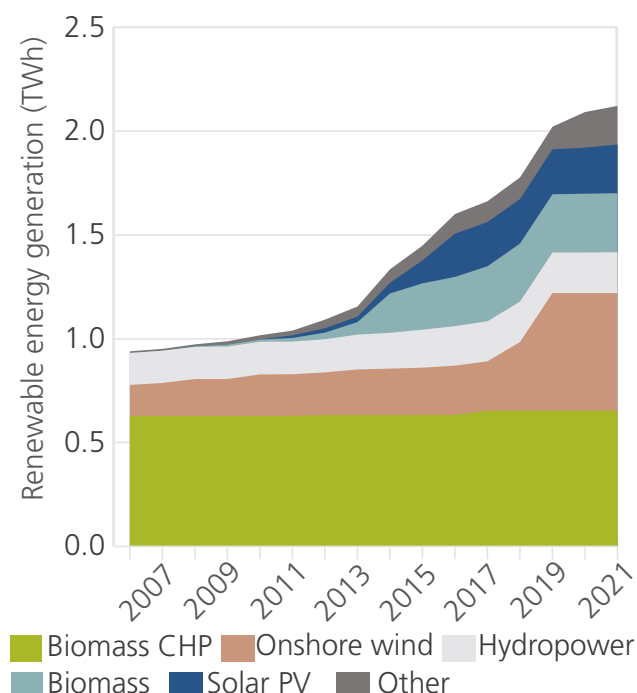


The majority (61%) of new capacity commissioned in North Wales for 2021 came from solar PV deployment. Renewable heat projects accounted for most of the remaining new capacity, with almost 800 heat pumps, 16 solar thermal and 5 biomass installations in 2021.



In 2021, a combination of biomass technologies represented the greatest proportion of renewable energy in North Wales, with biomass electricity and CHP accounting for 31% and biomass 14%. Apart from one 115 MW capacity biomass electricity and CHP site in Flintshire, and a 23 MWth biomass site in Wrexham, the remainder of this generation comes from smaller (less than 2.5 MW capacity) sites. Onshore wind generated 566 GWh of renewable electricity in North Wales in 2021, the lowest figure across all four regions. Clocaenog, the largest wind farm in the region, accounted for 32% (180 GWh) of this.

### Renewable energy generation in the North Wales Region Data source: (1)



### Largest projects in the North Wales Region commissioned in 2021, by capacity Data source: (1)

Project name	Local authority area	Technology	Capacity (MW)
Llwyndyrus Solar Farm	Gwynedd	Solar PV	6.0
Flint Landfill Solar Farm	Flintshire	Solar PV	1.8
Rhuddlan Road	Conwy	Biomass	0.5

### Arete Outdoor Education

Arete Outdoor Centre in Gwynedd, North Wales is a residential activity centre. It was purpose built for schools and groups, with a maximum capacity of 100 pupils plus staff. In February 2021, ground source heating was installed to replace the oil and gas boiler for all heating and hot water demand, as well as a computer controlled system programmed to heat rooms and water depending on the number of people staying at the centre, movements in and out of the building and outside temperatures – all helping to reduce unnecessary heating<sup>18</sup>.

Since 2014, a 16 kW solar PV system has also been in operation, providing electricity to the site during the day, with any excess powering highly efficient hot water tanks to provide the demand for showers in the evening. This all forms part of their plans to create an entirely carbon-free energy system onsite.



Image credit: Arete Outdoor Centre

18 Arete Outdoor Centre, 2022; [www.aretecentre.co.uk/environmental-policy](http://www.aretecentre.co.uk/environmental-policy)

# Low carbon technologies

# Hydropower

**There were seven new hydro projects commissioned across Wales in 2021, with a total capacity of 0.4 MW. All of these sites have an electrical capacity of under 100 kW, and all but one are located in North Wales. This brings the total installed capacity to 170 MW across 376 projects, generating an estimated 338 GWh of renewable electricity in 2021.**

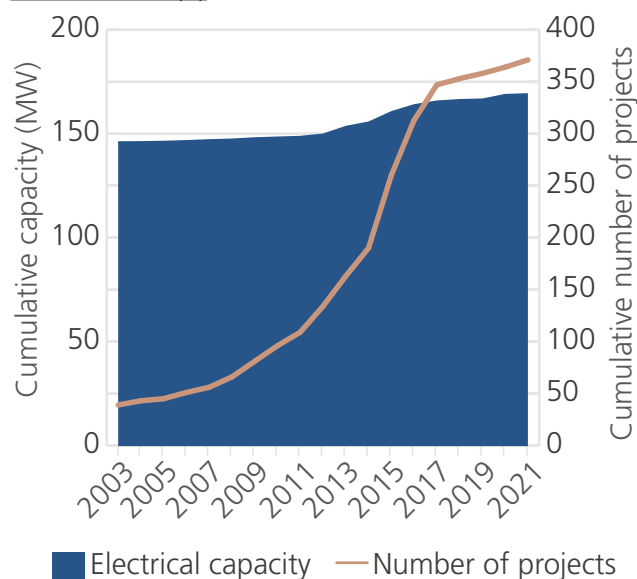
North Wales hosts the majority of hydropower generation in Wales, accounting for 57% of total capacity. Over the last decade, 15 MW of hydropower capacity has been commissioned in the region across 167 projects. There has also been significant activity in Mid Wales, which hosts 38% of Wales' overall hydropower capacity, with 2.7 MW developed across 77 projects since the start of 2010. Meanwhile, Cardiff Capital Region and Swansea Bay City Region have seen deployment of 0.9 MW and 2.6 MW of hydropower capacity respectively over the same timeframe.

Three-quarters of hydropower capacity in Wales, totalling 126 MW, is represented by six large-scale projects ranging from 9.9 MW to 41 MW in size, all of which were commissioned before 1989.

More recently, and specifically since the beginning of the 2010s, the vast majority of hydropower deployment in Wales has been through small-scale projects under 1 MW in capacity. With the exception of a 1.8 MW project commissioned in Carmarthenshire in 2020, all 290 hydropower projects deployed in this timeframe were under 1 MW, with an average capacity of 77 kW. The increased number of projects delivered in this period resulted from the support that was available through the Feed-in Tariff and Renewables Obligation, creating an additional 21 MW of capacity. These support schemes have since been removed; as a result, the number of projects connecting has slowed since 2017, with very little new capacity currently in the planning pipeline.

## Deployment of hydropower in Wales

Data source: (1)



## Top local authority areas by hydropower capacity

Data source: (1)

Local authority area	Region	Capacity (MW)
Gwynedd	North Wales	60
Ceredigion	Mid Wales	56
Conwy	North Wales	35

# Offshore wind

**With a total capacity of 726 MW, and accounting for approximately 29% of renewable electricity generation in 2021, offshore wind continues to contribute significantly to Wales' renewable generation mix. The UK government's revised target of 50 GW of offshore wind by 2030, including 5 GW of floating offshore wind, signals a key area for future growth in renewable electricity generation for Wales.**

Installed capacity in Welsh waters has remained constant since 2015 when the last fixed offshore wind farm was commissioned. Meanwhile, development activity in Welsh waters is continuing and has increased The Crown Estate's portfolio of marine assets in Wales from £49.2 million in 2020 to £603 million in 2022<sup>19</sup>. This includes a variety of new offshore wind projects currently in the planning stages, such as a 1.5 GW Mona project by a consortium between EnBW and BP, which is expected to connect to the grid near Bodelwyddan in North Wales, as well as an extension to Gwynt y Môr wind farm, Awel y Môr, of up to 576 MW.

In April 2022<sup>20</sup>, the British Energy Security Strategy confirmed a revised target of 50 GW of offshore wind by 2030, including a sub-target of 5 GW of floating offshore wind. This increase in ambition, coupled with the need to diversify the UK's offshore wind portfolio to take advantage of geographic variations in weather conditions, means that Welsh waters are on track to play a major role in the UK's net zero transition.

## **Existing or in development offshore wind projects that could contribute to Welsh renewable electricity generation**

Data source: (4)

Wind farm	Status	Actual or expected commissioning date	Actual or expected capacity (MW)
North Hoyle	Commissioned	2003	60
Rhyl Flats	Commissioned	2009	90
Gwynt y Môr	Commissioned	2015	576
Erebus	In planning	2026	99
Mona	Pre-planning	2026	1,500
Llŷr 1	Pre-planning	2027	100
Llŷr 2	Pre-planning	2027	100
Whitecross	Pre-planning	2027	100
Awel y Môr	In planning	TBC	<576

19 House of Commons, 2022; Crown Estate: Devolution [www.hansard.parliament.uk/commons/2022-02-09/debates/DC9680A9-AF53-443D-9EFA-CFBA2386FE47/CrownEstateDevolution](http://www.hansard.parliament.uk/commons/2022-02-09/debates/DC9680A9-AF53-443D-9EFA-CFBA2386FE47/CrownEstateDevolution)

20 UK Government, 2022; British energy security strategy [www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy#renewables](http://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy#renewables)

The Crown Estate recently identified five ‘areas of search’ for the intended deployment of 4 GW of floating offshore wind in the Celtic Sea by 2035, with the potential to accommodate up to an additional 20 GW by 2045. There are also a number of test and demonstration projects already recognised by The Crown Estate off the south Pembroke coast, including the 100 MW Erebus project which has a grid connection in Pembrokeshire. Floating offshore wind is a crucial technology for Wales, having already contributed nearly £2.2 million to the Welsh economy<sup>21</sup> as of 2021. Recent analysis from the ORE Catapult forecasts potential benefits of £682 million in supply chain opportunities across Wales and Cornwall by 2030, and The Crown Estate estimates around 10,000 FTE jobs to be created in Wales from this new industry.

In October 2022, RWE – the largest power producer in Wales – confirmed it had commissioned Swansea-based Marine Power Systems (MPS) to develop a project plan for delivering up to 1 GW of floating wind using the ports ABP Port Talbot and Pembroke Dock for foundation assembly and turbine assembly<sup>22</sup>. This announcement, following the UK government’s pledge in November 2021 to invest £160 million into modern ports<sup>23</sup>, has furthered calls from stakeholders to prioritise Welsh developments.

## Location of offshore wind projects



21 Marine Energy Wales, 2021; State of the Sector 2021: Economic Benefits for Wales [www.marineenergywales.co.uk/wp-content/uploads/2021/07/State-of-the-Sector-2021.pdf](http://www.marineenergywales.co.uk/wp-content/uploads/2021/07/State-of-the-Sector-2021.pdf)

22 RWE, 2022; RWE commissions study with Swansea-based Marine Power Systems into Celtic Sea opportunities for ports and suppliers [www.rwe.com/en/press/rwe-renewables/2022-10-06-rwe-commissions-study-with-swansea-based-marine-power-systems-into-celtic-sea-op](http://www.rwe.com/en/press/rwe-renewables/2022-10-06-rwe-commissions-study-with-swansea-based-marine-power-systems-into-celtic-sea-op)

23 UK Government, 2021; Scotland and Wales could be home to new floating offshore wind ports thanks to £160m UK government funding [www.gov.uk/government/news/scotland-and-wales-could-be-home-to-new-floating-offshore-wind-ports-thanks-to-160m-uk-government-funding](http://www.gov.uk/government/news/scotland-and-wales-could-be-home-to-new-floating-offshore-wind-ports-thanks-to-160m-uk-government-funding)

**A total of £159.6 million has been invested into marine renewable energy in Wales<sup>24</sup>, an increase of £13.7 million from 2021. There are currently seabed leases in place for 465 MW<sup>25</sup>, including for two tidal stream and wave energy demonstration sites currently in development. The Welsh Government has also committed to working with National Resources Wales to identify marine ‘strategic resource areas’ by 2023<sup>26</sup>. Therefore, whilst marine technologies have not yet contributed to Welsh electricity generation, Wales is in a prime position to capitalise on marine energy development.**

2021 to 2022 has been a valuable year for marine energy in Wales, with £3.8 million invested in tidal stream alone. Magallanes Renovables were awarded the first contract for marine technology in Wales through the Contracts for Difference (CfD) scheme, bidding into the latest allocation round with a 5.62 MW tidal stream turbine at £178/MWh<sup>27</sup>. This is due to be operational in 2025 and will be located within the Morlais test and demonstration zone. The Morlais zone received £31 million from the EU’s regional funding programme<sup>28</sup>, in addition to a further £1.2 million from The Crown Estate, to develop infrastructure to allow up to 240 MW of marine capacity to connect to the grid.

While there are currently no large-scale operational wave energy devices in Wales, Bombora Wave Power is conducting the final test and assembly phase of its Pembrokeshire demonstration project ahead of deployment of a 1.5 MW mWave system later this year. Both Bombora and MPS are also progressing floating platform designs to integrate wave energy with floating offshore wind.

The Welsh Government is committed to further developing marine renewable energy in Wales, with a three-year grant worth £450,000 given to Marine Energy Wales<sup>29</sup> to ensure they can continue to “create a supportive policy environment for marine energy to ensure that Wales remains one of the best places globally for emerging offshore renewables”.

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24 Marine Energy Wales, 2022; State of the Sector, 2022 [www.marineenergywales.co.uk/wp-content/uploads/2022/09/MEW-2022-State-Of-The-Sector.pdf](http://www.marineenergywales.co.uk/wp-content/uploads/2022/09/MEW-2022-State-Of-The-Sector.pdf)

25 Marine Energy Wales, 2021; State of the Sector, 2021: Economic Benefits for Wales [www.marineenergywales.co.uk/wp-content/uploads/2021/07/State-of-the-Sector-2021.pdf](http://www.marineenergywales.co.uk/wp-content/uploads/2021/07/State-of-the-Sector-2021.pdf)

26 Welsh Government, 2022; Renewable Energy Deep Dive Biannual Recommendations Update 1 [www.gov.wales/sites/default/files/pdf-versions/2022/9/3/1663774216/renewable-energy-deep-dive-biannual-recommendations-update-1.pdf](http://www.gov.wales/sites/default/files/pdf-versions/2022/9/3/1663774216/renewable-energy-deep-dive-biannual-recommendations-update-1.pdf)

27 BEIS, 2022; Contracts for difference allocation round 4 results [www.assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1088875/contracts-for-difference-allocation-round-4-results.pdf](http://www.assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1088875/contracts-for-difference-allocation-round-4-results.pdf)

28 Welsh Government, 2022; £31m to turn the tide towards renewable energy <https://gov.wales/31m-turn-tide-towards-renewable-energy>

29 Marine Energy Wales, 2022; Future funding secured for Marine Energy Wales [www.marineenergywales.co.uk/future-funding-secured-for-marine-energy-wales](http://www.marineenergywales.co.uk/future-funding-secured-for-marine-energy-wales)

# Onshore wind

**2021 saw the smallest increase in onshore wind capacity since 2005, with less than 3.5 MW installed across two sites. This is the second year in a row to see a reduction in growth, after the boom of the late 2010's when, on average, over 160 MW of capacity was installed each year from 2016 to 2019. Onshore wind capacity now stands at 1,266 MW in Wales, 34% of which is situated in the Swansea Bay City Region. The Cardiff Capital Region contains 25% of onshore wind capacity, followed closely by Mid Wales (22%) and North Wales (19%).**

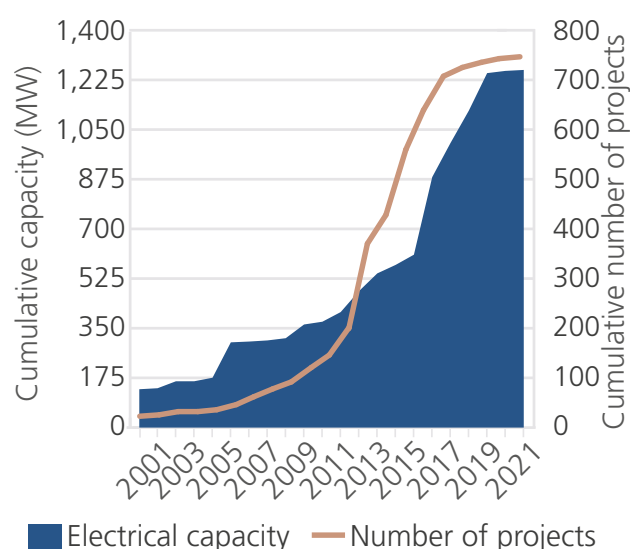
Both of the sites commissioned in 2021 were located in the Cardiff Capital Region; energy company Ripple's 2.5 MW Graig Fatha wind farm, situated in Rhondda Cynon Taf, and a 0.9 MW capacity turbine at the Rassau industrial estate in Bleanau Gwent. This was constructed as part of a new energy centre, which also contains solar PV and supplies electricity directly to businesses onsite.

Under current legislation<sup>30</sup> all onshore wind generation projects with a capacity of 10 MW or more are classed as Developments of National Significance, with planning decisions made by Welsh Ministers. Smaller projects are determined by local planning authorities. However, in July 2022 the First Minister committed to introducing a new infrastructure consenting Bill<sup>31</sup>. The planned Bill should replace existing statutory regimes and aims to simplify the consenting process for large infrastructure projects, reducing the number of authorisations required to construct and operate a project into a single consent.

As of July 2022, there were three onshore wind projects under construction. A further 13 with planning permission and 14 sites awaiting planning permission in Wales, representing a total combined pipeline capacity of almost 74 MW<sup>32</sup>.

## Deployment of onshore wind in Wales

Data source: (1)



30 The National Archives, 2022; Regulation 4A of the Developments of National Significance (Specified Criteria and Prescribed Secondary Consents) (Wales) Regulations 2016 [www.legislation.gov.uk/wsi/2016/53/contents/made](http://www.legislation.gov.uk/wsi/2016/53/contents/made)

31 Welsh Government, 2022; Wales' green agenda: First Minister announces Welsh Government's legislative programme [www.gov.wales/wales-green-agenda-first-minister-announces-welsh-governments-legislative-programme](http://www.gov.wales/wales-green-agenda-first-minister-announces-welsh-governments-legislative-programme)

32 Sourced from the Renewable Energy Planning Database Quarterly Extract, July 2022 [www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract](http://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract)



# Renewable heat

**Almost 29 MW of new renewable heat capacity was commissioned in 2021, from 2,210 individual projects. The majority of this new capacity was due to 2,073 heat pump projects, adding 21 MW of electrified heat. Deployment of biomass projects was 30% higher than in 2020, with 82 projects delivering an additional 7.6 MW of renewable heat capacity.**

The Welsh Government is due to release a Heat Strategy for Wales in 2023, helping to ensure that funding and effort is focused on the most appropriate solutions for decarbonising heat generation in Wales.

## Heat pumps

There were 2,073 heat pumps installed in 2021, the highest number of installations in a single year to date. The majority of these were domestic installations, which represented 92% (19 MW) of the capacity increase seen in the year.

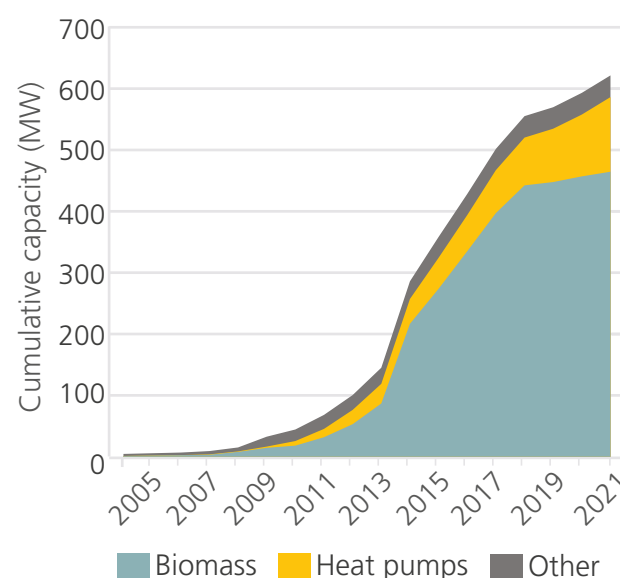
The primary support scheme for installing domestic heat pumps changed in 2022, with the closure of the Domestic Renewable Heat Incentive. This has broadly been replaced by the Boiler Upgrade Scheme, which helps to cover the additional costs associated with switching from a gas boiler to a heat pump. The Welsh Government is committed to increasing the proportion of electrified heat by 3% by 2025, as stated in the Second All Wales Low Carbon Delivery Plan (2021-2025)<sup>33</sup>.

## Biomass

With an additional 7.6 MW commissioned in 2021, biomass represents by far the largest proportion (64%) of all low carbon heat technologies deployed in Wales. However, deployment rates for biomass have dropped since 2014, which saw a peak capacity increase of 130 MW. The largest single biomass project commissioned in 2021 was a 1.2 MW site in Rhondda Cynon Taf, which generated an estimated 3,679 MWh of heat in 2021.

## Deployment of renewable heat over time

Data source: (1)



<sup>33</sup> Welsh Government, 2021; Net Zero Wales Carbon Budget (2021 to 2025) [www.gov.wales/net-zero-wales-carbon-budget-2-2021-2025](https://www.gov.wales/net-zero-wales-carbon-budget-2-2021-2025)



# Solar PV

**In 2021, 113 MW of new solar PV capacity was installed in Wales – five times the amount installed in 2020. A single 75 MW site in Newport made up the majority of this new capacity. The total solar PV capacity in Wales is now over 1.1 GW, across almost 64,000 individual projects. Over 75% of this capacity is accounted for by 128 ground-mounted solar PV projects with a capacity of 1 MW or more.**

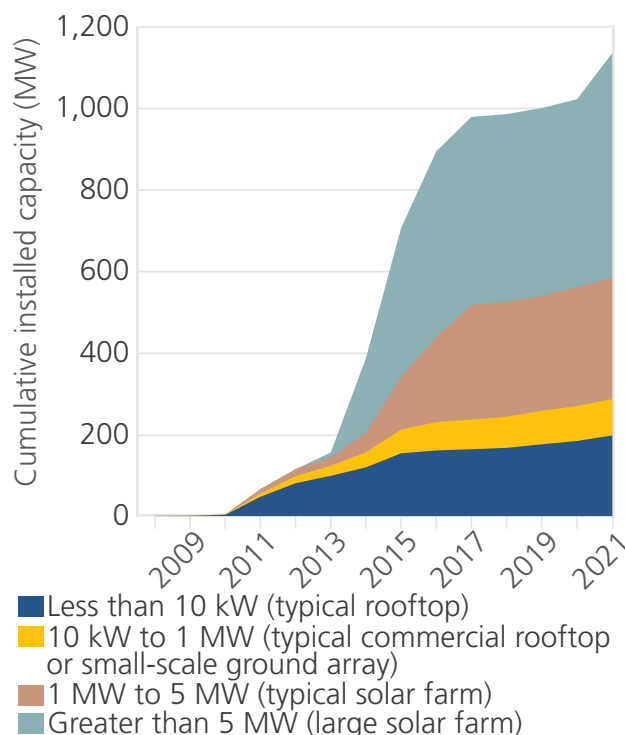
The 75 MW Llanwern Farm Solar Park in Newport, commissioned in early 2021, was the largest operational solar farm in the UK at time of construction, slightly above the 72 MW Shotwick Solar Park in Flintshire that was commissioned in 2016. Four further solar farms, ranging from 1.8 MW to 9.2 MW in capacity and totalling 21 MW, were also commissioned in Wales in 2021: these sites are located in Swansea, Gwynedd and Flintshire.

Deployment of smaller-scale solar PV, less than 1 MW in capacity, typically in the form of rooftop solar on domestic and commercial roofs, has also increased significantly in 2021. With 14.4 MW of new capacity, deployment at this scale is almost 40% higher than in 2020. Geographically, the majority of solar PV in Wales is in the two southern regions, with Swansea Bay City Region and Cardiff Capital Region, hosting 37% and 36% of capacity respectively. North Wales hosts 22% of solar PV capacity, with Mid Wales representing the remaining 5%. Three local authority areas now contain over 100 MW of capacity each – Pembrokeshire (199 MW), Carmarthenshire (111 MW) and Newport (101 MW).

The ending of support mechanisms such as the Feed-in Tariff during the latter part of the 2010s, saw deployment of solar PV slow considerably at both rooftop and ground-mounted scale. However, deployment rates in 2021 suggest that subsidy-free business models for large-scale solar, and the benefits of rooftop solar on homes and businesses at a smaller scale, are encouraging deployment across Wales.

## Solar PV deployment in Wales by scale

Data source: (1)



# Waste technologies

**The development of generation from waste projects in Wales continued to slow into 2021, with only one anaerobic digestion plant in North Wales being commissioned. Between 2017 and 2021, six new projects were developed, in contrast to the 38 waste energy sites commissioned in the preceding five years. Waste technologies generated 608 GWh of energy in 2021, 86% of which is classed as renewable.**

Wales continues to hit its recycling targets, with a 3% decrease in local authority municipal waste in October to December 2021, in comparison to the same quarter of 2020<sup>34</sup>. With the recycling rate currently at just over 65% and a government target of 70% by 2025, generation from waste technologies may have a diminishing role in Wales' energy mix in the future.

## Energy from Waste (EfW)

With 51 MW of capacity, the two operational EfW sites represent 40% of all energy capacity from waste technologies in Wales. However, for both of these sites, only 50% of the generation capacity is classed as renewable, due to the nature of the waste.

## Anaerobic digestion

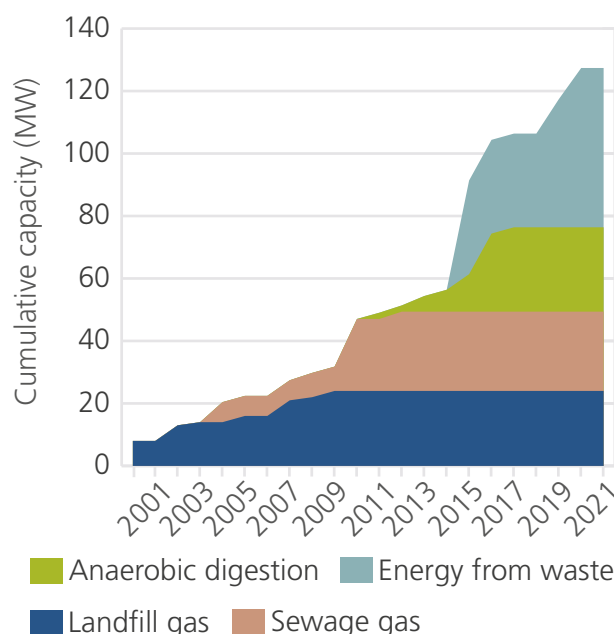
Anaerobic digestion plants make up the majority of Welsh waste energy sites by number, with 47 different projects currently in operation, 30 of which are locally owned. Most of these generators are small scale, with only 10 sites having an individual capacity of more than 1 MW.

## Sewage and landfill gas

There are 28 sewage and landfill gas generators across the country, the majority of which are landfill (23 sites). Together, these technologies have a total combined thermal and electrical capacity of almost 50 MW. The amount of generation from landfill gas has been steadily decreasing from a peak in 2014, due to decreasing volumes of methane gas captured from decomposing waste.

## Deployment of waste technology over time

Data source: (1)



<sup>34</sup> Welsh Government, 2022; Local authority municipal waste management: October to December 2021 [www.gov.wales/local-authority-municipal-waste-management-october-december-2021](http://www.gov.wales/local-authority-municipal-waste-management-october-december-2021)

# Fossil fuels

# Fossil fuel electricity generation

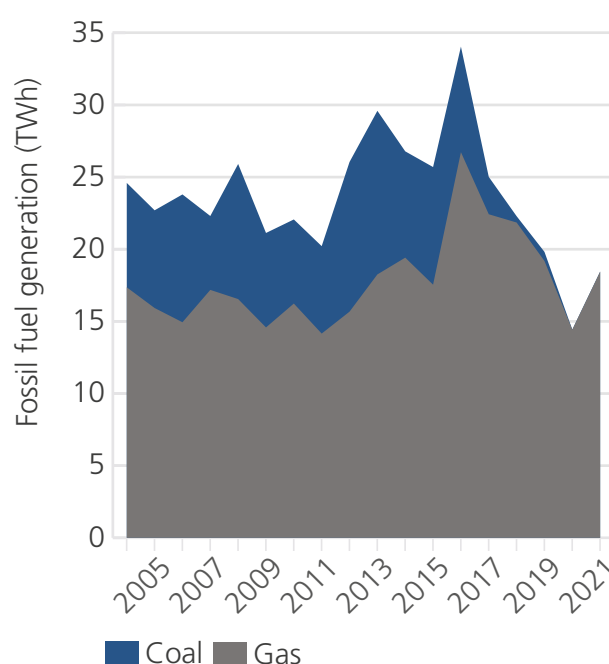
**The total capacity of fossil fuel electricity generation in Wales in 2021 was 4.3 GW, a figure similar to the total in 2020. Collectively, fossil fuels generated 19.5 TWh of electricity in 2021, representing 72% of total electricity generation in Wales and the equivalent of 141% of Wales' electricity consumption.**

In 2021, the total capacity of natural gas electricity plants in Wales was 4,338 MW, the majority of which came from the two remaining large Combined Cycle Gas Turbine (CCGT) power stations at Pembroke (2,181 MW) and Connah's Quay (1,380 MW). However, despite a number of large gas plants closing in recent years in Wales, market conditions in the past 18 months have led to high utilisation of the remaining sites. This means that the reduction in capacity of gas plants in Wales has not necessarily resulted in a corresponding reduction in electricity generation from gas. There are also more than 70 other smaller gas generators in Wales with a combined capacity of 482 MW, which operate principally as flexible 'peaking' plants.

The majority of the remaining fossil fuel generation capacity comes from small-scale diesel generation, which is typically deployed as a short-term operating reserve. This represents 269 MW of fossil fuel generation capacity, with the largest generator having 22.4 MW of installed capacity. It is also assumed that half of the electricity generated from waste is non-renewable, comprising around 26 MW of assumed non-renewable waste electrical capacity.

## Fossil fuel generation over time

Data source: (1)



## Fossil fuel electricity capacity by technology type

Data source: (1)

Technology	Electrical capacity (MW)
Coal	0
Diesel	269
Energy from Waste	26
Gas	4,043

## Regional context

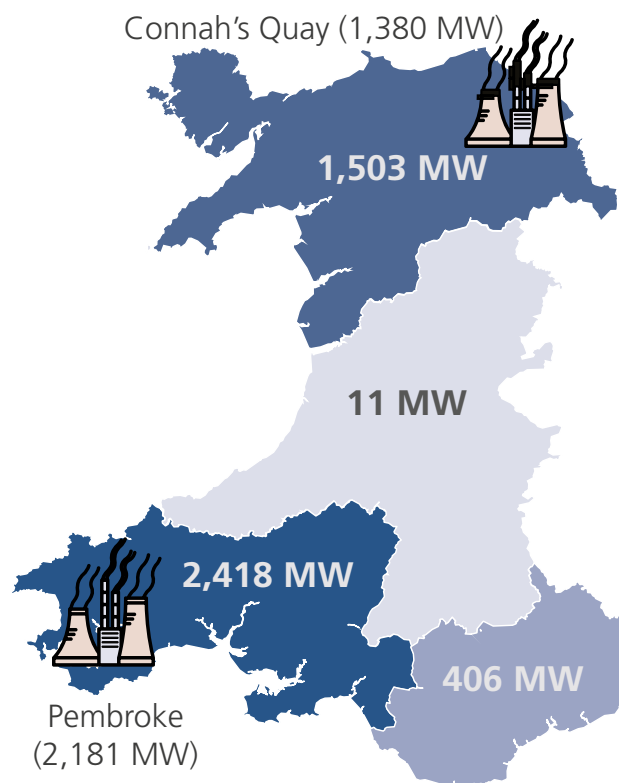
Following two years of very little activity, the development of new fossil fuel generation increased in 2021, causing total fossil fuel capacity in Wales to grow by 36 MW. A single, 21 MW diesel generator, located in Blaenau Gwent in the Cardiff Capital Region, accounts for almost 60% of this capacity increase.

The Cardiff Capital Region holds the greatest concentration of fossil fuel generators in Wales, with 55 sites representing a combined capacity of 406 MW. However, these are all small-scale sites, with no individual site exceeding a capacity of 30 MW. This is in stark contrast to North Wales, which has far fewer fossil fuel projects, but a total installed capacity of 1,503 MW, most of which is represented by the large CCGT power station at Connah's Quay (1,380 MW). This is also the case for the Swansea Bay City region, where 20 sites represent just 10% (237 MW) of the region's total generation capacity, with Pembroke Power Station accounting for the rest (2,181 MW).

Mid Wales is the only region where, at 9.7 MW, the installed capacity of diesel generation exceeds the gas generation capacity (0.8 MW). This may be due to the lack of natural gas infrastructure in the Mid Wales region, which is a barrier to the development of gas-powered electricity generation.

## Fossil fuel electricity capacity by region

Data source: (1)



# Storage and flexible technologies

# Battery storage

**There are three commercial-scale batteries in Wales currently operational, with a total power capacity of 26.6 MW.**

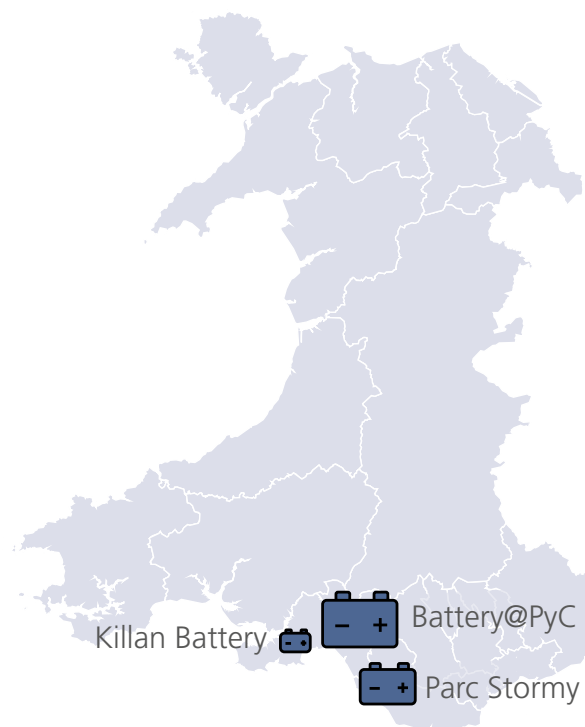
The battery storage sector is continuing to grow; the volume of projects in development, individual project sizes (MW and MWh) and the number of companies that are active in the sector all collectively and consistently increased in recent years. There are currently 11 projects with a capacity greater than 150 kW with planning permission or under construction in Wales, and another nine projects with applications that have been submitted – two of which have a planned capacity of almost 50 MW<sup>35</sup>.

The development of commercial-scale battery storage across the UK is driven by the growing need for zero-carbon flexibility in the electricity system. Projects provide services to the electricity grid, including the balancing of supply and demand and providing fast-response services such as Dynamic Containment.

Despite the ever-growing pipeline of prospective projects, the proportion of sites that will move through to commissioning in the next 5 to 10 years is unclear. There are a number of national commercial markets and revenue opportunities that battery storage projects are targeting, such as the relatively recently reformed trio of commercial frequency balancing services<sup>36</sup>, reformed 'Quick' and 'Slow' reserve services<sup>37</sup> and the Network Option Assessment pathfinders<sup>38</sup>. In addition to these markets, some distribution network operators have also been ramping up activity to procure flexibility services in discrete constraint management zones in 2022<sup>39</sup>. While ongoing network constraint issues could delay the deployment of many battery projects seeking to move forward to construction, such issues also strengthen the business case for flexible assets such as batteries.

## Location of battery storage projects

Data source: (1)



35 Sourced from the Renewable Energy Planning Database Quarterly Extract, July 2022 [www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract](https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract)

36 National Grid ESO, 2022; Frequency Response Services [www.nationalgrideso.com/industry-information/balancing-services/frequency-response-services](https://www.nationalgrideso.com/industry-information/balancing-services/frequency-response-services)

37 National Grid ESO, 2022; Reserve Services [www.nationalgrideso.com/industry-information/balancing-services/reserve-services](https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services)

38 National Grid ESO, 2022; NOA pathfinders [www.nationalgrideso.com/future-energy/projects/pathfinders](https://www.nationalgrideso.com/future-energy/projects/pathfinders)

39 SSEN, 2022; SSEN goes to market for flexibility capacity worth £6.7m [www.ssen.co.uk/news-views/2022/ssen-goes-to-market-for-flexibility-capacity-worth-6.7m](https://www.ssen.co.uk/news-views/2022/ssen-goes-to-market-for-flexibility-capacity-worth-6.7m)

# Pumped hydropower

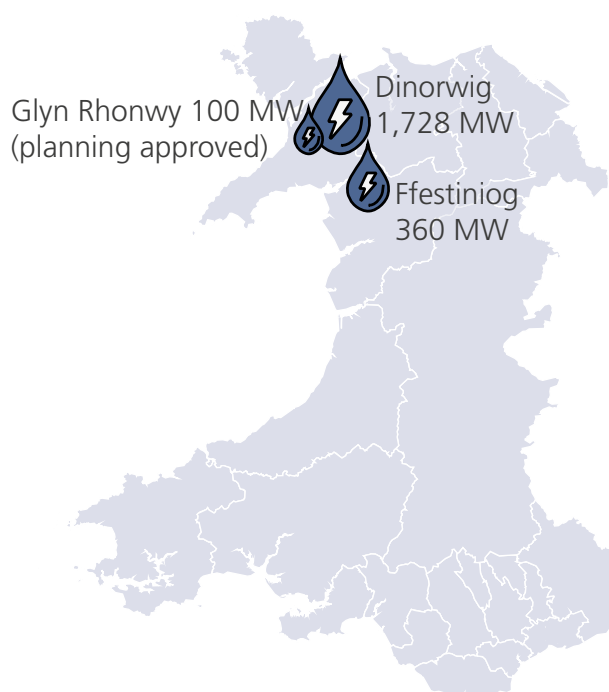
**Pumped storage has the same capacity as in 2020, with two operational plants at Ffestiniog and Dinorwig waiting to be joined by the planned site at Glyn Rhonwy in Snowdonia. Together, they will contribute over 2.1 GW of storage, with 360 MW and 1.7 GW from Ffestiniog and Dinorwig respectively, and an additional 100 MW from Glyn Rhonwy once operational.**

Pumped hydropower storage is one of the most established forms of storage, having been in use since the first decade of the 1900s. Ffestiniog was opened in 1963 and Dinorwig in 1984, and they currently contribute the majority of the UK's existing 2.8 GW of pumped hydropower storage. Glyn Rhonwy was granted a Development Consent Order in 2017 to begin construction by April 2022. However, due to delays caused by COVID-19, the developers have been unable to begin construction. Therefore, in November 2021 the Welsh Government granted an extension to the planning consent to allow construction to commence by April 2025.

Pumped hydropower provides vital long-term storage flexibility to respond to changes in demand, with project lifespans typically extending beyond 80 years. It will continue to play a key role in ensuring stability in an energy system featuring an increasing number of variable renewable generation sources.

## Location of pumped hydropower projects

Data source: (1)





# Hydrogen

**The production and wider use of low carbon hydrogen is a developing technology sector that has gained momentum in recent years. Hydrogen requires energy to produce, meaning the hydrogen process can be viewed under both supply and demand of energy. However, within the context of electricity generation, hydrogen's primary application is as a storage technology.**

The Welsh Government has recognised hydrogen as “a necessary part of achieving net zero” and several objectives in Wales’ proposed Hydrogen Pathway have progressed across 2021 and 2022, ranging from opportunities in the deployment of fuel cell transport to establishing a 10 MW renewable hydrogen production facility by 2024<sup>40</sup>. Following on from recent responses to the 2021 consultation on the Hydrogen Pathway in Wales<sup>41</sup>, the Welsh Government remains “convinced that hydrogen will have an important role to play in meeting net zero”<sup>40</sup>, and will continue to support the hydrogen energy sector in Wales, engaging with key stakeholders and initiatives to ensure socio-economic benefits are maintained with the country.

There is also an increasing focus on the development of hydrogen via electrolysis from renewable energy sources – known as ‘green’ hydrogen – with the Minister for Climate Change stating during a Senedd debate in June 2022 that “we have to move to the exclusive use of green hydrogen as soon as is practically possible”<sup>42</sup>. She also discussed the Welsh Government’s Small Business Research Initiative (SBRI) HyBRID (Hydrogen Business Research & Innovation for Decarbonisation) which, since December 2021, has supported a number of feasibility studies to develop hydrogen projects in Wales.

In May 2021, RWE launched the Pembroke Net Zero Centre (PNZC)<sup>43</sup>. The Centre is built on three key pillars: green hydrogen, development of floating offshore wind in the Celtic Sea and decarbonisation of the Pembroke Power Station. Subsequently, in March 2022, the Centre concluded a four-month joint study investigating the feasibility of an initial installation of a 100 MW electrolyser at the power station<sup>44</sup>. The study proposed green hydrogen from local and grid-connected renewable generation and aims to scale its future hydrogen production once floating offshore wind sites in development in the Celtic Sea become operational.

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40 Welsh Government, 2022; Hydrogen in Wales – A pathway and next steps for developing the hydrogen energy sector in Wales [www.gov.wales/sites/default/files/consultations/2022-06/hydrogen-in-wales-consultation-response\\_0.pdf](https://www.gov.wales/sites/default/files/consultations/2022-06/hydrogen-in-wales-consultation-response_0.pdf)

41 Element Energy, 2020; Hydrogen Development in Wales [www.gov.wales/sites/default/files/consultations/2021-01/baselining-report-hydrogen-development-in-wales.pdf](https://www.gov.wales/sites/default/files/consultations/2021-01/baselining-report-hydrogen-development-in-wales.pdf)

42 Welsh Parliament, 2022; 7. Plaid Cymru Debate: Hydrogen strategy <https://record.assembly.wales/Plenary/12877>

43 RWE, 2021; RWE launches its Pembroke Net Zero Centre to help drive decarbonisation in South Wales [www.rwe.com/en/press/rwe-generation/2021-05-26-rwe-launches-its-pembroke-net-zero-centre](https://www.rwe.com/en/press/rwe-generation/2021-05-26-rwe-launches-its-pembroke-net-zero-centre)

44 RWE, 2021; RWE is driving hydrogen plans forward in Wales [www.rwe.com/en/press/rwe-generation/2021-12-17-rwe-is-driving-hydrogen-plans-forward-in-wales](https://www.rwe.com/en/press/rwe-generation/2021-12-17-rwe-is-driving-hydrogen-plans-forward-in-wales)

# Reference pages

# Data tables

Local authority	Totals					Renewables								
	Renewables			Fossil fuels		AD			Biomass heat		Biomass electricity and CHP			
	Number of projects	Capacity (MW <sub>e</sub> )	Capacity (MW <sub>th</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	Capacity (MW <sub>th</sub> )	Number of projects	Capacity (MW <sub>th</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	Capacity (MW <sub>th</sub> )	
Blaenau Gwent	1,269	24	10	6	107	-	-	-	14	9	1	4	-	
Bridgend	2,804	92	10	4	24	1	3	-	36	8	-	-	-	
Caerphilly	3,228	69	10	3	19	2	2	1	50	7	2	0	-	
Cardiff	3,963	44	13	7	37	1	2	-	21	5	1	0	-	
Carmarthenshire	6,945	264	60	2	10	2	1	0	530	46	-	-	-	
Ceredigion	4,892	177	78	2	10	4	1	1	268	44	4	3	17	
Conwy	2,742	95	15	3	2	3	-	0	122	9	5	1	0	
Denbighshire	3,073	163	25	2	1	3	1	1	174	16	5	1	0	
Flintshire	4,729	133	112	8	1,432	-	-	-	142	14	1	25	90	
Gwynedd	3,955	111	26	2	5	2	0	0	222	17	1	0	-	
Isle of Anglesey	3,429	81	12	1	0	2	2	0	60	3	1	0	0	
Merthyr Tydfil	936	17	6	3	40	-	-	-	15	4	1	1	2	
Monmouthshire	4,887	68	37	4	6	2	0	0	189	22	4	18	7	
Neath Port Talbot	2,136	330	23	7	86	-	-	-	90	19	2	56	-	
Newport	2,419	127	13	4	39	2	0	0	41	11	2	9	0	
Pembrokeshire	6,452	228	39	6	2,240	2	0	0	297	28	2	0	0	
Powys	7,913	241	157	4	1	13	4	2	981	133	10	1	2	
Rhondda Cynon Taf	4,991	253	22	11	71	1	1	1	64	17	-	-	-	
Swansea	3,552	104	13	6	82	-	-	-	59	8	1	1	-	
Torfaen	2,218	15	4	5	0	-	-	-	21	3	1	0	1	
Vale of Glamorgan	2,741	98	16	8	63	1	1	-	65	9	2	10	-	
Wrexham	5,174	46	40	4	63	6	0	1	89	34	2		1	
Offshore	3	726	-	-	-	-	-	-	-	-	-	-	-	
Unknown	28	0	0	-	-	-	-	-	-	-	2	0	0	
Total	84,477	3,508	742	102	4,337	47	19	8	3,550	465	50	131	120	

In these backing data tables, 0 represents a value of greater than 0 and less than 1 that has been rounded down. Hyphens represent 0 values.

# Data tables

Local authority	Renewables											
	Energy from waste		Heat pumps		Hydropower		Landfill gas		Offshore wind		Onshore wind	
	Number of projects	Capacity (MW <sub>e</sub> )	Number of projects	Capacity (MW <sub>th</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	Number of projects	Capacity (MW <sub>e</sub> )
Blaenau Gwent	-	-	58	1	1	0	1	1	-	-	9	7
Bridgend	-	-	188	2	3	0	1	0	-	-	14	59
Caerphilly	-	-	146	2	-	-	-	-	-	-	21	17
Cardiff	1	30	226	3	1	0	2	2	-	-	3	0
Carmarthenshire	-	-	1,158	13	14	6	1	1	-	-	113	145
Ceredigion	-	-	1,575	15	26	56	-	-	-	-	78	85
Conwy	-	-	313	4	30	35	1	1	-	-	40	40
Denbighshire	-	-	629	7	21	3	-	-	-	-	39	147
Flintshire	1	21	813	8	-	-	2	0	-	-	17	2
Gwynedd	-	-	797	9	150	60	1	0	-	-	36	7
Isle of Anglesey	-	-	732	8	-	-	1	0	-	-	49	40
Merthyr Tydfil	-	-	42	1	4	0	2	6	-	-	5	2
Monmouthshire	-	-	624	7	11	0	-	-	-	-	11	4
Neath Port Talbot	-	-	129	1	10	1	2	1	-	-	12	230
Newport	-	-	80	1	-	-	1	1	-	-	11	16
Pembrokeshire	-	-	867	10	14	1	1	2	-	-	150	26
Powys	-	-	1,458	17	81	8	1	2	-	-	118	199
Rhondda Cynon Taf	-	-	330	3	4	0	2	1	-	-	14	204
Swansea	-	-	370	4	2	0	1	1	-	-	5	34
Torfaen	-	-	61	1	1	0	-	-	-	-	3	0
Vale of Glamorgan	-	-	274	3	-	-	-	-	-	-	6	1
Wrexham	-	-	301	4	-	-	3	3	-	-	1	0
Offshore	-	-	-	-	-	-	-	-	3	726	-	-
Unknown	-	-	-	-	3	0	-	-	-	-	-	-
Total	2	51	11,171	122	376	170	23	24	3	726	753	1,266

In these backing data tables, 0 represents a value of greater than 0 and less than 1 that has been rounded down. Hyphens represent 0 values.

# Data tables

Local authority	Renewables								Fossil fuels					
	Sewage gas			Solar PV		Solar thermal			Coal		Diesel and unknown		Gas	
	Number of projects	Capacity (MW <sub>e</sub> )	Capacity (MW <sub>th</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	Number of projects	Capacity (MW <sub>th</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	Number of projects	Capacity (MW <sub>e</sub> )	
Blaenau Gwent	-	-	-	895	12	290	1	-	-	1	21	5	86	
Bridgend	-	-	-	2,460	30	101	0	-	-	-	-	4	24	
Caerphilly	-	-	-	2,661	50	346	1	-	-	1	18	2	1	
Cardiff	1	4	5	3,610	21	96	0	-	-	1	1	5	21	
Carmarthenshire	-	-	-	4,813	111	314	1	-	-	-	-	2	10	
Ceredigion	-	-	-	2,579	32	358	1	-	-	1	10	1	0	
Conwy	-	-	-	1,974	18	254	1	-	-	-	-	3	2	
Denbighshire	-	-	-	2,059	11	143	0	-	-	-	-	2	1	
Flintshire	-	-	-	3,667	95	86	0	-	-	1	14	6	1,407	
Gwynedd	-	-	-	2,566	43	180	1	-	-	-	-	2	5	
Isle of Anglesey	-	-	-	2,394	40	190	1	-	-	-	-	1	0	
Merthyr Tydfil	-	-	-	800	7	67	0	-	-	1	20	2	19	
Monmouthshire	-	-	-	3,929	46	117	0	-	-	2	6	2	0	
Neath Port Talbot	1	3	3	1,851	40	39	0	-	-	4	47	3	39	
Newport	-	-	-	2,248	101	34	0	-	-	1	12	3	27	
Pembrokeshire	-	-	-	4,558	199	561	2	-	-	-	-	6	2,240	
Powys	-	-	-	4,564	27	687	2	-	-	-	-	4	1	
Rhondda Cynon Taf	-	-	-	4,031	46	545	2	-	-	1	20	10	51	
Swansea	1	1	1	2,951	67	162	0	-	-	3	45	3	37	
Torfaen	-	-	-	2,113	15	18	0	-	-	-	-	5	0	
Vale of Glamorgan	1	3	3	2,303	84	89	0	-	-	3	19	5	43	
Wrexham	1	1	1	4,658	41	113	0	-	-	2	36	2	27	
Offshore	-	-	-	-	-	-	-	-	-	-	-	-	-	
Unknown	-	-	-	23	0	-	-	-	-	-	-	-	-	
Total	5	12	14	63,707	1,134	4,790	14	-	-	22	269	78	4,043	

In these backing data tables, 0 represents a value of greater than 0 and less than 1 that has been rounded down. Hyphens represent 0 values.

# 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, cleaning 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.
- MCS data.
- Renewable Energy Planning Database.
- Contact with utilities, installers and industry organisations.
- BEIS energy statistics.

## **Further data sources**

- (1) Database compiled by Regen, as described above
- (2) BEIS, 2021; Sub-national total final energy consumption United Kingdom, 2019
- (3) BEIS, 2021; Sub-national electricity consumption statistics 2005 to 2020
- (4) The Crown Estate, 2022; Project listings

# Assumptions

Assumption	Source
Estimated Welsh domestic heat demand	Evaluated using BEIS Regional and Local Authority Gas Consumption Statistics (2020).
Local authority and Welsh electricity consumption	BEIS Regional and Local Authority Electricity Consumption Statistics (2020).
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 five-year average of DUKES regional capacity factors and other industry established values.
Energy consumption	Welsh electricity consumption for 2021 has not yet been published, and so an estimate has been analysed. Welsh electricity consumption for 2021 is estimated by increasing 2020 BEIS sub-national electricity consumption data for Wales by the increase in the UK's electricity consumption seen between 2020 and 2021 in BEIS UK electricity trends data (ET_5.2_JUL_22).
Heat pump heat generation	To calculate the renewable portion of heat pump generation, the proportion of heat generated from heat pumps that is delivered by fossil fuels through the consumption of electricity is calculated. This proportion (~14%) is then removed from total heat pump generation. The remaining 86% of heat generation from heat pumps is, therefore, categorised as renewable and is published in this report.
Progress towards targets	Progress towards the target for Wales to meet the equivalent of 70% of its electricity demand from Welsh renewable electricity sources by 2030 is estimated by using national consumption for Wales (see above), and estimated generation figures.

# Abbreviations and definitions

Abbreviation	Explanation
Capacity	How much power a project can generate at maximum output.
Capacity factor	The percentage of a project's maximum theoretical output that it actually achieves. This is calculated by dividing the actual energy generated over a year by its theoretical maximum capacity, i.e., the amount it would have generated if it ran at full capacity, 24 hours a day, 365 days a year. 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
CO <sub>2</sub>	Carbon dioxide emissions
CHP	Combined Heat and Power
CCGT	Combined Cycle Gas Turbine
Solar PV	Solar photovoltaic panels
<1	Less than 1
>1	Greater than 1

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



20 hours

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



1,000,000 watts (1 MW)



1 hour

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



