

Distribution Future Energy Scenarios: Regional Review

South Wales licence area



Foreword by WPD

The electricity distribution network across the four Western Power Distribution (WPD) licence areas has changed dramatically in the last ten years.

Primarily designed to operate as a passive network, WPD has connected 10GW of distributed energy resources and transitioned to operating a more active distribution system. In addition, annual electricity demand has decreased during this time as we start to use more energy efficient devices in everyday life.

The next decade will see even more far-reaching changes. That is why we have worked with Regen to help us understand what these changes might mean for our distribution network and the investment that may be needed to meet customers' changing needs.

This report summarises the 2020 Distribution Future Energy Scenarios (DFES) study for the South Wales licence area. During the next 30 years, we are predicting to see a large increase in distributed generation connected to the network, a large proportion being supplied from renewable sources.

The network will also see electricity storage technologies and high levels of new low-carbon technologies, such as electric vehicles and heat pumps, increasing household demand for electricity.

The scenario framework used in this study is heavily influenced by the UK government targets to reach Net Zero greenhouse gas emissions by 2050, our projections out to 2050 provide a granular breakdown of the customers connected to the distribution network in a Net Zero compliant future.

The DFES projections are used to assess the distribution network and identify areas of strategic network investment, which can be delivered through conventional reinforcement or a range of smart and flexible solutions. By performing this study, WPD is able to demonstrate that we will be able to continue to meet the needs of our customers as we transition to a low carbon future.

This regional review is part of a wider suite of DFES documents, which along with an interactive map of the data can be found on our [website](#).



Ben Godfrey
Network Strategy Manager



The DFES process



The Distribution Future Energy Scenarios outline the range of credible pathways to 2050 for the change in connections to the distribution network.

Using a scenario framework consistent with other distribution network operators and National Grid ESO (known as the Future Energy Scenarios or FES), these local stakeholder informed projections are created on an annual cycle and encompass changes in demand, storage and distributed generation, including electrified transport and heat.

The four scenarios include three compliant with UK's target to reduce carbon emissions by 100%, **achieving 'net zero' by 2050**. A fourth, non-compliant scenario is also modelled.

The factors used to project deployment at a local level are the result of consultation with developers, local authorities and community energy groups, as well as analysis of existing trends, spatial data and technological innovation.



South Wales story to date



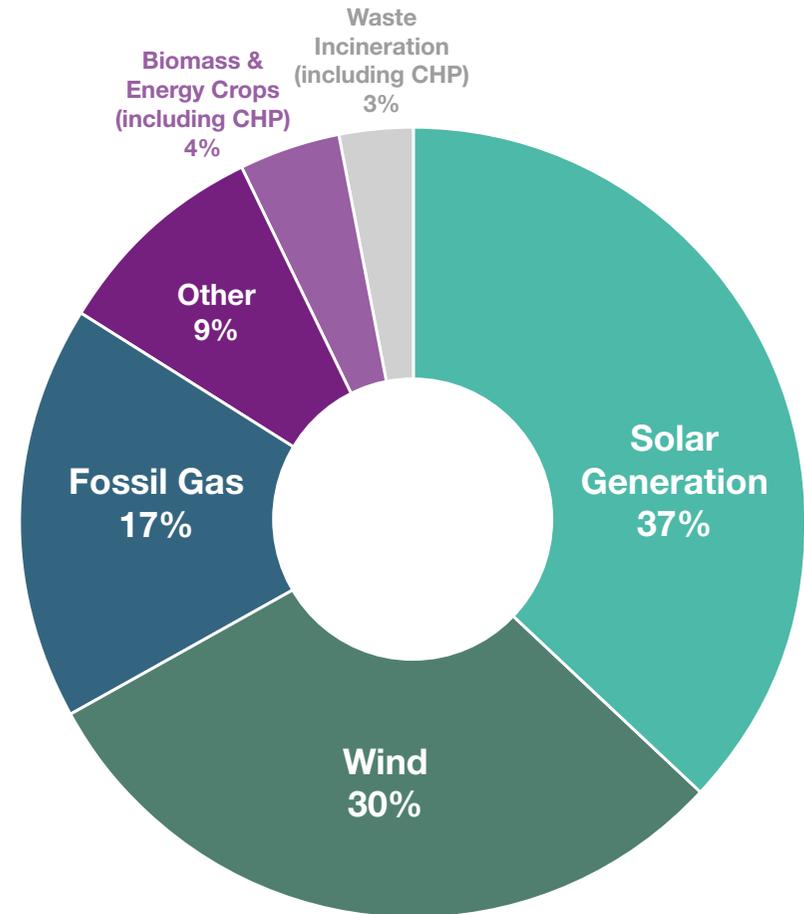
As of April 2020, there is 1.9GW of distributed generation in the South Wales licence area, 1.4GW of this is low carbon or renewable generation.

The South Wales accounts for around 3% of the total distributed renewable energy capacity in GB, enough to power around half a million homes.

Distributed electricity generation has changed a lot in recent years, with over 50% of capacity having connected since 2015. Over half of total generating capacity is from onshore wind and solar PV. The remainder of capacity is fossil gas power plants, hydropower, biomass and other generation. The largest single power generation site in the licence area is the 57.4MW Brechfa Forest West wind farm, in Carmarthenshire.

Electricity demand has changed more slowly. Only 0.4% of South Wales homes currently have a heat pump and 0.4% of cars are electric, however widespread change is expected with as new policies are brought forward to encourage electrification of heat and demand.

Total distributed energy generation in the South Wales licence area

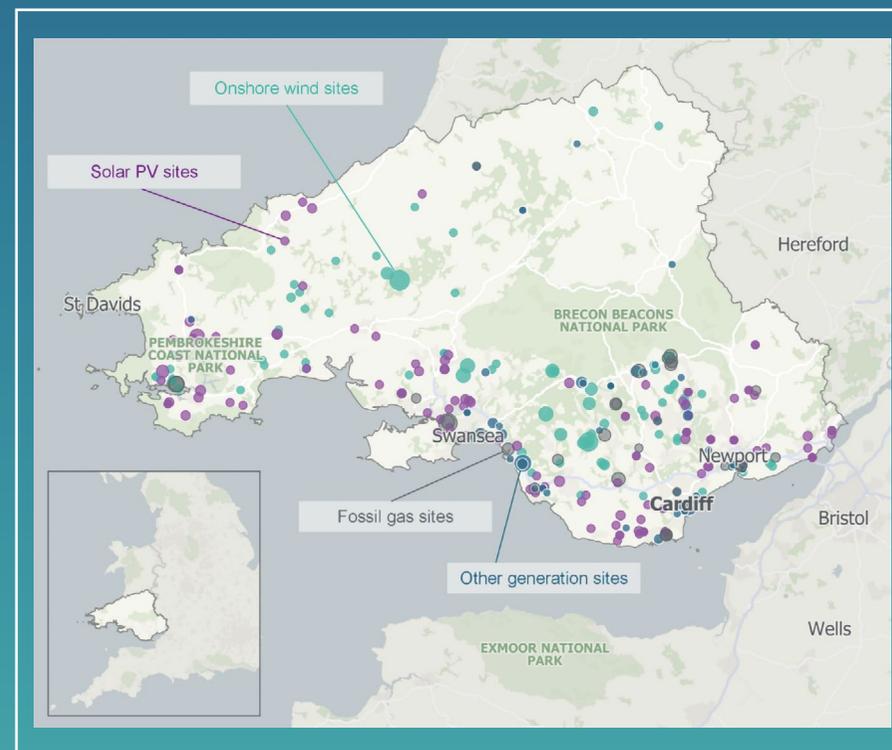


Distributed energy generation in the South Wales licence area

Distributed generation is mainly clustered along the southern part of the licence area, following the populated areas and electricity network coverage.

There is higher solar irradiance further south, and this is where most of the solar PV sites are located. The multiple large wind farms in the area are inland and built around the less densely-populated strategic areas as outlined by Welsh Government planning policy.

The largest power generation site in the licence area is the 57.4MW Brechfa Forest West wind farm, in Carmarthenshire. There are also several large biomass and fossil gas sites in the licence area.



Near term pipeline summary



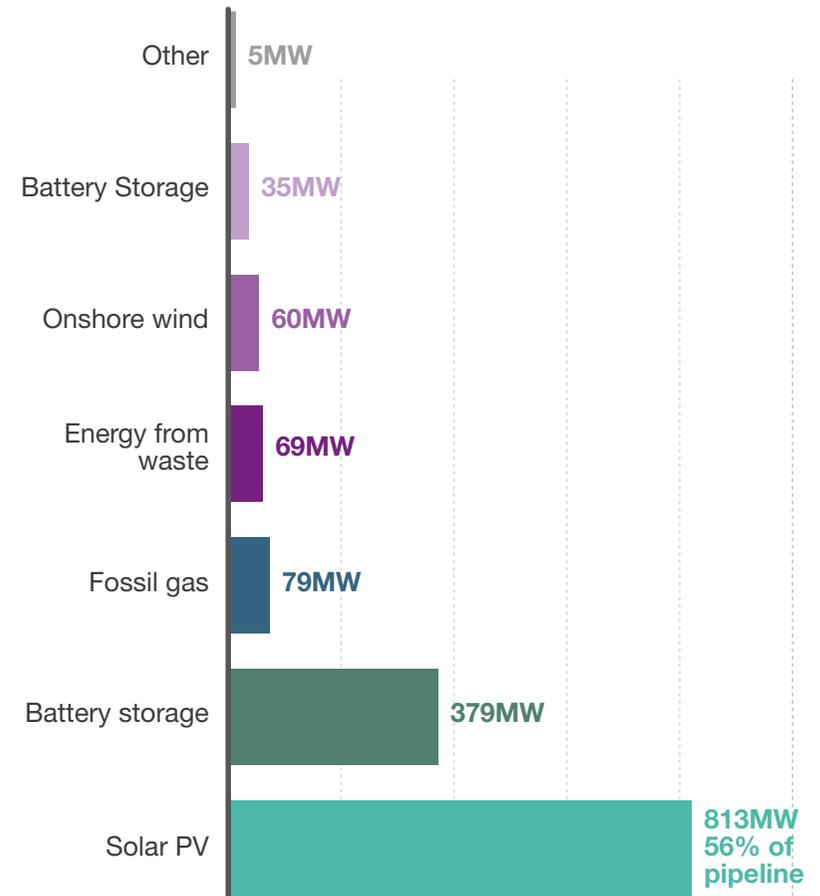
There are over 170 projects poised to connect to the South Wales distribution network in the near future, totalling 1.4GW of additional generating capacity.

Most of the pipeline sites accepted a network connection offer with WPD in 2018 or later and over 0.5GW of the pipeline of solar sites accepted a network connection in since the beginning of 2019. This shows clear interest to develop new solar capacity in the area.

Over half of the pipeline capacity comes from solar PV, we have projected that over 400MW could connect in the next five years. The largest proposed solar farm in the pipeline is a 75MW project however this is the only pipeline site over 50MW. Over two thirds of the solar pipeline capacity comes from sites of between 30-50MW.

Energy storage is projected to play a larger role in the energy system as the country decarbonises. There are only 11 battery sites with accepted connection offers which could connect in the near term. The National Grid Electricity Transmission Statement of Works currently in force prevents the deployment of new thermal generation and battery storage projects until c.2028.

Sites with an accepted connection offer in the South Wales licence area



Stakeholder engagement



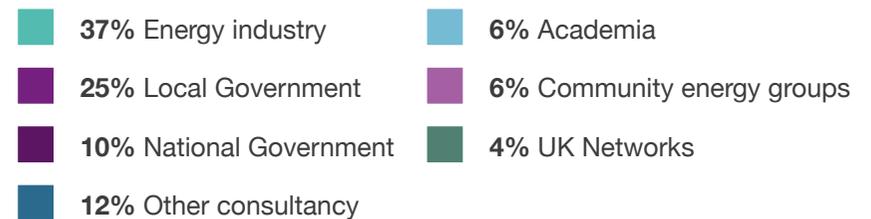
Stakeholder insight is critical to the shaping of the DFES projections and ensuring they are accurate and relevant.

Four consultation events were held in May 2020 with 266 attendees across the four licence areas. Each local authority in the WPD areas were also contacted as part of the analysis of planned new developments.

In the South Wales consultation webinar, 57% of respondents were already aware of the WPD DFES process, and 25% had already engaged with the results.

Local policies identified by stakeholders are included as positive weightings within the DFES projections. As an example, the Swansea Bay City Deal, South Wales industrial cluster and local climate emergency declarations. Details of local policies which may support electric vehicle infrastructure is included in the weightings, for example the Welsh Government Clean Air Plan increases uptake of electric vehicles through measures such as Clean Air or Low Emission Zones in the net zero scenarios.

South Wales webinar



Summary of results in 2035

DFES scenario	Description of scenario	Baseline Renewable energy capacity	2035 Renewable energy capacity	Baseline Battery electric vehicles (000s)	2035 Battery electric vehicles (000s)
Steady Progression Not net zero compliant	Not compliant with the net zero emissions target.	1.4GW Including: 0.6GW of solar 0.5GW of wind	1.9GW	2.9 Equivalent to: 0.4% of total vehicles	359 Equivalent to: 27% of total vehicles
	Low levels of decarbonisation and societal change.				
System Transformation Net zero compliant	High level of decarbonisation with lower societal change. Larger, more centralised solutions are developed. This scenario has the highest levels of hydrogen deployment.		2.5GW		596 Equivalent to: 43% of total vehicles
	High levels of decarbonisation and societal change. Consumers adopt new technologies rapidly, and more decentralised solutions are developed. This scenario has significant electrification of domestic heat.		3.3GW		887 Equivalent to: 69% of total vehicles
Leading the Way Net zero compliant	Very high levels of decarbonisation and societal change. Consumers adopt new technologies rapidly, and a mix of solutions are developed. This scenario aims for the “fastest credible” decarbonisation pathway.	3.3GW	1,035 Equivalent to: 77% of total vehicles		

Summary of results in 2035

DFES scenario	Description of scenario	Baseline Energy storage capacity	2035 Energy storage capacity	Baseline Heat pumps	2035 Heat pumps	
Steady Progression Not net zero compliant	Not compliant with the net zero emissions target.	4MW Around 0.8% of the GB total installed battery storage capacity.	76MW	4,040 Heat pumps Equivalent to: 0.4% of total homes. < 10 hybrids	8,650 Heat pumps c.0.8% of homes, and 0.8% with hybrids	
	Low levels of decarbonisation and societal change.				36,190 Heat pumps c.3.2% of homes, plus 2.5% with hybrids	
System Transformation Net zero compliant 	High level of decarbonisation with lower societal change. Larger, more centralised solutions are developed. This scenario has the highest levels of hydrogen deployment.				145MW	200,650 Heat pumps c.17.8% of homes, plus 1.9% with hybrids
Consumer Transformation Net zero compliant 	High levels of decarbonisation and societal change. Consumers adopt new technologies rapidly, and more decentralised solutions are developed. This scenario has significant electrification of domestic heat.				151MW	200,050 Heat pumps c.17.4% of homes, plus 6.6% with hybrids
Leading the Way Net zero compliant 	Very high levels of decarbonisation and societal change. Consumers adopt new technologies rapidly, and a mix of solutions is developed. This scenario aims for the “fastest credible” decarbonisation pathway.					

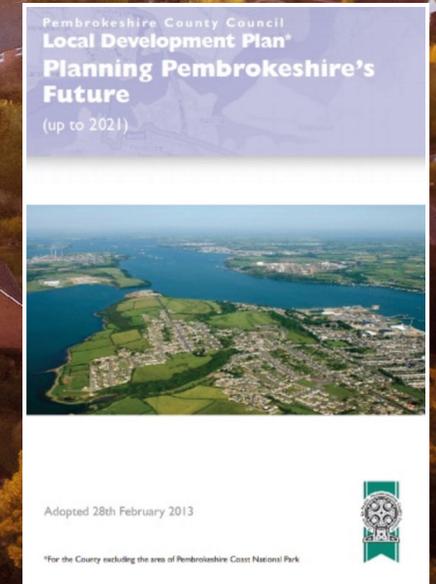
Working with local authorities

New homes, industry, and commercial properties can have a significant impact on local electricity demand. These homes and commercial properties are also likely to be more energy efficient, heated by new technologies or be designed to facilitate low carbon transport.

Over 1,200 individual data records were brought together to model the impact of new developments on the WPD network in the future. Local authorities were also asked about plans which may affect uptake of low-carbon technologies in their areas, for example support for electric chargers or renewable generation.

Where and when these buildings and new technologies are expected to connect is projected using the scenario frameworks and based on data from local authority plans along with historic data on the number of new homes per year.

High and low scenarios were produced to model the variable building rates of these developments over the scenario period. Between 25,000 and 44,000 homes are projected be built over the next 5 years, with some of the largest domestic developments planned in Cardiff, and near the new Northern Access Road in Vale of Glamorgan.



Renewable energy



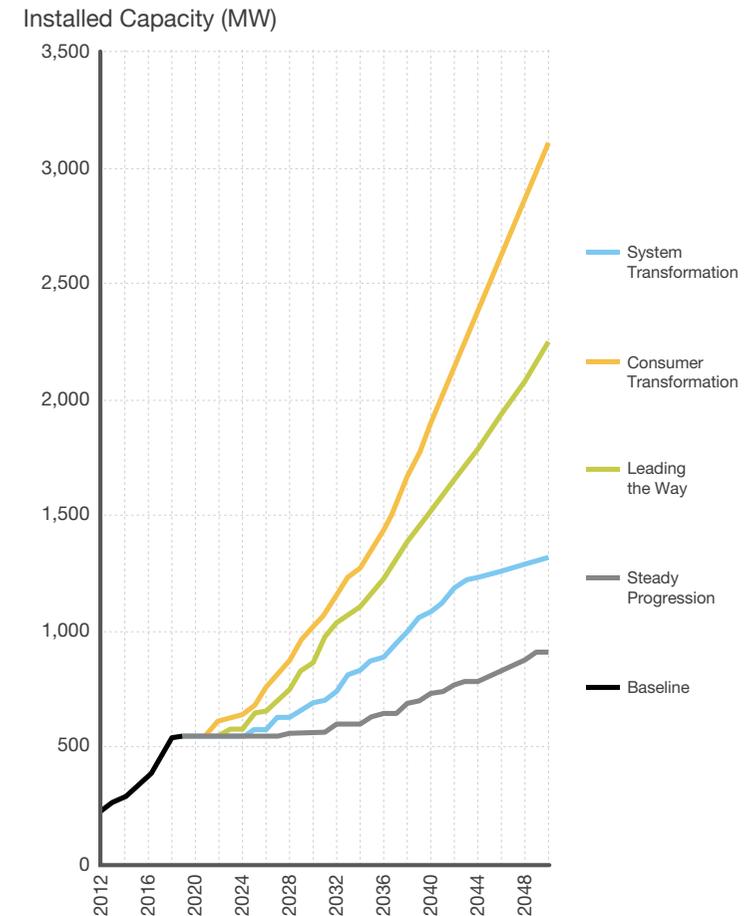
There is currently 681MW of solar PV capacity connected in the South Wales licence area, and 548MW of onshore wind power, from larger scale ground mounted sites to rooftop installations.

Around two-thirds of rooftop solar installations are at the domestic scale, with an average capacity of 3kW.

The cost of solar **reduced by 82%** over the last decade, however deployment in South Wales has slowed in the last few years as government subsidies reduce and market uncertainties mean that fewer sites have been completed. DFES analysis suggests that there is a large pipeline of potential projects totalling over 800MW, which are typically around 50MW in size. If all of these projects are installed, it would double the currently installed ground mounted solar PV capacity in the licence area.

High wind speeds and a supportive policy framework have contributed to the South Wales licence area having the highest installed onshore wind capacity of the WPD licence areas. Furthermore, the relatively large pipeline of potential sites contributes to high deployment in all DFES net zero compliant scenarios.

Scenarios for onshore wind power in the South Wales licence area



Fossil Gas



Another of the key distributed energy generation technologies in the licence area is fossil gas fired power stations.

The energy output of the fossil gas power plants significantly decreases in all net zero complaint scenarios, though the installed capacity may remain stable in the near term.

The largest fossil gas site in Carmarthenshire at 40MW, as well as large installations at Milford Haven in Pembrokeshire. These sites form a significant portion of the 462MW total capacity of fossil gas power currently connected. Most of the current sites are towards the southern part of the licence area, around urban areas near Cardiff, Newport, and Merthyr Tydfil. The proposed pipeline projects follow a similar pattern, though are more focussed on the south western parts of the licence area.

The DFES analysis shows the potential for increases in fossil gas capacity based on the successful planning and Capacity Market applications of sites in the pipeline. However, the operational hours of large plant are limited by emissions regulation, and a significant reduction in energy output and capacity is projected for the net zero scenarios.

Energy storage



Energy storage is expected to be critical for balancing a high renewables electricity system.

National Grid ESO announced in 2019 that it will be able to operate a **zero carbon electricity system by 2025** and will need new technologies like storage to provide network services to support this. The four scenarios include a variety of assumptions regarding these network service providers, a key uncertainty is the development of energy storage technologies.

There is a limited pipeline of sites that could connect in the near term in the South Wales licence area, reflecting the National Grid Statement of Works which is in place in the area. However, there is projected development in the long term for sites co-located with large wind and solar developments in the area.

The DFES has modelled the deployment of a range of energy storage applications, from domestic batteries to large sites co-located with renewable energy. Due to the scenario specific assumptions around the deployment of other providers of network services, there is a wide envelope of storage capacity between the scenarios.

Low carbon heat



A key area of change in the energy system is the decarbonisation of heat.

The four DFES scenarios model a variety of decarbonisation pathways, all showing a large increase in domestic heat pump deployment in the medium and long term.

The South Wales licence area currently has c.66,500 properties electrically heated and c.4,000 domestic heat pumps, all of which are fully electric. This represents c.0.4% of homes with heat pumps, a slightly lower baseline than the average across Great Britain.

There is a dramatic shift to low carbon heating in all net zero compliant scenarios. In the near term, deployment is supported by national policies such as the Renewable Heat Incentive and the Green Homes Grant.

National policy is also expected to target off-gas homes over the next decade (Clean Growth Strategy 2017), the slightly higher than average proportion of off-gas homes in the South Wales licence area compared to the UK average leads to higher near-term deployment of heat pumps in these areas.

By 2050

Steady Progression



System Transformation



Consumer Transformation



Leading the way



Low carbon transport



The UK government ban on new petrol and diesel vehicles from 2040 drives a significant increase in uptake of electric vehicles over the next 10 years. However, to be net zero compliant, DFES scenarios assume that this ban is brought forward to the early 2030s, in line with assumptions in National Grid ESO FES.

There are around 3,000 battery electric cars (excluding hybrids) registered in the South Wales licence area, just over 0.4% of the total. This is slightly below the average level nationwide though is expected to increase rapidly over the next decade. The projections are based on local factors that influence take up in the near term including:



The availability of off-street parking, and the level of car and second-car ownership



Initiatives to encourage electric vehicle chargers or potential Clean Air or Low Emission Zones

For electricity networks the key factor is how and when these electric vehicles are charged. The deployment of chargers is also projected in the DFES by charger size and type such as domestic chargers, car parks or refuelling stations.

By 2050, all road transport is projected to be decarbonised, the majority being electric vehicles. By 2035:

Steady Progression



359,000
battery electric vehicles



204,000
domestic charge points

System Transformation Net Zero Target compliant



596,000
battery electric vehicles



316,000
domestic charge points

Consumer Transformation Net Zero Target compliant



887,000
battery electric vehicles



517,000
domestic charge points

Leading the way Net Zero Target compliant



1,035,000
battery electric vehicles



583,000
domestic charge points

Next steps

The WPD DFES 2020 suite of output documents is now available online:

The DFES is an annual process conducted by WPD and Regen, the WPD DFES 2021 process will begin in February 2021.

WPD Distribution Managers are in contact with local authorities to discuss the results. The stakeholder engagement process for DFES 2021 runs from February to July 2021.

If you have any questions in relation WPD's Network Strategy work, please contact WPD on the details below:

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