

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 10 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 continue 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 2021 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, particularly 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.

Our annual DFES cycle allows incorporation of newly developed and projected technologies to the analysis. In DFES 2021, we have included hydrogen electrolysis, hydrogen-fuelled generation and further granularity to electrified heating technology demand profiles.

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.

This regional review is part of a wider suite of DFES documents hosted on our website alongside our interactive map, which has been updated this year to provide increased insight into local authority energy mix.



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 the National Grid Energy System Operator (ESO) Future Energy Scenarios (FES) framework, these local stakeholder informed projections are created on an annual cycle and encompass changes in demand, electricity storage and distributed generation, including electrified transport and heat.

The four scenarios include three compliant with the 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, technology companies and community energy groups, as well as analysis of existing trends, spatial data and future innovations in technology.



South Wales story to date



As of April 2021, there is 2.1GW of distributed generation in the South Wales licence area, 1.4GW of this is low carbon or renewable generation.

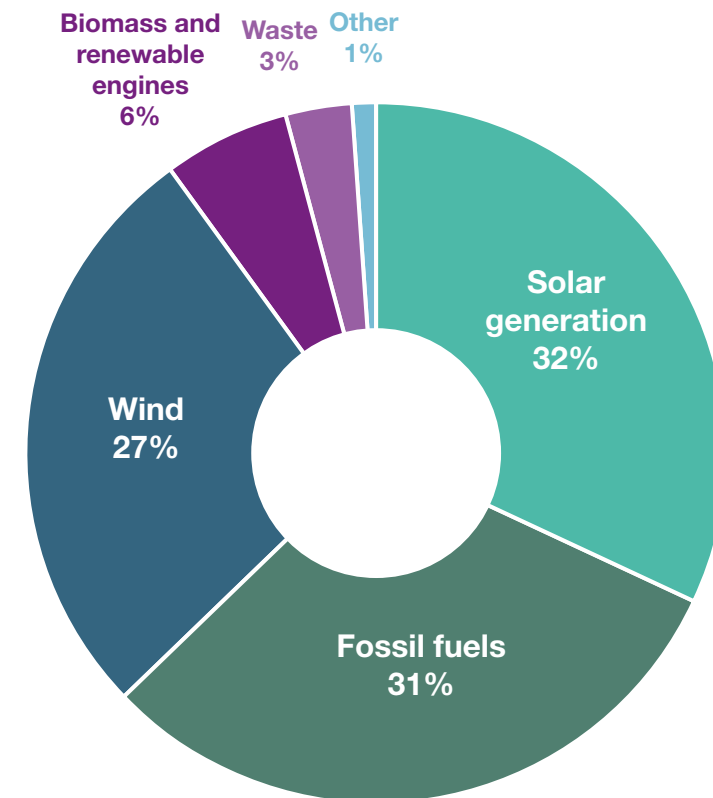
This distributed renewable generation capacity accounts for around 3% of the total distributed renewable energy capacity in GB, enough to power around half a million homes.

Distributed electricity generation capacity in the licence area has increased significantly over the last 5 years, with over 50% of capacity having connected since 2015. Most of the generation capacity in the licence area is split between solar PV, fossil fuels and onshore wind.

The significant capacity of onshore wind in the licence area is partly due to good wind resource in South Wales, but also the supportive planning regime for onshore wind from the Welsh government. This has led to the development of several large scale wind farms, such as the 57.4MW Brechfa Forest West wind farm in Carmarthenshire.

Electricity demand has changed more slowly. Only 0.5% of South Wales homes currently have a heat pump and the same proportion of cars are battery electric. However, this is expected to change quickly, as new policies encourage decarbonisation of heat and transport.

Total distributed energy generation in the South Wales licence area

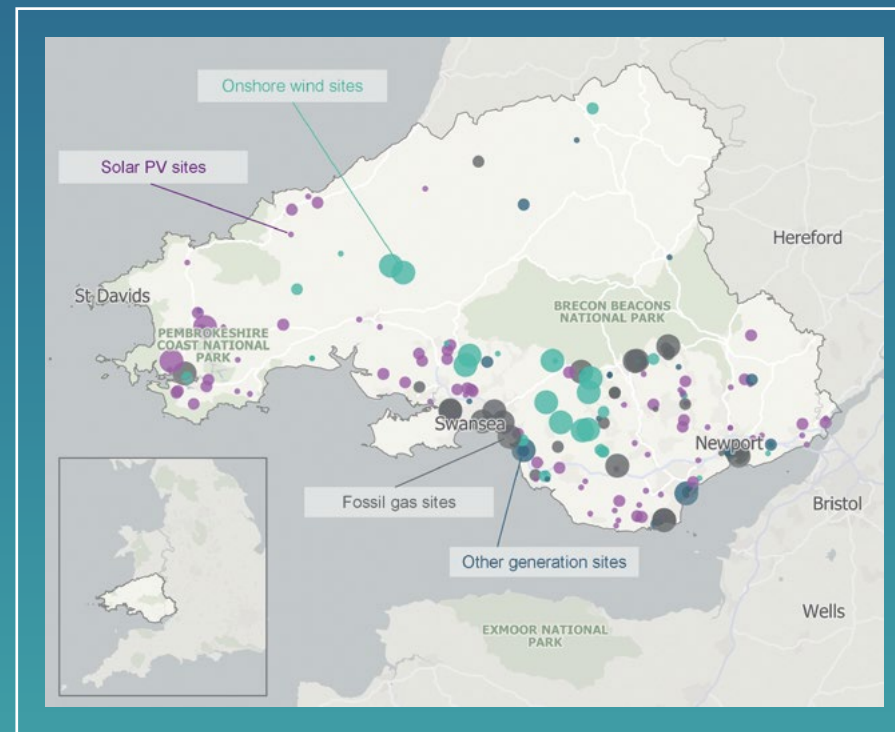


Distributed energy generation in the South Wales licence area

Distributed generation is mainly clustered along the south of the licence area, due to the greater density of network and transport infrastructure, and population.

Solar PV sites are present across the licence area, with several large scale solar farms located in Pembrokeshire, where irradiance is highest. Many large scale wind farms, such as the 57MW Brechfa Forest West wind farm, have been deployed in the South Wales Valleys, reflecting Welsh government planning policy.

There are also several large fossil gas and biomass sites in the licence area, particularly in the South Wales Industrial Cluster around Swansea and Port Talbot.



Near term pipeline summary



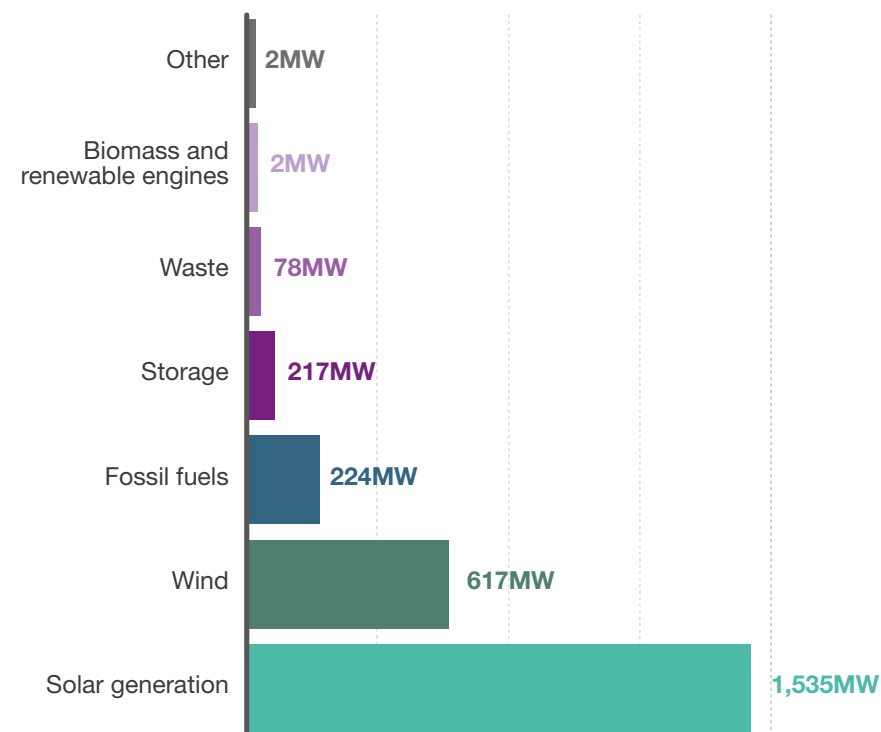
There are over 190 generation and storage projects, totalling 2.7GW that could connect to the South Wales distribution network in the near future. These pipeline projects were assessed for planning status, participation in auctions, and via direct discussions with developers.

Increased activity in solar and onshore wind development has seen the pipeline increase significantly in recent years. Over half the pipeline capacity secured a network connection offer since January 2020.

In contrast to the English licence areas, a positive planning environment for onshore wind has resulted in a pipeline of over 600MW in the South Wales licence area. As seen in other licence areas, solar PV has high levels of interest, including 12 potential large scale sites of 40MW or greater.

A National Grid Electricity Transmission restriction on new thermal plants and battery storage in the South Wales licence area previously restricted development of these technologies. As of September 2020, this has been lifted and over 200MW of potential battery storage capacity has since entered the pipeline.

Generation and storage sites with an accepted connection offer in the South Wales licence area



Stakeholder engagement



Stakeholder insight is critical to informing and shaping the DFES projections and ensuring they are accurate, up to date and regionally relevant.

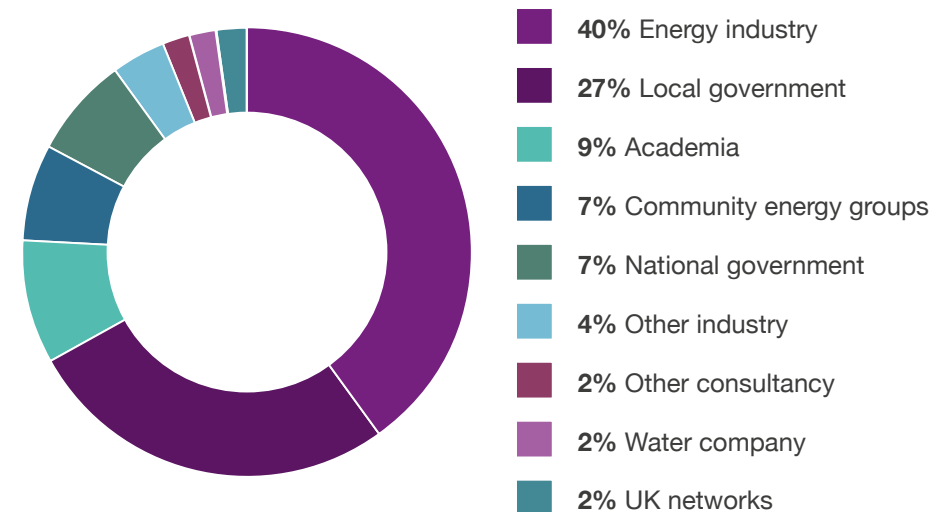
Four consultation events were held in June and July 2021 with 226 attendees across the four licence areas. Each local authority in WPD's licence areas was also contacted as part of the analysis of planned new housing and non-domestic developments.

In the South Wales consultation webinar, 68% of respondents were already aware of the WPD DFES process. Stakeholders mainly wanted to understand more about the DFES process and learn more about the deployment of renewables and low carbon technologies in South Wales.

Attendees were asked for views around the potential deployment of renewable generation, the evolution and future use of flexible generation and storage, and the uptake of electric vehicles and heat pumps. The results, alongside comments and insights around the DFES process and modelling, were incorporated into the analysis to reflect regional factors and variation across each licence area.

With the significant pipeline of potential onshore wind compared to the other WPD licence areas, views were sought on the potential timing and scale of future onshore wind deployment. Attendees were also asked for their insight on the future deployment of hydrogen in South Wales, given the presence of the South Wales Industrial Cluster in the licence area.

South Wales webinar






Summary of results in 2035

As the midpoint between the baseline and the UK government’s 2050 net zero ambitions, the scenario results in 2035 show how distributed electricity generation, storage and demand could change in the near and medium term.

DFES scenario	Description of scenario	Baseline Renewable energy capacity	2035 Renewable energy capacity	Baseline Energy storage capacity	2035 Energy storage capacity		
Steady Progression Not net zero compliant	Not compliant with the net zero emissions target.	1.4GW Including: 0.7GW of solar 0.6GW of wind.	2.2GW	0.7MW Less than 1% of the GB total installed battery storage capacity.	55MW		
	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.					3.0GW	119MW
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.					4.2GW	256MW
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.		4.5GW		331MW		

Summary of results in 2035

DFES scenario	Description of scenario	Baseline Battery electric vehicles (000s)	2035 Battery electric vehicles (000s)	Baseline Domestic heat pumps (000s)	2035 Domestic heat pumps (000s)	
Steady Progression Not net zero compliant	Not compliant with the net zero emissions target.	4 Equivalent to: 0.5% of total vehicles.	466 32% of total vehicles.	5 Heat pumps 0.5% of homes.	164 14% of homes.	
	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.				747 51% of total vehicles.	140 12% of homes.
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.				1,051 72% of total vehicles.	393 34% of homes.
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.	1,140 79% of total vehicles.	580 50% of homes.			

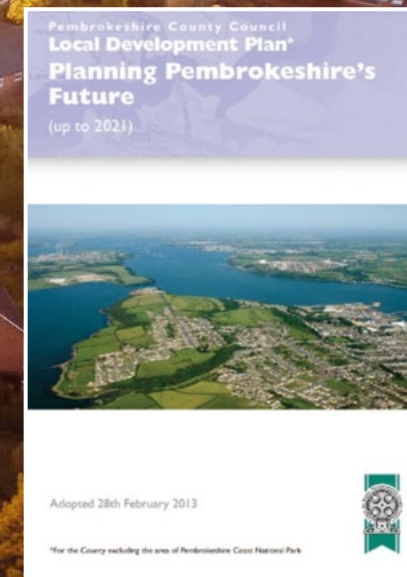
Working with local authorities

New homes and new industrial and commercial properties can have a significant impact on local electricity demand. With the recent publication of the Heat and Buildings Strategy, these homes and commercial properties are also likely to be a focal point for more energy efficiency, low carbon technologies like heat pumps and solar panels, and be designed to facilitate low carbon transport.

Over 8,000 individual data records were brought together to model the potential future impact of new developments across the WPD licence areas. 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 28,000 and 38,000 homes are projected to be built in South Wales over the next five years, with some of the largest domestic developments planned in and around Cardiff, Newport, Swansea and Glamorgan.

Local authorities were also asked about plans, strategies and policies for low carbon transport, heat, renewable generation, waste and hydrogen and climate declarations in their area. The information provided was also used to inform the analysis of the potential uptake/evolution of the various technologies in their local area.



Welsh government

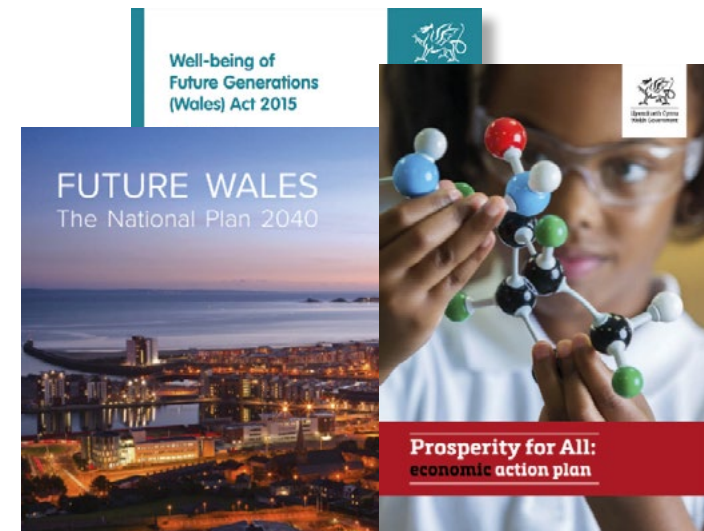
The WPD South Wales licence area has unique drivers and factors for the uptake and deployment of distributed generation, electricity storage and demand, due to specific Welsh government policies, targets and ambitions.

The Welsh Assembly and Government has several devolved energy policy responsibilities, which are integrated into the scenarios. This includes planning policy for Developments of National Significance, including all onshore wind of more than 10MW capacity, and any other generation between 10MW and 350MW; this encompasses the majority of generation in the DFES.

The impact of these devolved policies and responsibilities can already be seen in the pipeline, with over 600MW of potential onshore wind in South Wales. In contrast, the licence areas in England have little to no onshore wind development in the near term.

Welsh government ambitions for low carbon energy, such as 1GW of locally owned renewable energy capacity and 70% of energy consumption generated by renewables by 2030, have been reflected in the analysis. The Future Wales national plan sets out specific pre-assessed areas for wind and solar energy, which are directly reflected in the projections for these technologies.

Further Wales-specific policies, such as the ban on fossil fuel heating in new-build social homes and upcoming changes to building regulations, are also reflected in the DFES analysis.



Renewable energy generation



There is currently 0.7GW of solar PV capacity connected in the South Wales licence area, and 0.6GW of onshore wind capacity. Most of this renewable capacity is in the form of utility-scale solar and wind farms.

Deployment in South Wales has stagnated in recent years, due to some market uncertainty after the reduction in government subsidies. However, new business models for solar are becoming viable across the UK, which is shown in the pipeline of prospective new sites seen. The cost of deploying solar has also reduced dramatically over the last decade. Under the highest DFES scenarios, the South Wales licence area hosts c. 5GW of solar PV capacity by 2050.

High wind speeds and a supportive policy framework have resulted in the South Wales licence area having the highest baseline onshore wind capacity across WPD's network. A pipeline of over 0.6GW of onshore wind capacity suggests that South Wales will continue to be a hub for distributed onshore wind development over the coming decades. Under the Consumer Transformation scenario, onshore wind capacity connected to the South Wales distribution network reaches 2.8GW by 2050.

Fossil-fuelled energy generation



While at odds with net zero ambitions, fossil-fuelled power stations are prevalent in the licence area.

There is 0.7GW of fossil-fuelled generation connected to the South Wales distribution network. This is largely made up of flexible fossil gas-fired power, due to significant gas network availability in the licence area's more densely populated areas. This includes three sites of over 40MW capacity in Pembrokeshire and Carmarthenshire.

The annual energy output of these fossil fuel plants significantly decreases in all net zero compliant scenarios, especially in the late 2020s and 2030s.

The DFES analysis shows the potential for a near term increase in fossil gas-fired power in all scenarios, based on analysis of successful planning and Capacity Market applications of sites in the pipeline. In contrast, diesel power is expected to decrease in the near term due to air quality and environmental permitting regulations.

Overall, a significant reduction in fossil fuel energy output and installed capacity is projected by 2035 and out to 2050 under the net zero scenarios, as the UK looks to significantly decarbonise its electricity supply.

Hydrogen



Hydrogen has the potential to impact a number of aspects of the energy system, from decarbonising industry, heating and transport to use as a fuel for flexible, low carbon electricity generation.

Additionally, the production of hydrogen via electrolysis could result in significant electricity demand, with the distribution network potentially seeing electrolysis plants looking to connect in areas of localised hydrogen demand. Due to high levels of uncertainty around the approach to hydrogen production and the level of hydrogen demand, a wide range of outcomes are seen in the four scenarios.

The direct impacts of hydrogen on the electricity distribution networks manifest in two forms: demand for electricity for hydrogen electrolysis, and generation of electricity through hydrogen-fuelled generation.

There are already a couple of small scale hydrogen electrolyzers in South Wales, serving hydrogen-fuelled vehicles, and a number of innovation trials underway. By 2050, distribution-connected hydrogen electrolysis capacity in the South Wales licence area ranges significantly from less than 0.1GW to 2.2GW, reflecting the scale of uncertainty in this technology. Hydrogen-fuelled generation could reach up to 0.9GW, slightly higher than the current fossil-fuel baseline that it replaces.

Electricity storage



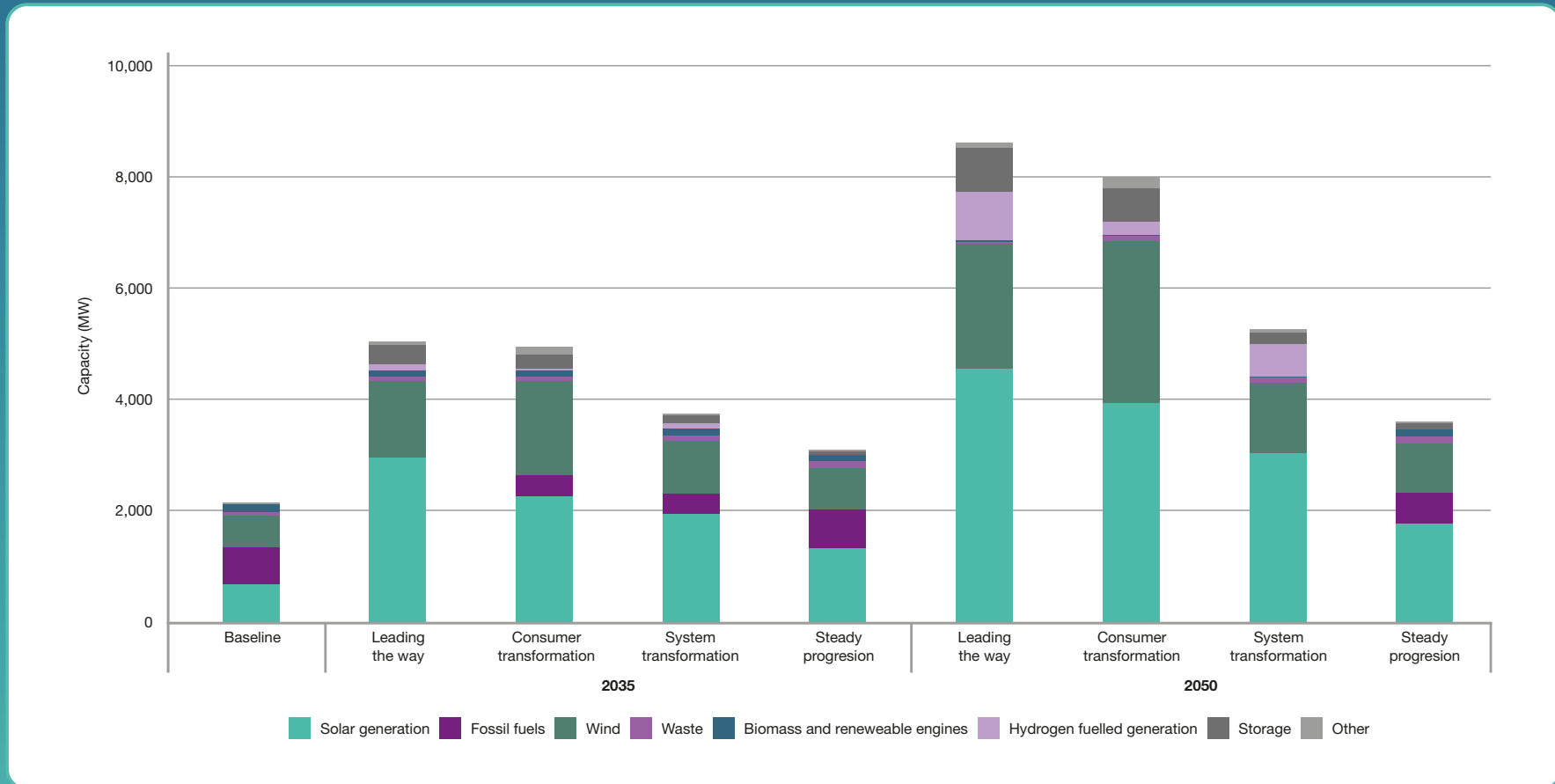
Electricity storage is expected to be critical for balancing a high renewables electricity system.

National Grid ESO announced in 2021 that it is on track to be able to operate a zero carbon electricity system by 2025. UK government recently also confirmed plans to eliminate fossil fuel generation from the electricity system by 2035. New sources of flexibility will be needed to provide services to the network to support this transition to low carbon electricity generation. The four scenarios include a number of assumptions regarding the technologies that will provide these services, including the scale of development of energy storage.

The South Wales licence area has just 0.2MW of electricity storage capacity, due to the restrictions on connecting new thermal generation and battery storage which have only recently been lifted. However, a pipeline of potential connections has quickly come forward, totalling 217MW across 15 prospective projects. Future business models for new storage assets include co-location with renewable generators and non-domestic consumers, as well as smaller batteries in homes.

There is a wide envelope of deployment between the scenarios. Overall battery storage capacity in 2050 in the South Wales licence area ranges from c. 0.1GW in Steady Progression to 0.8GW in Leading the Way.

Distribution connected generation and storage scenarios WPD South Wales licence area



Low carbon heat



As has been spotlighted by the recent UK government Heat and Buildings Strategy, a key area of change in the energy system will be 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 around 75,000 homes heated by electricity, including around 5,000 domestic heat pumps. This equates to around 0.5% of homes with a heat pump, just below the national average of 0.6%.

There is a dramatic shift to low carbon heating in all net zero compliant scenarios, with deployment of domestic and non-domestic heat pumps accelerating throughout the 2020s. Under Consumer Transformation, almost 90% of homes are primarily heated by a heat pump in 2050.

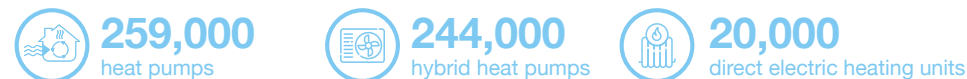
GB and Welsh government policy is expected to see off-gas homes and new build homes targeted in the near term. South Wales is broadly in-line with the GB average in terms of on-gas homes, and as such sees heat pump uptake similar to the national trajectory.

By 2050

Steady Progression



System Transformation Net zero target compliant



Consumer Transformation Net zero target compliant



Leading the Way Net zero target compliant



Low carbon transport



The UK government's ban on new petrol and diesel vehicles from 2030 is preceded by a significant increase in uptake of electric vehicles over the next 10 years. As a result of the ban, most road vehicles are expected to be electric by 2050 in every scenario.

There are around 4,000 battery electric vehicles and 3,000 plug-in hybrid electric vehicles registered in the South Wales licence area, totalling around 1% of all vehicles; this is less than half the GB average.

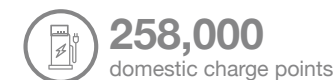
However, uptake is projected to increase rapidly over the next decade. Local factors that influence take up in the near term include:

- The availability of off-street parking.
- The level of car and second-car ownership.
- Initiatives to increase the number of electric vehicle chargers or potential clean air zones.

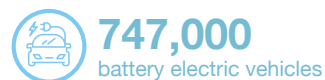
For electricity networks, the key question is how and when these electric vehicles are charged. The deployment of chargers is also projected in the DFES by charger size, type and use case, such as domestic chargers, chargers at car parks and chargers at existing petrol stations.

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

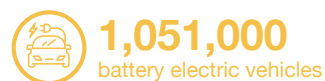
Steady Progression



System Transformation Net zero target compliant



Consumer Transformation Net zero target compliant



Leading the Way Net zero target compliant



Next steps

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



Stakeholder feedback summary reports for all licence areas available here.



Data available through the map hub.



Technology results and assumptions reports for all licence areas.



Methodology walkthrough slides.



'DFES regional review' summaries for all licence areas.

The DFES is an annual process conducted by WPD and Regen; the WPD DFES 2022 process will begin in spring 2022.

WPD Distribution Managers are in contact with local authorities to discuss the results. The stakeholder engagement process for DFES 2022 runs from February to July 2022.

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

Email:

wpdnetworkstrategy@westernpower.co.uk

By post:

Network Strategy Team
Western Power Distribution
Feeder Road
Bristol
BS2 0TB

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales



Western Power Distribution (East Midlands) plc, No2366923
Western Power Distribution (West Midlands) plc, No3600574
Western Power Distribution (South West) plc, No2366894
Western Power Distribution (South Wales) plc, No2366985

Registered in England and Wales
Registered Office: Avonbank, Feeder Road, Bristol BS2 0TB

www.westernpower.co.uk

