

# National Grid DFES 2023 regional review

South Wales

**DSO**

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electricity distribution

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## Foreword by National Grid DSO

April 2023 marked the start of the RII0-ED2 price control period, throughout which planning and investment in the distribution network will be an important factor to enable our customers to reach their decarbonisation targets.

We have worked with Regen to help us understand what the changes that are forecast throughout the next decade and beyond might mean for our distribution network, and the investment that may be needed to meet customers' changing needs.

These forecasts are the foundation of our strategic investment process, which is an ongoing analysis published biennially through the Network Development Plan (NDP).

The NDP feeds into the Distribution Network Options Assessment process to determine the investment required to facilitate the UK's net zero ambitions, while promoting a smart and flexible network. The next NDP will be published in May 2024 and will include the forecasts from the Distribution Future Energy Scenarios (DFES).

This report summarises the 2023 DFES study for the South Wales licence area.

The network will see a large increase in distributed renewable generation and electricity storage connections. We predict high levels of low carbon technologies, such as electric vehicles and heat pumps and increasing household demand for electricity. The DFES study aims to understand where the growth of different technologies will be spatially distributed, which will materialise as load on our networks.

Our annual DFES cycle allows incorporation of newly developed and projected technologies to the analysis. In DFES 2023, we have added

industrial heating to our projections and increased the granularity of our analysis down to LV level for a number of LCT technologies, to better inform secondary level reinforcement.

Additionally, we have continued to expand our engagement with Major Energy Users and industry representatives to better capture future changes in demand. As local authorities develop Local Area Energy Plans (LAEPs), we are continuing to proactively engage with the process, ensuring that these ambitions are captured within our strategic investment process.

The scenario framework used in this study is heavily influenced by the UK and devolved government targets to reach net zero greenhouse gas emissions by 2050.

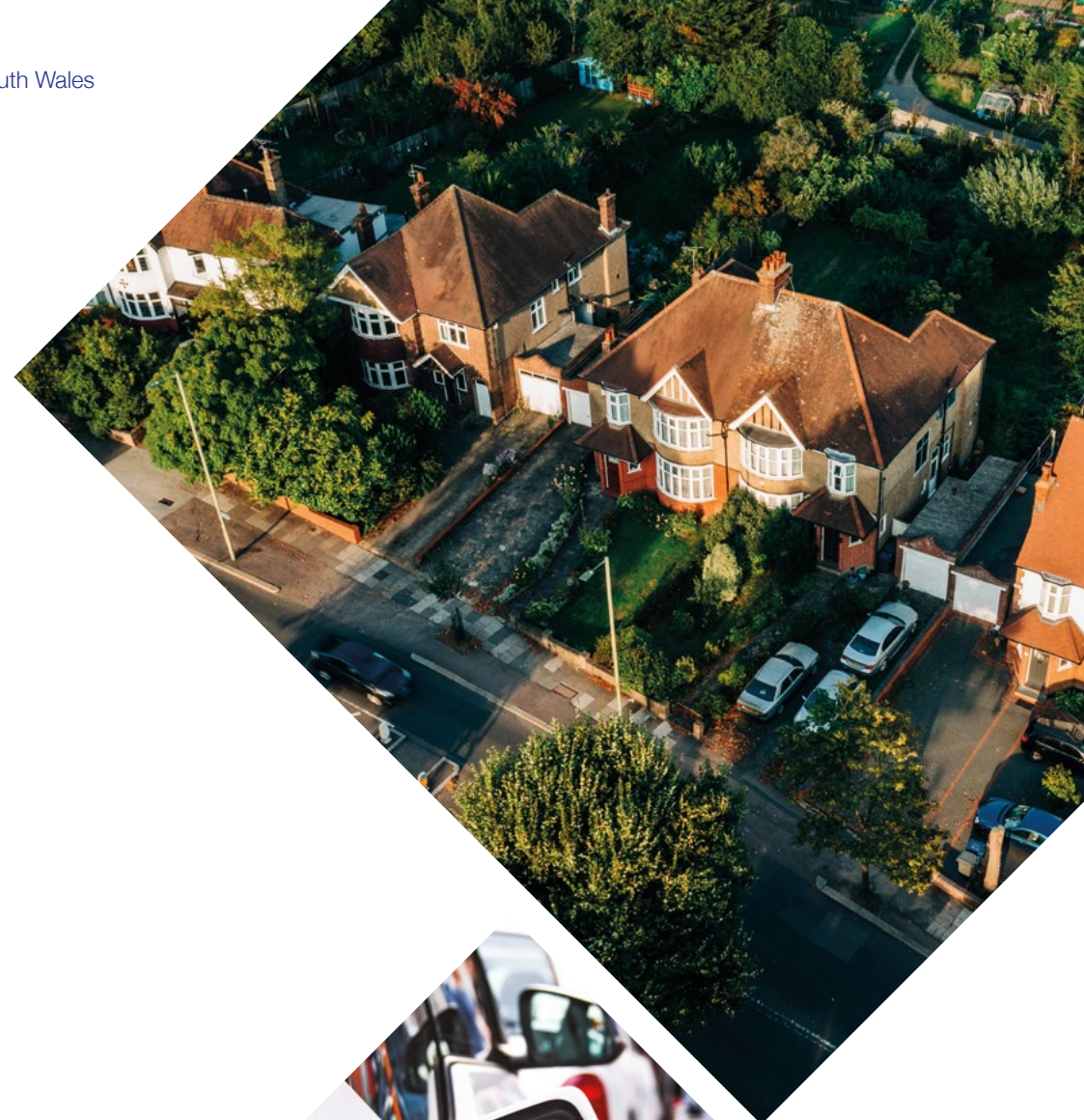
Our projections provide a granular breakdown of the customers connected to the distribution network out to 2050, with three of the four scenarios being compliant with the UK 2050 net zero target.

This regional review is part of a wider suite of DFES documents hosted on our website alongside our interactive map. We welcome any feedback on the DFES process and outputs and will incorporate any suggestions into future forecasting activities.



**Oliver Spink**

Head of System Planning  
Distribution System Operator  
National Grid



# 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.

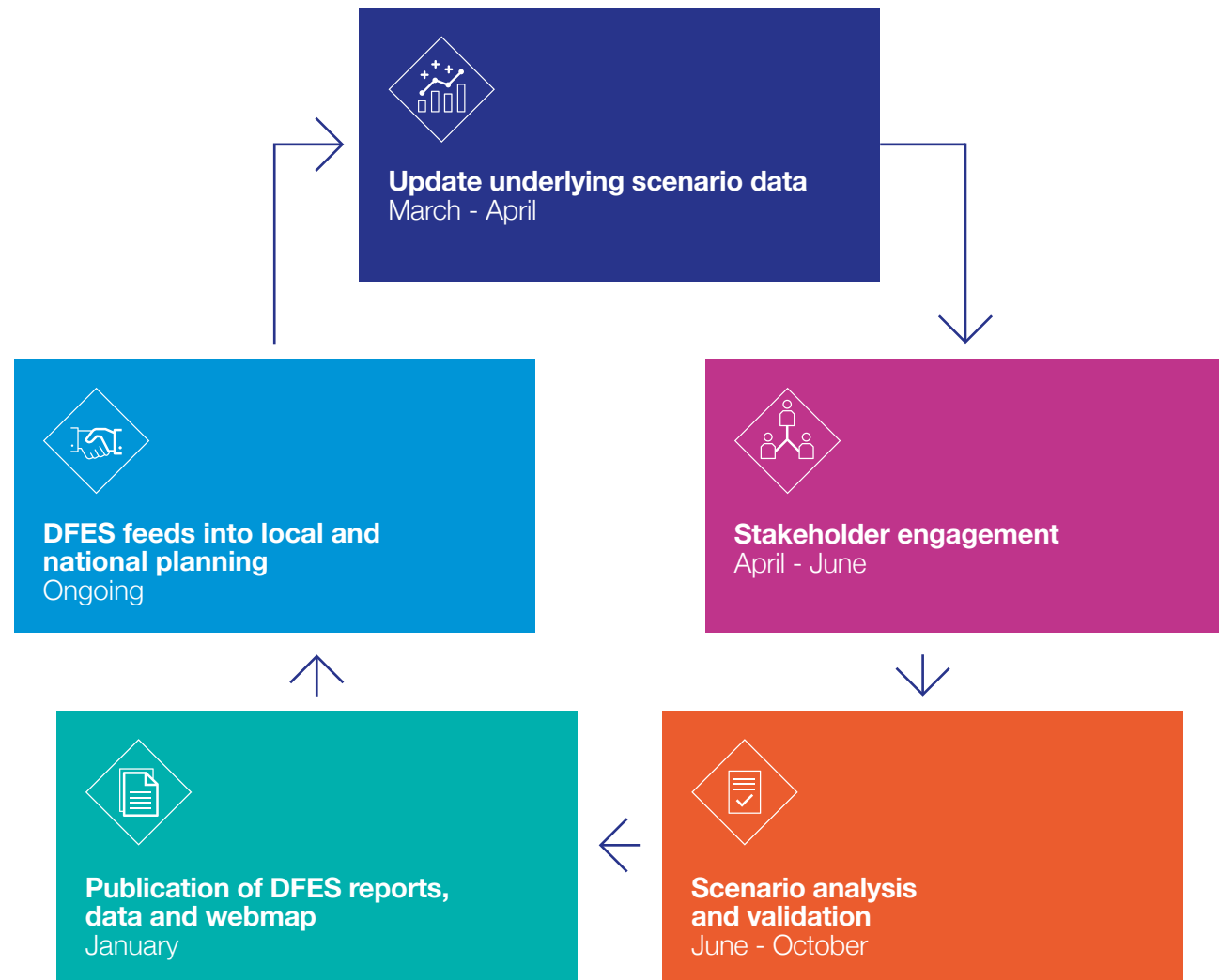
Using the National Grid ESO Future Energy Scenarios (FES) framework, these local stakeholder-informed projections are created on an annual cycle and encompass changes in electricity generation, storage and demand, including electrified transport and heat.

Of the four scenarios, three are 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, major energy users and community energy groups, as well as analysis of existing trends, spatial data and future technology innovation.

These are combined with the national FES scenario framework and overarching assumptions to produce the DFES scenario analysis.



## The South Wales licence area

As of September 2023, there is 2.2 GW of distributed electricity generation in the South Wales licence area.

This equates to around 7% of the total distributed generation capacity in GB. The majority of this generation, totalling 1.5 GW, is renewable or low carbon generation.

Distributed electricity generation capacity in the licence area has increased significantly in recent years, with over 70% having connected in the last decade.

Most of the generation capacity in the licence area consists of solar PV, fossil fuel and onshore wind generation.

The licence area has significant onshore wind resource and high levels of solar irradiance.

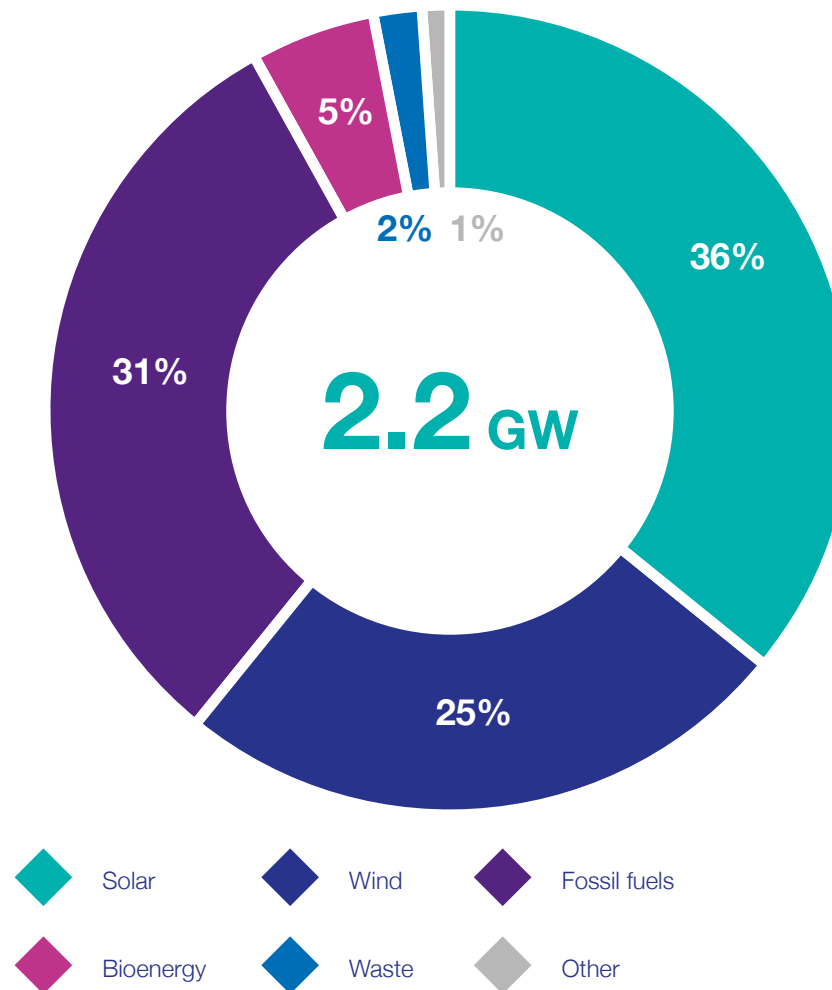
The supportive planning regime for onshore wind from the Welsh Government has led to the development of several large-scale wind farms, such as Brechfa Forest West wind farm in Carmarthenshire.

The recent energy crisis has seen renewed interest in on-site electricity generation across homes and businesses in the licence area.

Electricity demand has changed much more slowly. Less than 1% of homes in the South Wales licence area are heated by a heat pump, and similarly, only around 1% of vehicles are currently fully electric.

However, uptake of both of these low carbon technologies is accelerating, as new policies and support schemes emerge to encourage decarbonisation of heat and transport across the UK.

Total distributed electricity generation in the South Wales licence area



## Distributed electricity generation in South Wales

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

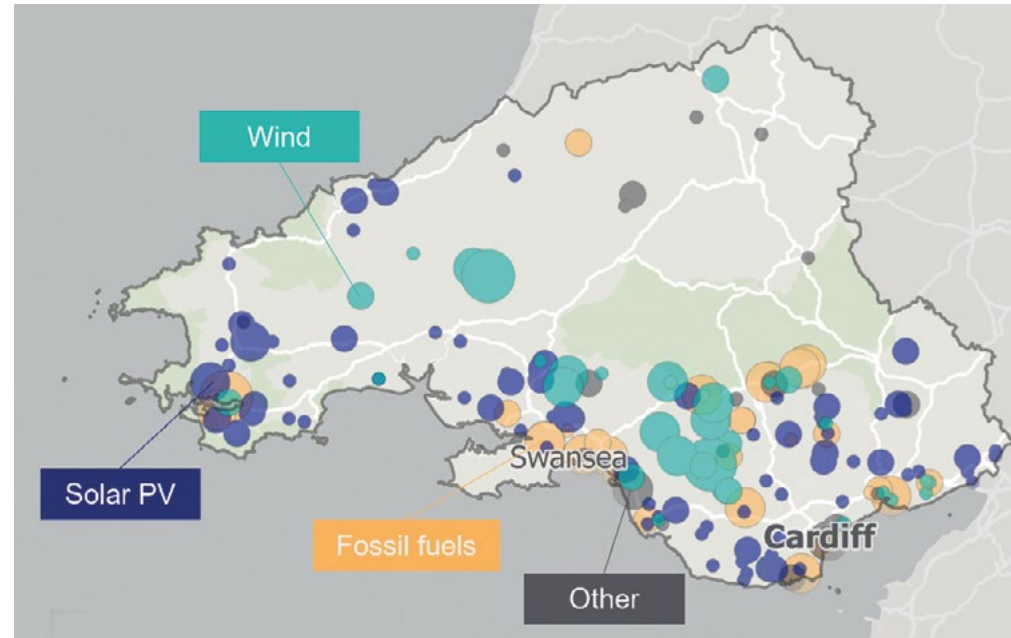
Solar PV capacity is present across the south of licence area, with several large-scale solar farms located in Pembrokeshire, where irradiance is particularly high.

Many large-scale wind farms, such as the 57 MW Brechfa Forest West wind farm, have been deployed in and around the South Wales Valleys, reflecting Welsh Government planning policy.

The largest connected site of any technology in the licence area is the 75 MW Pant Y Wal onshore wind farm, located in Bridgend.

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, in proximity to areas of high energy demand and available supply of fossil gas and other fuels.

### South Wales licence area - baseline connections



The highly rural area of mid-Wales has less transport and electricity infrastructure, leading to fewer large scale electricity generation sites in the baseline.

South Wales has a significant baseline onshore wind capacity, particularly in the South Wales Valleys south of the Brecon Beacons and in Carmarthenshire.

The urban areas of Cardiff, Swansea and the South Wales Valleys host most of the licence area's existing fossil fuel generation capacity, located close to electricity demand. This includes a number of sites related to the South Wales Industrial Cluster.

## Near-term pipeline summary

There are over 300 generation and storage projects totalling 4.9 GW that hold accepted connection agreements and could connect to the South Wales distribution network in the future.

These known pipeline projects were analysed for activity in the planning system and market auctions, augmented by direct engagement with project developers and desk-based research.

A renewed interest in solar, onshore wind and storage have seen the pipeline increase significantly in recent years.

Two-thirds of this pipeline capacity secured a network connection offer after January 2021.

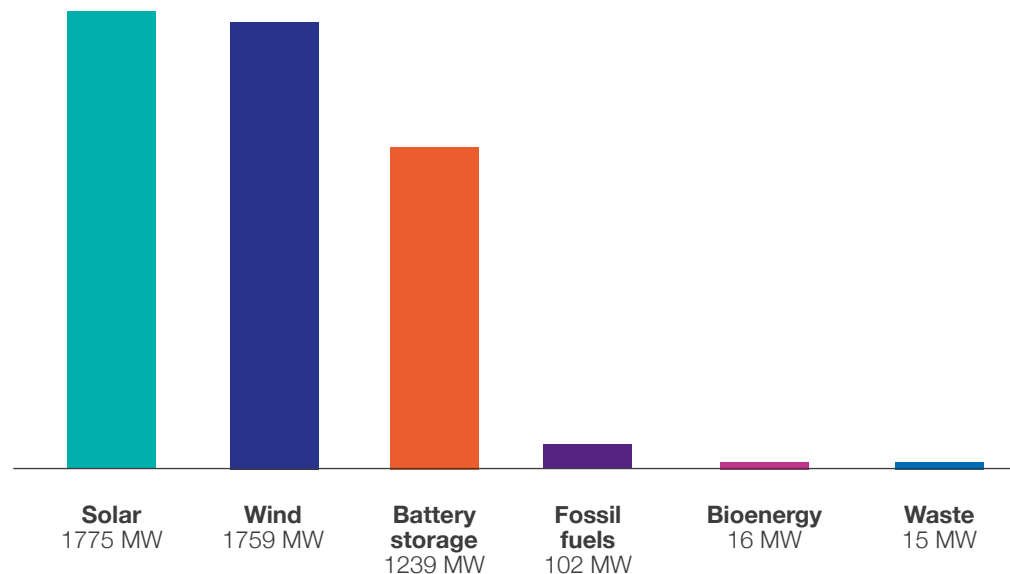
In contrast to the English licence areas, a positive planning environment for onshore wind has resulted in a pipeline of nearly 1.8 GW in the South Wales licence area.

As seen in other licence areas, solar PV has high levels of interest, including 17 potential large-scale sites of 40 MW or greater.

A National Grid Electricity Transmission restriction previously restricted development of battery storage in the licence area.

Since being lifted in late 2020, over 1.2 GW of potential battery storage capacity has secured a connection agreement with NG.

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 2023, with 258 attendees across the four licence areas. Every local authority in NG's distribution licence areas was also contacted as part of the analysis of planned new housing and non-domestic developments.

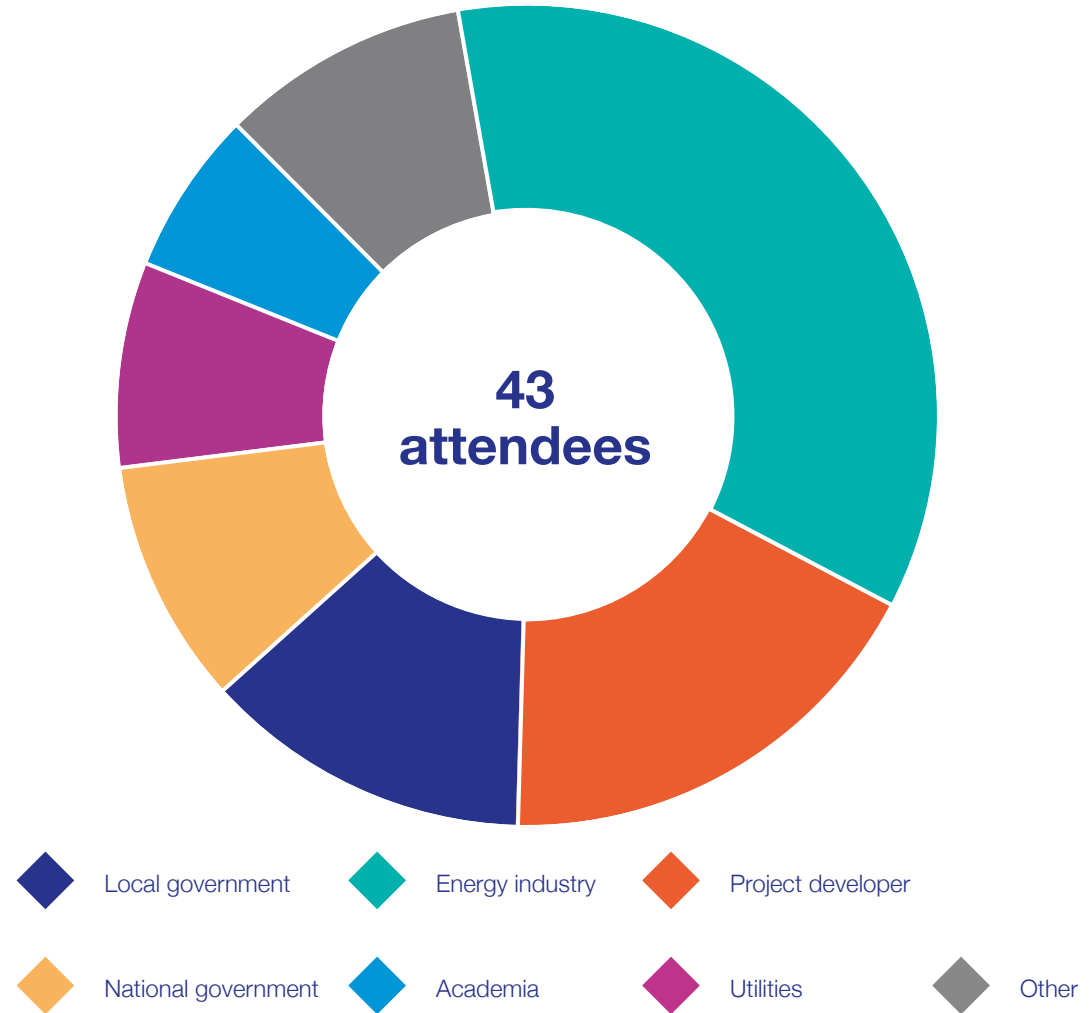
Attendees were asked for views on:

- The scale of the ground-mounted solar and onshore wind pipeline
- Drivers behind domestic rooftop PV uptake
- The planning landscape for new fossil fuelled electricity generation
- Future prospects for conversion of fossil fuel generation sites to low carbon fuels or energy storage
- The potential location of EV chargers for company fleets and eHGVs
- Factors impacting the uptake of domestic heat pumps in on-gas homes
- Locations of future heat networks in South Wales.

In addition, the session featured a number of open-form questions for attendees to input their specific local, regional and sectoral knowledge.

The results, alongside views shared around the broader DFES process and modelling, were **incorporated into the analysis**. The feedback supplied refined regional factors and key drivers in each licence area, as well as informing the overall modelling.

South Wales webinar registrants





## Working with local authorities

New homes and new industrial and commercial properties can have a significant impact on local electricity demand. New homes and commercial properties have higher building standards and could be hotspots for low carbon technologies such as heat pumps, EV chargers and rooftop solar PV, in addition to representing new points of conventional electricity demand.

Over 7,000 individual data records were brought together to model the potential future impact of new developments across the NG distribution licence areas.

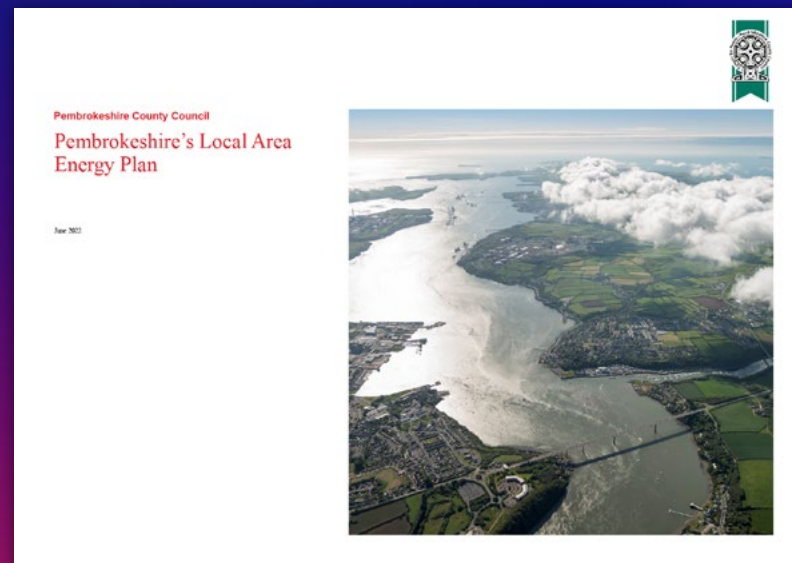
Where and when these buildings and associated low carbon technologies are expected to connect is determined using the scenario framework and based on data sourced from local authority plans, historic building rates and direct engagement with local authority planning departments.

High and low scenarios were produced to model the variable building rates of these developments over the scenario period, out to 2050. Between 32,000 and 53,000 homes are projected to be built in the South Wales licence area by April 2028.

Local authorities were also asked about plans, strategies, targets and policies for low carbon transport, heat, renewable generation, waste, hydrogen and climate declarations in their area.

The information provided was used to inform the analysis of the potential uptake/evolution of the various technologies in their local area.

As local authorities develop and produce local area energy plans (LAEPs), they will be used as inputs and comparisons to our DFES analysis, while the DFES outputs are used as an input to the LAEP process.



# Welsh Government

The NG 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 Government has several devolved energy policy responsibilities, which are integrated into the scenarios where applicable.

This includes planning policy for Developments of National Significance, including all onshore wind of more than 10 MW capacity, and any other generation between 10 MW and 350 MW; this encompasses the majority of generation capacity in the DFES.

The impact of these devolved policies and responsibilities can already be seen in the pipeline, with over 1.7 GW of potential onshore wind in South Wales. In contrast, the NG licence areas in England are anticipated to have little to no onshore wind development in the near term.

Welsh Government have several ambitions for low carbon energy, such as 1.5 GW of locally owned renewable energy capacity (excluding heat pumps), 5.5 GWth of heat pump capacity, and the equivalent of 100% of electricity consumption generated by renewables by 2035.

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 designated areas for renewable projects and upcoming changes to building regulations, are also considered in the DFES analysis.

**Well-being of Future Generations (Wales) Act 2015**  
The Essentials

www.gov.wales

- Advise, Encourage & Promote
- Advisory Panel
- Annual Report
- Auditor General for Wales
- Carry out Reviews
- Collaboration
- Future Generations Commissioner for Wales
- Future Generations Report
- Future Trends Report
- Integration
- Involvement
- Long Term
- Make Recommendations
- National Indicators & Milestones
- Prevention
- Public Services Boards
- Research
- Responding to the Future Generations Commissioner
- Sustainable Development
- Sustainable Development Principle
- Transparency
- Well-being Duty
- Well-being Goals
- Well-being Statement

**Prosperity for All:  
economic action plan**

**FUTURE WALES**  
The National Plan 2040

## 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 South Wales licence area in the near and medium term.

DFES scenario	Scenario description	Renewable energy capacity		Electricity storage capacity	
		Baseline	2035	Baseline	2035
<b>Falling Short</b> Not net zero compliant	Not compliant with the net zero emissions target. Low levels of decarbonisation and societal change.	<b>1.5 GW</b> Including: 0.8 GW of solar 0.6 GW of wind	<b>2.4 GW</b>	<b>0.0 GW</b>	<b>0.3 GW</b>
<b>System Transformation</b> 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 and use.		<b>3.3 GW</b>		<b>0.4 GW</b>
<b>Consumer Transformation</b> Net zero compliant	High levels of decarbonisation and societal change. Consumers adopt new technologies rapidly, and more decentralised solutions are developed. This scenario sees a significant electrification of domestic heat.		<b>4.6 GW</b>		<b>0.5 GW</b>
<b>Leading the Way</b> Net zero compliant	Very high levels of decarbonisation and societal change. Consumers adopt new technologies rapidly, and a mix of solutions at various scales are developed. This scenario aims for the fastest credible decarbonisation pathway.		<b>4.3 GW</b>		<b>0.6 GW</b>

## Summary of results in 2035

DFES scenario	Battery electric vehicles (000s)		Domestic heat pumps (000s)		Hydrogen electrolysis capacity	
	Baseline	2035	Baseline	2035	Baseline	2035
<b>Falling Short</b> Not net zero compliant		<b>371</b> 25% of vehicles		<b>115</b> 10% of homes		<b>0.1 GW</b>
<b>System Transformation</b> Net zero compliant	<b>13</b> 0.9% of total vehicles	<b>555</b> 38% of vehicles	<b>8</b> 0.7% of homes	<b>104</b> 89% of homes	<b>0.0GW</b>	<b>0.1 GW</b>
<b>Consumer Transformation</b> Net zero compliant		<b>928</b> 63% of vehicles		<b>395</b> 37% of homes		<b>0.1 GW</b>
<b>Leading the Way</b> Net zero compliant		<b>991</b> 68% of vehicles		<b>461</b> 40% of homes		<b>0.1 GW</b>

## Renewable energy generation

There is currently 0.8 GW of solar PV capacity connected in the South Wales licence area, and 0.6 GW of onshore wind capacity. Most of this renewable capacity is in the form of large-scale solar arrays and wind farms.

Solar deployment in South Wales has stagnated in recent years, due to some market uncertainty after the reduction in government subsidies.

However, new business models 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 over 4.3 GW 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 NGED's network.

A pipeline of around 1.8 GW of wind capacity suggests that South Wales will also continue to be a hub for distributed onshore wind development over the coming decades.

Under the Consumer Transformation scenario, total wind capacity reaches 3.1 GW by 2050.

## Fossil-fuelled generation

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

There is 0.7 GW 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 more densely populated areas of the South Wales licence area.

The annual energy output of these fossil fuel plants significantly decreases in all net zero compliant scenarios, especially in the late 2020s and 2030s, as the UK's electricity supply is rapidly decarbonised in order to meet interim carbon budgets.

The DFES analysis does show 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 generation is expected to decrease in the near term due to air quality and environmental 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.



## Electricity storage

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

National Grid ESO is aiming to be able to operate a zero-carbon electricity system by 2025, and the UK government aims to eliminate unabated fossil fuel generation from the electricity system by 2035.

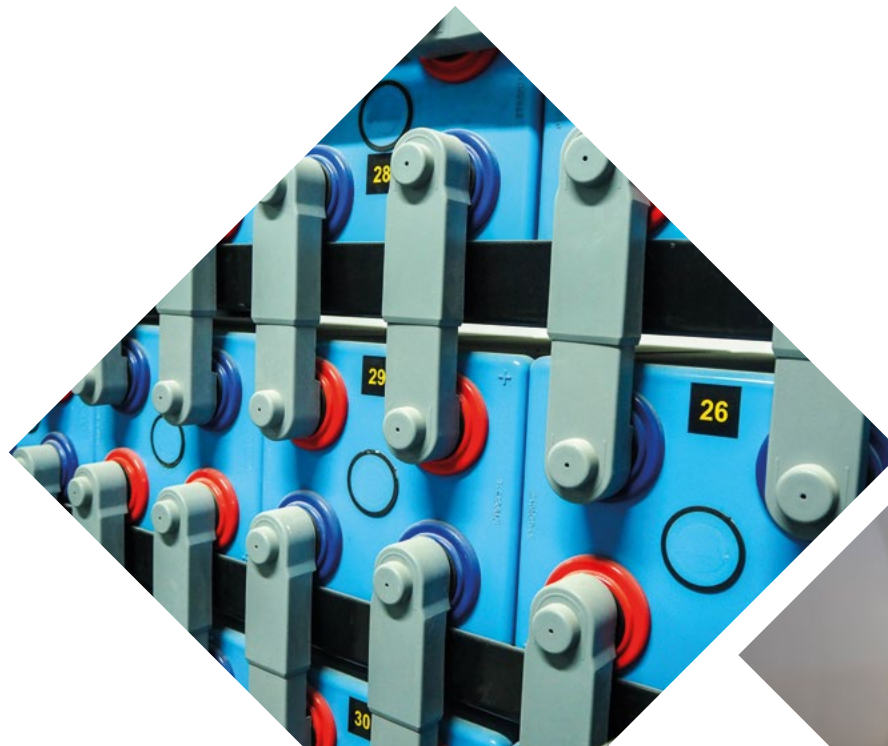
New sources of flexibility, such as electricity storage, will be needed to provide services to the network to support this transition to low carbon electricity generation.

Future business models for storage include co-location with renewable generators and non-domestic consumers, as well as smaller batteries in homes to increase self-use of rooftop solar.

The South Wales licence area currently has less than 0.1 GW of connected electricity storage capacity. However, the project pipeline totals over 1.2 GW of capacity, much of which could potentially progress in the near term.

Due to the scenario-specific assumptions around the deployment of other providers of network services, there is a wide envelope of capacity projections between the scenarios.

Battery storage capacity in 2050 in the South Wales licence area resultantly ranges from 0.4 GW under Falling Short to 1.0 GW under Leading the Way.



## 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.

Under some scenarios, the production of hydrogen via electrolysis could result in significant new electricity demand where low carbon hydrogen could be required, such as hard-to-decarbonise industries in the South Wales Industrial Cluster.

Projects such as CymruH2Wales are investigating the potential role of hydrogen in South Wales. National Gas' Project Union plans also include a hydrogen pipeline running through South Wales to the Milford Haven fuel terminal in Pembrokeshire.

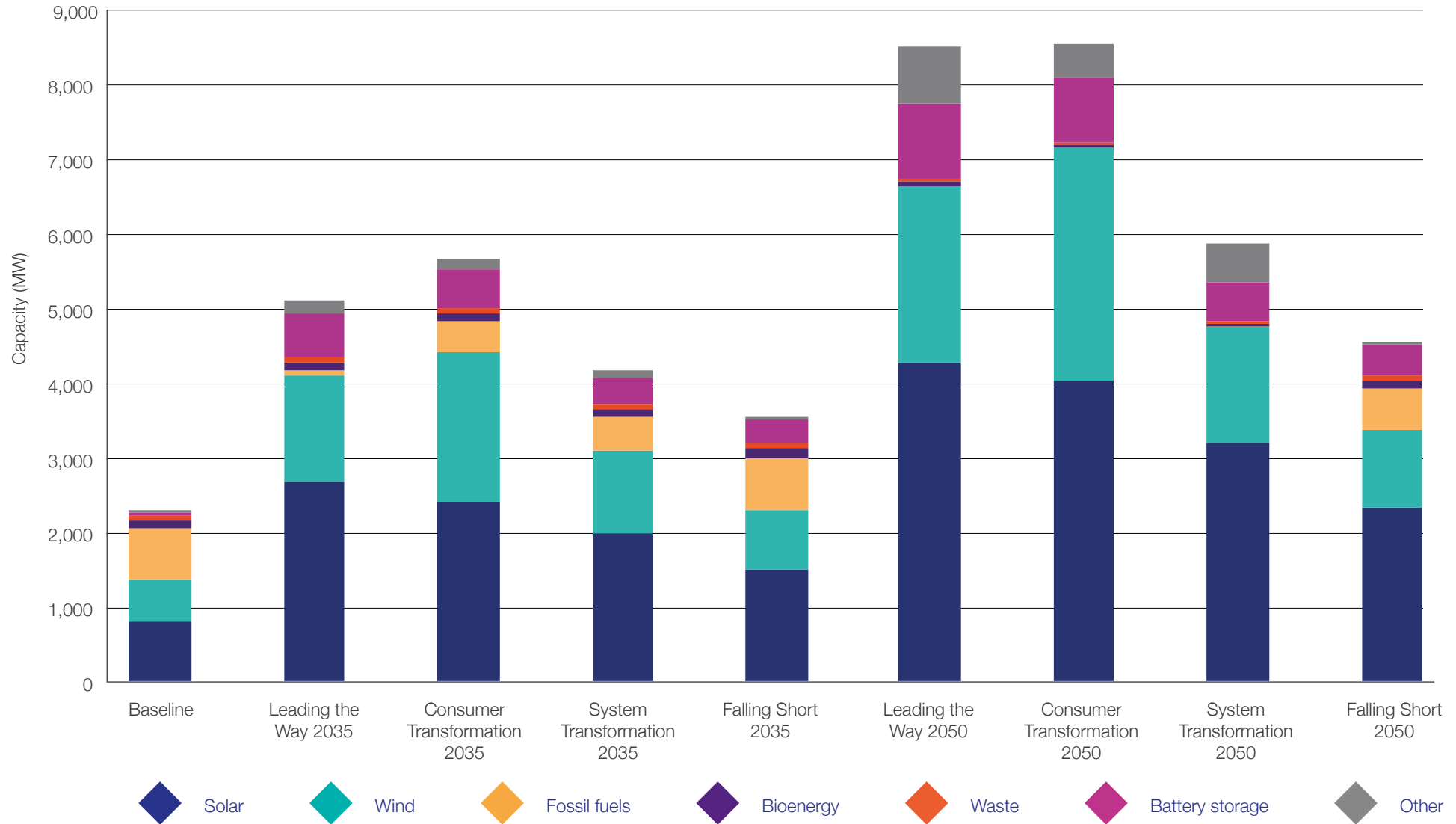
The direct impacts of hydrogen on the electricity distribution networks manifest in two forms: demand for electricity for hydrogen electrolysis, and generation of electricity through hydrogen-fuelled generation capacity.

By 2050, distribution-connected hydrogen electrolysis capacity in the South Wales licence area ranges from 0.1 GW to 0.5 GW, reflecting a level of uncertainty in this technology.

Hydrogen-fuelled generation could reach up to 0.7 GW, a similar capacity to the current fossil fuel baseline that it could replace.



Distribution-connected generation and storage scenarios – NG South Wales licence area



## Low carbon heat

As has been spotlighted by the UK government’s Heat and Buildings Strategy, a key aspect of the energy transition will be the decarbonisation of heat.

The four DFES scenarios model a variety of heat 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 700,000 homes heated electrically, including around 7,000 domestic heat pumps. This equates to c.0.7% of all homes in the licence area having a heat pump, which is below the national average of just over 1%.

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 and off-gas homes, and as such sees heat pump uptake similar to the national trajectory.



DFES scenario	By 2050:
<b>Falling Short</b> Not net zero compliant	<b>520,000</b> non-hybrid heat pumps <b>15,000</b> hybrid heat pumps <b>47,000</b> homes heated by district heating heat pumps
<b>System Transformation</b> Net zero compliant	<b>291,000</b> non-hybrid heat pumps <b>365,000</b> hybrid heat pumps <b>65,000</b> homes heated by district heating heat pumps
<b>Consumer Transformation</b> Net zero compliant	<b>987,000</b> non-hybrid heat pumps <b>32,000</b> hybrid heat pumps <b>78,000</b> homes heated by district heating heat pumps
<b>Leading the Way</b> Net zero compliant	<b>776,000</b> non-hybrid heat pumps <b>145,000</b> hybrid heat pumps <b>66,000</b> homes heated by district heating heat pumps



## Low carbon transport

The UK government's proposed ban on new petrol and diesel vehicles from 2030 is preceded by a significant increase in the uptake of EVs over the next ten years.

As a result of the ban, most road vehicles are expected to be electric by 2050 in every scenario.

There are around 13,000 battery electric vehicles and 7,000 plug-in hybrid electric vehicles already registered in the South Wales licence area, totalling nearly 1.5% of all vehicles; this is well below the GB average.

However, uptake is projected to increase rapidly over the next decade.

Local factors that influence uptake in the near term include:

- The availability of off-street parking
- The level of car ownership, including second cars
- Local initiatives to increase the number of EV chargers or potential clean air zones.

For electricity networks, the key question is how and when these EVs are charged.

The deployment of EV chargers is also projected in the DFES, categorised by charger size, charger type and use case, such as domestic chargers, eHGV chargers at service stations, and ultrarapid chargers at existing petrol stations.

DFES scenario	By 2035:
<b>Falling Short</b> Not net zero compliant	<b>371,000</b> battery electric vehicles <b>1,315 MW</b> (c. 190,000) domestic chargepoints <b>264 MW</b> of non-domestic chargepoints
<b>System Transformation</b> Net zero compliant	<b>555,000</b> battery electric vehicles <b>1,846 MW</b> (c. 260,000) domestic chargepoints <b>435 MW</b> of non-domestic chargepoints
<b>Consumer Transformation</b> Net zero compliant	<b>928,000</b> battery electric vehicles <b>3,762 MW</b> (c. 540,000) domestic chargepoints <b>540 MW</b> of non-domestic chargepoints
<b>Leading the Way</b> Net zero compliant	<b>991,000</b> battery electric vehicles <b>4,053 MW</b> (c. 580,000) domestic chargepoints <b>584 MW</b> of non-domestic chargepoints



## Next steps

The DFES is an annual process; the National Grid Electricity Distribution DFES 2024 analysis will begin in Spring 2024.

Stakeholder engagement will run from February to July 2024. NGED Distribution System Operator's (DSO) Strategic Engagement Officers will be in contact with local authorities to discuss the results of the DFES 2023.

If you have any questions in relation to the NGED DSO System Planning team or would like to be consulted for the DFES 2024, please get in touch via the details below.

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The suite of NG DFES 2023 outputs are **available online**.  
The results are also available as an **interactive map**.



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