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# National Grid DFES 2022 regional review

South Wales

Electricity Distribution

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# Contents

# Foreword by National Grid DSO

## Throughout the next RIIO-ED2 price control period, strategic 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 then 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.

This report summarises the 2022 Distribution Future Energy Scenarios (DFES) study for the South Wales licence area. The network will see a large increase in distributed renewable generation and electricity storage connections.

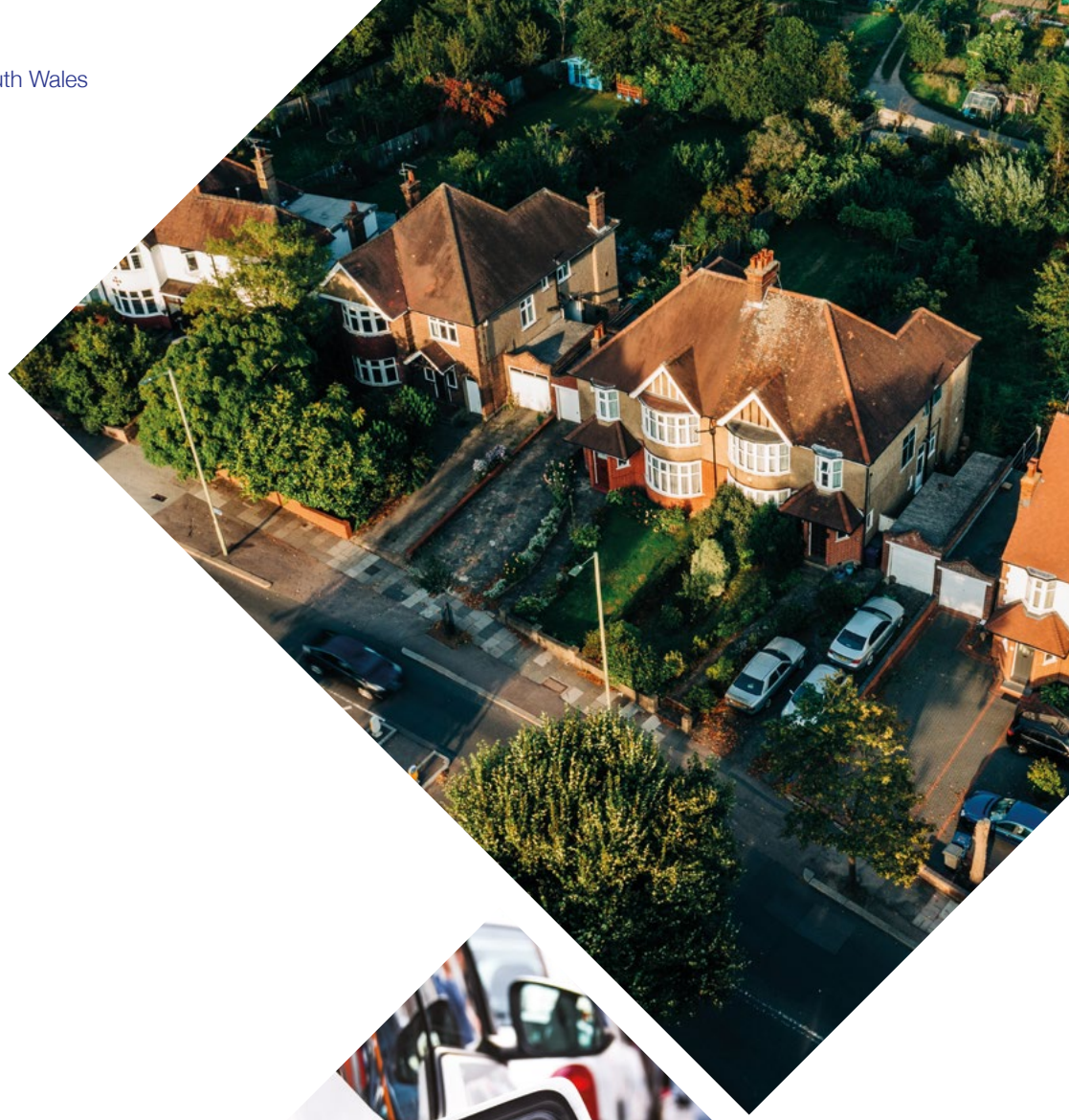
We predict high levels of low carbon technologies, such as electric vehicles and heat pumps and increasing household demand for electricity. The DFES study aims to understand where the growth of different technologies will be spatially distributed, which will materialise as load on our networks.

Our annual DFES cycle allows incorporation of newly developed and projected technologies to the analysis. In DFES 2022, we have further developed the assumptions behind the storage pipeline and electrified heating technology demand profiles, as well as starting routine engagement with Major Energy Users to better capture future changes in demand.

As local authorities develop Local Area Energy Plans (LAEPs), we are 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**
Forecasting & Capacity Manager
Distribution System Operator
National Grid

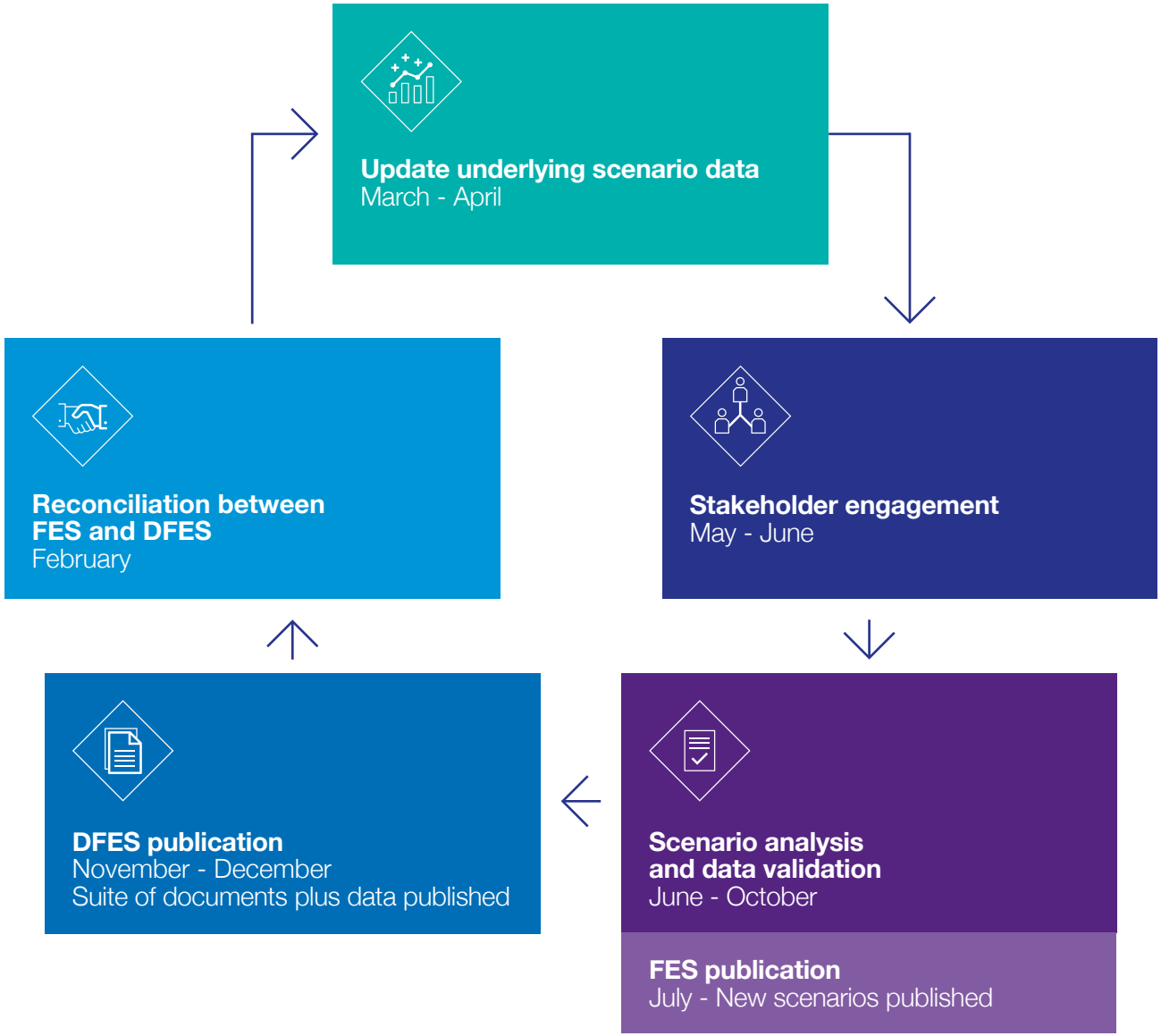
# The DFES process

## 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 to produce the DFES scenario analysis.



# South Wales story to date

## As of September 2022, 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 1.5GW, is renewable or low carbon generation.

Distributed electricity generation capacity in the licence area has increased significantly in recent years, with over 50% having connected since 2015.

Most of the generation capacity in the licence area consists of solar PV, fossil fuels and onshore wind. The licence area features significant onshore wind resource and high levels of solar irradiance.

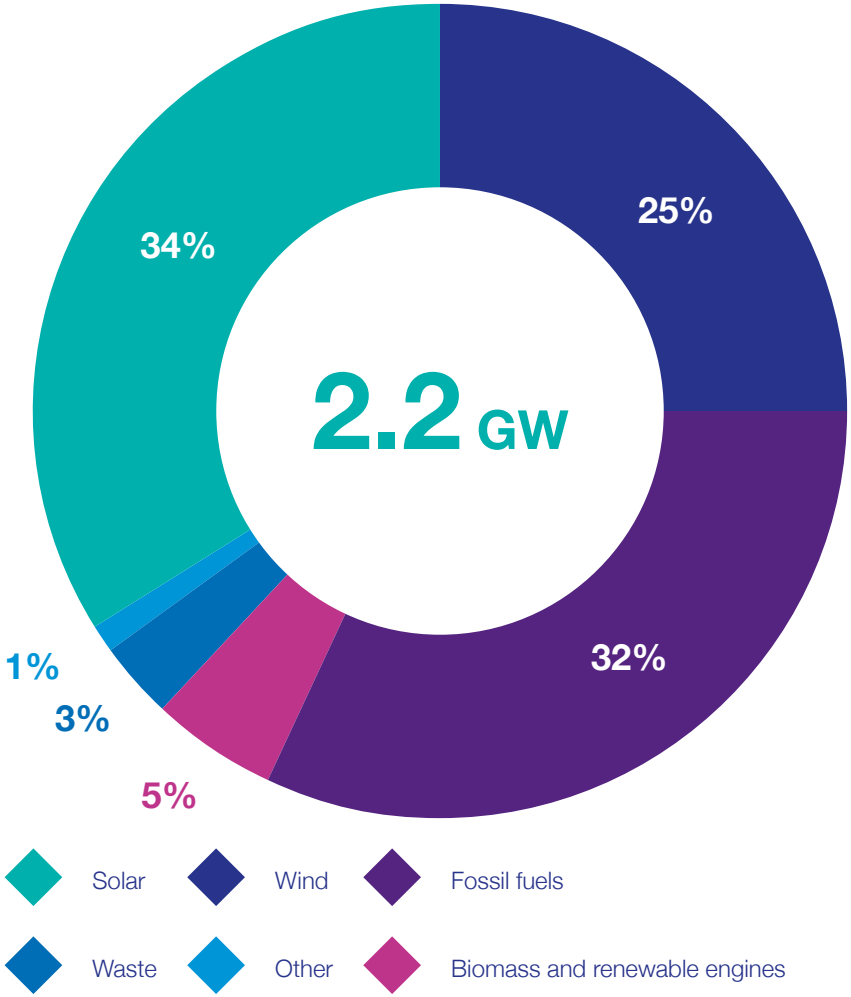
The supportive planning regime for onshore wind from the Welsh Government has led to the development of several large-scale wind farms, such as Brechfa Forest West wind farm in Carmarthenshire.

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, less than 1% of vehicles are currently electric.

However, uptake of both of these low carbon technologies is accelerating, as new policies and support 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.

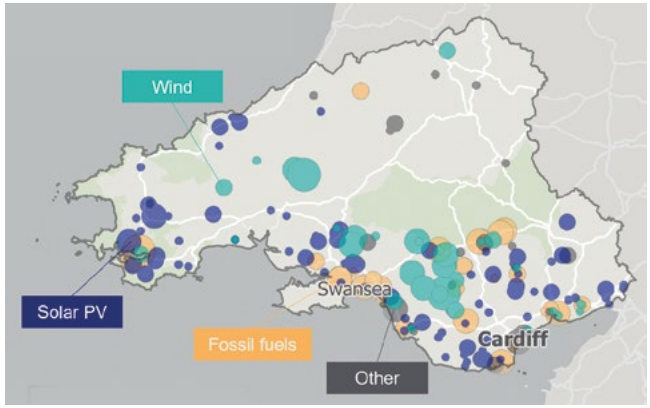
Solar PV sites are present across the south of licence area, with several large-scale solar farms located in Pembrokeshire, where irradiance is particularly high.

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 3.2 GW that could connect to the South Wales distribution network in the near 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. Nearly half of this pipeline capacity secured a network connection offer since January 2021.

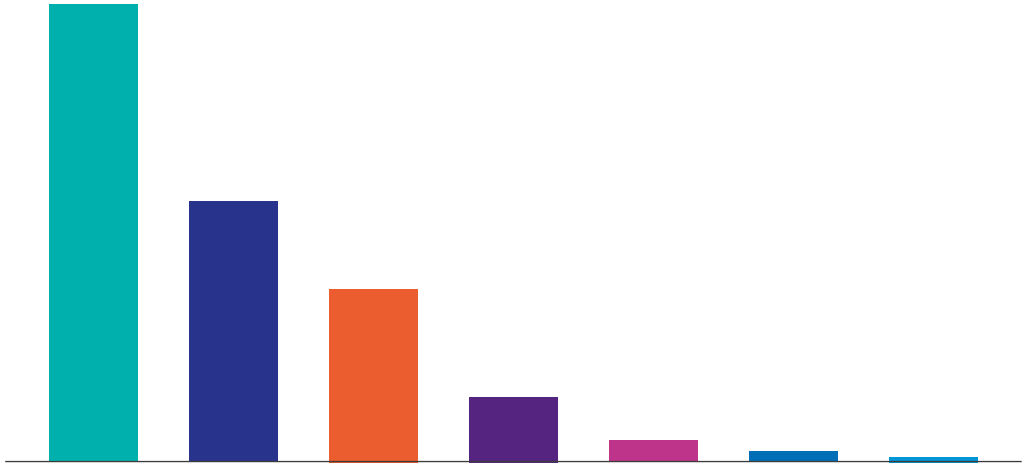
In contrast to the English licence areas, a positive planning environment for onshore wind has resulted in a pipeline of nearly 900 MW in the South Wales licence area.

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 350 MW 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 July 2022, with 221 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.

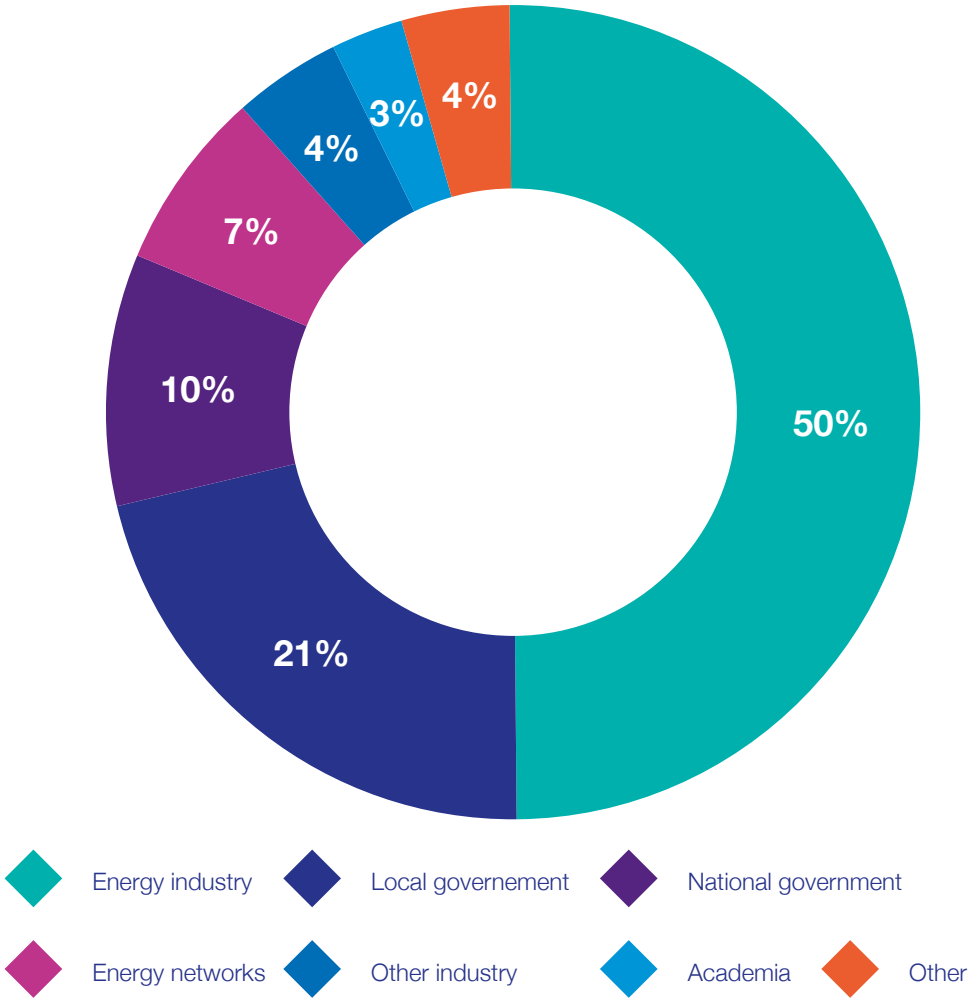
Attendees were asked for views on:

- the ground-mounted solar and onshore wind pipeline
- the planning environment for fossil fuel generation
- potential for hydrogen-fuelled generation
- drivers behind standalone electricity storage
- the potential locations of future hydrogen electrolysers
- the uptake of heat pumps to achieve the UK government's 2028 ambition
- factors influencing the location of future heat networks
- the reasons behind the low uptake of EVs in South Wales to date.

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 arrays, 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 23,000 and 32,000 homes are projected to be built in the South Wales licence area by April 2026.

Local authorities were also asked about plans, strategies 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. The DFES outputs may also be 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 900 MW 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 ambitions for low carbon energy, such as 1 GW 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 considered in the DFES analysis.



# 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 | Scenario description | Renewable energy capacity | | Electricity storage capacity | |
|---|---|---|---|---|---|
| | | Baseline | 2035 | Baseline | 2035 |
| **Falling short**<br>Not net zero compliant | Not compliant with the net zero emissions target. Low levels of decarbonisation and societal change. | **1.5 GW**<br>Including:<br>0.8 GW of solar<br>0.6 GW of wind | **2.4 GW** | **0.0 GW** | **0.2 GW** |
| **System transformation**<br>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. | | **3.1 GW** | | **0.2 GW** |
| **Consumer transformation**<br>Net zero compliant | High levels of decarbonisation and societal change. Consumers adopt new technologies rapidly, and more decentralised solutions are developed.<br><br>This scenario sees a significant electrification of domestic heat. | | **3.9 GW** | | **0.3 GW** |
| **Leading the way**<br>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.<br><br>This scenario aims for the fastest credible decarbonisation pathway. | | **4.3 GW** | | **0.4 GW** |

# Summary of results in 2035

| DFES scenario | Battery electric vehicles (000s) | | Domestic heat pumps (000s) | | Hydrogen electrolysis capacity | |
|---|---|---|---|---|---|---|
| | Baseline | 2035 | Baseline | 2035 | Baseline | 2035 |
| **Falling short**<br>Not net zero compliant | **8**<br>0.5% of total vehicles | **371**<br>25% of vehicles | **7**<br>0.7% of homes | **135**<br>12% of homes | **0.0GW** | **0.1 GW** |
| **System transformation**<br>Net zero compliant | | **555**<br>38% of vehicles | | **109**<br>9% of homes | | **0.1 GW** |
| **Consumer Transformation**<br>Net zero compliant | | **928**<br>63% of vehicles | | **395**<br>37% of homes | | **0.1 GW** |
| **Leading the Way**<br>Net zero compliant | | **991**<br>68% of vehicles | | **482**<br>42% of homes | | **0.2 GW** |

# 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 and wind farms.

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

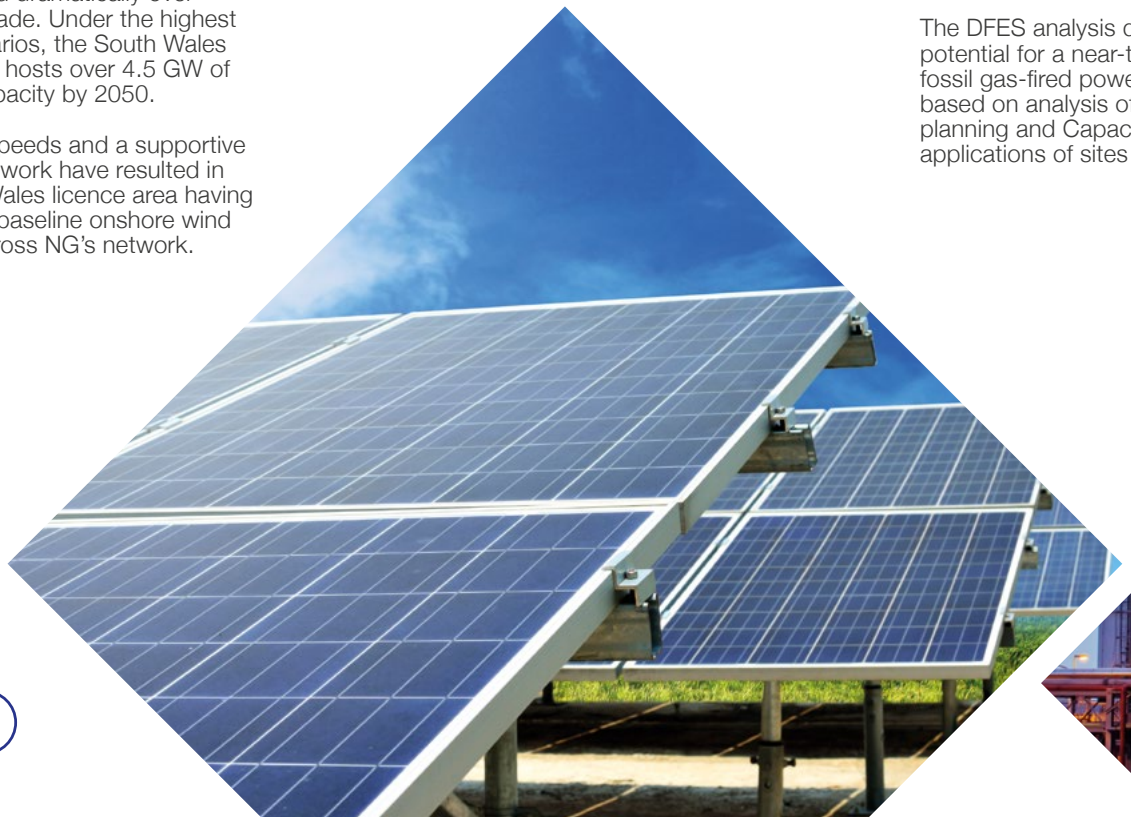
However, new business models for solar are becoming viable across the UK, which is shown in the pipeline of prospective new sites seen.

The cost of deploying solar has also reduced dramatically over the last decade. Under the highest DFES scenarios, the South Wales licence area hosts over 4.5 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 NG's network.

A pipeline of around 900 MW 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 reaches 2.7 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 licence area's more densely populated areas.

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 0.6 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 ranges from 0.2 GW under Falling Short to 0.8 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 in areas of the licence area where low carbon hydrogen could be required.

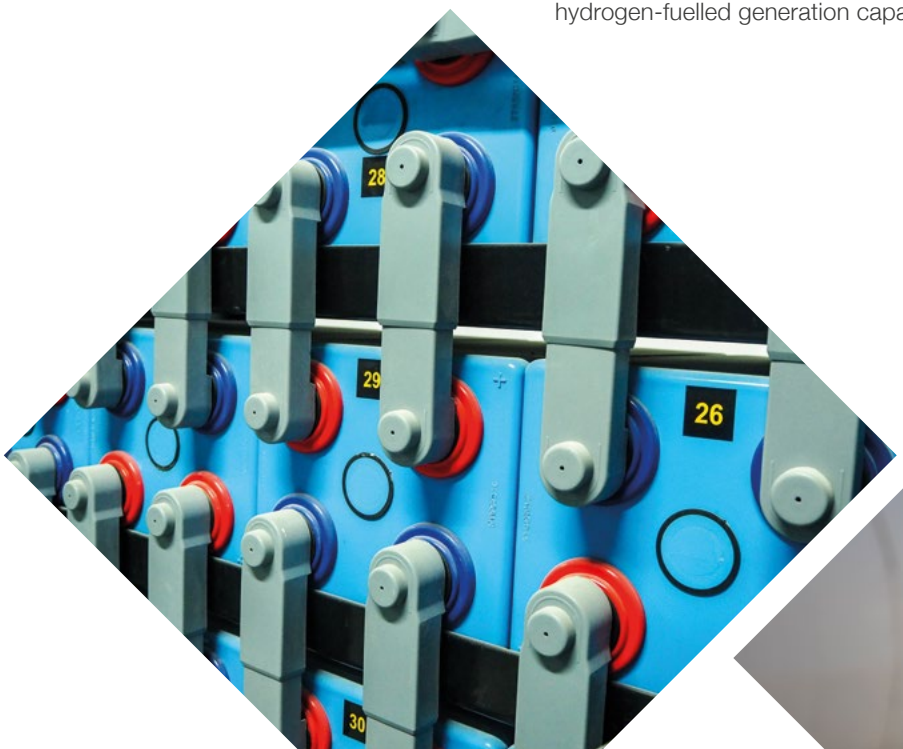
This could include for industrial processes, electricity generation or as a fuel for heavy vehicles.

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.

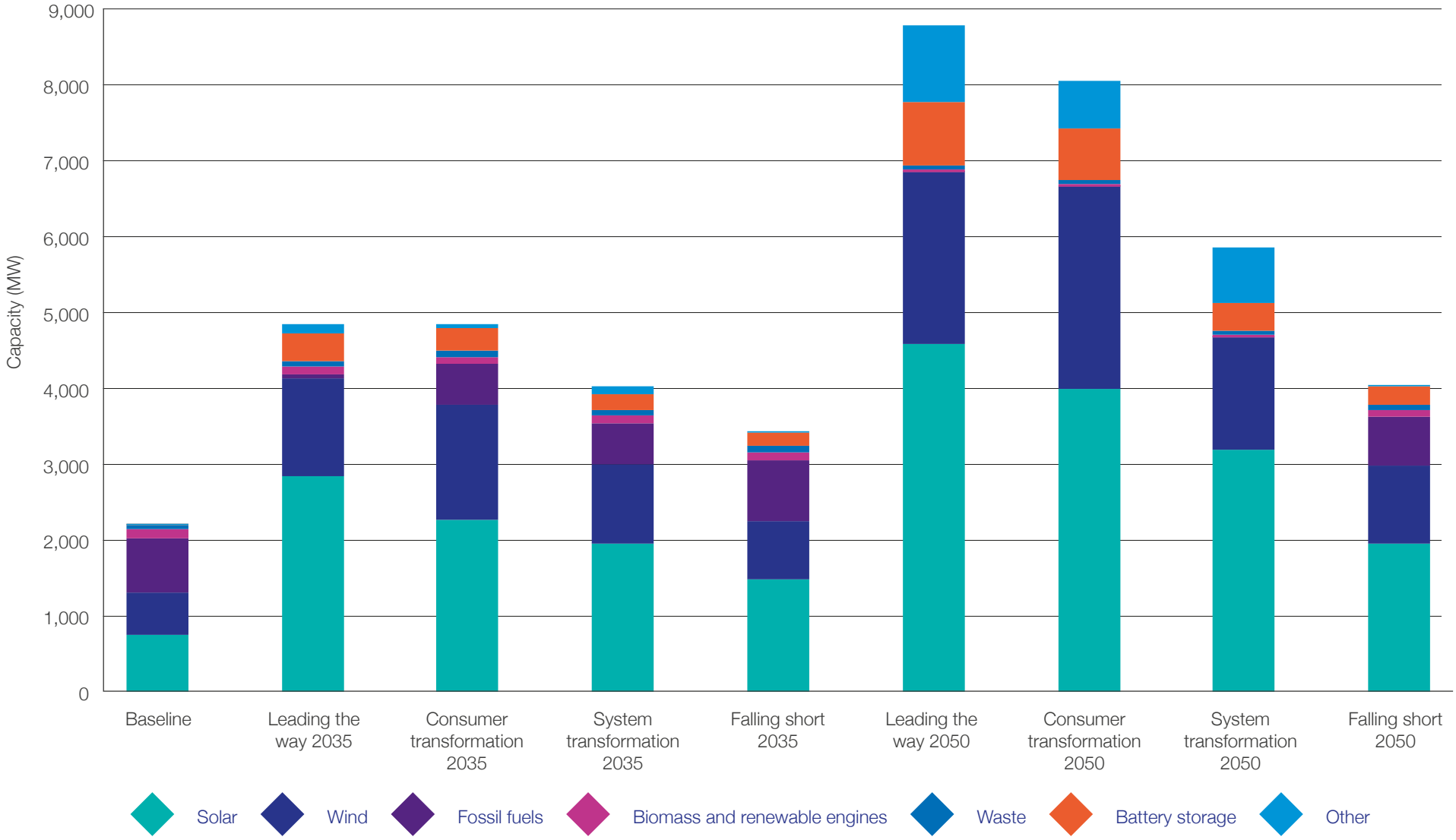
In addition, the level of hydrogen availability impacts other areas of the distribution network, i.e. as an alternative to the level of electrified heating and transport.

By 2050, distribution-connected hydrogen electrolysis capacity in the South Wales licence area ranges significantly from 0.2 GW to 0.6 GW, reflecting the scale of uncertainty in this technology.

Hydrogen-fuelled generation could reach up to 0.9 GW, slightly higher than the current fossil-fuel baseline that it could displace.




## 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 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 100,000 homes heated electrically, including around 7,000 domestic heat pumps. This equates to around 0.7% of all homes in the licence area having a heat pump, just below the national average of 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: |
|---|---|
| Falling Short | **526,000** non-hybrid heat pumps<br>**15,000** hybrid heat pumps<br>**40,000** homes heated by district heating heat pumps |
| System Transformation | **323,000** non-hybrid heat pumps<br>**283,000** hybrid heat pumps<br>**55,000** homes heated by district heating heat pumps |
| Consumer Transformation | **987,000** non-hybrid heat pumps<br>**16,000** hybrid heat pumps<br>**66,000** homes heated by district heating heat pumps |
| Leading the Way | **749,000** non-hybrid heat pumps<br>**106,000** hybrid heat pumps<br>**53,000** 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 8,000 battery electric vehicles and 5,000 plug-in hybrid electric vehicles already registered in the South Wales licence area, totalling around 1% 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 chargers is also projected in the DFES, categorised by charger size, charger type and use case, such as domestic chargers, chargers at car parks and chargers at existing petrol stations.

| **DFES scenario** | **By 2050, all road transport is projected to be decarbonised, the majority being EVs. By 2035:** |
|---|---|
| Falling Short | **371,000** battery electric vehicles<br>**208,000** domestic charge points<br>**7,000** non-domestic charge points |
| System Transformation | **555,000** battery electric vehicles<br>**327,000** domestic charge points<br>**12,000** non-domestic charge points |
| Consumer Transformation | **928,000** battery electric vehicles<br>**510,000** domestic charge points<br>**16,000** non-domestic charge points |
| Leading the Way | **991,000** battery electric vehicles<br>**605,000** domestic charge points<br>**16,000** non-domestic charge points |

# Next steps

## The DFES is an annual process; the National Grid DFES 2023 analysis will begin in Spring 2023.

Stakeholder consultation will run from February to July 2023. NG DSO's newly appointed Strategic Engagement Officers are in contact with local authorities to discuss the results of the DFES 2022.

If you have any questions in relation to the NG DSO Forecasting & Capacity team or would like to be consulted for the DFES 2023, please get in touch via the details below:

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The suite of NG DFES 2022 outputs are **available online.** The results are also available as an **interactive map.**

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