DistributionSystemOperator

National Grid DFES 2023 regional review

South West

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Foreword by National Grid DSO

April 2023 marked the start of the RIIO-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 East Midlands 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.

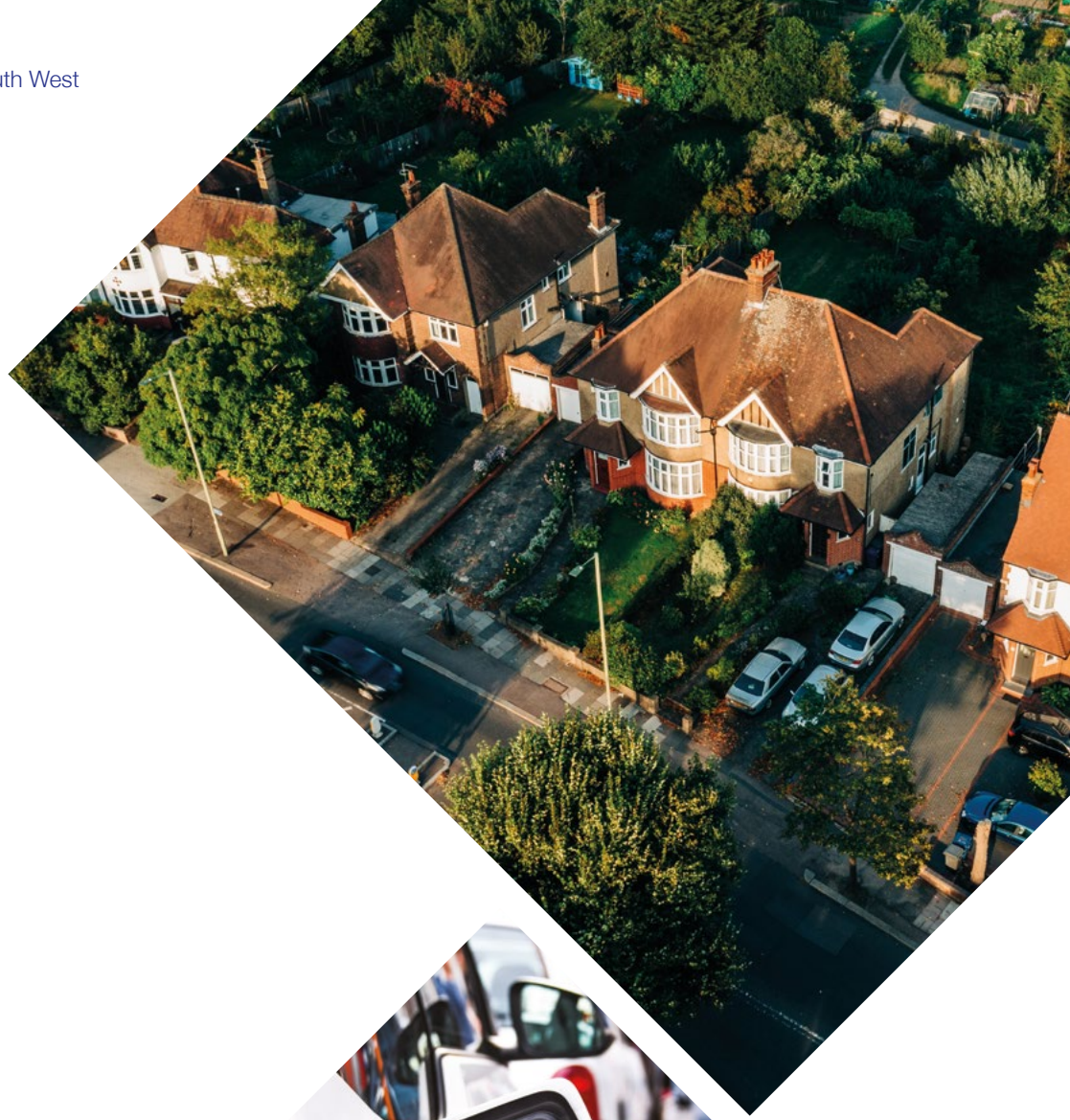
Our annual DFES cycle allows incorporation of newly developed and projected technologies to the analysis. In DFES 2023, we have added industrial heating to our projections and increased the granularity of our analysis down to LV level for a number of LCT technologies, to better inform secondary level 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.

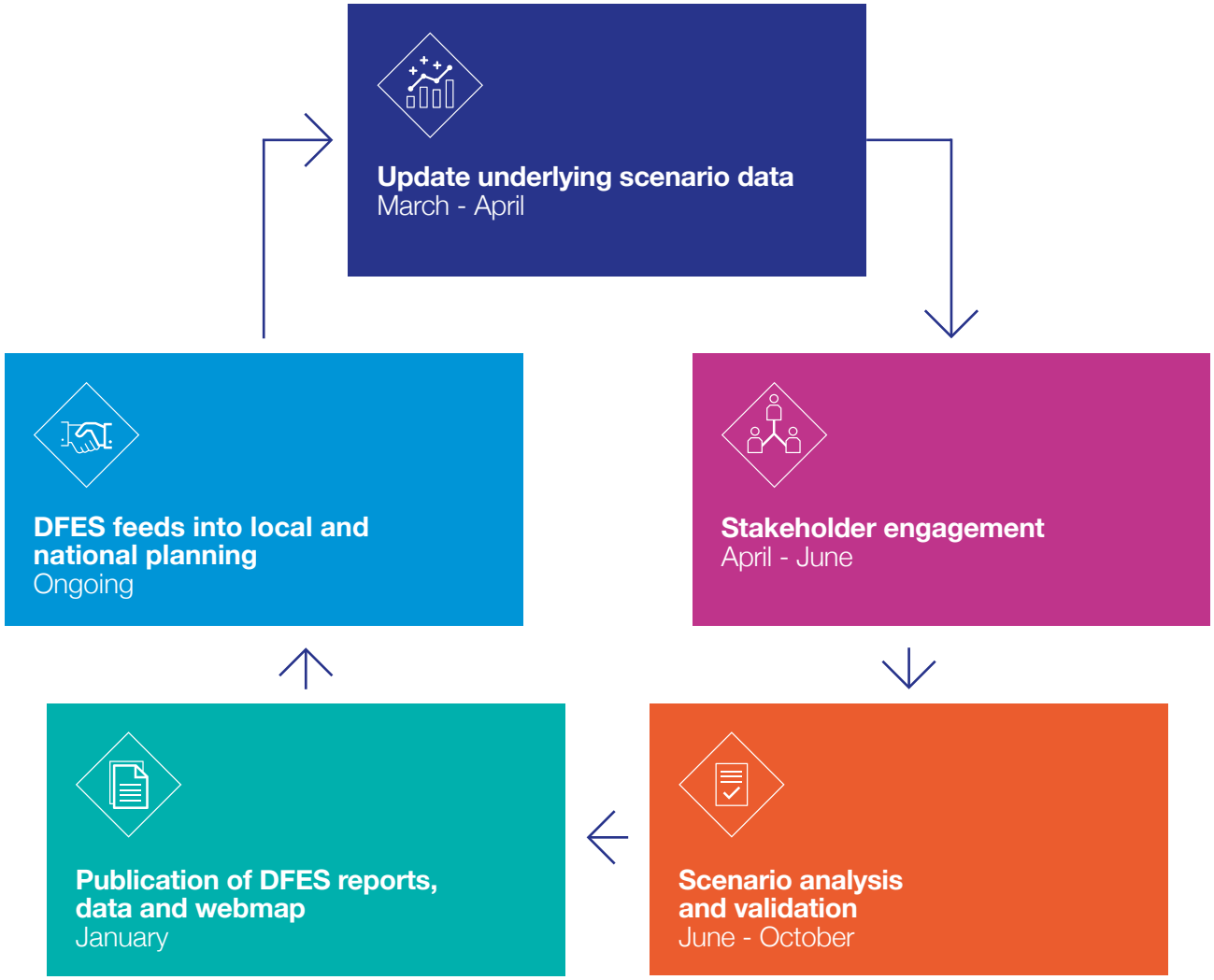
Using the National Grid ESO Future Energy Scenarios (FES) framework, these local stakeholder-informed projections are created on an annual cycle and encompass changes in electricity generation, storage and demand, including electrified transport and heat.

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 West licence area

As of September 2023, there is 2.9 GW of distributed electricity generation in the South West licence area.

This equates to around 9% of the total distributed generation capacity in GB. The significant majority of this generation, totalling 2.1 GW, is renewable or low carbon generation.

Distributed electricity generation capacity in the licence area has increased significantly in recent years, with around 65% having connected in the past decade.

The South West licence area has some of the best solar irradiance in the UK, alongside areas of substantial onshore wind resource, and resultantly saw a very high deployment of renewable generation between 2012 and 2017.

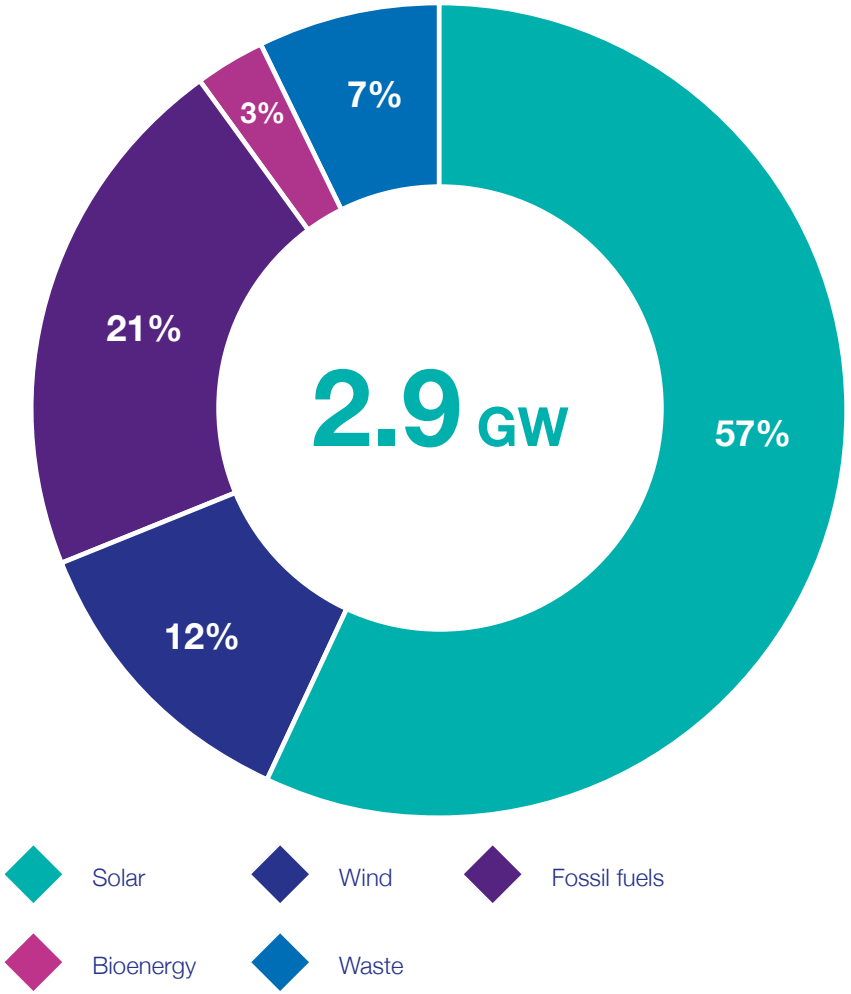
Over half of all distribution-connected generation capacity in the South West licence area is solar PV, ranging from rooftop arrays to large-scale ground-mounted solar farms.

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 more slowly. Just 2% of homes in the South West licence area are heated by a heat pump, and similarly less than 2% 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 West licence area



Distributed electricity generation in the South West

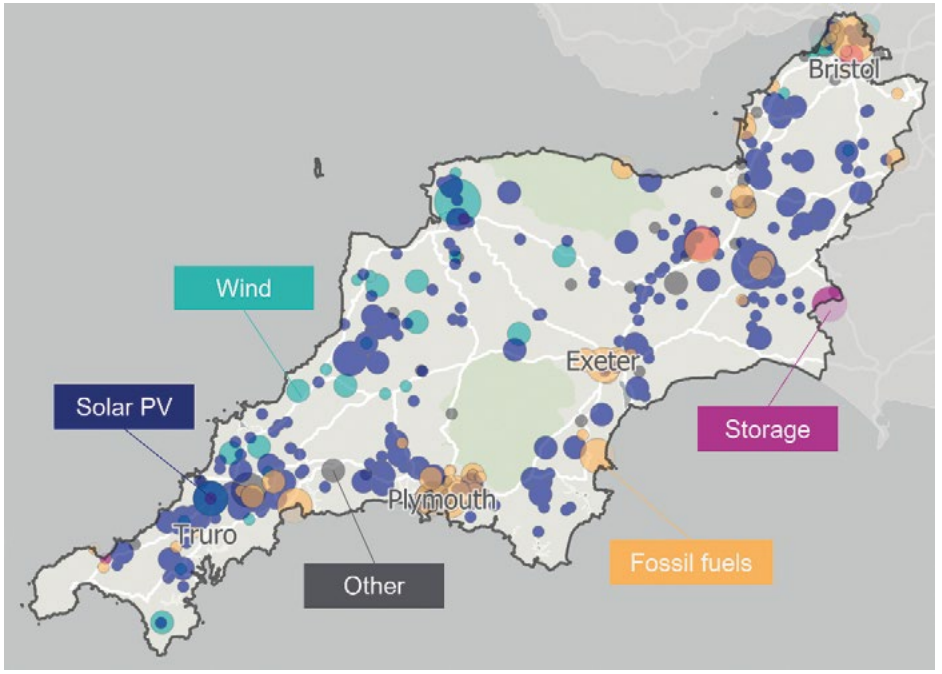
Representing over half the baseline capacity, ground-mounted solar PV is connected at various locations across the licence area.

Solar farms are particularly prevalent in Cornwall, and along the M5 motorway between Exeter and Bristol, situated near distribution network infrastructure.

There is also a significant capacity of onshore wind in the licence area, mainly along the north coasts of Devon and Cornwall. This includes the 66 MW Fullabrook Wind Farm in North Devon, which is the largest connected site of any technology in the licence area.

The licence area also contains over 700 MW of fossil-fuelled and waste-fuelled generation sites. These sites are typically located near urban areas with high electricity demand, as seen around Bristol, Plymouth, Exeter and Torbay.

South West licence area - baseline connections



The north coast of the licence area has particularly good wind resource, and hosted many of the earliest wind farms in the UK. Medium scale solar farms, mostly supported by the Feed-in tariff, are located in rural areas across the licence area.

The urban areas of Bristol, Exeter and Plymouth host most of the licence area's existing fossil fuel generation capacity, located close to electricity demand.

The licence area features a number of protected areas, including the Dartmoor and Exmoor National Parks, which host very little large scale electricity generation capacity.

Near-term pipeline summary

There are over 500 generation and storage projects, totalling 8.1 GW, that hold accepted connection agreements and could connect to the South West 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 and an explosive growth in the number of prospective battery storage projects has resulted in the near-term pipeline increasing significantly in recent years.

Over 85% of this pipeline capacity secured a network connection offer after January 2021.

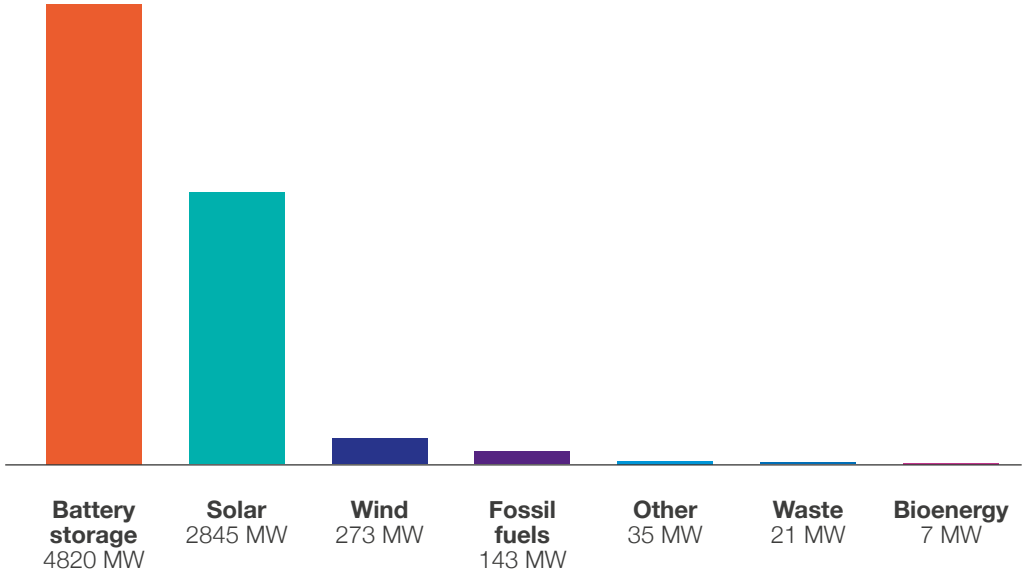
Although deployment has slowed in recent years, the DFES analysis shows that there is an increasing interest in deploying new generation and storage capacity in the licence area.

With a recent commitment to a zero-carbon electricity system by 2035, electricity storage could play a significant role in balancing the system.

There are over 130 battery sites, totalling over 4.8 GW, with an accepted connection offer in the licence area.

Many of these sites have attained planning permission and are anticipated to begin construction in the next few years.

Generation and storage sites with an accepted connection offer in the South West 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.

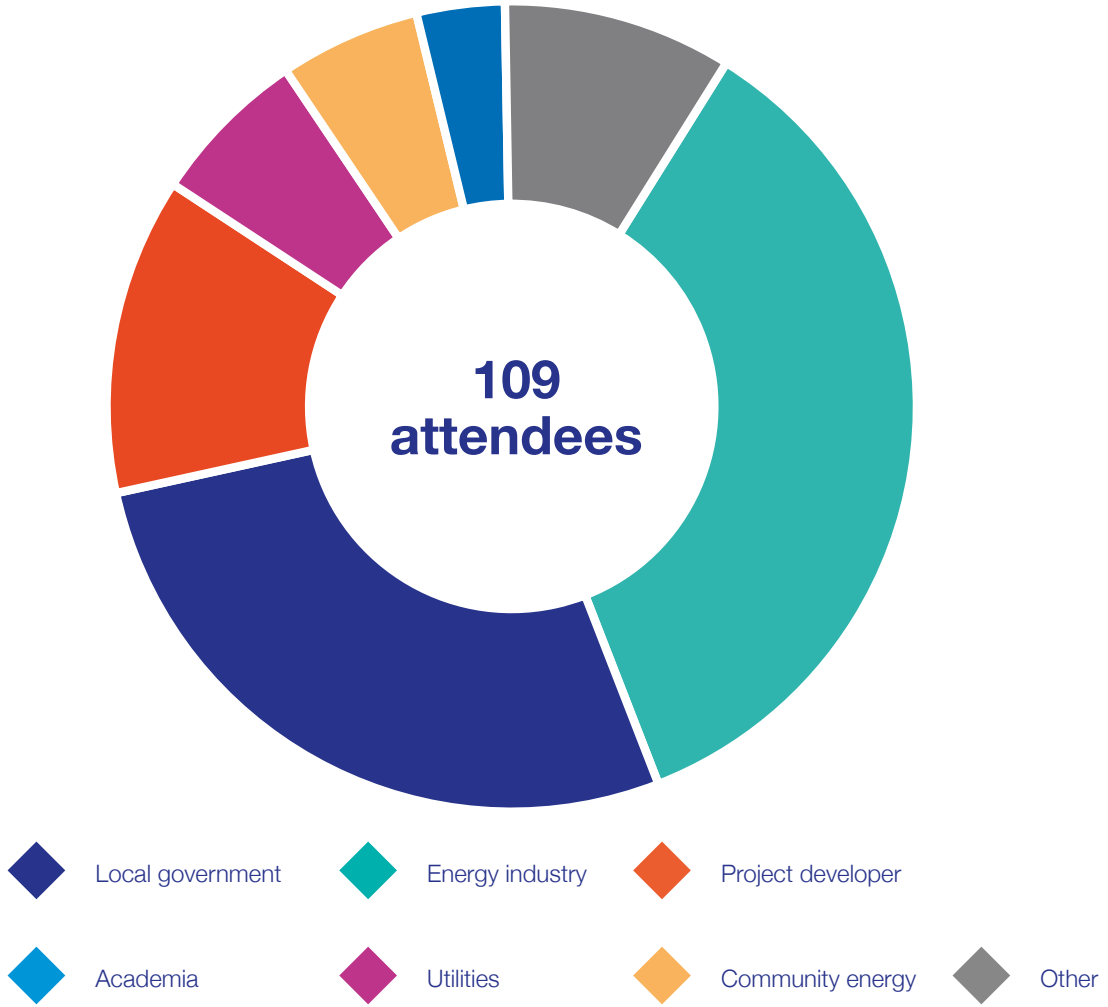
Attendees were asked for views on:

- The scale of the ground-mounted solar and onshore wind pipeline
- Outcomes for solar and wind farms at the end of their operational life
- Drivers behind domestic rooftop PV uptake
- Future prospects for co-located energy storage
- Factors influencing uptake of domestic battery storage
- The potential location of EV chargers for company fleets and eHGVs
- Factors impacting the current uptake of domestic heat pumps.

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 West 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 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.

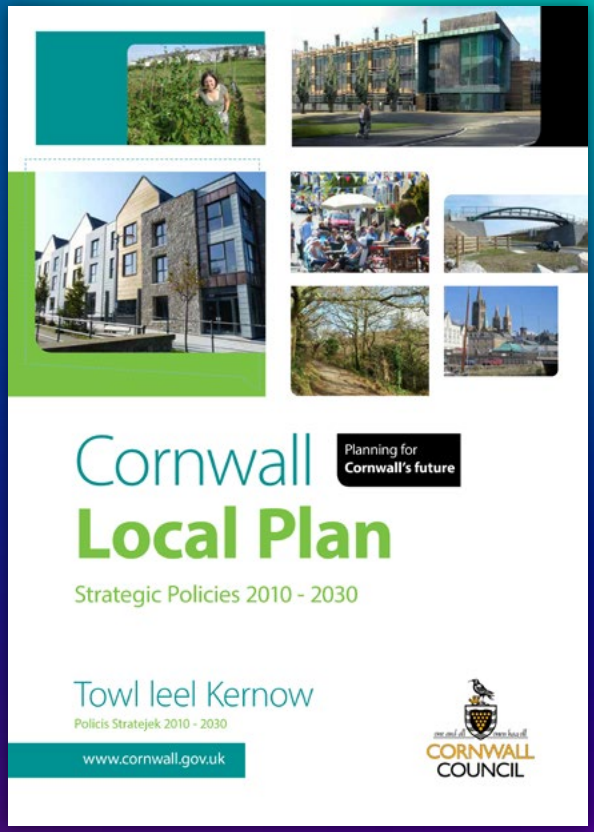
Where and when these buildings and associated low carbon technologies are expected to connect is determined using the scenario framework and based on data sourced from local authority plans, historic building rates and direct engagement with local authority planning departments.

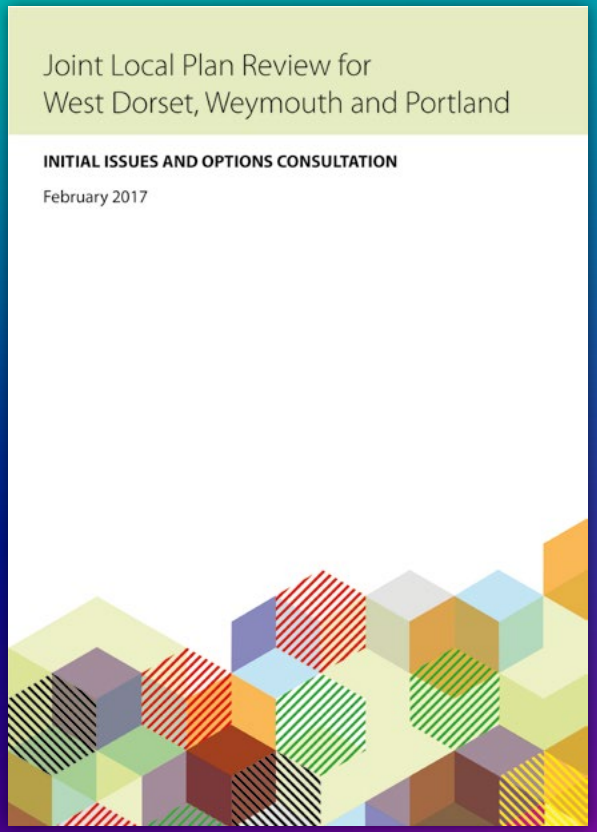
High and low scenarios were produced to model the variable building rates of these developments over the scenario period, out to 2050. Between 81,000 and 126,000 homes are projected to be built in the South West licence area by April 2028.

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.





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 West licence area in the near and medium term.

DFES scenario	Scenario description	Renewable energy capacity		Electricity storage capacity	
		Baseline	2035	Baseline	2035
Falling Short Not net zero compliant	Not compliant with the net zero emissions target. Low levels of decarbonisation and societal change.	**2.1 GW** Including: 1.7 GW of solar 0.3 GW of wind	**3.6 GW**	**0.2 GW**	**0.7 GW**
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 and use.		**4.7 GW**		**1.0 GW**
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 sees a significant electrification of domestic heat.		**5.6 GW**		**1.5 GW**
Leading the Way 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.		**6.7 GW**		**2.1 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 Not net zero compliant	**36** 1.6% of total vehicles	**567** 25% of vehicles	**30** 1.7% of homes	**213** 13% of homes	**0.0GW**	**0.0 GW**
System Transformation Net zero compliant		**858** 37% of vehicles		**225** 13% of homes		**0.0 GW**
Consumer Transformation Net zero compliant		**1,430** 62% of vehicles		**614** 421% of homes		**0.0 GW**
Leading the Way Net zero compliant		**1,527** 67% of vehicles		**708** 42% of homes		**0.1 GW**

Renewable energy generation

There is currently c.1.7 GW of solar PV capacity in the South West licence area. Ground-mounted solar accounts for around 1.1 GW of this, with the remaining capacity comprised of rooftop solar installations.

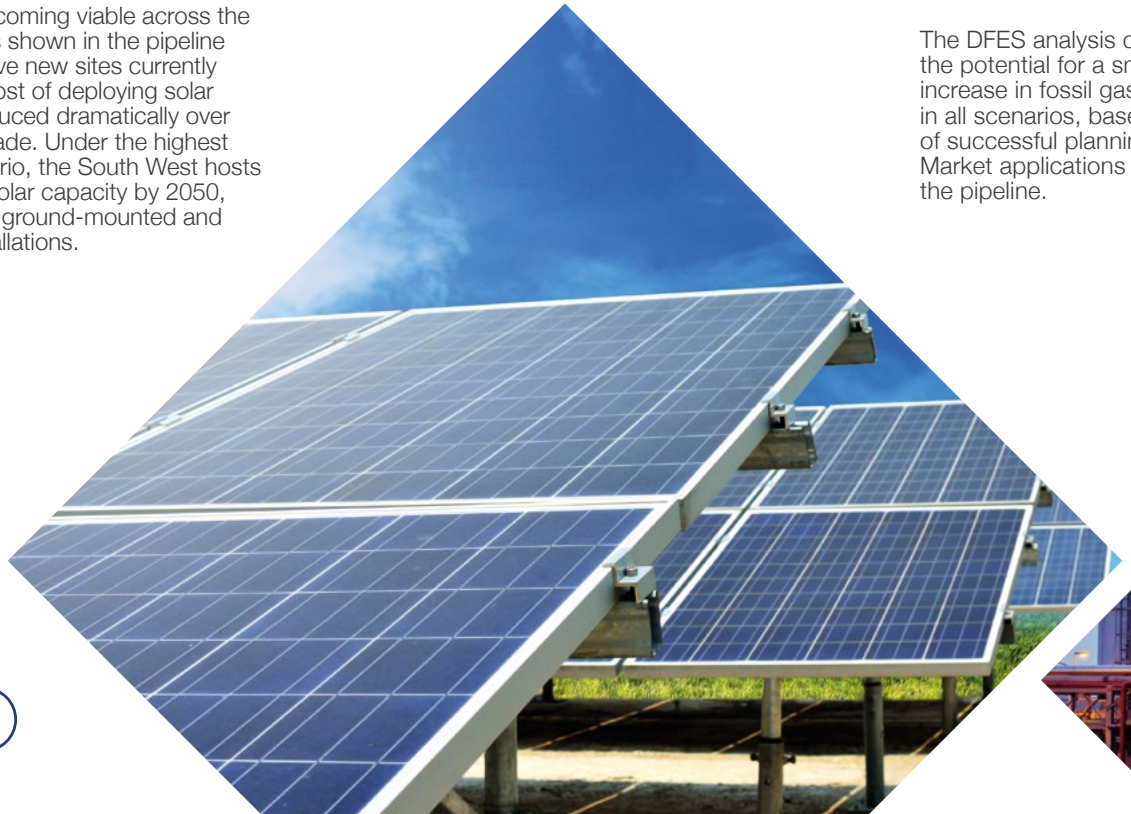
Solar deployment was high from 2012 onwards, earlier than in other parts of the UK.

Despite this, solar deployment in the South West has stagnated in recent years, due to some market uncertainty after the reduction in government subsidies. This has meant few sites have been commissioned since 2017.

However, new business models for solar are becoming viable across the UK, which is shown in the pipeline of prospective new sites currently seen. The cost of deploying solar has also reduced dramatically over the last decade. Under the highest DFES scenario, the South West hosts 8.5 GW of solar capacity by 2050, across both ground-mounted and rooftop installations.

Onshore wind deployment has stalled in recent years, due to difficulties in achieving planning.

However, there is scope for renewed deployment of wind farms. The DFES scenarios project between 0.8 GW and 1.8 GW of onshore and offshore wind capacity connecting to the South West licence area by 2050.



Fossil-fuelled generation

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

There is currently over 600 MW of fossil-fuelled generation connected in the South West licence area.

This is made up of gas and diesel engines, gas CHPs and large OCGT sites.

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 small 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 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.

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 West licence area currently has less than 200 MW of connected electricity storage capacity.

However, the project pipeline totals over 4.8 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 West licence area resultantly ranges from 0.9 GW under Falling Short to 2.9 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.

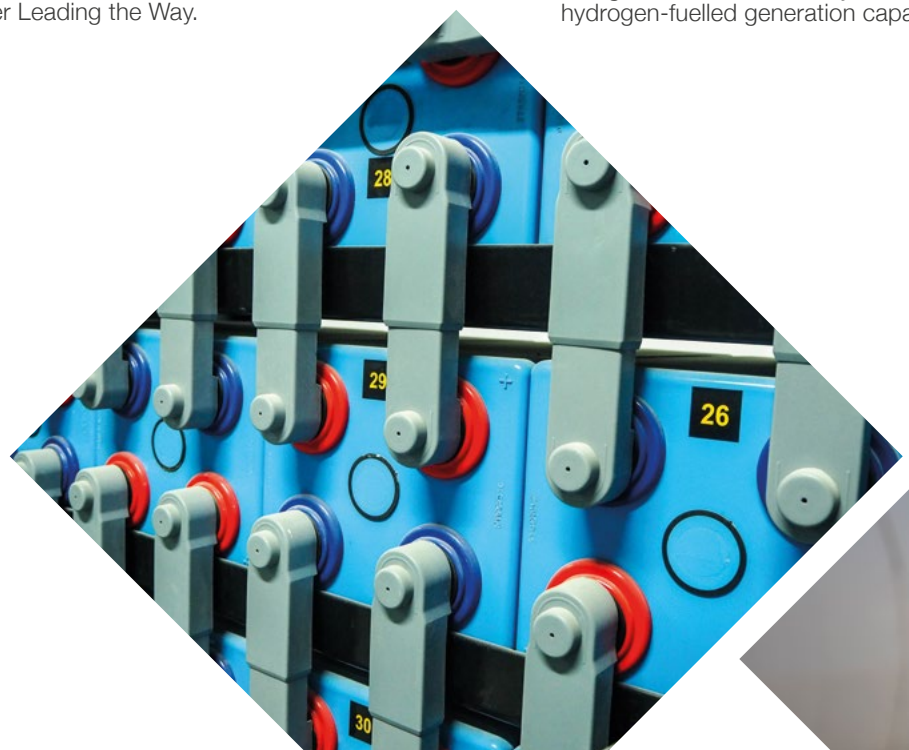
This could include for industrial processes, electricity generation or as a fuel for heavy vehicles.

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.

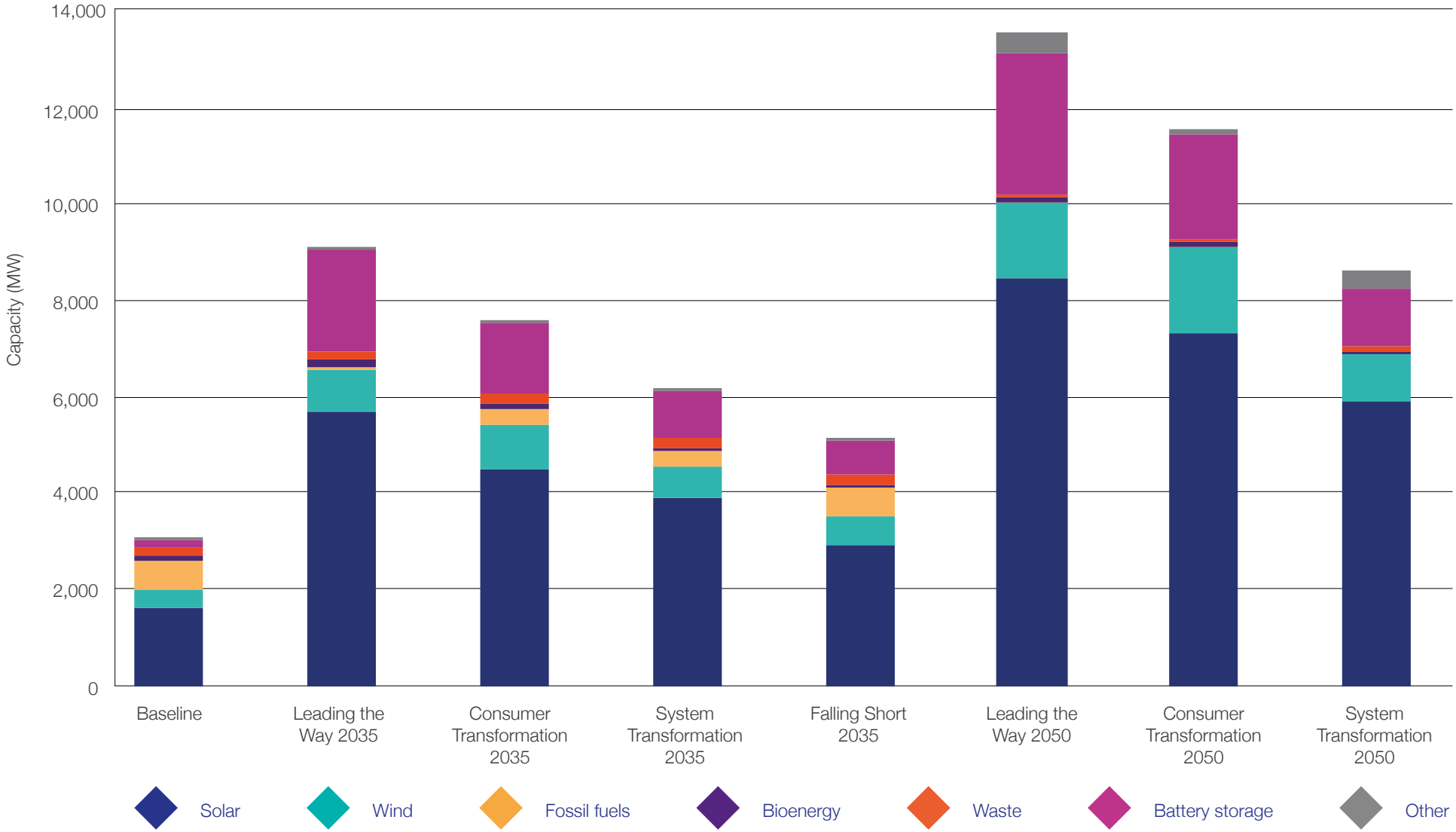
In addition, the level of hydrogen availability impacts other areas of the distribution network, i.e. as an alternative to the level of electrified heating and transport.

By 2050, distribution-connected hydrogen electrolysis capacity in the South West licence area ranges from 0.05 GW to 0.2 GW, reflecting a level of uncertainty in this technology.

Hydrogen-fuelled generation could reach up to 0.3 GW, around half the capacity of the current fossil-fuel baseline that it could replace.



Distribution-connected generation and storage scenarios – NG South West 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 West licence area currently has over 260,000 homes heated electrically, including around 30,000 domestic heat pumps. This equates to around 2% of all homes in the licence area having a heat pump, which is well above 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.

National policy is expected to see off-gas homes and new-build homes targeted in the near term. The above-average proportion of off-gas homes in the South West, compared to the UK average, leads to higher near-term deployment of heat pumps in the licence area.

DFES scenario	By 2050:
Falling Short Not net zero compliant	**767,000** non-hybrid heat pumps **31,000** hybrid heat pumps **100,000** homes heated by district heating heat pumps
System Transformation Net zero compliant	**508,000** non-hybrid heat pumps **393,000** hybrid heat pumps **141,000** homes heated by district heating heat pumps
Consumer Transformation Net zero compliant	**1,390,000** non-hybrid heat pumps **62,000** hybrid heat pumps **177,000** homes heated by district heating heat pumps
Leading the Way Net zero compliant	**1,165,000** non-hybrid heat pumps **178,000** hybrid heat pumps **156,000** 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 36,000 battery electric vehicles and 17,000 plug-in hybrid electric vehicles already registered in the South West licence area, totalling over 2% of all vehicles. This is projected to increase rapidly over the next decade.

The projections use local factors that influence uptake in the near term, including:

- 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, such as in Bristol.

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:
Falling Short Not net zero compliant	**567,000** battery electric vehicles **2,003 MW** (c. 290,000) domestic chargepoints **405 MW** of non-domestic chargepoints
System Transformation Net zero compliant	**858,000** battery electric vehicles **2,790 MW** (c. 400,000) domestic chargepoints **663 MW** of non-domestic chargepoints
Consumer Transformation Net zero compliant	**1,430,000** battery electric vehicles **5,681 MW** (c. 810,000) domestic chargepoints **798 MW** of non-domestic chargepoints
Leading the Way Net zero compliant	**1,527,000** battery electric vehicles **6,100 MW** (c. 870,000) domestic chargepoints **868 MW** 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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