

Distribution Future Energy Scenarios: Regional Review

West Midlands 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 West Midlands 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.



West Midlands story to date



As of April 2021, there is 1.9GW of distributed generation in the West Midlands licence area, 1.1GW of this is low carbon or renewable generation.

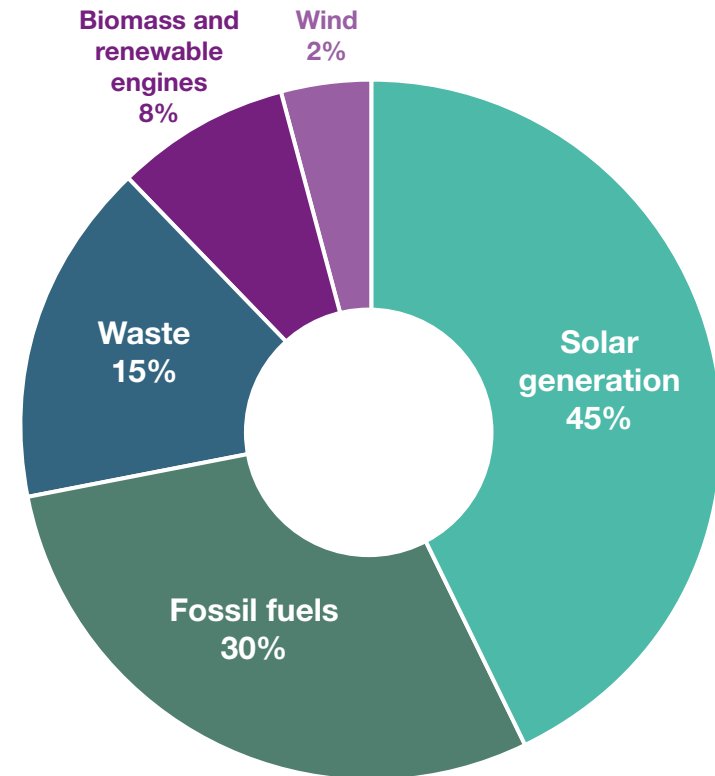
This distributed renewable generation capacity accounts for around 3% of the total renewable energy capacity in GB, enough to power around half a million homes.

Distributed electricity generation capacity in the licence area has increased significantly over the last five years, with over 50% of capacity having connected since 2015. Almost half this capacity comes from solar PV, in the form of both smaller-scale rooftop solar and larger solar farms.

Most of the remaining generation capacity comes from high carbon sources, across fossil gas, diesel and waste-fuelled power. Compared to its neighbouring licence areas, the West Midlands has very little onshore wind generation capacity, due to limited resource.

Electricity demand has changed more slowly. Only 0.6% of West Midlands' homes currently have a heat pump and only 1% of cars are electric. However, widespread change is expected as new policies are brought forward to encourage the electrification of heat and transport.

Total distributed energy generation in the West Midlands licence area



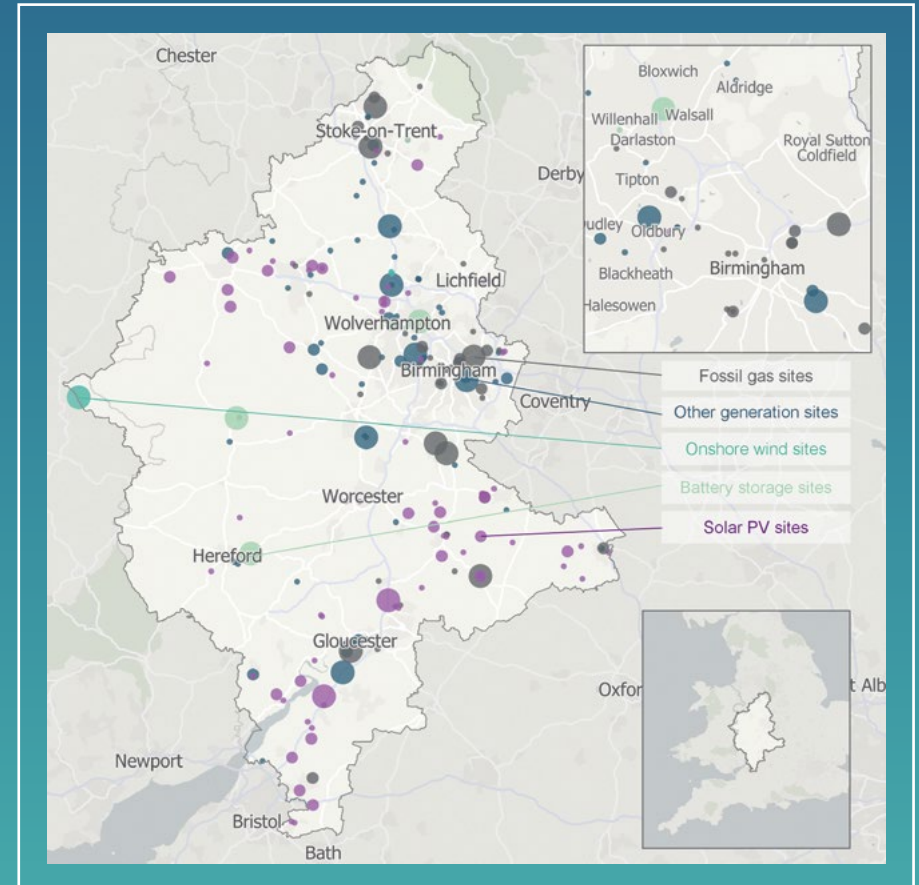
Distributed energy generation in the West Midlands licence area

Representing almost half the baseline capacity, large-scale solar PV is mainly connected in the south-east and north-west of the licence area.

The current deployment of solar PV avoids built-up areas, such as around Birmingham, and Areas of Outstanding Natural Beauty, such as the Shropshire and Malvern Hills.

Comparatively fewer onshore wind sites have been developed in the area. The biggest site sits right on the border of the licence area in Powys, Wales. Lower wind speeds and protected areas limit the number of viable sites for new onshore wind in the licence area.

Fossil-fuel generation sites, mainly fossil gas, are common in the east and north-east of the licence area. These sites are located near urban centres. For example, the largest capacity fossil gas sites are situated around Stoke-on-Trent, Birmingham and Gloucester.



Near term pipeline summary



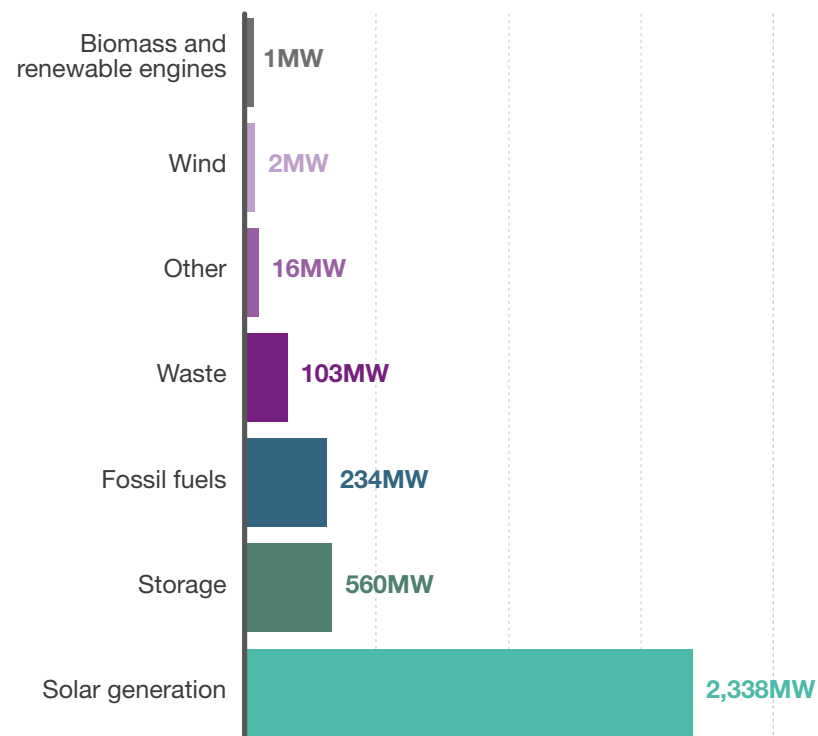
There are around 220 generation and storage projects, totalling 3.3GW that could connect to the West Midlands distribution network in the near future. These pipeline projects were assessed for planning status, participation in auctions, and via direct discussions with developers.

The majority of the pipeline, totalling 2.3GW, consists of ground-mounted solar farms. There are 38 solar sites of 40MW or larger in the pipeline. Most of the pipeline capacity accepted connection offers within 2020. While previous solar deployment has been more in the south of the UK, analysis shows clear interest to deploy new solar capacity in the West Midlands licence area as well.

With a recent commitment to a fossil-fuel-free electricity system by 2035, energy storage is projected to play a larger role in the energy system as the country decarbonises. There are 24 battery sites, totalling 560MW, with accepted connection offers that could connect in the near term. The energy storage pipeline is over six times the current installed capacity.

The majority of the remaining pipeline capacity is new fossil gas-fired generation, totalling 200MW of potential capacity. This is mainly composed of reciprocating engines aiming to provide flexibility services to the grid.

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

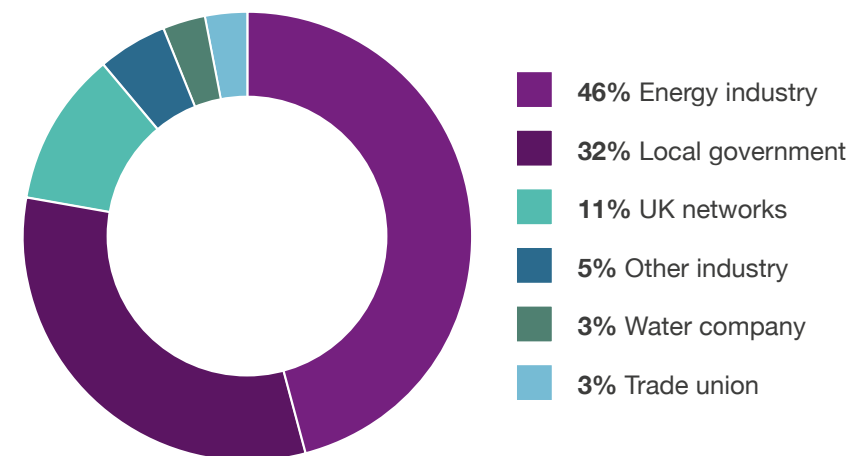
Four consultation events were held in June and July 2021 with 226 attendees across the four licence areas. Each local authority in WPD's licence areas was also contacted as part of the analysis of planned new housing and non-domestic developments.

In the West Midlands consultation webinar, 79% of respondents were already aware of the WPD DFES process. Stakeholders mainly wanted to learn more about the deployment of renewables and low carbon technologies in the West Midlands, and understand more about the DFES process.

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 a high proportion of households in the licence area located in urban areas, attendees were asked for views on the role of resistive electric heating such as night storage heaters in a future net zero scenario, which are more common in urban areas. In addition, views were sought on the potential solutions for electric vehicle charging for on-street parked vehicles, which are also most common in built-up areas.

West Midlands 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.	1.1GW Including: 0.9GW of solar.	2.1GW	92MW Around 8% of the GB total installed battery storage capacity.	225MW		
	Low levels of decarbonisation and societal change.						
System Transformation Net zero compliant	High level of decarbonisation with lower societal change. Larger, more centralised solutions are developed. This scenario has the highest levels of hydrogen deployment.					2.9GW	331MW
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.					3.7GW	516MW
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.		5.0GW		634MW		

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.	21 Equivalent to: 1% of total vehicles.	1,206 34% of total vehicles.	18 Heat pumps 0.7% of homes.	345 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.				1,862 52% of total vehicles.	304 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.	2,663 75% of total vehicles.
Leading the Way Net zero compliant 		Very high levels of decarbonisation and societal change. Consumers adopt new technologies rapidly, and a mix of solutions are developed. This scenario aims for the “fastest credible” decarbonisation pathway.	2,874 81% of total vehicles.	1,328 52% 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 78,000 and 102,000 homes are projected to be built in the West Midlands over the next five years, including several urban expansions around towns and cities, such as around Worcester, Birmingham, Gloucester and Stoke-on-Trent.

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.



Renewable energy generation



There is currently c. 0.9GW of solar PV connected in the West Midlands licence area, split roughly equally between large-scale ground-mounted arrays, and smaller-scale rooftop installations.

Despite having less baseline capacity than the neighbouring East Midlands and South West licence areas, the West Midlands still has significant potential for solar PV deployment. The pipeline of sites with accepted network connection offers exceeds 2GW, the second-highest of the four WPD licence areas.

Deployment in the West Midlands and GB as a whole 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. The cost of deploying solar has also reduced dramatically over the last decade. Under the highest DFES scenario, the West Midlands hosts over 7GW of solar PV capacity by 2050.

Onshore wind potential is low in the licence area, due to limited wind speeds and built-up or protected areas. As a result, even the most ambitious scenario, Leading the Way, has less than 300MW wind capacity 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 currently almost 600MW of fossil-fuelled generation in the licence area, including the 100MW Fort Dunlop OCGT site in Birmingham. Around three-quarters of the 600MW baseline capacity is fuelled by fossil gas, with the remainder fuelled by diesel. The pipeline, consisting of 234MW across 25 projects, is all fuelled by fossil gas.

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 West Midlands, serving hydrogen-fuelled vehicles, and a number of innovation trials underway. By 2050, distribution-connected hydrogen electrolysis capacity in the West Midlands licence area ranges significantly from less than 0.1GW to 2.1GW, reflecting the scale of uncertainty in this technology. Hydrogen-fuelled generation could reach up to 0.7GW, slightly higher than the current fossil fuel baseline that it replaces.

Electricity storage



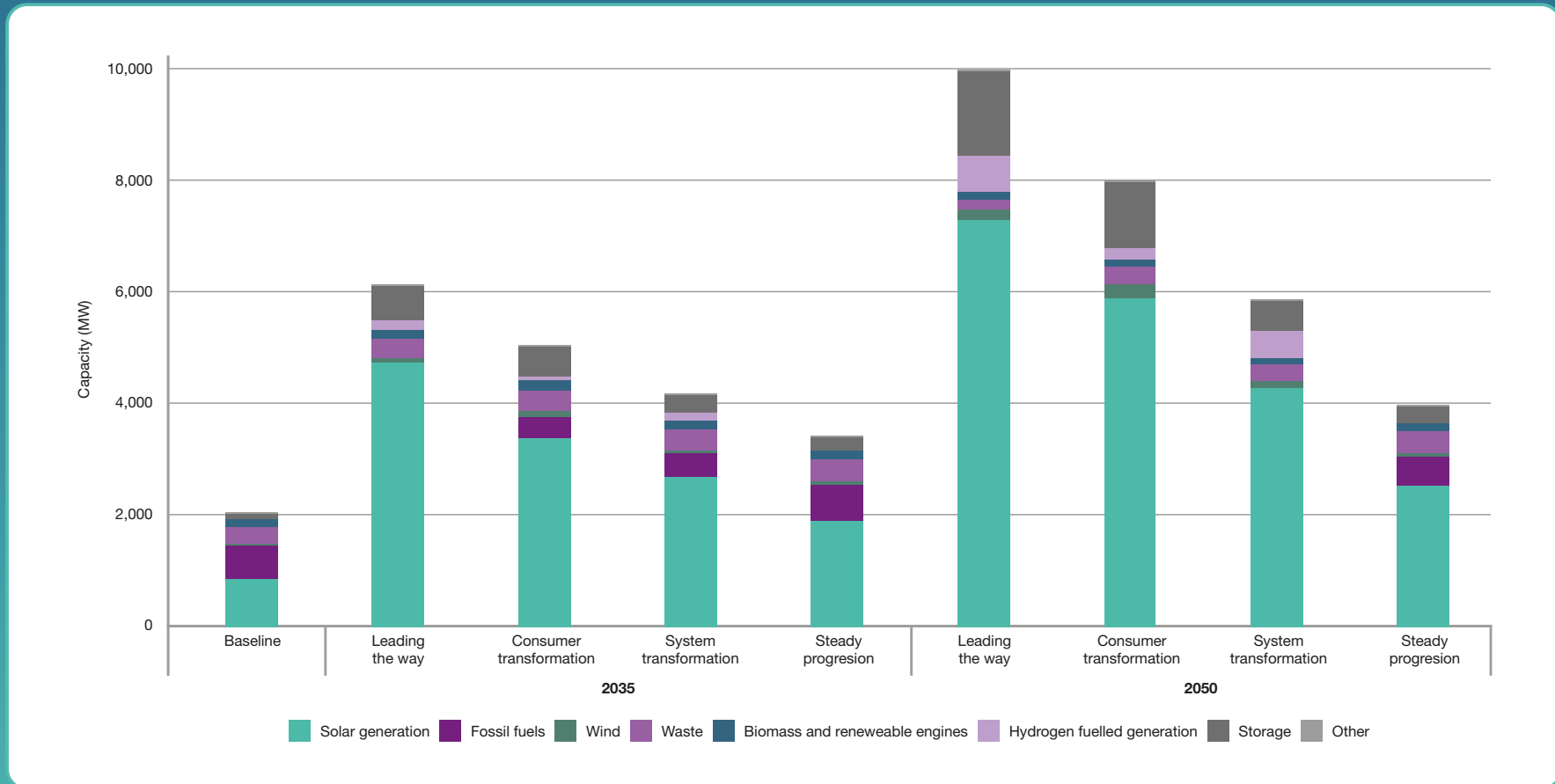
Electricity storage is expected to be critical for balancing a high renewables electricity system.

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 West Midlands licence area has a total of 92MW of battery storage, the highest across the four WPD licence areas, made up of 14 sites. This includes a single 41MW site in Lichfield. DFES analysis shows there to be 24 pipeline sites, totalling 560MW, which could connect in the near term. Future business models for new storage assets include co-location with renewable generators and non-domestic consumers, as well as domestic batteries.

There is a wide envelope of deployment between the scenarios. Overall battery storage capacity in 2050 in the West Midlands licence area ranges from c. 0.3GW in Steady Progression to 1.5GW in Leading the Way.

Distribution connected generation and storage scenarios WPD West Midlands 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 West Midlands licence area currently has around 270,000 properties electrically heated, including around 14,000 domestic heat pumps.

This equates to 0.6% of homes with heat pumps, in line with the national average.

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 West Midlands 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 in the near and medium term.

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.

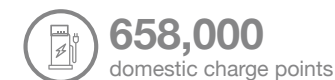
There are around 21,000 battery electric vehicles and 15,000 plug-in hybrid electric vehicles registered in the West Midlands licence area, totalling around 2% of all vehicles. This is projected to increase rapidly over the next decade. The projections use local factors that influence take up in the near term, including:

- 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:

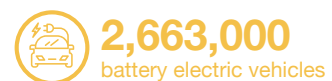
Steady Progression



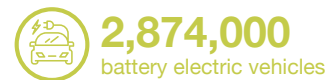
System Transformation Net zero target compliant



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:

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