

# Distribution Future Energy Scenarios: Regional Review

East 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 East Midlands licence area. During the next 30 years, we are predicting 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.

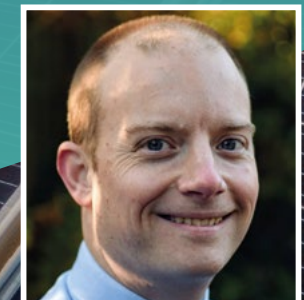
Our annual DFES cycle allows incorporation of newly developed and projected technologies to the analysis. In DFES 2021, we have included hydrogen electrolysis, hydrogen-fuelled generation and further granularity to electrified heating technology demand profiles.

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.



# East Midlands story to date



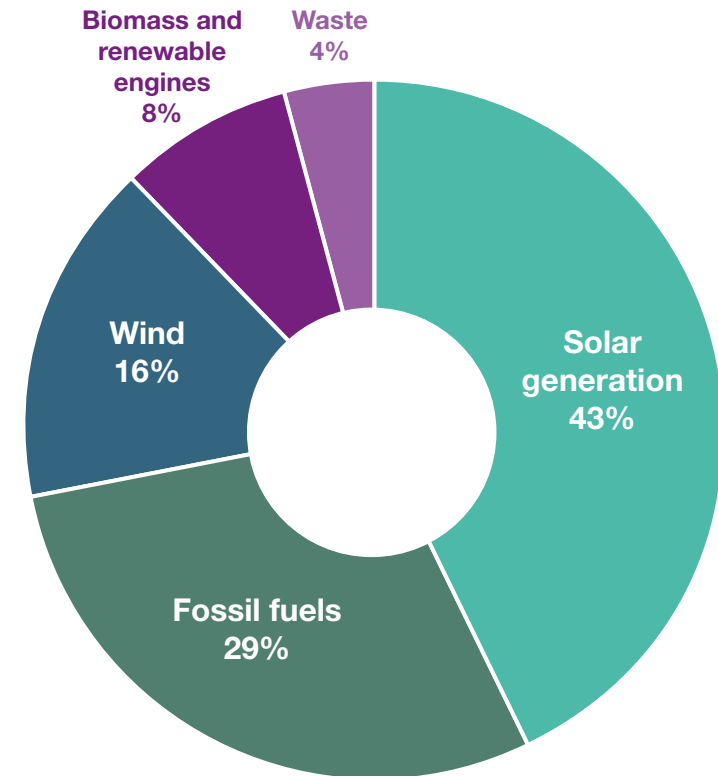
As of April 2021, there is 3.7GW of distributed generation in the East Midlands licence area, 2.5GW of this is low carbon or renewable generation.

This distributed renewable generation capacity accounts for around 7% of the total renewable energy capacity in GB, enough to power over 1 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. Solar and wind account for around 60% of the total generation capacity in the licence area, across rooftop PV, solar farms, onshore and offshore wind. Fossil-fuelled generation, both fossil gas and diesel, make up most of the remaining capacity. Alongside waste-fuelled generation, which is situated around the built-up areas in the west of the licence area, where demand is highest.

Electricity demand has changed more slowly. Only 0.7% of East Midlands homes currently have a heat pump and 1.2% of cars are battery 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 East Midlands licence area



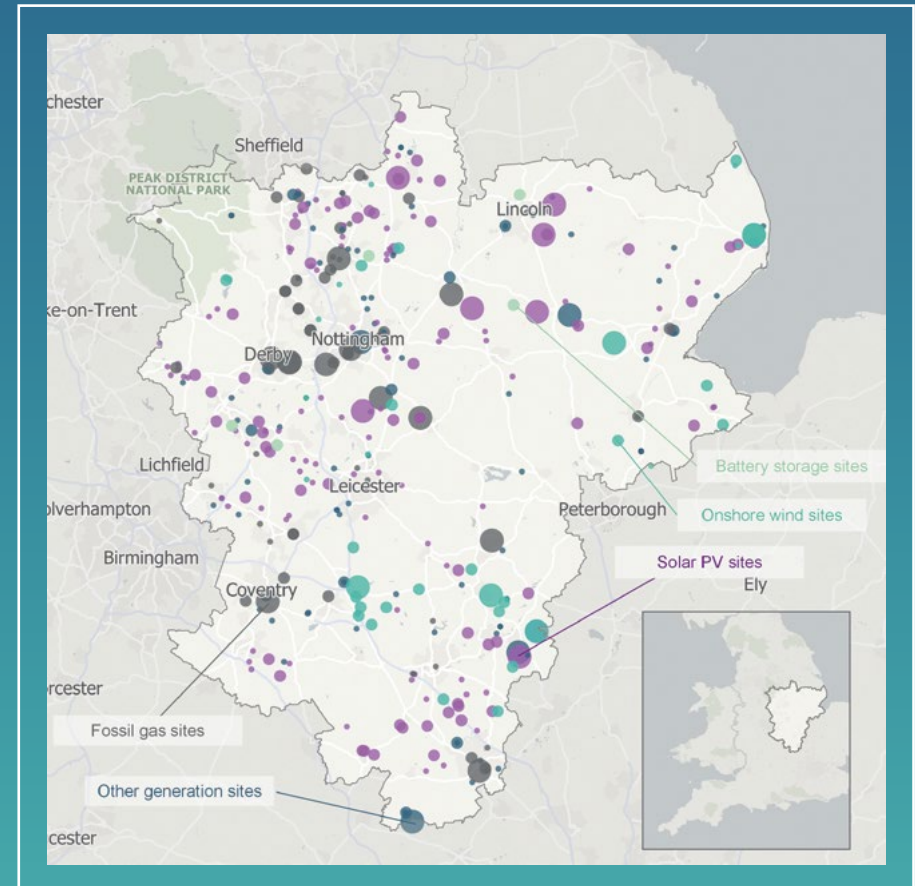
## Distributed energy generation in the East Midlands licence area

The majority of distributed generation is hosted in the more built-up western half of the East Midlands licence area, containing several population centres along the M1 motorway.

A significant proportion of this is fossil gas generation sites.

The more rural nature of the eastern half of the licence area has seen the deployment of larger scale solar and wind projects in recent years. However, high-grade agricultural land, such as the East Anglian fenland in the south-east of the licence area, has not seen any deployment.

The East Midlands as a region has a long history of fossil-fuelled power generation, having hosted a number of transmission-scale fossil gas and coal-fired power stations. Several large scale fossil gas generation sites are located around Nottingham and Derby, but the largest in the licence area is the 350MW Corby Power Station in Northamptonshire.



# Near term pipeline summary



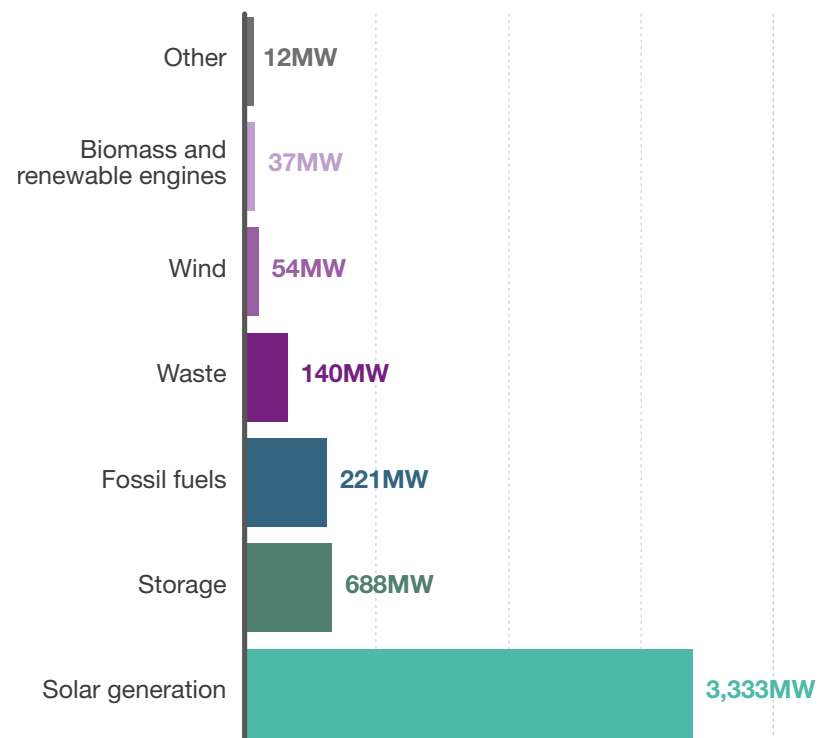
There are over 300 generation and storage projects, totalling 4.5GW that could connect to the East Midlands distribution network in the near future. These pipeline projects were assessed for planning status, participation in auctions, and via direct discussions with developers.

Increased activity in solar and battery storage development has seen the pipeline increase significantly in recent years. Well over half of the pipeline capacity secured a network connection offer in the past two years. Although deployment of solar PV has slowed in recent years, the pipeline shows that there is increasing interest in deploying new capacity in the licence area.

Solar PV represents almost three-quarters of the pipeline capacity. This includes 44 sites of 40MW or greater, totalling 2.2GW of potential capacity from these sites alone. Nine pipeline battery storage projects, also of a scale of 40MW or greater, total an additional 480MW.

New fossil-fuelled generation and energy from waste plants also make up a significant proportion of the known pipeline. The pipeline of these technologies has decreased compared to previous DFES assessments.

## Generation and storage sites with an accepted connection offer in the East 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.**

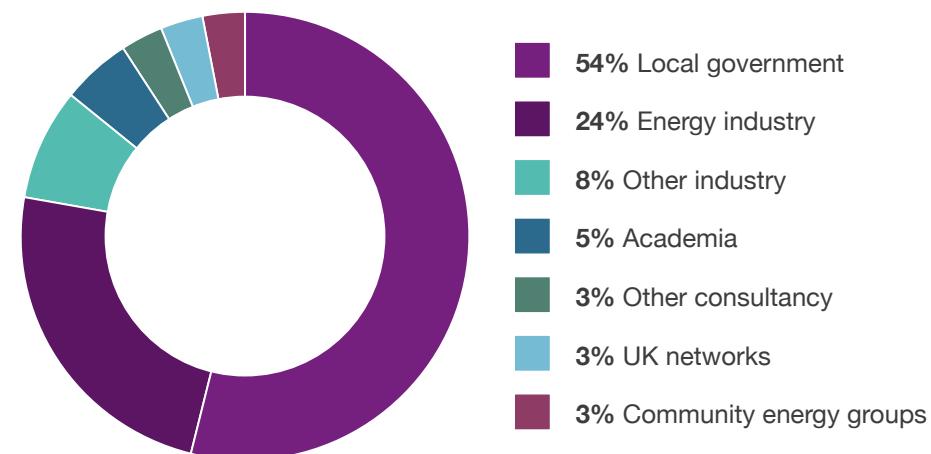
Four consultation events were held in June and July 2021 with 226 attendees across the four licence areas. Each local authority in WPD's licence areas was also contacted as part of the analysis of planned new housing and non-domestic developments.

In the East Midlands consultation webinar, 76% 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 licence area, and hear more from WPD about the distribution network in the East Midlands.

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.

Due to the particularly large pipeline of solar PV connections in the East Midlands licence area, attendees were asked for insight as to why the licence area was particularly attractive to solar developers. Stakeholders were also asked about the uptake of electric vehicles in the East Midlands, and why it is currently ahead of the national average.

## East 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
<b>Steady Progression</b> Not net zero compliant	Not compliant with the net zero emissions target.	<b>2.5GW</b>  Including: 1.6GW of solar 0.6GW of wind.	<b>4.7GW</b>	<b>49.5MW</b>  Around 4% of the GB total installed battery storage capacity.	<b>101MW</b>
	Low levels of decarbonisation and societal change.				
<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.		<b>6.1GW</b>		<b>254MW</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 has significant electrification of domestic heat.		<b>7.3GW</b>		<b>464MW</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 are developed. This scenario aims for the “fastest credible” decarbonisation pathway.	<b>8.3GW</b>	<b>625MW</b>		



# 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)	
<b>Steady Progression</b> Not net zero compliant	Not compliant with the net zero emissions target.	<b>28</b> Equivalent to: 1.2% of total vehicles.	<b>1,385</b> 34% of total vehicles.	<b>18</b> Heat pumps 0.7% of homes.	<b>387</b> 14% of homes.	
	Low levels of decarbonisation and societal change.					
<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.				<b>2,110</b> 52% of total vehicles.	<b>362</b> 13% of homes.
	<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 has significant electrification of domestic heat.	<b>3,034</b> 75% of total vehicles.
<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 are developed. This scenario aims for the “fastest credible” decarbonisation pathway.	<b>3,268</b> 81% of total vehicles.	<b>1,577</b> 53% of homes.		

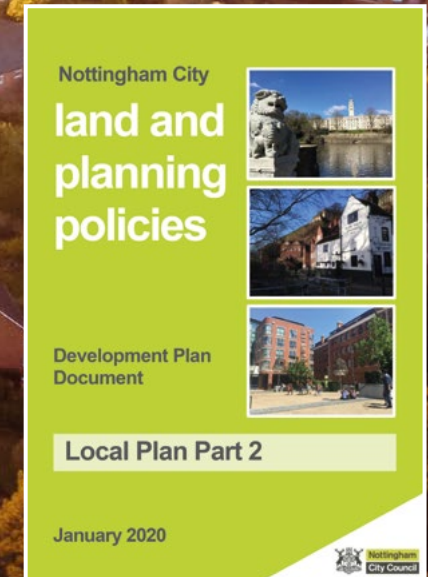
## Working with local authorities

**New homes and 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 126,000 and 164,000 homes are projected to be built in the East Midlands over the next five years, with some of the largest individual domestic developments being located on the outskirts of existing population centres such as Rugby, Leicester and Milton Keynes.

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 over 1.5GW of solar PV connected in the East Midlands licence area, including over 1GW of large scale ground-mounted arrays.**

The East Midlands has become a key area for the deployment of ground-mounted solar PV over recent years. The area has the highest installed capacity of the 4 WPD licence areas, and a pipeline of new sites with accepted network connection offers totalling over 3GW.

Deployment in the East 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, 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 scenario, the East Midlands hosts c. 11GW of distributed solar PV capacity by 2050.

As seen in the baseline, the licence area also has strong onshore and offshore wind resource, despite a minimal pipeline of just 54MW. Under the highest scenario, combined wind capacity reaches over 2GW by 2050.

## Fossil-fuelled energy generation



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

The largest site in the East Midlands licence area is Corby Power Station, with a capacity of 350MW, around one-third of the total 1.1GW of fossil-fuelled generation capacity in the licence area. Most of the current sites are towards the west of the licence area, around Derby and Nottingham and other population centres along the M1 corridor.

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 electrolyser in East Midlands, serving hydrogen-fuelled vehicles, and a number of innovation trials underway. By 2050, distribution-connected hydrogen electrolysis capacity in the East Midlands licence area ranges significantly from less than 0.1GW to 1.4GW, reflecting the scale of uncertainty in this technology. Hydrogen-fuelled generation could reach up to 1.4GW, slightly higher than the current fossil fuel baseline that it replaces.

## Electricity storage



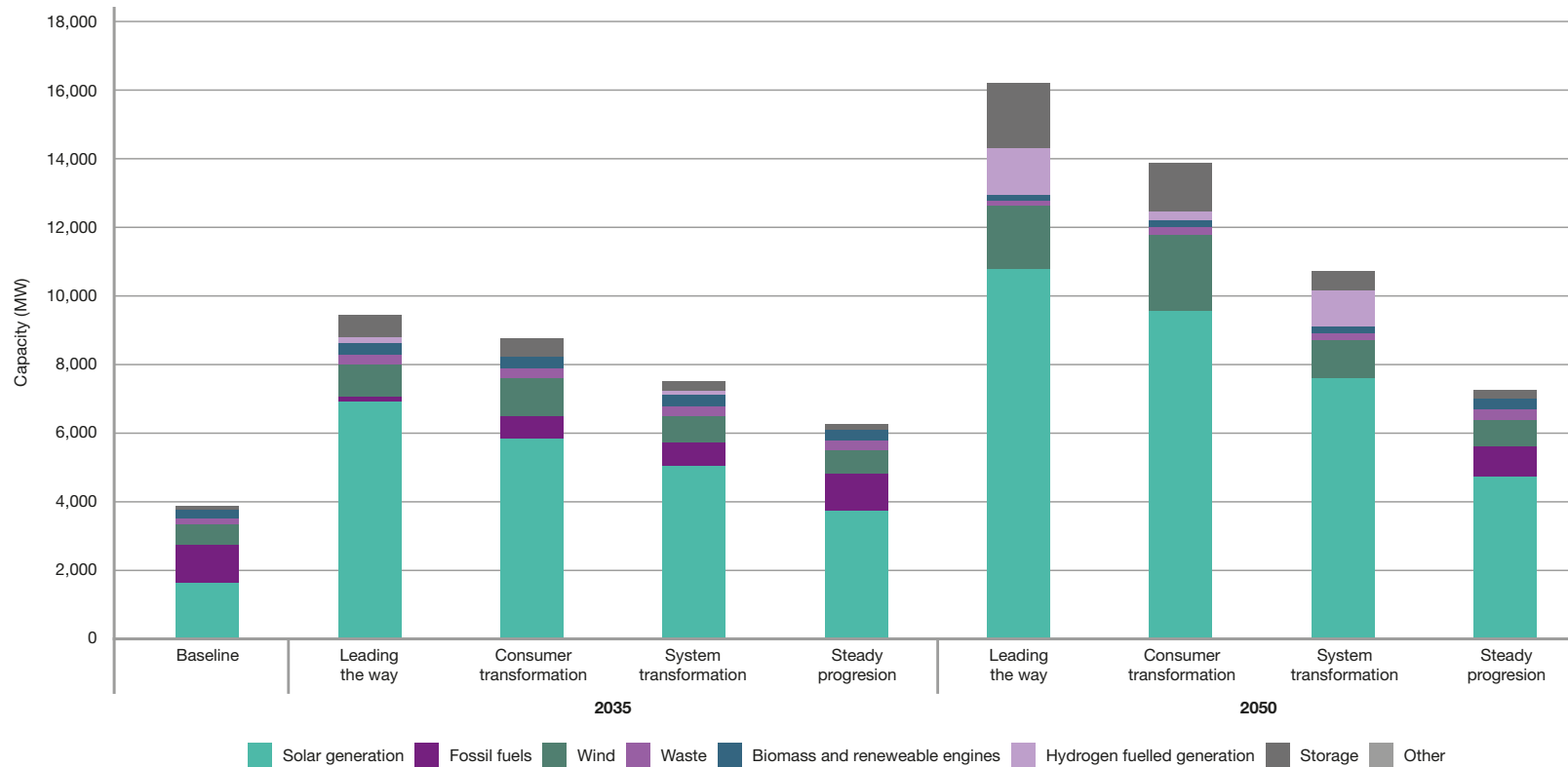
**Electricity storage is expected to be critical for balancing a high renewables electricity system.**

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 East Midlands licence area has a total of 49MW of battery storage, made up of 13 sites, three of which are 10MW in capacity. DFES analysis shows there to be 41 pipeline sites, totalling 688MW, 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.

Due to the scenario-specific assumptions around the deployment of other providers of network services, there is a wide envelope of deployment between the scenarios. Overall battery storage capacity in 2050 in the East Midlands licence area ranges from c. 0.2GW in Steady Progression to 1.8GW in Leading the Way.

## Distribution connected generation and storage scenarios WPD East 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 East Midlands licence area currently has around 250,000 properties electrically heated, including around 18,000 domestic heat pumps.

This equates to 0.7% of homes with a heat pump, slightly above the national average of 0.6%.

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

National policy is expected to see off-gas homes and new build homes targeted in the near term. The East 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.

## 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.

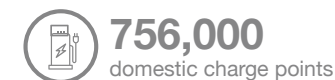
There are around 28,000 battery electric vehicles and 21,000 plug-in hybrid electric vehicles registered in the East Midlands licence area, totalling around 2% of all vehicles. This is projected to increase rapidly over the next decade. The projections use local factors that influence take up in the 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:

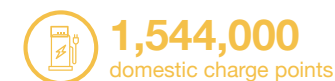
## Steady Progression



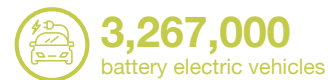
## System Transformation Net zero target compliant



## 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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