DistributionSystemOperator

National Grid DFES 2023 regional review

East Midlands

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Contents

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.

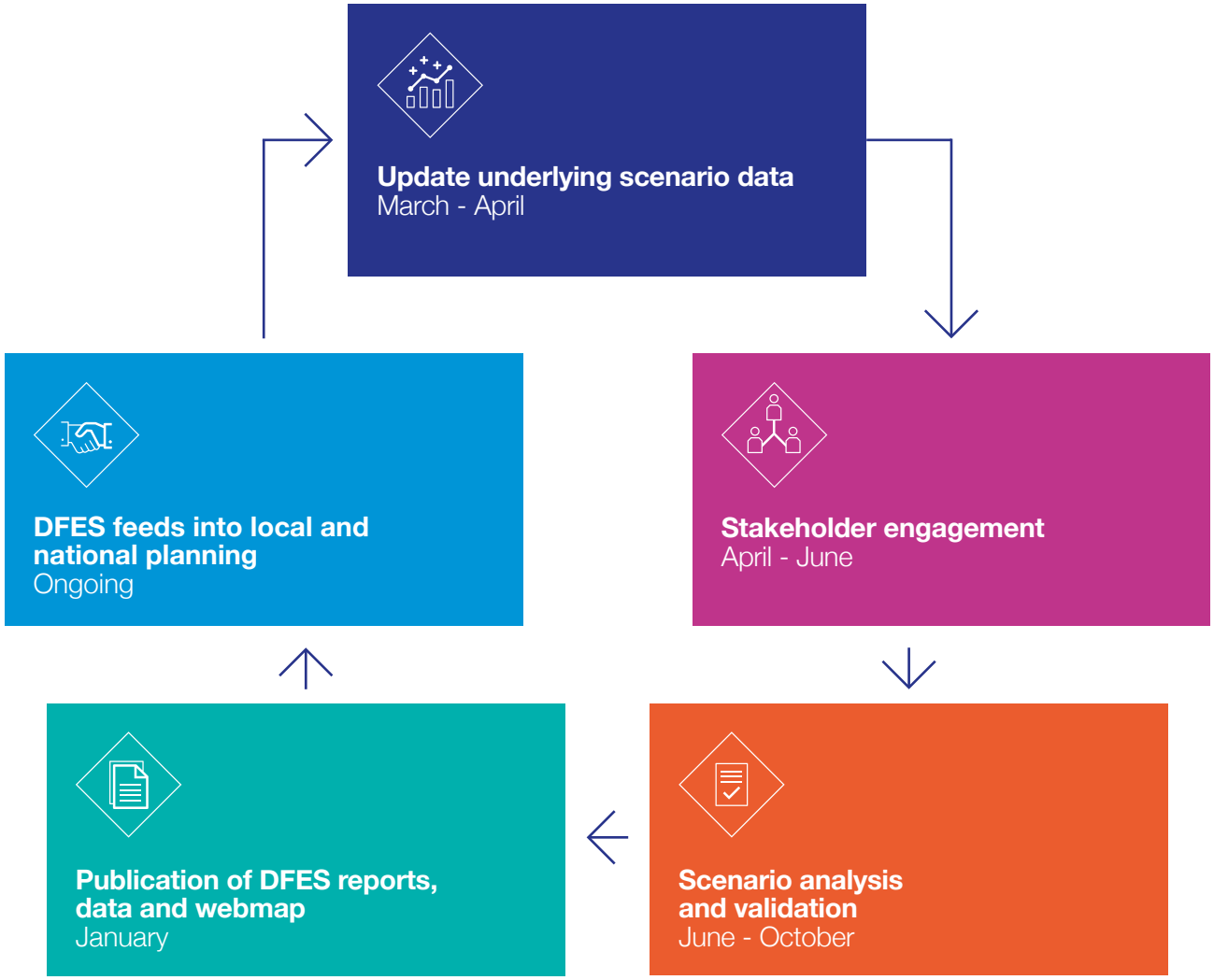
Using the National Grid ESO Future Energy Scenarios (FES) framework, these local stakeholder-informed projections are created on an annual cycle and encompass changes in electricity generation, storage and demand, including electrified transport and heat.

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 East Midlands licence area

As of September 2023, there is 4.3 GW of distributed electricity generation in the East Midlands licence area.

This equates to around 13% of the total distributed generation capacity in GB. The majority of this generation, totalling 2.7 GW, is renewable or low carbon generation.

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

Solar and wind generation accounts for around 60% of total distributed generation capacity in the licence area across rooftop PV, solar farms, onshore and offshore wind.

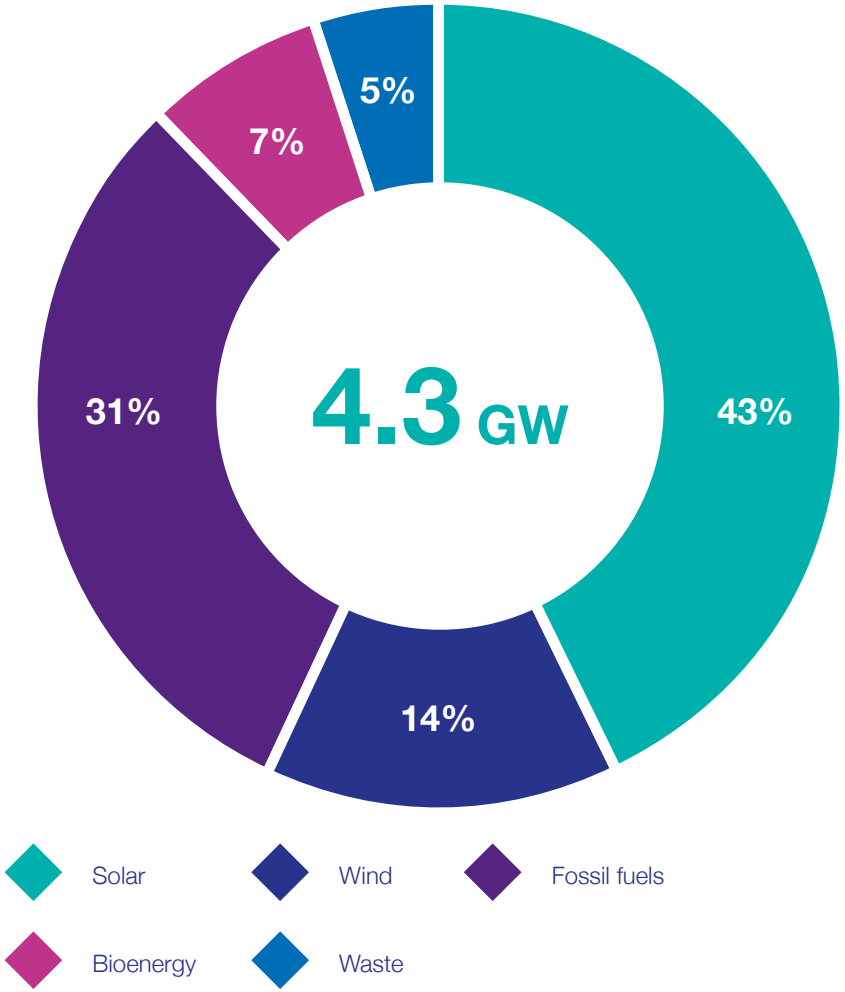
Fossil-fuelled generation, both fossil gas and diesel, make up most of the remaining capacity. In recent years, a number of large-scale battery storage sites have also commissioned in the licence area.

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 over 1% of homes in the East Midlands licence area are heated by a heat pump, and around 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 East Midlands licence area



Distributed electricity generation in the East Midlands

The majority of distributed generation is hosted in the more built-up western half of the East Midlands licence area, with a notable amount of fossil gas generation sites located nearby to population centres along the M1 motorway, such as Nottingham and Leicester.

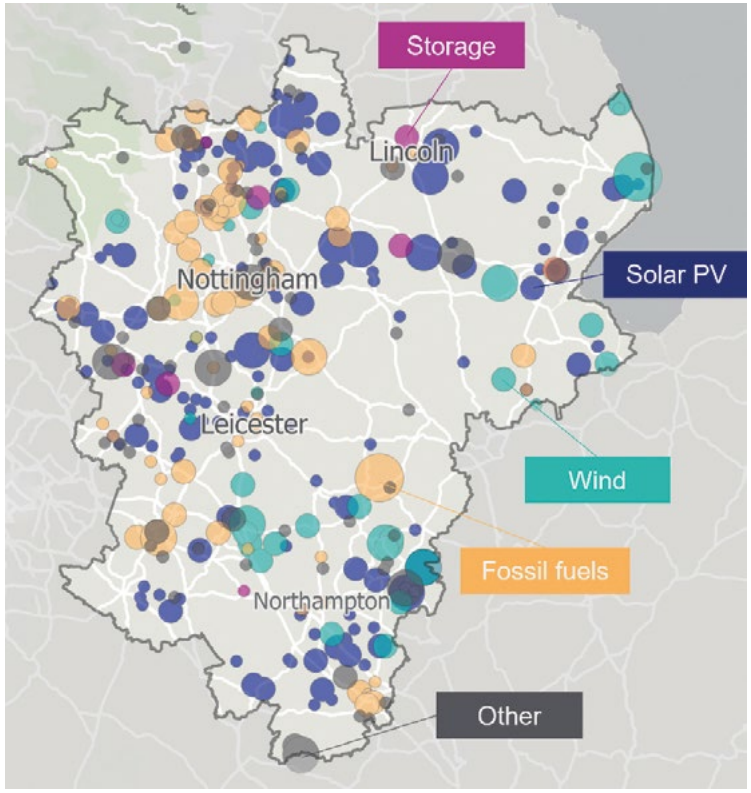
The East Midlands as a region has a long history of fossil-fuelled power generation, having hosted a number of transmission-scale fossil gas and coal-fired power stations.

Several distribution-connected fossil gas generation sites are located around Nottingham and Derby, but the largest in the licence area is the 407 MW Corby Power Station in Northamptonshire. In recent years, a number of large-scale battery storage projects have commissioned in similar areas.

The more rural nature of the eastern half of the licence area has driven the deployment of large-scale solar and wind projects in recent years.

However, high-grade agricultural land areas have not seen any deployment. The east coast also features the Lynn and Inner Dowsing offshore wind farms, connected in 2008, each with a capacity of 97 MW.

East Midlands licence area - baseline connections



The western side of the licence area contains major population centres like Nottingham and Leicester, which host most of the area's fossil fuel generation capacity.

Much of the 'other' generation in the baseline is waste incineration, as a result of the high population in the licence area.

The more rural eastern and southern parts of the licence area contain some areas of wind resource, particularly around Northampton and in Lincolnshire. The East Midlands also hosts off shore wind capacity, in the form of the Lyn and Inner Dowsing wind farms.

Near-term pipeline summary

There are over 900 generation and storage projects, totalling 15.3 GW, that hold accepted connection agreements and could connect to the East Midlands 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 capacity significantly increasing in recent years.

Over 80% of this pipeline capacity secured a network connection offer after January 2021.

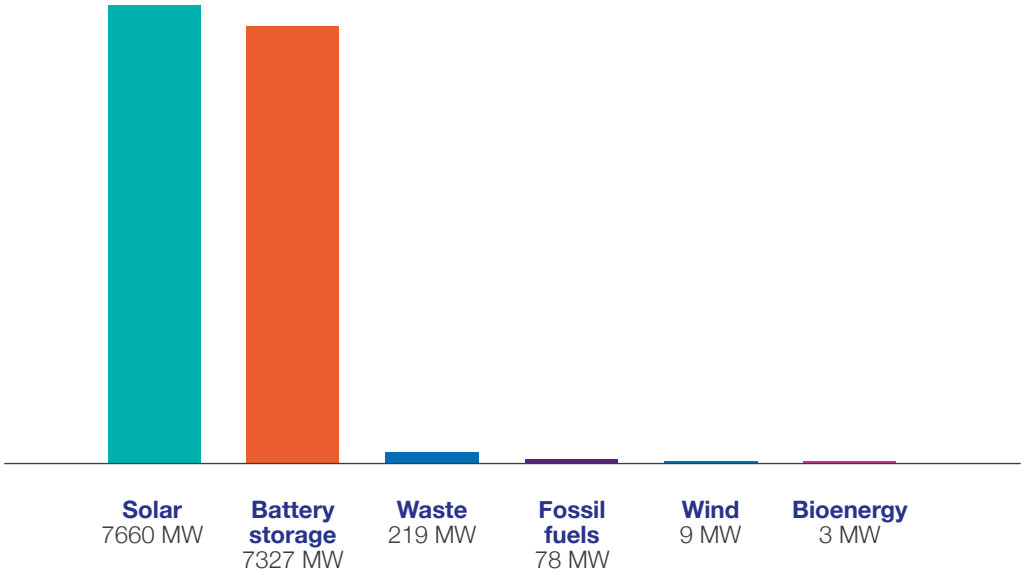
Although deployment has slowed in recent years, the DFES analysis shows that there is an increasing interest in deploying new generation and storage capacity in the licence area.

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 180 battery sites, totalling 7.3 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 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 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.

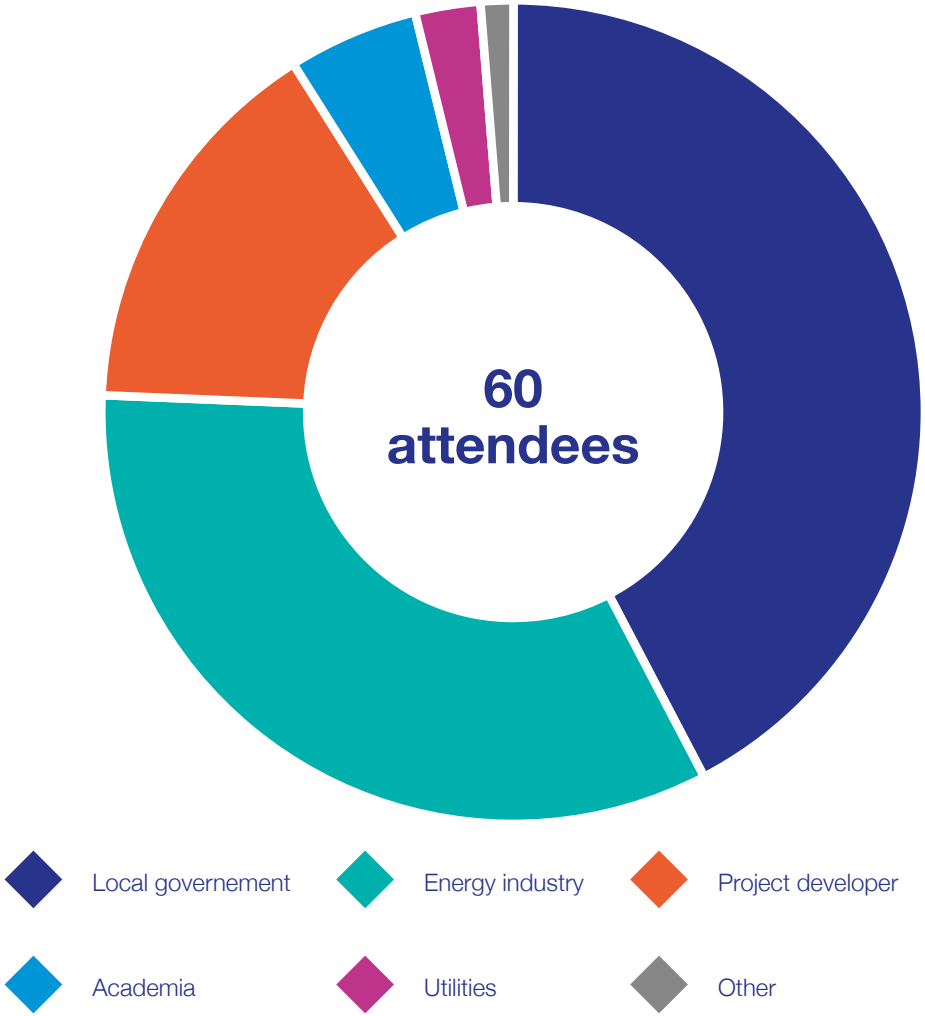
Attendees were asked for views on:

- The rate of rooftop solar PV uptake on domestic and non-domestic buildings
- Support for onshore wind development in the East Midlands
- Future prospects for conversion of fossil fuel generation sites to low carbon fuels or energy storage
- The future of rapid en-route charging for electric vehicles
- The potential uptake of air-to-air heat pumps to provide heating and cooling in homes
- The rate of heat pump uptake in non-domestic buildings.

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.

East Midlands webinar registrants



Working with local authorities

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

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

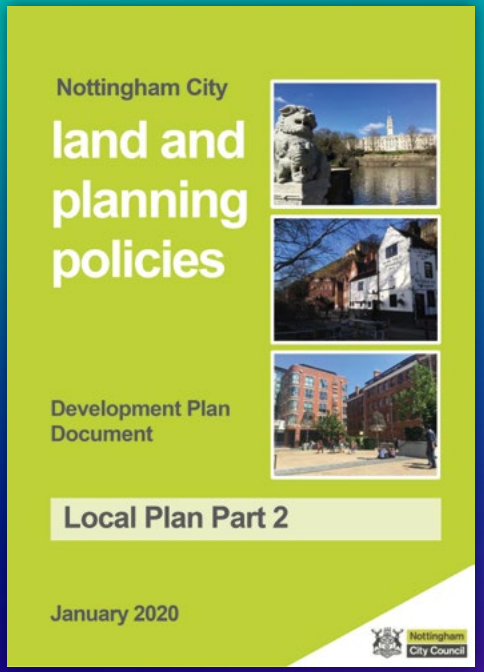
Where and when these buildings and associated low carbon technologies are expected to connect is determined using the scenario framework and based on data sourced from local authority plans, historic building rates and direct engagement with local authority planning departments.

High and low scenarios were produced to model the variable building rates of these developments over the scenario period, out to 2050. Between 135,000 and 220,000 homes are projected to be built in the East Midlands 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 East Midlands 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.	**2.7 GW** Including: 1.8 GW of solar 0.6 GW of wind	**5.4 GW**	**0.2 GW**	**1.4 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.		**6.8 GW**		**1.6 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.		**8.1 GW**		**2.6 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.		**9.0 GW**		**3.4 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 Not net zero compliant	**78** 1.9% of total vehicles	**1,040** 25% of vehicles	**25** 1.0% of homes	**315** 11% of homes	**0.0GW**	**0.0 GW**
System Transformation Net zero compliant		**1,560** 38% of vehicles		**230** 8% of homes		**0.1 GW**
Consumer Transformation Net zero compliant		**2,604** 63% of vehicles		**1,035** 42% of homes		**0.1 GW**
Leading the Way Net zero compliant		**2,781** 68% of vehicles		**1,188** 41% of homes		**0.2 GW**

Renewable energy generation

There is currently over 1.8 GW of solar PV connected in the East Midlands licence area, including nearly 1.2 GW of large-scale ground-mounted solar arrays.

The East Midlands has become key area for the deployment of ground-mounted solar PV over recent years due to land availability, grid infrastructure and relatively high irradiance.

The area has both the highest installed capacity of NG's four licence areas and over 7.6 GW of sites with accepted network connection offers.

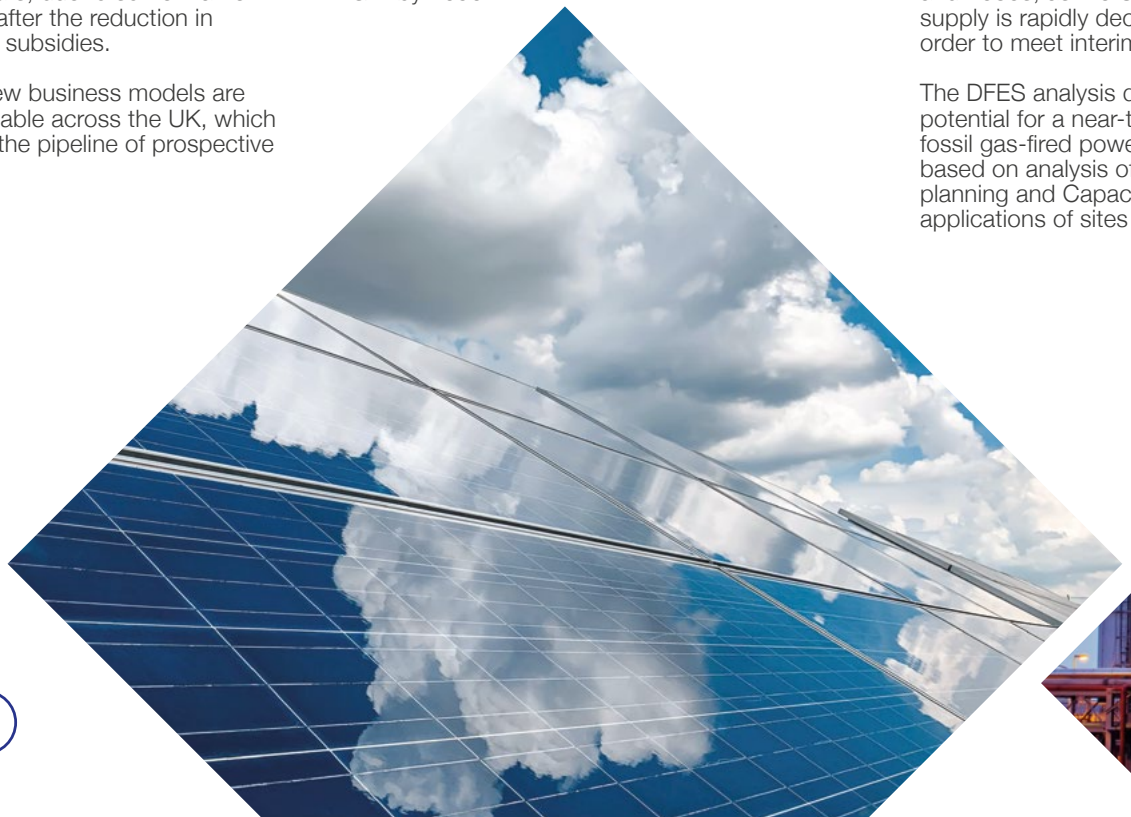
Solar deployment in the East Midlands and GB as a whole has stagnated in recent years, due to some market uncertainty after the reduction in government subsidies.

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

The cost of deploying solar has also reduced dramatically over the last decade. Under the highest DFES scenario, the East Midlands hosts c. 12 GW of distributed solar PV capacity by 2050.

As seen in the baseline, the licence area also has strong onshore wind resource. However, there are no significant projects in the pipeline.

Under the highest scenario, total wind capacity reaches over 2.1 GW by 2050.



Fossil-fuelled generation

While at odds with net zero ambitions, fossil-fuelled power stations are prevalent in the licence area, totalling 1.3 GW.

The largest site in the East Midlands licence area is Corby Power Station, a 407 MW closed-cycle gas turbine site that came online in 1994.

Most of the existing fossil-fuel sites are in the west of the licence area, around 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, 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 East Midlands licence area currently has less than 0.2 GW of connected electricity storage capacity.

However, the project pipeline totals over 7.3 GW, 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 East Midlands licence area resultantly ranges from 1.6 GW under Falling Short to 4.5 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.

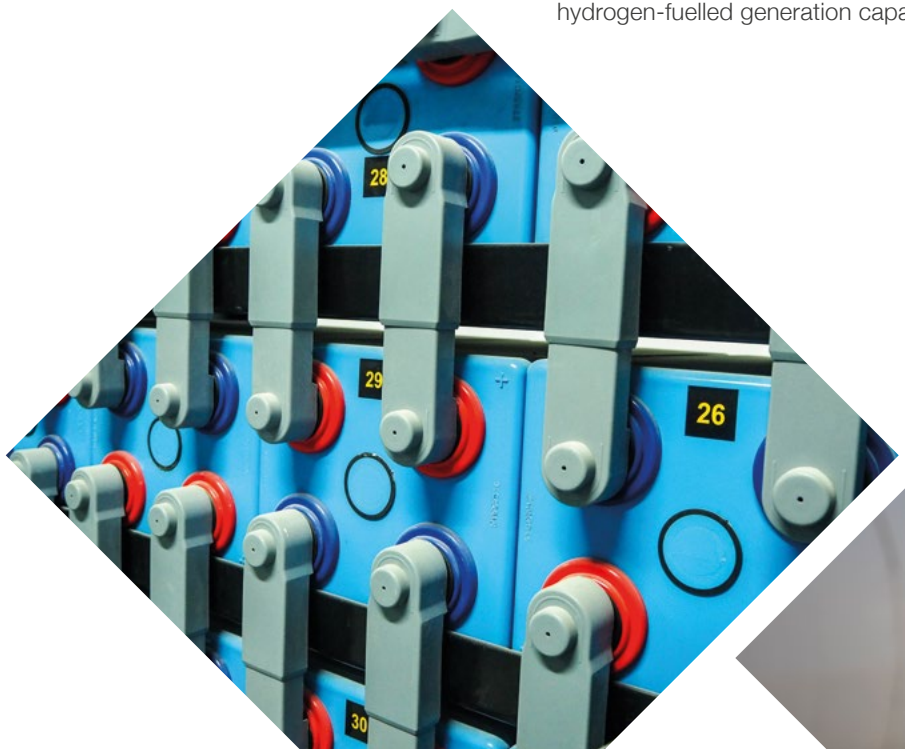
This could include for industrial processes, electricity generation or as a fuel for heavy vehicles.

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.

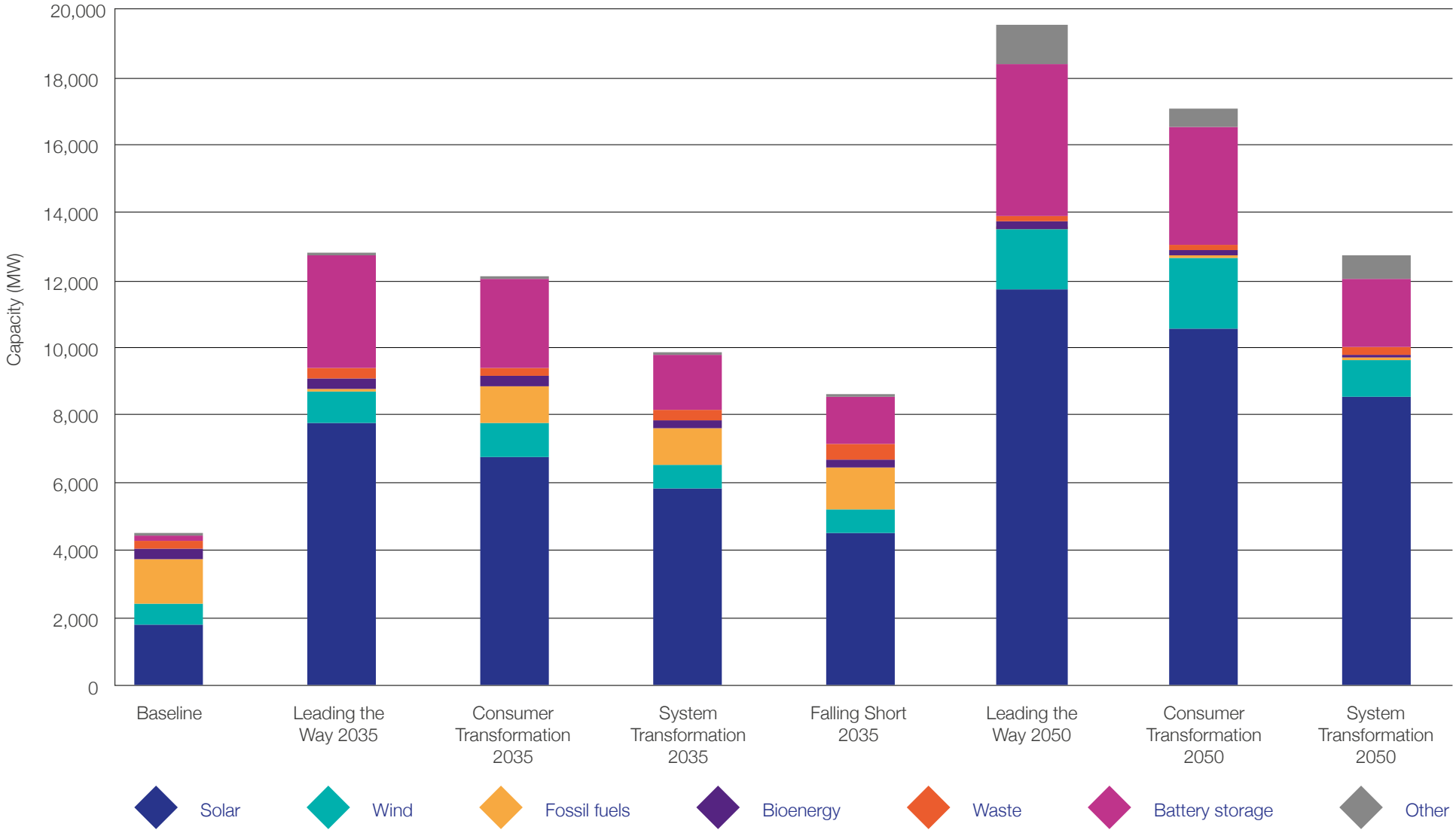
In addition, the level of hydrogen availability impacts other areas of the distribution network, i.e. as an alternative to the level of electrified heating and transport.

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

Hydrogen-fuelled generation could reach up to 1.1 GW, a similar capacity to the current fossil fuel baseline that it could replace.



Distribution-connected generation and storage scenarios – NG East Midlands 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 East Midlands licence area currently has over 220,000 properties heated electrically, including over 25,000 domestic heat pumps.

This equates to 1.0% of all homes in the licence area having a heat pump, in line with 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 East Midlands 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 Not net zero compliant	**1,235,000** non-hybrid heat pumps **21,000** hybrid heat pumps **202,000** homes heated by district heating heat pumps
System Transformation Net zero compliant	**657,000** non-hybrid heat pumps **757,000** hybrid heat pumps **282,000** homes heated by district heating heat pumps
Consumer Transformation Net zero compliant	**2,413,000** non-hybrid heat pumps **42,000** hybrid heat pumps **351,000** homes heated by district heating heat pumps
Leading the Way Net zero compliant	**1,964,000** non-hybrid heat pumps **286,000** hybrid heat pumps **299,000** 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 nearly 77,000 battery electric vehicles and 45,000 plug-in hybrid electric vehicles already registered in the East Midlands licence area, totalling around 3% 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.

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	**1,040,000** battery electric vehicles **3,316 MW** (c. 470,000) domestic chargepoints **639 MW** of non-domestic chargepoints
System Transformation Net zero compliant	**1,560,000** battery electric vehicles **4,692 MW** (c. 670,000) domestic chargepoints **1,068 MW** of non-domestic chargepoints
Consumer Transformation Net zero compliant	**2,605,000** battery electric vehicles **9,281 MW** (c. 1,300,000) domestic chargepoints **1,331 MW** of non-domestic chargepoints
Leading the Way Net zero compliant	**2,781,000** battery electric vehicles **9,984 MW** (c. 1,400,000) domestic chargepoints **1,418 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 2022 outputs are **available online.** The results are also available as an **interactive map.**

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