Electricity Distribution

Distribution Future Energy Scenarios 2023

Methodology
December 2023

nationalgrid

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transforming energy

Contents

Introduction to DFES

The Distribution Future Energy Scenarios (DFES) outline a range of credible futures for connections to the distribution network.

DFES makes use of a scenario framework that is consistent with other distribution network operators and National Grid ESO, known as the Future Energy Scenarios (FES).

The local stakeholder-informed DFES projections encompass potential changes in distributed generation, electricity storage and demand, including electrified heat and transport.

National Grid Electricity Distribution (NGED) works with Regen to undertake the DFES analysis out to 2050 for all four of its licence areas on an annual cycle.

The suite of NG DFES 2023 outputs are available online.

The results are also available as an interactive map.

The need for scenario-based planning

Our energy system is changing. Achieving a net zero electricity system by 2035, and a net zero economy by 2050, requires energy networks to evolve and adapt to changing customer and system needs.

The DFES builds on historic trends, the pipeline of near-term projects, local resource factors and stakeholder input to create a range of credible future scenarios.

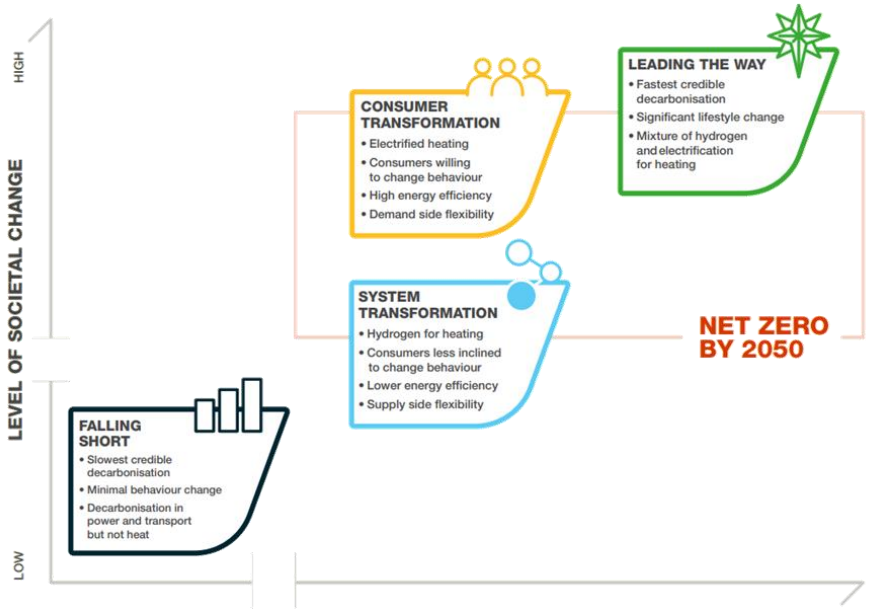
NGED uses the DFES to conduct a detailed review of how its network could be impacted under a range of possible futures. This helps NG to develop strategic reinforcement solutions to solve network constraints.

The DFES has also been used to inform NGED's RIIO-ED2 business plan and to publicly signpost potential system flexibility needs.

The four NG DFES scenarios – incorporating FES 2023

The National Grid ESO FES 2023 scenarios are used as the overarching scenario framework for the DFES 2023. This high-level framework has remained consistent since 2020.

Three of the scenarios are compliant with the UK government's net zero emissions target for 2050. Each of these scenarios meets this target in a different way. The four scenarios are defined by different 'speeds of decarbonisation' and 'levels of societal change'.

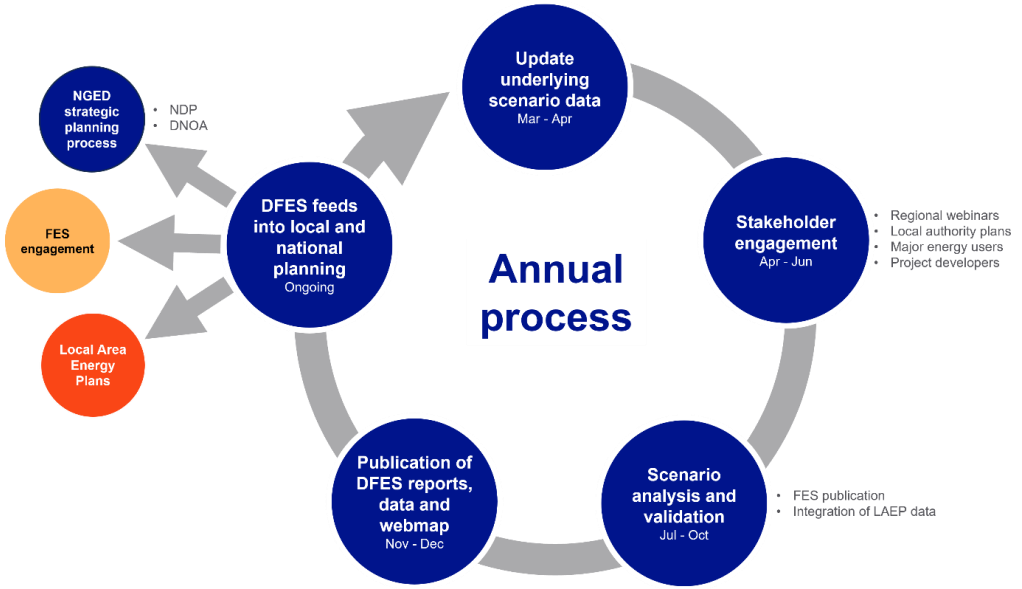


The four NG DFES scenarios – incorporating FES 2023

Key overarching assumptions are published by National Grid ESO for each of the four scenarios, which are applied in the DFES.

Additional local and regional assumptions are made by Regen and NGED. This includes analysis of developing ‘pipeline’ projects in the area and regional stakeholder and project developer engagement.

Renewable energy resources, building stock and socio-economic factors of each local area are also key to the regional analysis that informs the DFES.



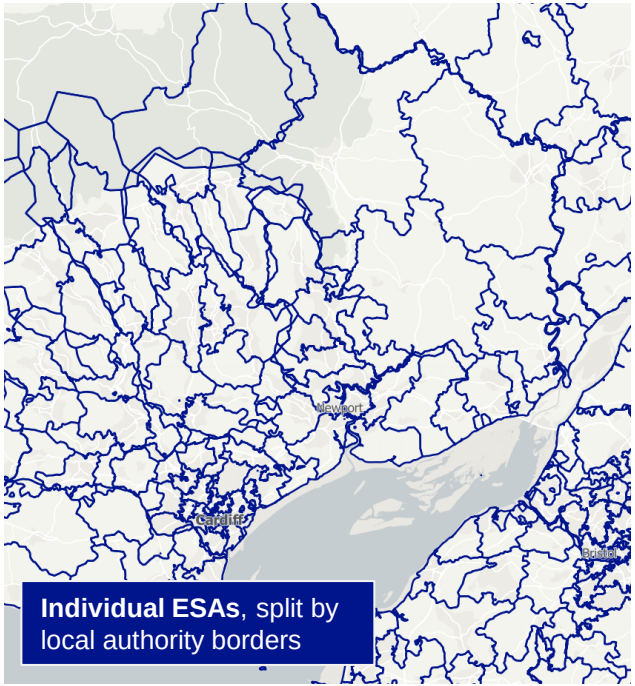
Electricity Supply Areas

DFES analysis is produced at a high granularity, using ‘Electricity Supply Areas’ (ESAs).

An ESA is defined as the geographical area supplied by a primary substation providing supplies at a voltage below 33 kV or a customer directly supplied at 33, 66 or 132 kV or by a dedicated primary substation.

Each ESA geographically represents a block of demand and generation based on the distribution network substation that it is connected to.

This way, projected new connections are linked to specific parts of the network, allowing for more granular network analysis.



Individual ESAs, split by local authority borders

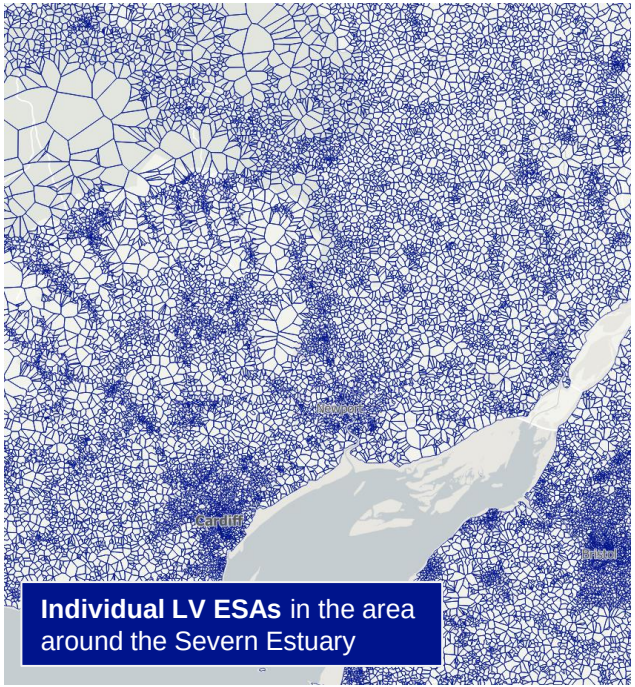
Electricity Supply Areas

The attributes of the land, buildings and people within an ESA inform the future deployment of each individual technology type.

These attributes include the number of different vehicles, homes and businesses, the amount of farmland, the level of solar irradiance or the average wind speed.

Local authority borders subdivide these network-informed spatial areas. This means the DFES 2023 results can be directly aggregated to local authority areas to inform Local Area Energy Plans.

For DFES 2023, Low Carbon Technologies (LCTs) such as rooftop solar PV, electric vehicles and heat pumps have been distributed to over 200,000 low-voltage transformer-level ESAs.



Individual LV ESAs in the area around the Severn Estuary

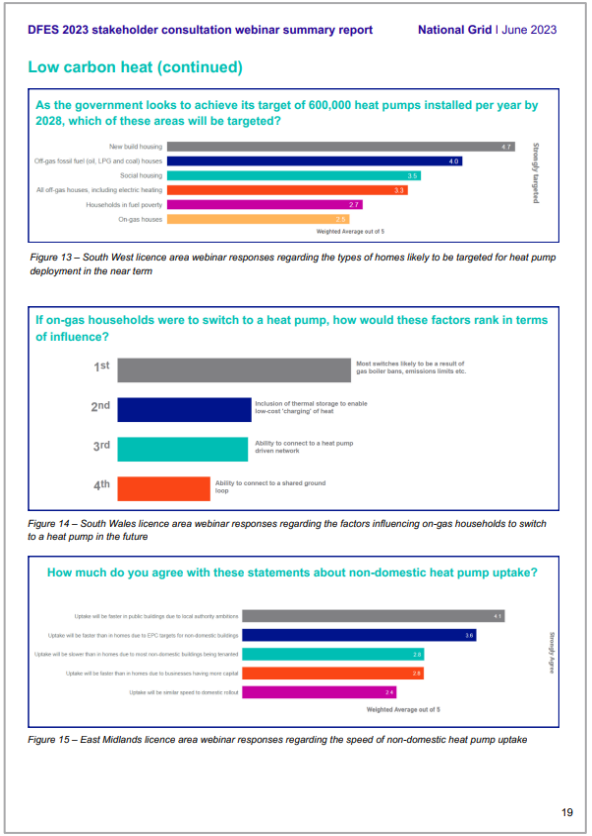
Stakeholder engagement

NGED and Regen ran four consultation webinars in June 2023. Each session focused on elements of distributed energy generation, demand and electricity storage that were particularly relevant or active in the region.

After the events, summary reports were published for each licence area detailing the content covered and how the comments raised would impact the analysis.

Regen also contacted every local authority in NGED's licence areas to collate data and information on new developments and local policies, plans and ambitions to support low carbon energy and infrastructure.

This includes analysis of published Local Area Energy Plans to understand whether they fall within the DFES scenario framework.



Stakeholder engagement

Developers of active pipeline sites (i.e. those with accepted network connection offers or planning permission) were contacted. Developer feedback received was used to augment the detailed desk-based research of each pipeline site, alongside discussion of key development factors and drivers in their respective industries.

Wider industry consultation was also completed for some technologies, with a particular focus on less established technology sectors. This included trade bodies, landowners, asset operators, technology companies and other relevant organisations. Information was gathered predominantly through direct conversations, as well as through existing industry networks and events.

DFES 2023 stakeholder consultation webinar summary report — National Grid | June 2023

Electric vehicles and EV chargers

Stakeholder feedback	Impact of DFES analysis
There were a range of views around the speed of electrification of HGVs. In the open-form section of the polling, this included views: • That the HGV switch to electric will happen ahead of the UK target for net zero emission HGVs by 2040 • That the 2040 target will not be met, and some HGV usage could move to rail freight • That HGVs will be mostly electric due to the pace of improvements in battery technology • That battery HGVs are not currently practical • That HGVs would be more likely to use biofuels or synthetic fuels rather than hydrogen or electrification • That there is a high level of uncertainty around the future decarbonisation of HGVs.	As shown by the range of views, the decarbonisation of HGVs is far less clear than that of cars and LGVs. As a result, the envelope of potential future scenarios for the uptake of electric HGVs in the DFES analysis will have a wide range, from near-full electrification to a mixed blend of hydrogen, biofuels, synthetic fuels and electrification.
Stakeholders felt that non-domestic EV charging, including on-street charging, would see high demand in the future, especially for business vehicles and dwellings without access to off-street parking. It was noted that local authorities could rapidly scale this via the government's Local Electric Vehicle Infrastructure (LEVI) fund.	Our DFES EV charger modelling aims to reflect the wide range of domestic and non-domestic EV charger types required to match EV uptake under each scenario. This is based on the EV uptake in each local area; as a result, areas with high levels of business vehicles or on-street parked vehicles will be modelled to have a higher uptake of non-domestic charge points.

How popular might these solutions be for charging of on-street parked EVs?

Charging at supermarkets, public car parks, workplaces etc. 7.2
Rapid en-route charging hubs, similar to petrol stations 7.1
On-street chargers outside homes 6.8
Local 'neighbourhood' charging hubs 3.8
Weighted Average out of 10

Figure 11 – West Midlands licence area webinar responses regarding the solutions for on-street parked electric vehicles

Which of these statements about future private vehicle ownership do you agree with?

19
18
13
9
Ownership will be lower in major cities due to low emissions zones and congestion charges
Ownership will be lower in towns and cities due to more public transport and active travel
Ownership will be lower in towns and cities due to car sharing clubs and autonomous vehicles
Ownership will be distributed similarly to today

15

Figure 12 – East Midlands licence area webinar responses regarding future private vehicle ownership

Stakeholder engagement

Newly for DFES 2023, a selection of large energy-consuming customers connected to NGED's network were contacted to seek views around decarbonisation plans, renewable energy deployment, flexibility technology uptake and electrification of heat and transport, if applicable.

This included intensive major energy users, typically industrial sites with substantial energy demand in a single location, and non-intensive major energy users with high energy demand across a number of distributed sites, such as water companies, supermarkets, ports and extractive industries.

Major energy user sectors surveyed included:
Academia
Agriculture
Airports
Extractive industries
Fleet operators and logistics
Health
Industry
Large property owners
Military
Ports and maritime
Rail
Supermarkets
Water utilities

Engagement with local authorities

Local authority development plans are incorporated into DFES to reflect their localised impact on the distribution network.

Regen works with local authorities to maintain an online database of all new development data collected during earlier DFES studies. This was shared with the local authority planners to provide updated data. These updates are then verified against the most recent local planning documents.

The following data is collected for each site:

- Use class, such as domestic, office, industrial, retail etc.
- Total number of homes or non-domestic floorspace (in sqm)
- Location address
- Stage of development

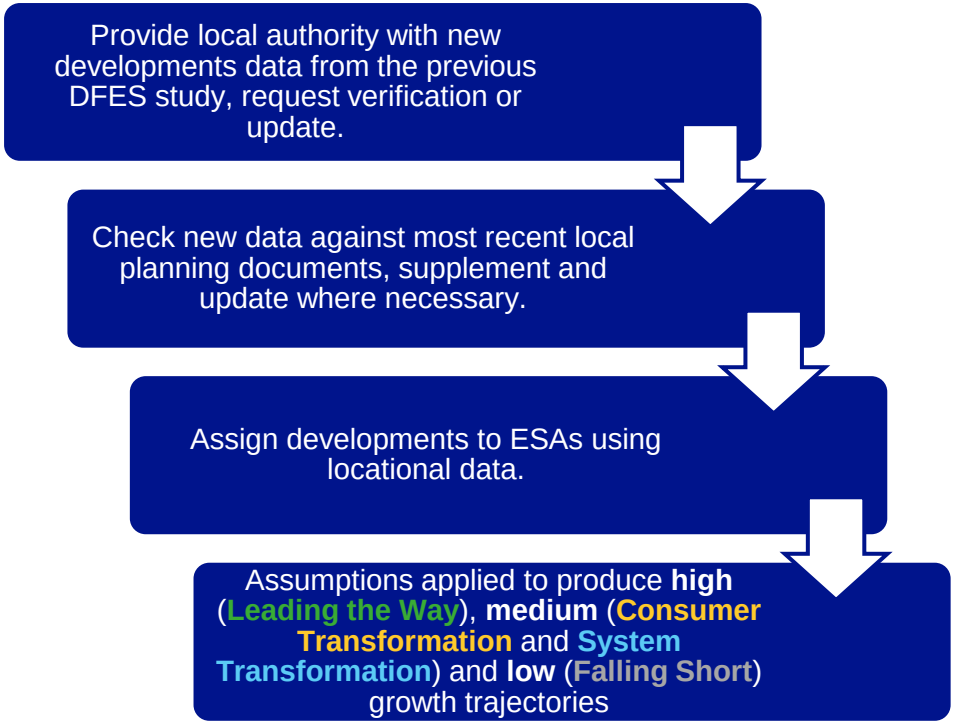
Over 10,000 new development records were processed as part of NG DFES 2023

Engagement with local authorities

Once processed and verified, the build-out rates of individual developments are modelled based on the data provided.

A delay in this schedule is applied to sites in earlier stages of development to reflect potential build-out delays and uncertainty.

The delay methodology means that the precise spatial data and scale of development are maintained, but the period over which the sites are built out varies, reflecting a realistic range of building rates over the coming years.



Engagement with local authorities

For planned new developments, each individual development is assigned to an ESA. This creates highly granular scenarios for domestic and non-domestic developments in the near and medium term.

Though some of these sites are already visible to NGED through accepted demand connection offers, many are not.

Not all local authority plans extend out to 2030 or later. Hence, there is a natural reduction in the data available for the analysis of planned developments in the later years of the scenarios.

To account for this reduction, additional domestic dwellings are modelled. Their locations are weighted towards areas of similar characteristics to those that have seen a recent deployment of new developments.

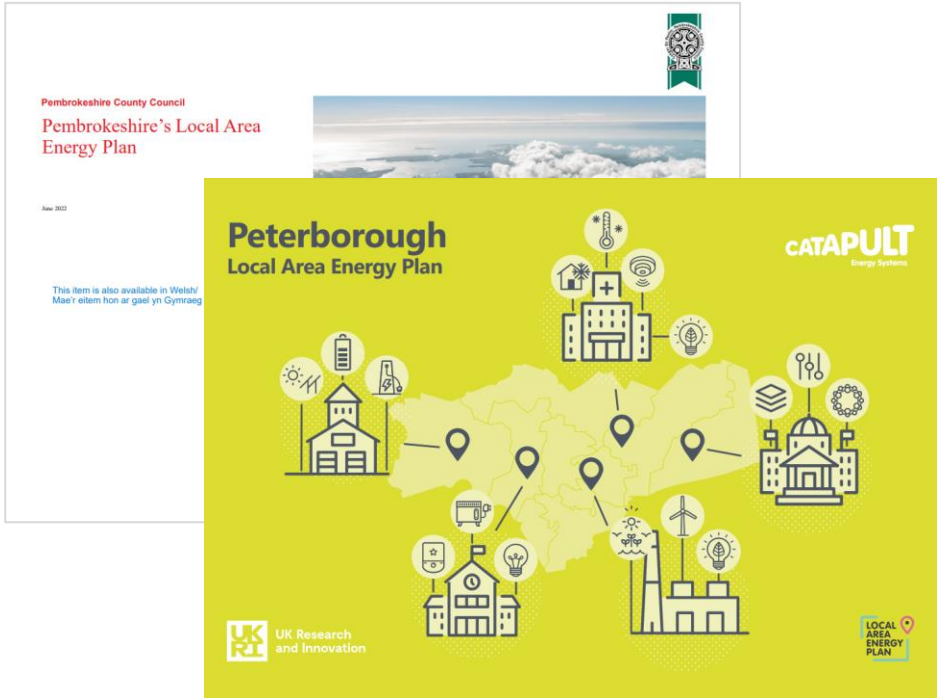
New build deployment also feeds into other areas of the DFES modelling, such as heat pump uptake, rooftop solar PV deployment and electric vehicle uptake.

Engagement with local authorities

Local authorities in the NGED area were surveyed for plans and policies that could impact local uptake of DFES technologies.

This included EV charging infrastructure or clean air zones, planned heat networks, waste collection, renewable energy policies or Local Area Energy Plans.

The surveys provided valuable insight into multiple factors, which fed into future projections and technology uptake. This process is repeated annually, as local policies can change year-on-year.



Creating the DFES projections

Baseline

Data is collected on the current installed capacity, or number of installed units, for each individual technology type.

This is based on NGED data, planning applications and other data sources, such as Census 2021 and Department for Transport data.

Pipeline

Proposed sites that may connect in the near term are individually assessed. Where possible, site developers are contacted around their project plans and timescales.

Pipeline sites are modelled to go ahead at different rates depending on the technology and the scenario.

Stakeholder engagement

Local information is collected from consultation with regional stakeholders and engagement with every local authority in NGED's licence areas.

This is combined with analysis of existing trends and spatial data and direct engagement with project developers, major energy users and industry bodies.

Scenario projections

The baseline, pipeline, local evidence and National Grid ESO FES 2023 assumptions are combined to create the DFES projections spanning from an April 2023 baseline to 2050.

Projections are produced at an ESA level for most technologies and at Low Voltage ESA level for domestic-scale technologies.

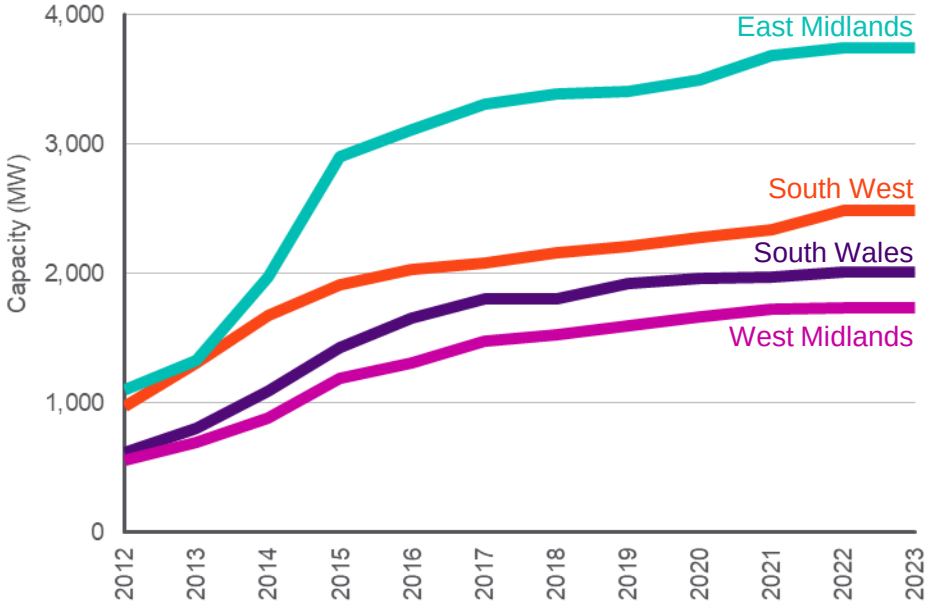
Creating the DFES projections

Baseline

The primary source of data for the baseline of connected generation and storage sites is NGED connection agreement data.

Additional data is sourced from public registers, records and other databases such as Census 2021, Capacity Market registers, Contracts for Difference auction data, Department for Transport statistics and Energy Performance Certificates.

Baseline large-scale generation and storage capacity
By NG distribution licence area



Creating the DFES projections

Pipeline

Sites with an accepted network connection offer are individually assessed to establish if and when they could connect to the distribution network under each scenario.

Records of planning applications, Capacity Market activity and Contracts for Difference auctions are also used to assess progress.

The planning activity of the individual pipeline sites is also assessed by reviewing the Renewable Energy Planning Database and local planning portals.

The impact of planning status on the scenario projections varies, as planning is a more significant barrier for some projects than others. This is backed by analysis of historic planning outcomes.

In addition, direct discussions are held with the developers of pipeline sites to identify their stage of development and any plans that could affect the year of connection.

These discussions are also used to gather broader information about the developer's sector to inform the scenario projections.

Creating the DFES projections

Scenario projections are derived from a number of factors:

	Solar	Wind	Bioenergy	Other renewables	Fossil fuels	Energy storage	Heat pumps	Electric vehicles	Hydrogen electrolysis
Analysis of pipeline sites	●	●	●	●	●	●	●	●	●
ESA-level resource availability	●	●	●	●		●			●
ESA-level housing and demographics	●					●	●	●	
FES 2023 assumptions	In line	In line	In line	In line	In line	In line	Led by	Led by	In line
Local authority factors	●	●	●	●	●		●	●	●
National and devolved policy	●	●	●	●	●	●	●	●	●
Local stakeholder input	●	●	●	●	●	●	●	●	●

Legend ● Major factor ● Minor factor

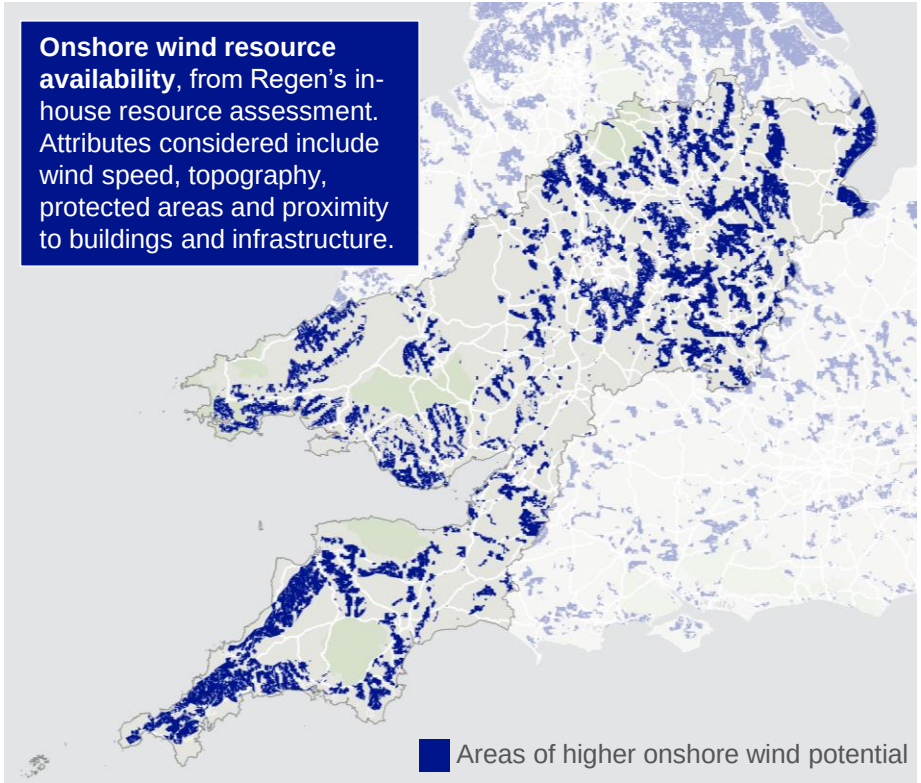
Creating the DFES projections

Resource availability

Projections for generation technologies, such as solar, onshore wind and anaerobic digestion, require areas of good resource. This includes solar irradiance, high wind speeds or biological feedstocks.

Constraints are also considered, such as protected areas and prime agricultural land, which are avoided due to planning considerations.

These spatial resource assessments are verified against existing projects.



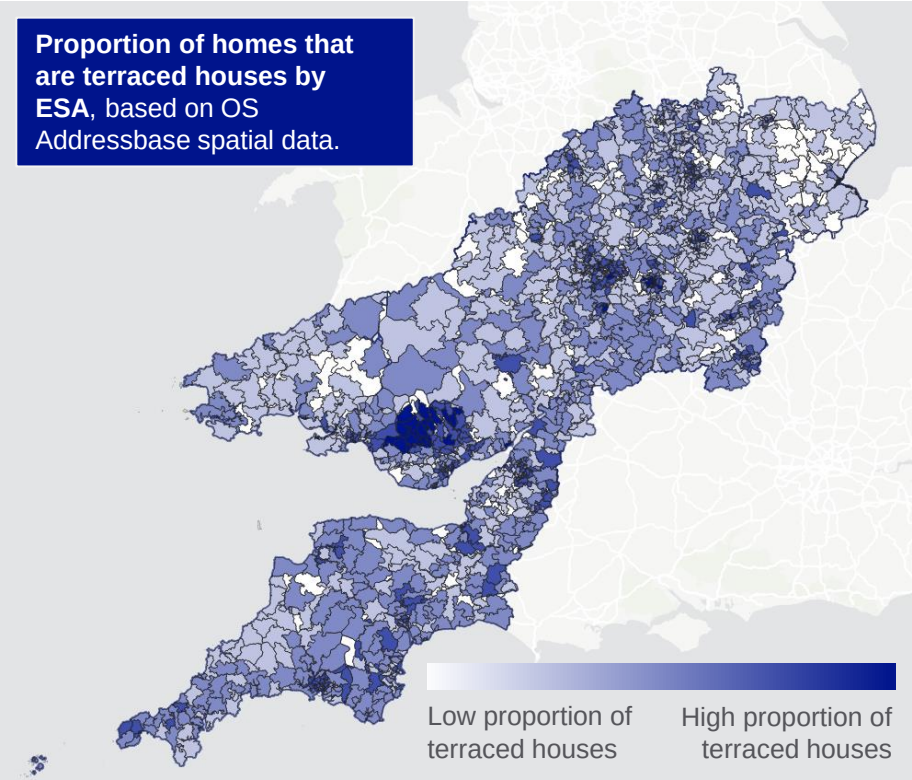
Creating the DFES projections

Housing and demographics

The uptake of domestic technologies, such as heat pumps, rooftop PV and EVs, is heavily affected by housing and demographic factors.

For example, heat pump deployment is impacted by gas network availability, the building type and the tenure of the household.

These demographics are assumed to have a greater impact in the early stages of technology adoption.



Reconciliation with FES

Scenarios

The DFES 2023 uses the same scenario framework as the National Grid ESO FES 2023.

This means there is a common and consistent set of assumptions that allow for comparison between the studies.

The scenarios are updated annually by the National Grid ESO FES team.

Technologies

The technology types used in DFES and FES data have been standardised using ‘building blocks’. In some areas, Regen and NGED have included greater detail.

For example, the standard ‘non-domestic’ demand technology type is divided into ten sub-technologies for DFES, as these developments can have wide-ranging impacts on the distribution network.

Assumptions

Underlying assumptions in FES 2023 are incorporated in the NGED DFES analysis where applicable.

Further technology-specific assumptions are made in DFES, for example around the deployment of projects in the pipeline or where the region or local area has different characteristics to the national picture.

Reporting

Like the FES, a suite of NGED DFES publications is produced to meet stakeholder needs.

This includes a summary report for each licence area detailing assumptions and results by technology and visualised outputs on the NGED DFES map.

‘Regional View’ reports and summaries of stakeholder engagement results are also separately published.

Reconciliation with FES

The DFES results are produced at ESA level. During the analysis, the outputs are aggregated and compared against FES data at a licence area level. The DFES summary reports include a review of any variances.

The DFES uses the FES as a framework and benchmark but reflects the regional and local factors for each technology and scenario. Therefore, some variance between the DFES and FES views is expected.

This variation is typically greatest in the near term as the DFES projections are based primarily on analysis of the pipeline sites.

In the medium and long term, there is more convergence, as the outcomes for many technologies are based on national-level outcomes and strategies. However, regional factors or those raised by local stakeholders also affect the DFES results out to 2050.

Typical regional and local variations include:

- Baseline and pipeline analysis
- Resource availability
- Local and national policy impacts
- Stakeholder input
- Housing stock analysis
- Reflecting transmission network constraints under ‘Falling Short’

Next steps

The DFES is an annual process; the NGED 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:

nged.energyplanning@nationalgrid.co.uk

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