nationalgrid DSO

Distribution Future Energy Scenarios 2024

Methodology report

January 2025

Document overview

Introduction to DFES

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

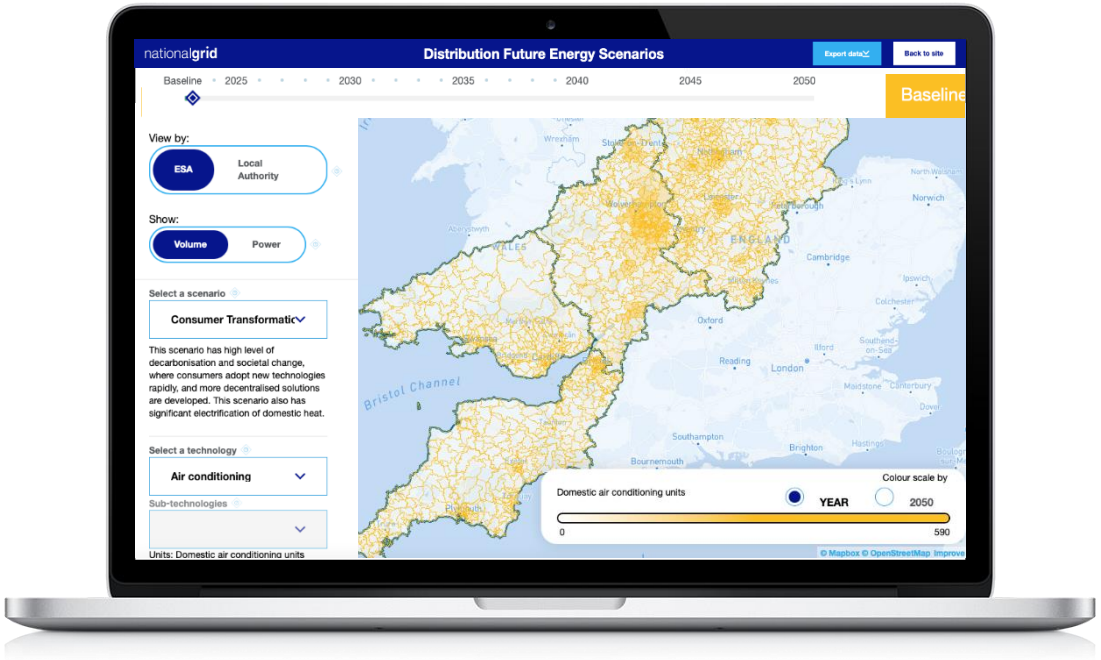
DFES makes use of the Future Energy Scenarios (FES) framework. This framework is consistent with other distribution network operators and the National Energy System Operator (NESO).

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 DFES analysis out to 2050 for all four of its licence areas on an annual cycle.

The DFES 2024 outputs are available online. You can download the reports and the results are also available as an interactive map. See QR codes below:

Distribution future energy scenarios regional information

Distribution future energy scenarios map



Distribution Future Energy Scenarios Map

The need for scenario-based planning

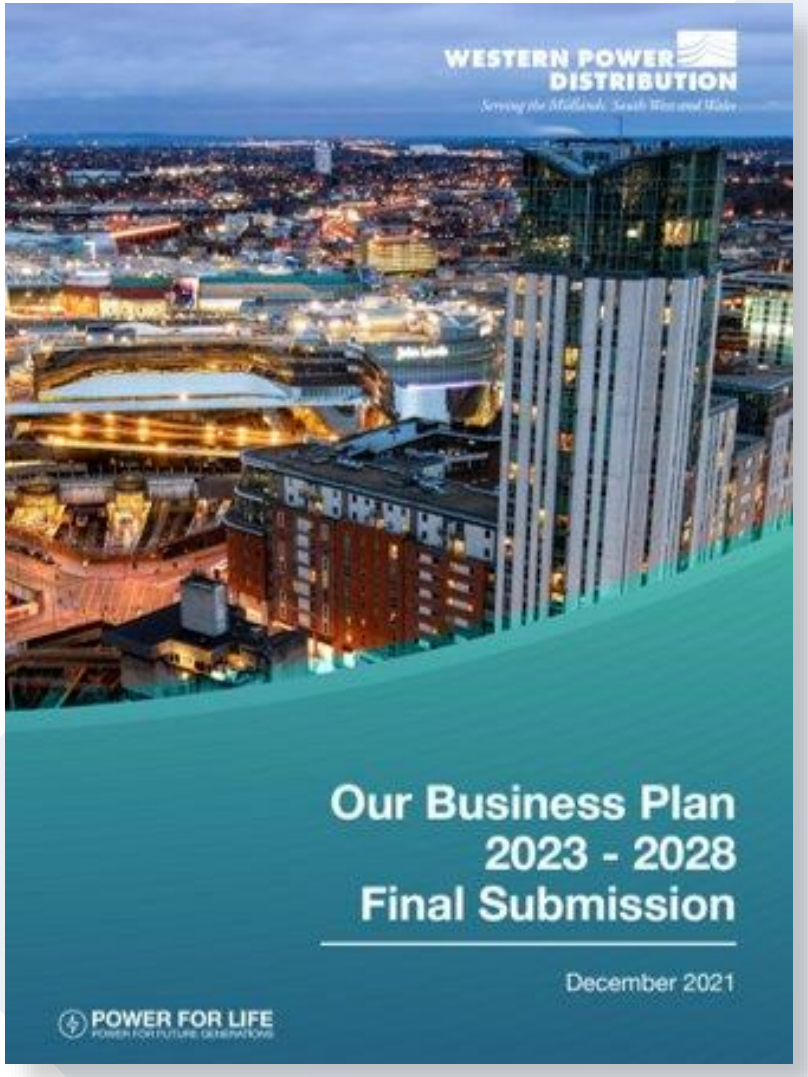
Whilst some clarity for our energy system is beginning to be seen through proposals like Clean Power 2030 (CP2030) from NESO, our energy system is still going through an unprecedented change.

Achieving a clean power electricity system in 2030 and a net zero economy by 2050 requires energy networks to evolve and adapt to changing customer requirements, system needs and national energy policy.

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 future pathways. This helps NGED to develop strategic reinforcement solutions to solve network constraints.

The DFES is also going to be used as an input to NGED's RIIO-ED3 business plan and to publicly signpost potential system flexibility needs.



Changing policy landscape

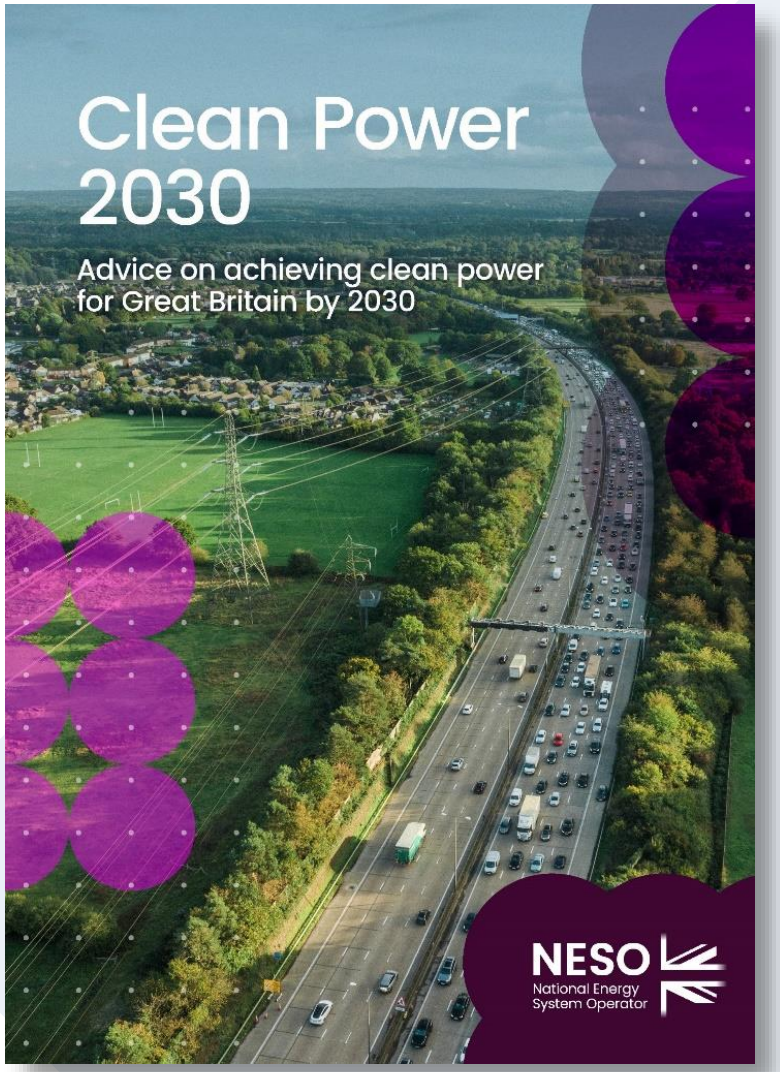
As part of their five missions for Britain, the Labour Government has made a commitment to achieving a clean power system by 2030.

A first step towards this plan was to commission NESO to develop a roadmap for how clean power 2030 could be achieved. NESO published this advice to government in November 2024.

This advice will be converted into an official plan from government. The proposals outlined by NESO are significant, transformational changes to our energy system.
This will require a significant overhaul of the approach to spatial planning and securing grid connections.

A clearer view of the technology mix that is required for a clean power system could also impact the connection pipelines in NGED's licence areas.

The DFES will assess the outcomes of CP2030 in more detail in 2025.



The four scenarios – incorporating FES 2024

The FES 2024 is used as the overarching scenario framework for the DFES 2024 analysis.

The FES 2024 framework has seen a move towards net zero scenario pathways that can more directly inform network investment planning.

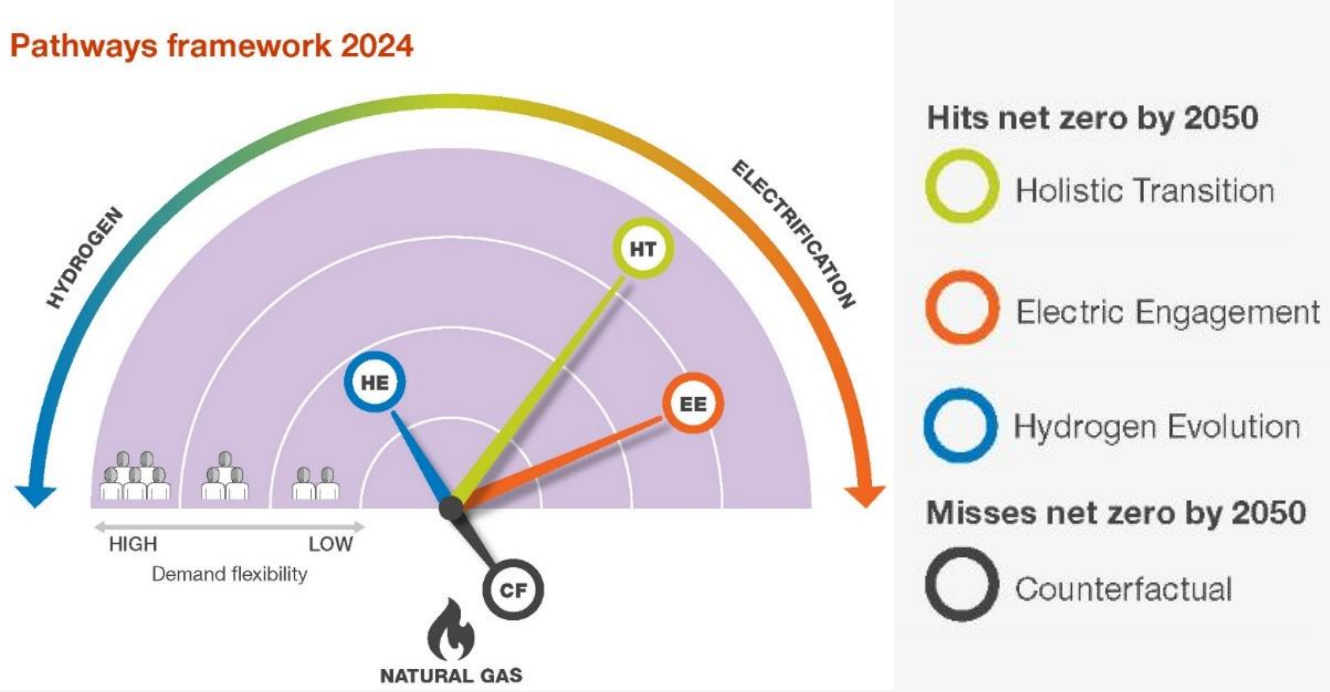
Three of these scenarios are compliant with the UK government's net zero emissions target for 2050. Each of these scenarios meets this target in a different way.

The three net zero scenarios are defined by different degrees of electrification and use of hydrogen as well as varying levels of demand-side flexibility.

The fourth, Counterfactual scenario does not achieve net zero by 2050 and continues the use of natural gas for electricity generation.

NESO Future Energy Scenarios 2024

The Future Energy Scenarios (FES) is an annual report produced by NESO that outlines three pathways to Net Zero that representing different, credible ways to decarbonise our energy system as we strive towards our 2050 target.



The DFES process

Each year the DFES follows a process that incorporates key industry data and inputs.

Key overarching assumptions are published as part of the FES framework for each of the four scenarios. These are considered and applied in the DFES.

Additional local and regional assumptions are made by Regen and NGED. This includes analysis of the pipeline of projects in NGED's licence areas (many of which hold accepted connection offers) and regional stakeholder and project developer engagement.

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

NGED's network planning process

Using the DFES projections, NGED undertake further work to assess the impact and demand peaks on individual network assets.

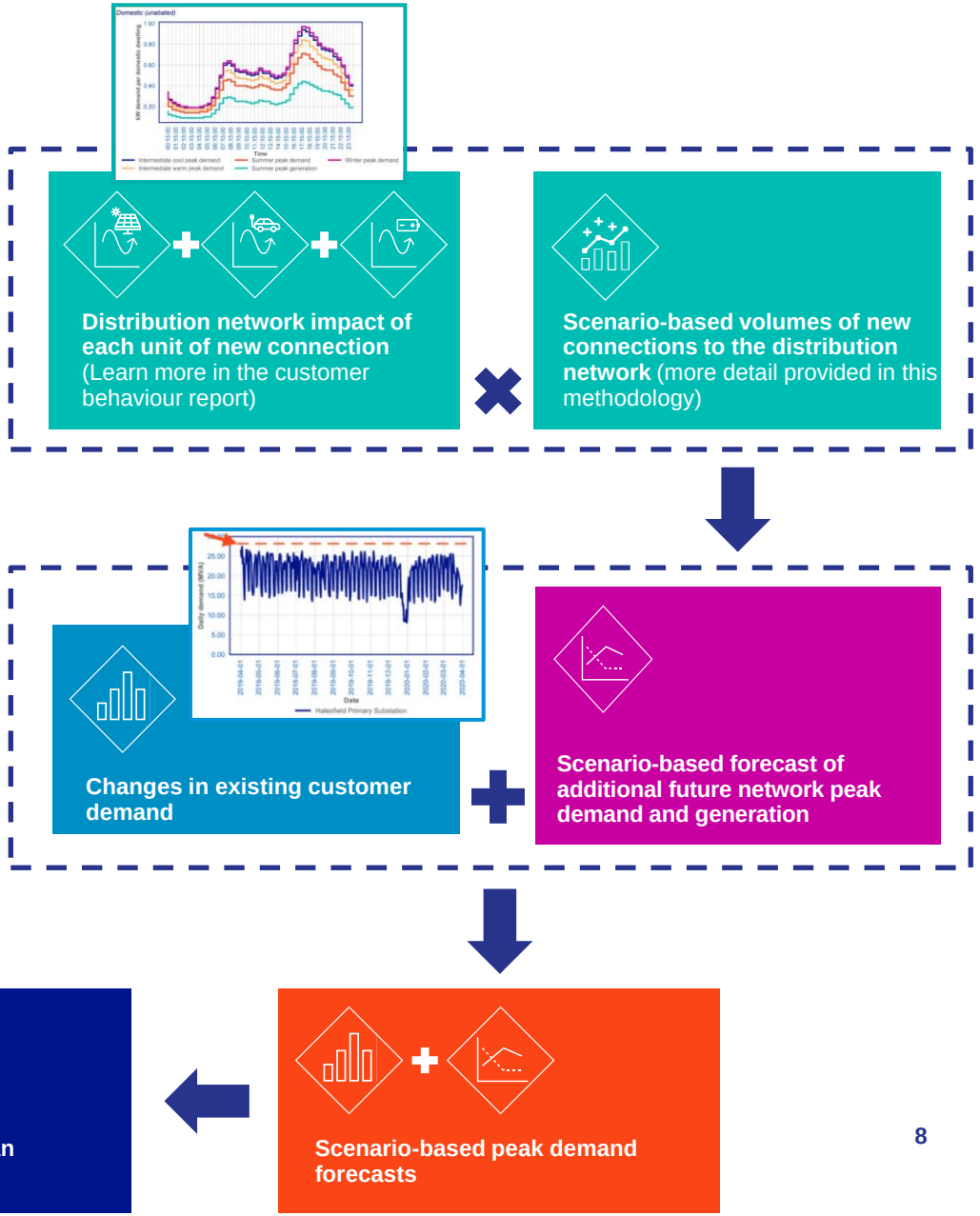
DFES feeds into local and national planning.

In order to use these scenario-based volumes in power systems analysis and wider network planning, they must be converted into load sets.

This is done through applying customer behaviour assumptions to the volumes created in the DFES, to understand when and how these customers will be using our network.

Existing customer demand is included in the load sets through the incorporation of measured data.

Further information about our network analysis can be found on NGED's [Network Development Plan](#) web page.



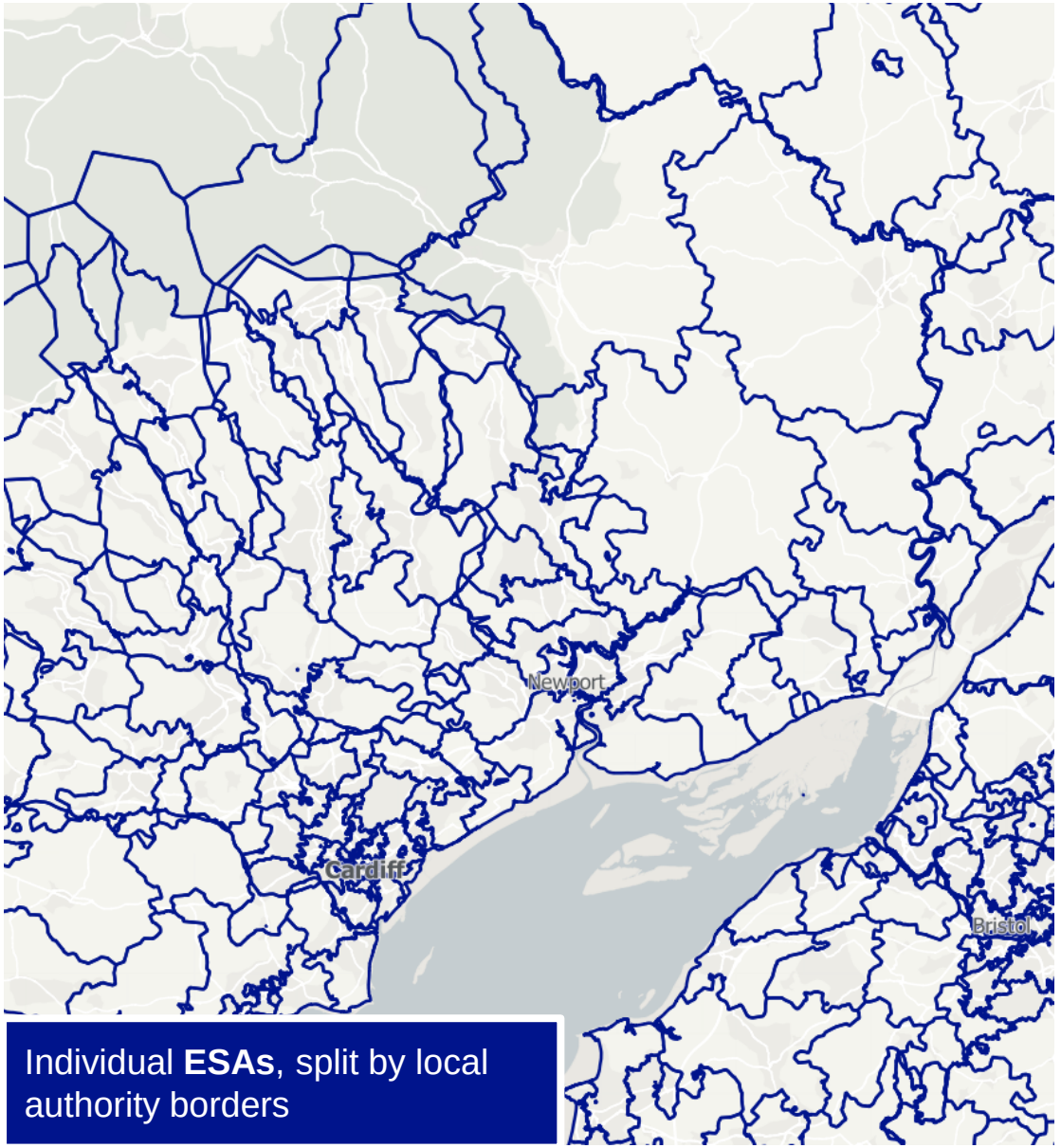
Electricity Supply Areas

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 that supplies electricity 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 the future demand to be mapped to our network models and more granular network analysis be carried out, which is then published in our Network Development Plans.



Individual **ESAs**, split by local authority borders

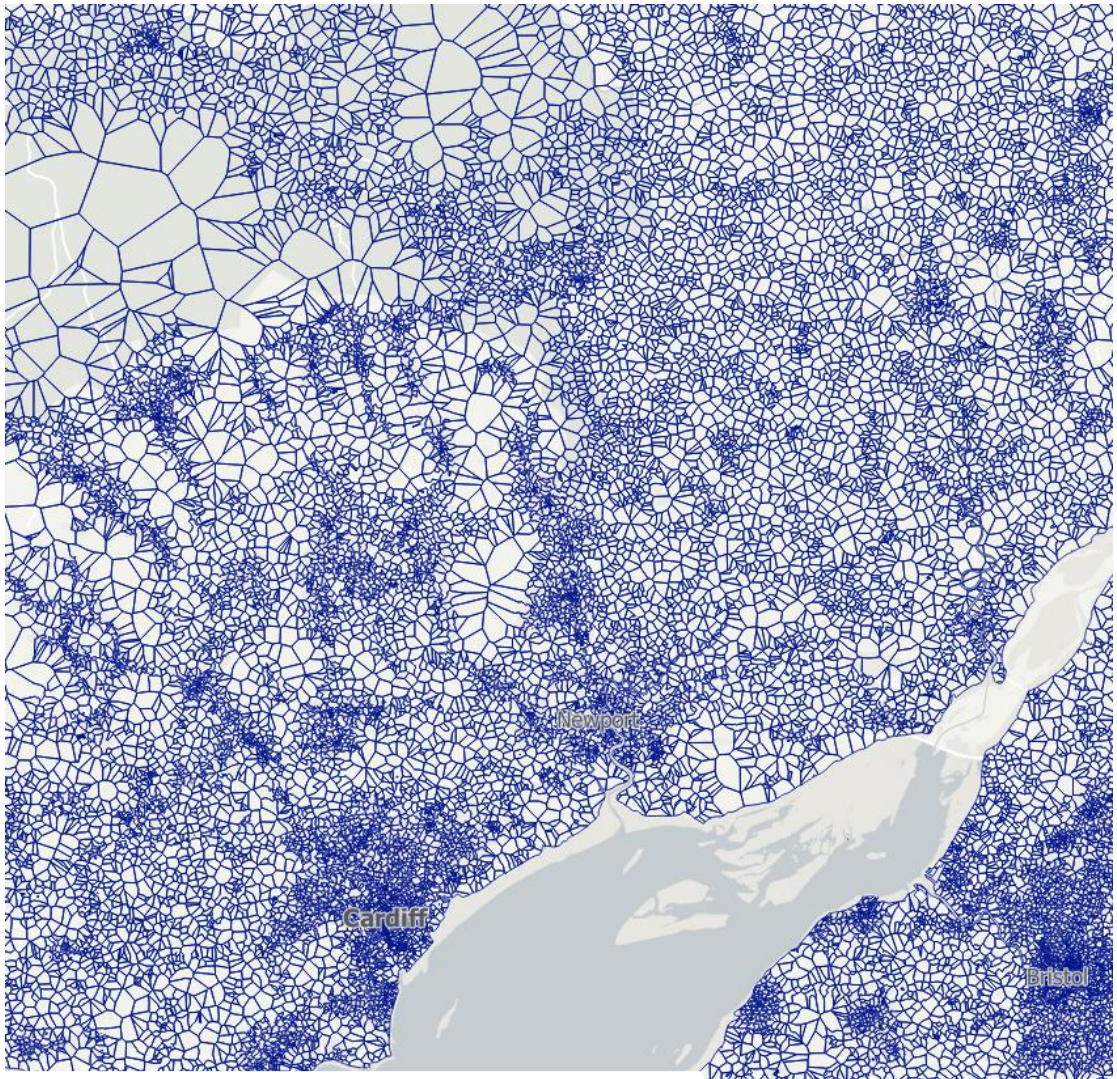
Electricity Supply Areas

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 2024 results can be directly aggregated to local authority areas to inform Local Area Energy Plans.

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



Individual **LV ESAs** in the area around the Severn Estuary

Stakeholder engagement

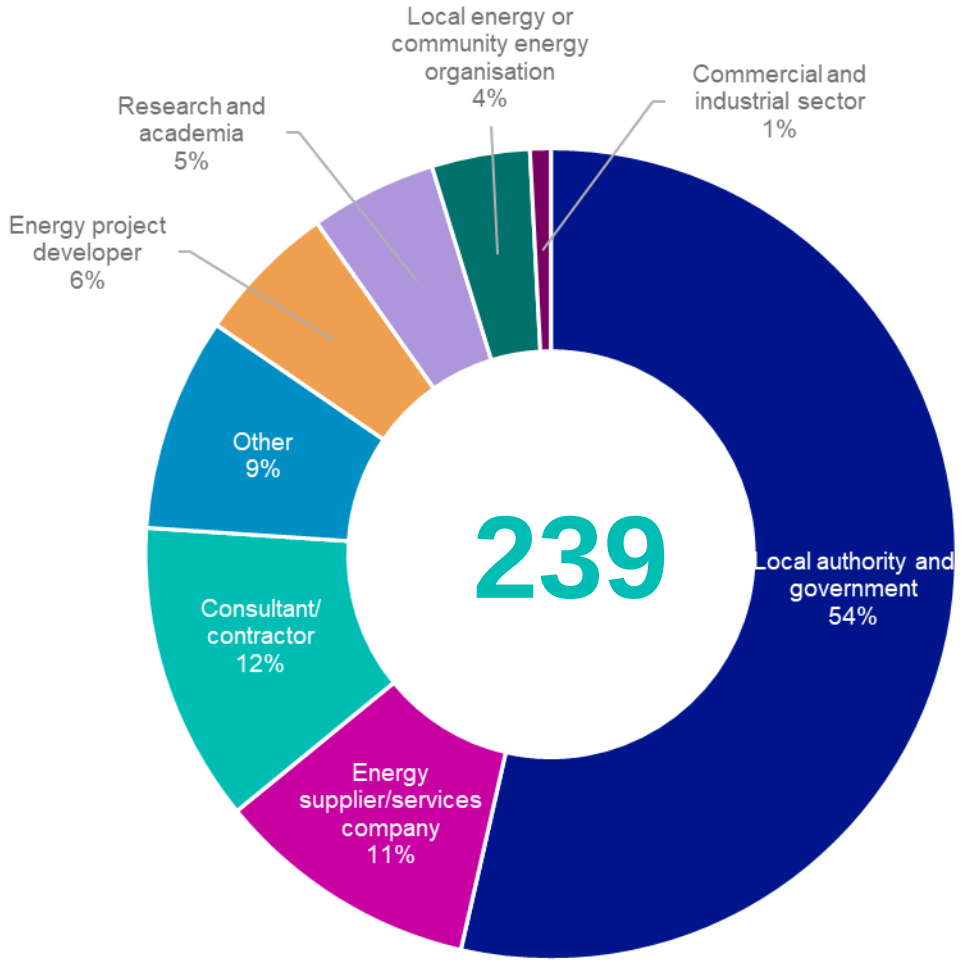
NGED and Regen ran four stakeholder engagement webinars in June 2024, one for each of NGED's licence areas.

Each session focused on elements of distributed energy generation, demand and electricity storage that were particularly relevant or active in the region.

Summary reports were published of each event, detailing the content covered, and how stakeholder feedback from each session was incorporated into the DFES analysis.

Regen also conducts local authority engagement through an annual Local Authority energy survey. The survey asks for data on local policies, plans and ambitions to support low carbon energy and infrastructure. This included EV charging infrastructure or clean air zones, planned heat networks, waste collection, renewable energy policy or Local Area Energy Plans.

Several hundred stakeholders were engaged to inform DFES 2024, across the webinars, local authority teams, LAEP teams, major energy users, Welsh Government and technology sector representatives.



Attendees from the DFES engagement webinars, by sector

Stakeholder engagement

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

Regen works with local authorities to maintain an online database of new housing and non-domestic developments.

This database is shared with the local authority planners to provide updated data for the current year. 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 received and processed as part of DFES 2024.

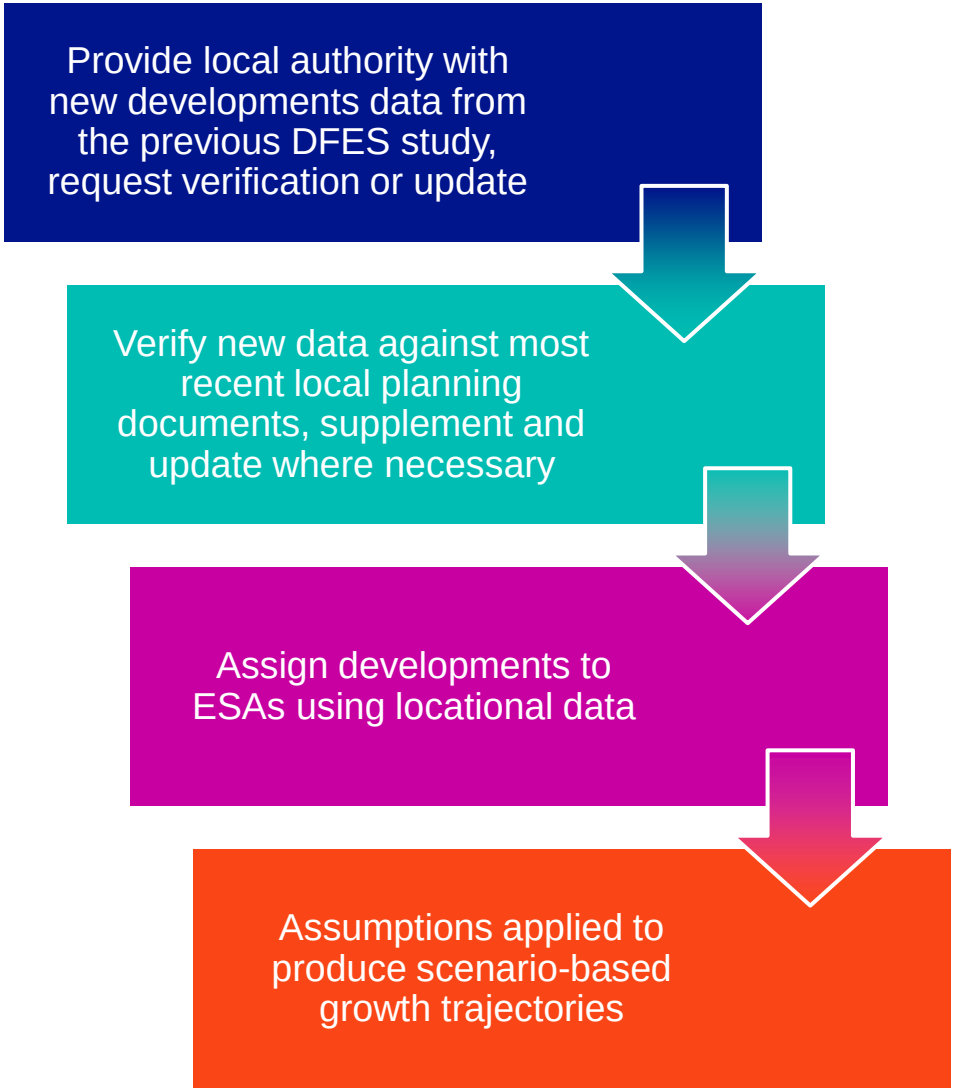
Stakeholder engagement

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

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.



Stakeholder engagement

Many local authorities have, or are in the process of developing, Local Area Energy Plans (LAEPs). These are key sources of input data to the DFES.

Published LAEPs are carefully reviewed for technology targets/projects and compared to DFES analysis for equivalent areas.

LAEP data is collected through:

- Direct data requests to Local Authority teams and via engagement with DSO Stakeholder Engagement Officers
- Desk research to extract specific technology targets from published LAEP reports
- A LAEP question that is within the DFES Local Authority Questionnaire.

Examples of how LAEP data may be reflected include:

- Reflecting local ambition through adjustments to spatial factor weightings for specific ESAs
- Specified targets in milestone years directly reflected under more ambitious scenarios
- Specific projects flagged by the local authority reflected or considered as part of the near-term pipeline analysis and modelling.

Stakeholder engagement

Alongside local authorities, other stakeholders are also directly contacted to inform the DFES modelling assumptions and projections.

A proportion of project developers with active pipeline sites (i.e. those with accepted network connection offers) were contacted.

The feedback received was used to augment the desk-based research for each pipeline site around timescales for projects being deployed, alongside wider discussion of key development factors and drivers in their respective industries.

Wider industry consultation was also completed for specific technology sectors. This included renewable energy trade bodies, landowners, asset operators, technology companies, port authorities and other relevant organisations.

Information was gathered predominantly through direct conversations, as well as through existing industry networks and events.

Stakeholder engagement

A subset of large-scale energy consumers in NGED's licence areas were engaged to inform the 2024 DFES analysis.

These major energy users were contacted to seek views on their plans regarding future electricity demand, onsite generation and electricity storage.

These customers were also asked about other types of information from NGED that could be of use to their decarbonisation plans.

This included industrial sites with substantial energy demand in a single location, as well as energy users with high demand spread across several sites e.g. water companies, supermarkets or ports.

Regen also contacted the Energy Intensive User Group and Major Energy Users Council for input and insights.

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

Creating the DFES projections

The process used to create the DFES projections can be split into four main steps.

Baseline

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

This is based on NGED connections 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 connect at different rates depending on technology, scenario and information about build-out timelines.

Stakeholder engagement

Local information is collected by Regen and NGED's Strategic Engagement Officers during consultation with regional stakeholders and engagement with every local authority in NGED's licence areas.

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

Scenario projections

The baseline, pipeline, local evidence and NESO FES 2024 framework assumptions are combined to create the DFES projections spanning from an April 2023 baseline to 2050.

Projections are produced at an 11 kV ESA level for most technologies and at Low Voltage ESA level for domestic-scale technologies.

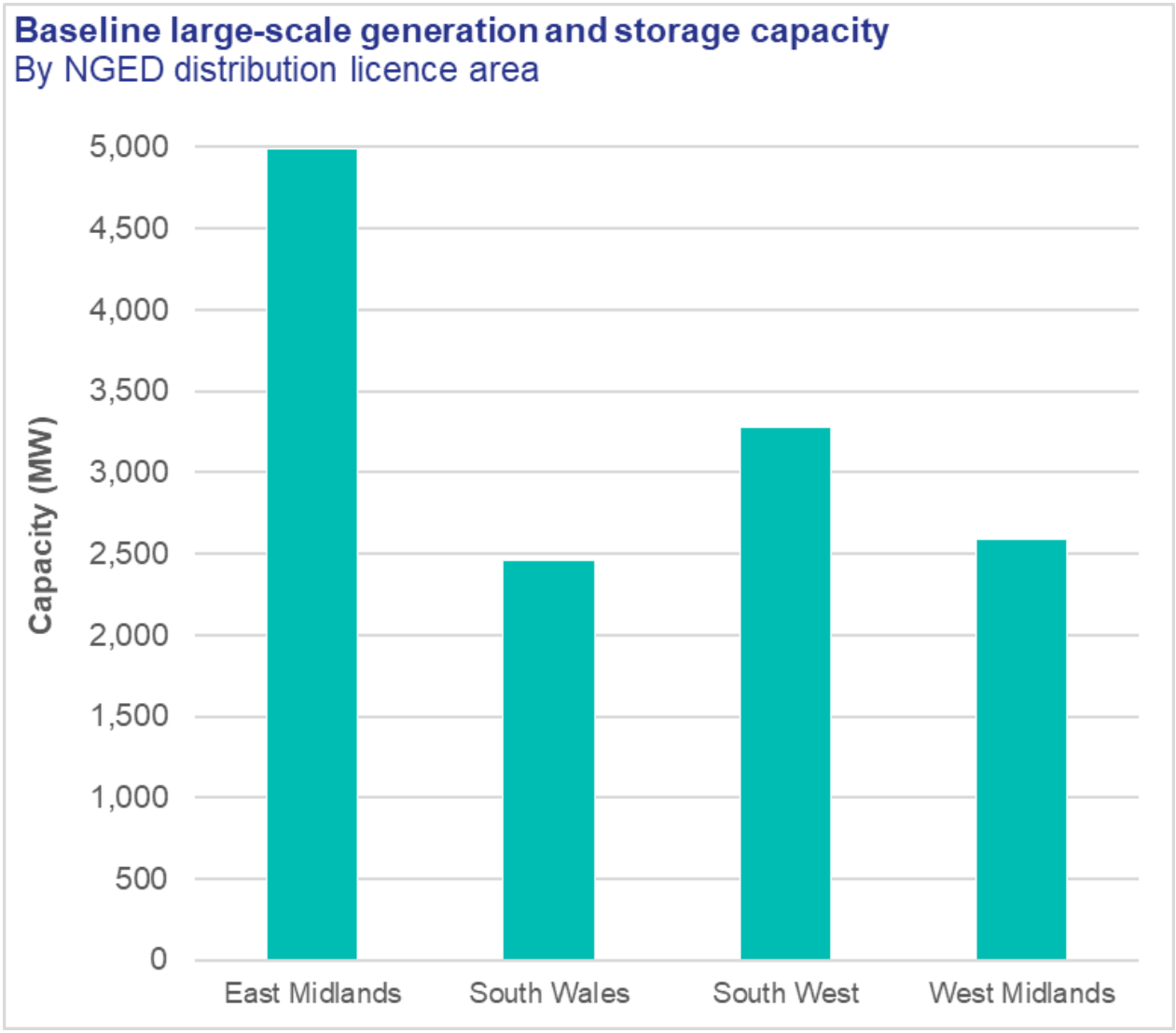
Creating the DFES projections

Baseline

The primary data used to determine the baselines for electricity generation and storage technologies are NGED connection agreement data.

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

This baseline is then disaggregated to ESAs and LV ESAs based on the physical site location address for each project.



Creating the DFES projections

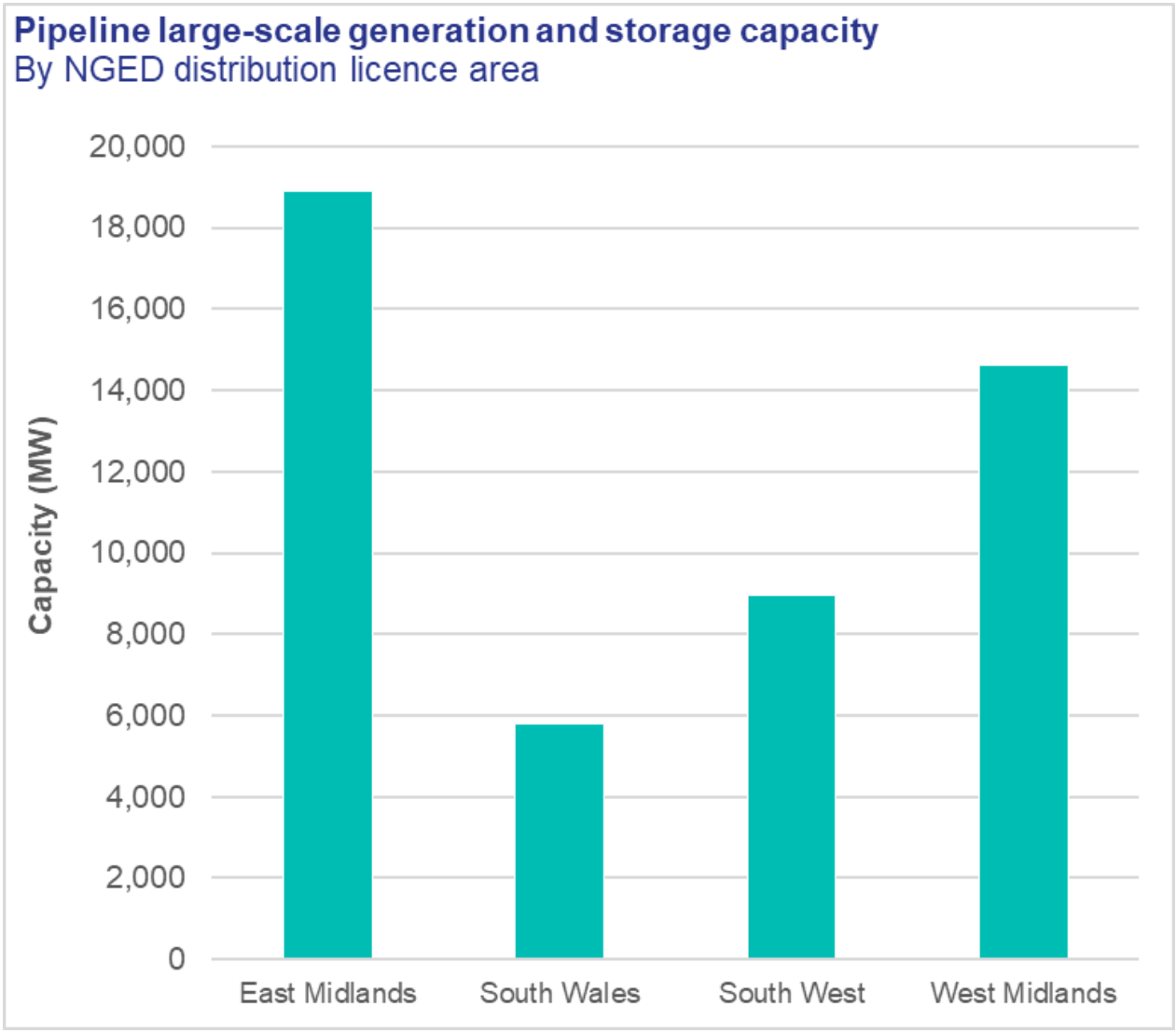
Pipeline

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

Spatial planning data from the Renewable Energy Planning Database and local planning portals, Capacity Market activity and Contracts for Difference auctions are also used to inform this assessment.

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.



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 2024 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

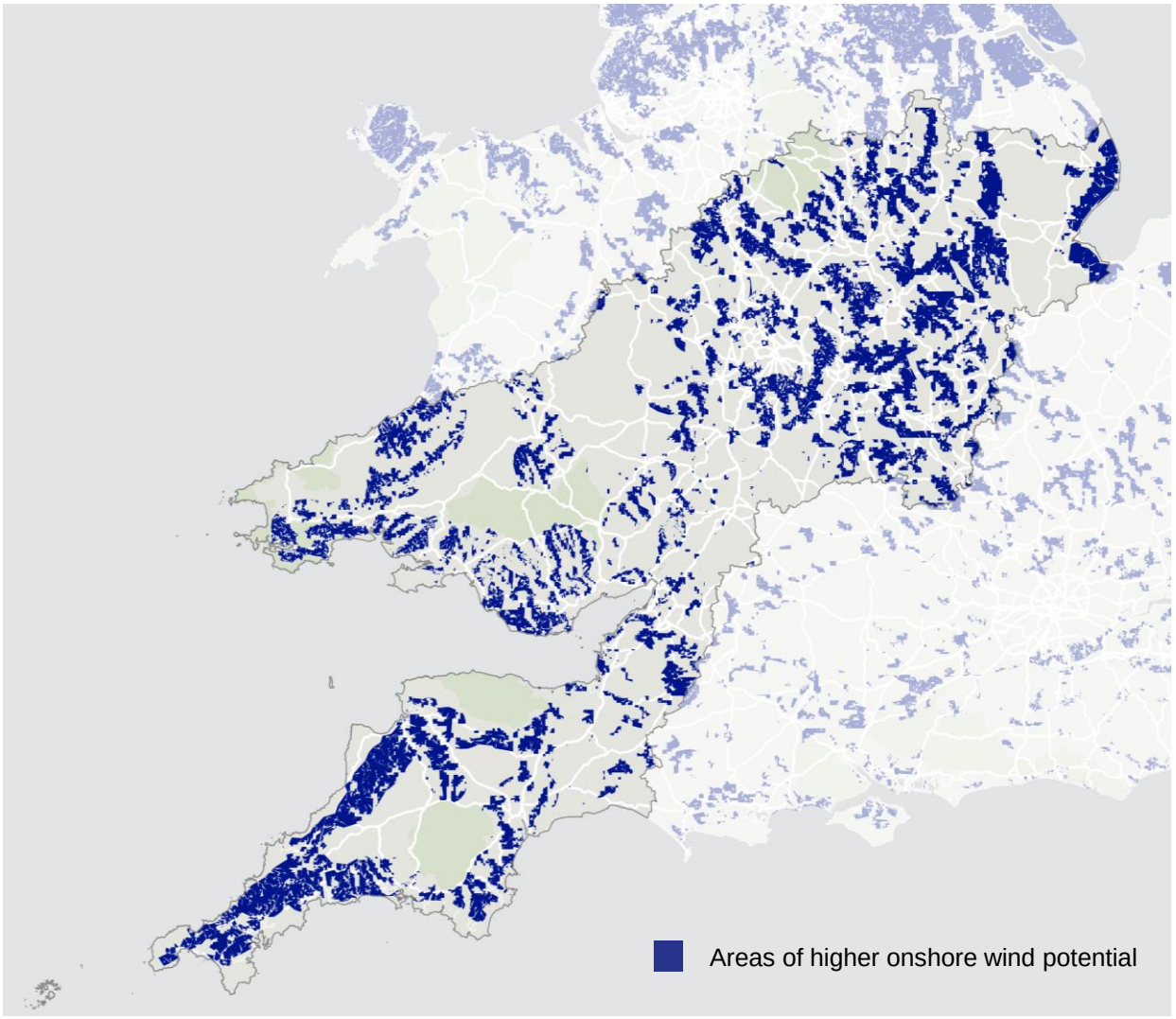
Resource availability

Projections for generation technologies, such as solar PV, onshore wind and anaerobic digestion, require areas with good resources. This includes solar irradiance levels, 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 project portals and are updated based on national planning policy revisions.

Onshore wind resource availability, from Regen's in-house resource assessment. Attributes considered include wind speed, topography, protected areas and proximity to buildings and infrastructure.



Creating the DFES projections

Housing and demographics

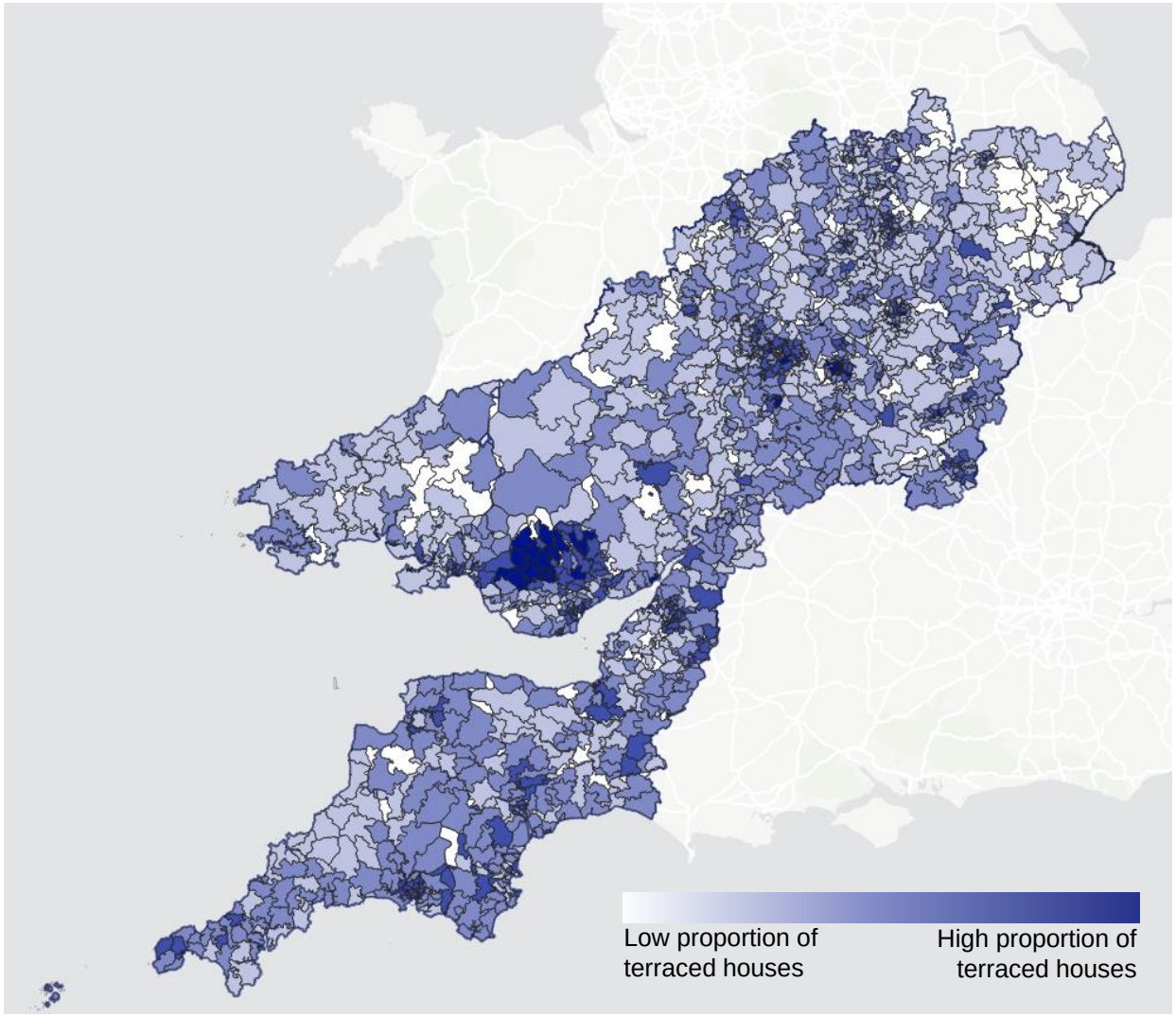
The uptake of domestic technologies, such as heat pumps, rooftop PV and EVs, is heavily affected by housing and demographic factors.

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.

In the longer term, the adoption of low carbon technologies in homes could become more ubiquitous across multiple types of housing and consumers.

Proportion of homes that are terraced houses by ESA, based on OS Addressbase spatial data.



Reconciliation with FES

Scenarios

The DFES 2024 uses the same scenario framework as the NESO FES 2024.

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 NESO FES team.

Technologies

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

For example, battery storage is modelled across four asset classes in the DFES.

This year new analysis for maritime, aviation, rail and agriculture has also been included.

Assumptions

Underlying assumptions in FES 2024 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

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 usually highest 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 projections for many technologies are based on national-level outcomes and strategies.

However, regional factors or local stakeholder input also affect the DFES results out to 2050.

Regional and local variations include:
Baseline and pipeline analysis
Resource availability
Local or national policy impacts
Stakeholder input
Housing stock analysis
Reflecting specific connection years for specific projects from NGED Technical Limit Offers
Reflecting transmission network constraints under the Counterfactual scenario

Next steps

The DFES is the first step of our strategic investment process. We use the DFES to identify future network constraints, and design the future network needed to facilitate net zero across our licence areas.

This analysis will be directly feeding into the planning for our next price control period, RIIO-ED3. To learn more about our strategic investment process and the Network Development Plan, click here.

NGED Distribution System Operator's (DSO) Strategic Engagement Officers will be in contact with Local Authorities to discuss the results of DFES 2024.

If you have any questions in relation to the NGED DSO System Planning team, please get in touch.

The DFES 2024 outputs are available online. You can download the reports and the results are also available as an interactive map. See QR codes:

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Distribution future energy scenarios map

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