Distribution Future Energy Scenarios

Mapping net zero locally

2024

Who we are

We're the people who manage the electricity network that powers everyday life for more than 8 million people across 3.9 million homes and businesses in the North East, Yorkshire and northern Lincolnshire.

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Foreword

Welcome to Northern Powergrid's Distribution Future Energy Scenarios (DFES), updated for 2024 – our locally informed view to 2050 for how we can achieve a net zero future for our region. DFES plays a crucial role in this process.

2024 has seen significant change in the energy sector, with the introduction of Regional Energy System Plans (RESPs), Future Energy Scenarios (FES) Pathways, the announcement of Clean Power 2030 and significant work done on Connections Reform to name but a few of the drivers. We have developed our 2024 DFES with these changes in mind, to ensure that our view of the future of our energy system remains relevant and accurate and will assist the RESP.

Our goals haven't changed – we are planning, designing and delivering a resilient and efficient network that meets the needs of our customers across our Licence Areas, taking into account regional ambition and the unique challenges and opportunities that each area presents. Decarbonisation is already underway and as we move towards achieving net zero by 2050, Northern Powergrid is actively enabling the transformation.

We have modified how we incorporate the local and regional intelligence gathered by our Regional Insights team, which has informed and validated inputs to our forecasts. This year, for example, we have expanded on previous DFES engagement by incorporating more local information on developments and the latest energy plans as they become available from more local authorities. Our 2024 DFES reflects local authority housing plans and house-building targets, moving away from a top-down national policy approach. This has pinpointed key growth areas that will guide our network development to prevent it being a barrier to progress in our region.

For the first time in more than a decade we're seeing demand growth, as the uptake of low-carbon technologies (LCTs) continues at pace. Electric vehicle (EV) registrations continue to accelerate, and more and more of our customers are installing heat pumps. These strong leading-edge indicators of change are reflected in our DFES 2024.

Taking this approach, we are uniquely positioned and ready to support the RESP for our region thanks to the bottom-up view of our region that reflects everything from individual LCTs at street level to major renewable energy projects including those in our connection pipeline. We are committed to collaborating with the NESO RESP team as they develop methodologies for creating RESPs.

We have also extended our thinking to account for changes in the policy environment – for example, Connections Reform, with the Technical Limits programme of works mirrored in our list of committed connections across all scenarios. We are ready to incorporate the policy decisions made around Clean Power 2030 as they arrive and have undertaken a sensitivity study to policy changes that were made after the publication of the national FES.

The Regional Insights Team's intelligence underpins our Reference Scenario, which is our current view of the long-term future for our region that reflects both local needs and central government policy out to 2050. Our Reference Scenario is an additional scenario which reflects the government's policy changes made after NESO and GB DNOs had agreed the scenario building blocks which ensure consistency across national approaches.

We believe our DFES forecasts are valuable to many stakeholders as they outline where, and how many LCTs are needed and the necessary shifts in generation required to meet net zero goals. Consequently, our DFES reports, data and methodologies are available on our Open Data Portal. This supports decarbonisation in our region by sharing information and encouraging stakeholders to feedback their plans back into our DFES.

We are dedicated to factoring in more local information in our DFES to ensure our investment decisions provide the best value for our customers and that our development plans meet our region's decarbonisation plans.

Thank you to the local authorities for their critical inputs, and to all our stakeholders for their invaluable feedback. Your contributions enable us to continually enhance our DFES, increasing its value to our region.

Paul Glendinning
Director of Energy Systems

Summary table

Scenario	Description	Year	Energy (Twh)	EVs (m)	Heat pumps (m)	Renewable generation (GW)	Battery Storage (GW)
NPg Reference Scenario	Highest certainty for the next 10 years reflecting policy positions and targets for our region – high uptake of EVs including heavy transport, and high uptake of heat pumps. Net zero by 2050	2030	42	1.75	0.35	5.71	1.26
		2040	58	4.37	1.37	10.28	2.50
		2050	68	5.08	2.61	14.25	2.99
Holistic Transition	Electrification and hydrogen – high uptake of EVs, heat pumps and rooftop solar, and highest levels of engagement with smart charging and smart management. Hydrogen plays an important role in the decarbonisation of industrial processes. Net zero by 2050	2030	41	1.40	0.26	5.59	1.17
		2040	56	4.06	1.27	9.59	2.36
		2050	65	4.51	2.58	13.29	3.09
Electric Engagement	Consumer-led electrification – high uptake of EVs, heat pumps and rooftop solar. High levels of engagement with smart charging and smart management, though less than that seen in Holistic Transition. Some localised hydrogen clusters are seen in this scenario. Net zero by 2050	2030	41	1.40	0.27	5.57	1.22
		2040	57	4.06	1.29	9.54	2.21
		2050	67	4.78	2.61	14.39	2.83
Hydrogen Evolution	Natural gas is replaced with green hydrogen - high uptake of EVs and heating, but low levels of engagement with smart charging and smart management. HGVs and buses fuelled largely by hydrogen, and more dispatchable hydrogen-fuelled generation at times of peak demand, using hydrogen produced and stored during low demand and high renewable output. Net zero by 2050	2030	40	1.40	0.17	4.67	1.08
		2040	57	4.06	1.09	6.50	1.64
		2050	68	5.05	2.19	8.81	1.80
Counterfactual	Some change driven by economic effects rather than policy support – lowest EV uptake, with a heavy reliance on gas for heat. The energy sector is not fully decarbonised. Does not achieve net zero by 2050	2030	40	1.17	0.12	4.33	1.10
		2040	51	3.49	0.43	5.48	1.53
		2050	57	4.33	0.66	6.67	1.68

Executive summary

The decarbonisation of heat and transport in our region has led to an uptick in energy demand after a long term trend of decline since the late 2000s, with the uptake of LCTs outweighing efficiency savings and industrial change.

Over 48,000 additional EVs and 4,900 new heat pumps were recorded in our licence areas in 2024. As LCTs continue to be rapidly connected to our network, our data models predict that overall demand will double by 2050, quickly surpassing the capacity our network was originally built to handle, especially in areas with the highest local LCT uptake.

System demand trends at Northern Powergrid

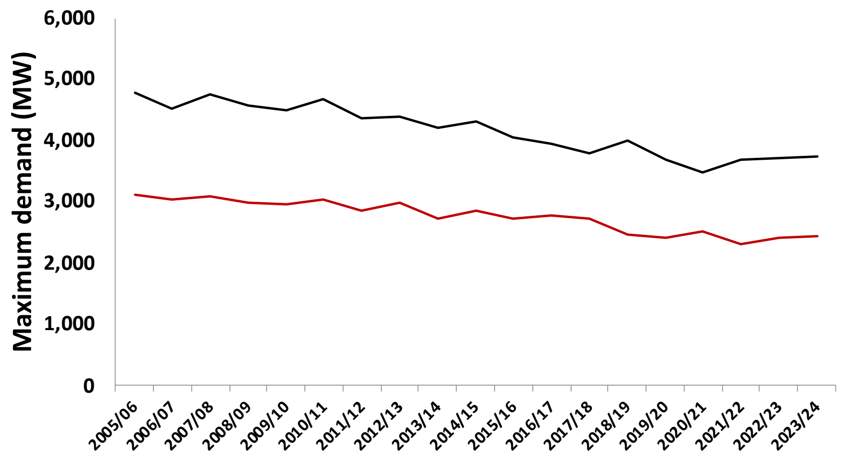

Figure 1:
Northern Powergrid gross peak demand

Transport and heat

All our scenarios that achieve net zero by 2050 forecast an eleven-fold increase in the number of EVs and a seven-fold increase in the number of heat pumps in our region by 2030 - compared to April 2024 levels.

Property

Intelligence from Local Authority growth plans forecasts 14% growth in housing across our region by 2050. This will significantly increase electricity demand as new builds are required to be built in an energy efficient way, with a low carbon footprint. This means the installation of low-carbon heating systems, such as electric heat pumps or electric boilers. Gas boilers cannot be fitted in new homes after 2025, based on the current policies and standards.[1]

Our region's transition

Our data models forecast high energy demand from the new CCUS facility in the Northeast, new hydrogen facilities and new energy parks (more than 300MW in total) by 2030.

Public charging

A further 80MW of energy demand is forecast to come from rapid charging facilities at Motorway Service Areas by 2035.

Renewables

By 2030, most of our region's embedded energy generation capacity is forecast to be renewable.

Just transition

To support a just transition, we have identified areas with slower LCT uptake - to guide regional balancing actions and ensure inclusivity.

Government policy shifts

We conducted additional analysis following shifts in government policy and new measures occurring after NESO and all DNOs agreed the building blocks which underpin modelling consistency. This analysis is presented later in the document and compares the Reference Scenario to NG FES's Holistic Transition.

1 https://www.theguardian.com/environment/2025/jan/06/uk-government-scraps-plan-to-ban-sale-of-gas-boilers-by-2035

Future scenarios

Previously, National Grid Electricity System Operator (NG ESO) was the UK's ESO. In conjunction with the DNOs, it produced the Future Energy Scenarios (FES) publication from a transmission network perspective. Accordingly, our DFES document has historically aligned to National Grid ESO's FES publication.

However, in October the government acquired the ESO from National Grid, transferring it into public ownership – NESO is now the UK's ESO. Moving forward, our DFES document will be aligned to NESO's FES publication, with the distinction that while NESO has opted to transition from 'Scenarios' to 'Pathways' in its FES 2024 publication, we and our DNO colleagues have decided to continue to use the term 'Scenarios' in our DFES 2024 documents. This is because these two terms refer to distinct concepts:

- Pathways describe strategic directions that should occur and are informed by transmission practicalities.
- Scenarios illustrate how things could occur and are not informed by the transmission practicalities of pathways.

Pathways framework 2024

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Our DFES 2024 scenarios use the same names as NESO's FES 2024 pathways, aligning each scenario's name to a pathway with comparable assumptions. These are:

NPg Reference Scenario

Net zero is met by 2050 with ambitious early momentum and support for our region in line with existing commitments, It relies on intensive investment in low carbon technologies, early action from government, and a high level of engagement from consumers to achieve ambitious rollout rates. It falls under the Energy Networks Association's definition of a 'best view' scenario.

Holistic Transition

Net zero is met by 2050 through a mix of electrification and hydrogen, with hydrogen mainly around industrial clusters. Strongest consumer engagement in the transition with demand shifting and smart homes and electric vehicles providing flexibility to the grid. It has some elements close to 2023's Leading The Way with notable differences - namely that it does not meet net zero early and is a more hybrid Electric-Hydrogen pathway.[2]

Electric Engagement

Net zero is met by 2050 through mainly electrified demand. Consumers are highly engaged in the energy transition with adoption of smart technologies that reduce energy demands from electric heat pumps and EVs. It is similar in its assumptions to the 2023 'Consumer Transformation' scenario.

Hydrogen Evolution

Net zero is met by 2050 through fast progress for hydrogen in industry and heat. Electric vehicle uptake is strong, yet there are low levels of consumer engagement. It is similar in its assumptions to the 2023 'System Transformation' scenario.

Counterfactual

Net zero is missed by 2050, though some progress is made for decarbonisation compared to today. It is similar in its assumptions to the 2023 'Falling Short' scenario.

2 2023's 'Leading The Way' scenario achieved net zero by 2047 through a combination of electrification and innovation. NESO's FES Holistic Transition achieves it by 2050 through combining electrification and efficiency measures with the use of hydrogen for transport and hard-to-decarbonise industries, and our DFES 2024 scenario matches this.

How DFES can benefit you

It is important that our DFES informs and supports not only our plans, but those of stakeholders across our region who are also planning for their net zero futures.

Our DFES illustrates potential changes in energy demand and generation across various net zero future scenarios, using data models and local intelligence. It is used to inform our network development plans to support our region's net zero goals, as well as stakeholders' decarbonisation efforts.

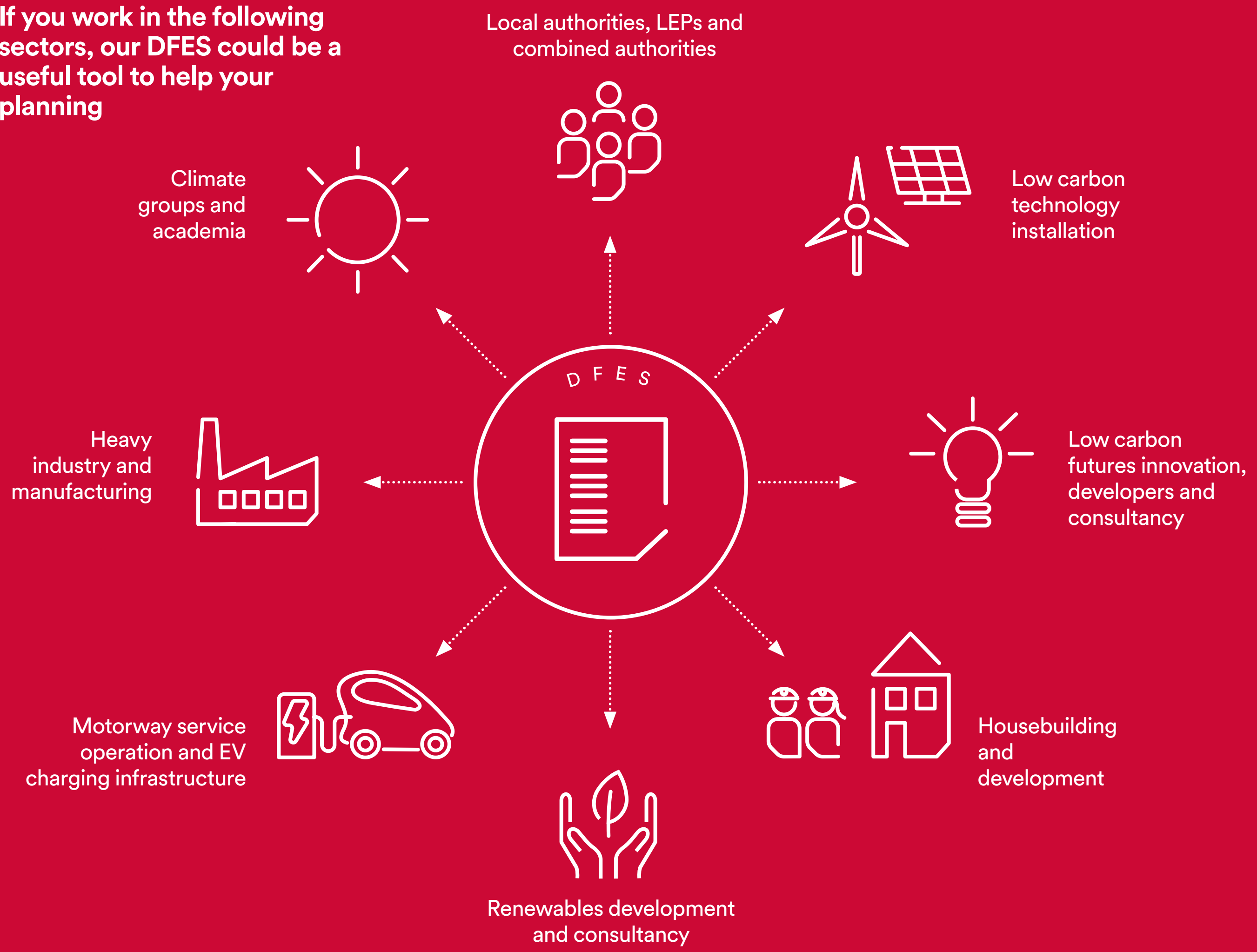
We want our scenarios to accurately reflect the decarbonisation ambitions of our region and help stakeholders to map out their plans by utilising our DFES data.

You can use DFES' open data to:

— Model your own future energy scenarios at a hyper-local level;
— Provide a strategic overview of forecast EV and heat pump numbers, to help shape local area energy planning;
— Bolster funding applications for decarbonising interventions like local energy generation schemes; and
— Engage and educate people about regional decarbonisation.

Our team uses our DFES to inform the network development plans and flexibility studies that play a key role in our decision-making processes for the short, medium, and long term. Our network development plan and business plan, shaped by DFES, can further support your planning.

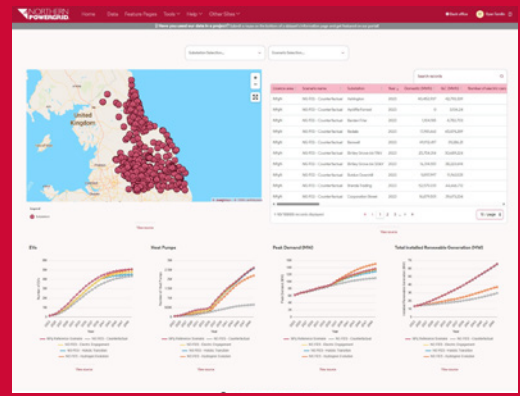
If you work in the following sectors, our DFES could be a useful tool to help your planning



Using key data

Data that can benefit you

To make our DFES as accessible as possible, we have packaged up key data from our DFES scenarios and relevant tools to support you. We have also made all this available in multiple places to ensure it reaches the widest possible audience.

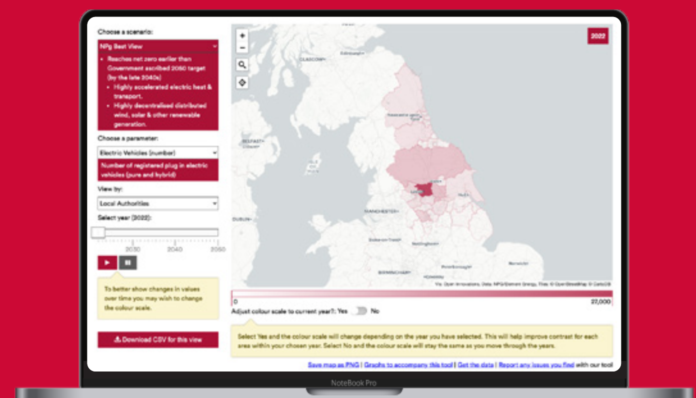


Open Data Portal: Use and merge data sets online

Our Open Data Portal allows users to explore growing sets of data, locate our assets on maps, browse charts, and publish their own data. It also has an API feature for automation. A valuable feature is that any user can overlay and visualise our DFES data alongside other data sets. Find this tool here: Open Data Portal

Visualisation Tool: See key data on a map of your area

You can use our visualisation tool to see key data items on a map, which you can adjust by scenario and by year.
You can find this tool here: Northern Powergrid Visualisation Tool



Data Mill North: Download and use our data

Data Mill North enables you to download and use relevant data, to help you map out your plans.
Find this tool here: Data Mill North

Please contact our System Forecasting team via email at opendata@northernpowergrid.com if you have any questions or feedback.

NPg Reference Scenario and working with other networks

In addition to the four scenarios aligning with FES Pathways, we have produced an additional scenario as part of our DFES to reflect the highest certainty view of credible shorter-term trends for the next 10 years.

By providing this additional scenario, Northern Powergrid hope to offer more clarity about energy demand and supply patterns in our regions in the short term and remove the complexities of multiple scenarios for stakeholders.

Our best single scenario is called the NPg Reference Scenario. In developing our Reference Scenario, we are working to three justification criteria that ensure all DNOs are aligned in their approach:

- alignment with existing and announced Government policies;
- consideration of stakeholder engagement inputs; and
- use of regional and local characteristics.

The DFES 'building blocks', which we have detailed in the table below, are key technology parameters that are selected by us and our DNO colleagues to create a common language, to enable stakeholders like you to compare DFES data.

All DNOs agree on these building blocks each year and exchange these with the ESO (now NESO, formerly National Grid ESO) to inform its FES publication.

The indicators used in the below table – "highest", "high", "medium" and "low" – refer to the relative strength of the input drivers for the technology parameters using the credible range for each technology.

Scenario building blocks

Building Block	NPg Reference Scenario	Holistic Transition	Electric Engagement	Hydrogen Evolution	FES Counterfactual
Heat Pumps – Domestic	Early High	High	Highest	Medium	Low
Heat Pumps – I&C	Highest	High	Highest	Medium	Low
Hybrid Heat Pumps	None	Low	None	High	None
Thermal Efficiency	Moderate	Accelerated	Moderate	Moderate	Baseline
Small EVs (cars and vans)	Early High (low modal shift)	High (high modal shift)	High (medium modal shift)	High (low modal shift)	Low
Large EVs (HGVs and buses)	High	High	High	Medium	Low
EV Smart Charging	High (excluding NPg procured managed charging)	High (excluding NPg procured managed charging)	High (excluding NPg procured managed charging)	High (excluding NPg procured managed charging)	High (excluding NPg procured managed charging)
Domestic Stock	Regional Insights	NG FES	NG FES	NG FES	NG FES
I&C Stock	NPg model	NPg model	NPg model	NPg model	NPg model
Time-of-Use Tariffs	High Uptake	High Uptake	High Uptake	Medium Uptake	Low Uptake
Electrolysers	Medium	Highest	Medium	High	Low
Large Industry	Deep Electrification (later growth, highest load)	Deep Electrification (later growth, highest load)	Early Net Zero (early growth, high load)	High Hydrogen (later growth, mid load)	High Hydrogen (later growth, mid load)
Appliance Efficiency	Future Policies	Future Policies	Future Policies	Future Policies	Future Policies

Key assumptions at a glance

The table below indicates key assumptions made in all our scenarios, including policy sensitivities. These inputs ensure that our scenarios account for existing policies which are influencing the uptake of LCTs.

Scenario assumptions

Key assumptions	Gas/Oil Phase-out	Thermal Efficiency	Heat Pump Suitability	Heat Pump Technology Awareness	EV Charging Access	ZEV Mandate	BEV Supply Constraints
NPg Reference Scenario	2035 (2025 New Builds)	Early high	Very rapid increase	Very High	100% by 2030	Car: 100% BEV/PHEV by 2030; 100% BEV by 2035; eVans 100% BEV by 2035;	Optimistic BEV to 2025, unconstrained from 2026
Holistic Transition	2035 (2025 New Builds)	High	Rapid Increase	High	100% by 2030	100% BEV by 2035	Restricted to ZEV Mandate to 2028
Electric Engagement	2035 (2025 New Builds)	High	Rapid Increase	High	100% by 2030	100% BEV by 2035	Restricted to ZEV Mandate to 2028
Hydrogen Evolution	2035 (2025 New Builds)	Medium	Steady Increase	High	100% by 2030	100% BEV by 2035	Restricted to ZEV Mandate to 2028
Counterfactual	No restrictions (2030 New Builds)	Low	Steady Increase	Medium	100% by 2035	Not enforced	Restricted to ZEV Mandate to 2027

Government policy shifts: analysis

Some of the shifts in government policy and new measures put in place to facilitate a faster transition to net zero for our region (and the UK more widely) occurred after National Grid ESO and all the DNOs agreed the building blocks which underpin modelling consistency. They are not represented in the FES-linked scenarios.

However, recent government policy announcements and speculation concerning heat pumps and EVs (listed below) could also impact future long-term forecasting.

Accordingly, we have conducted some additional analysis to account for these potential changes, as well as potential policy sensitivities – to aid stakeholders like you.

Here, it is worth noting that the implications of these announcements and this speculation are currently unclear. Because of this, we have not implemented them fully into all of our DFES scenarios. Instead, we have opted to incorporate them into a version of our NPg Reference Scenario, as shown on the following page.

Policy updates and speculation

ICE PHASE OUT [3]

— The UK government's current policy states that sales of new cars running solely on petrol or diesel will now be phased out by 2030, rather than 2035, subject to ongoing industry consultation.

GAS BOILER PHASE OUT

— Gas boilers will not be phased out from existing properties, but they cannot be fitted in new homes after 2025, based on the current policies and standards.

Analysis of policy updates and speculation

— **ICE phase out:**
Our analysis shows that this policy shift could impact all our DFES scenarios through increasing the uptake of EVs – by boosting consumer confidence and driving long-term investment from car manufacturers, EV charging infrastructure developers and EV charging service providers.

This would accelerate our region's transition to net zero while increasing electrical demand.

— **Heat pump technology awareness and suitability:**
Whilst there is no confirmed date for when gas boilers will be phased out from existing properties by, we have considered the impact of making the improvements to UK homes required to install heat pumps. We have modelled this based on improvements to thermal efficiency and short term increases in the suitability, and people's awareness, of heat pumps. Our analysis shows that these changes could impact our DFES scenarios through increasing the uptake of heat pumps (and electric boilers) and thereby aiding consumer confidence and stimulating investment from manufacturers.

3 For cars and vans only – we have not included HGVs or buses.

Sensitivity study results: Peak Demand, EVs and Heat Pumps

Our modelling shows that the previously mentioned policy shifts and measures (as of 2024) could increase energy demand across our network compared to Holistic Transition.

Our additional analysis shows Gross Peak Demand noticeably rises above the Holistic Transition scenario from 2026 onwards due to earlier LCT uptake.

The reason for the higher levels of energy demand is the increased uptake of EVs and heat pumps.

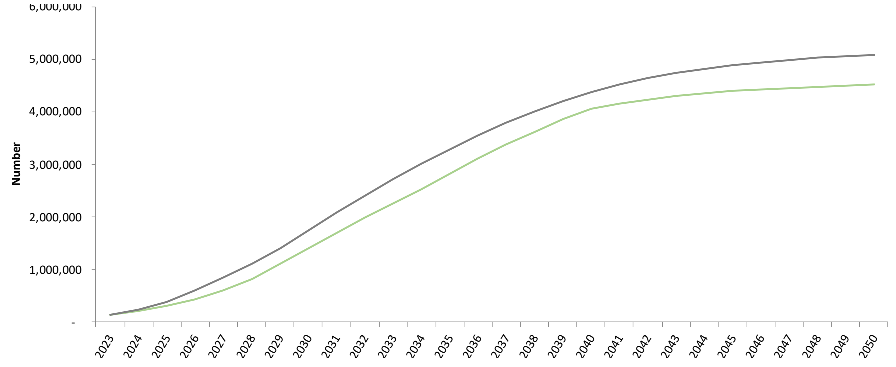


Figure 4:
Electric Vehicles policy sensitivity

NPg RS 2024 Policy Sensitivity
DFES 2024 - Holistic Transition

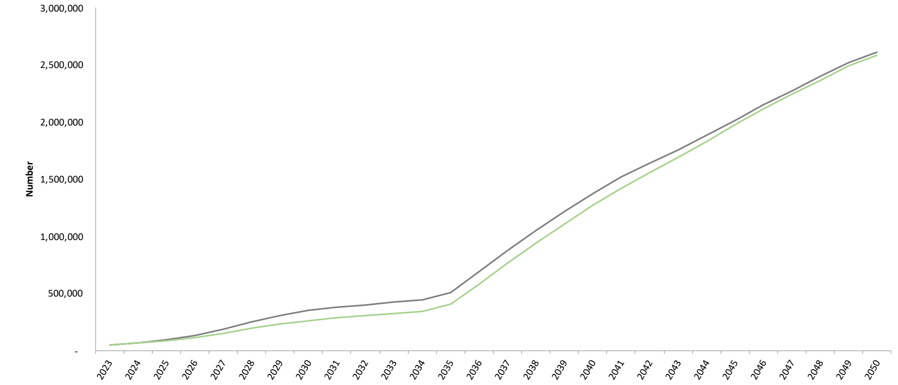


Figure 5:
Heat Pumps policy sensitivity

NPg RS 2024 Policy Sensitivity
DFES 2024 - Holistic Transition

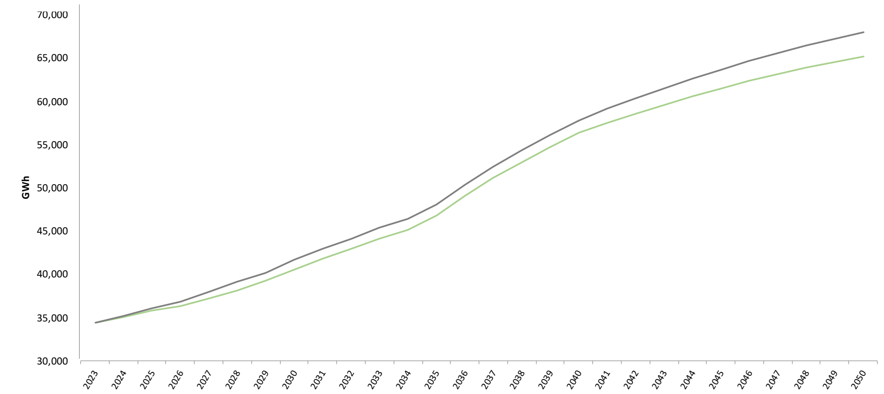


Figure 6:
Electrical Energy Consumption policy sensitivity

NPg RS 2024 Policy Sensitivity
DFES 2024 - Holistic Transition

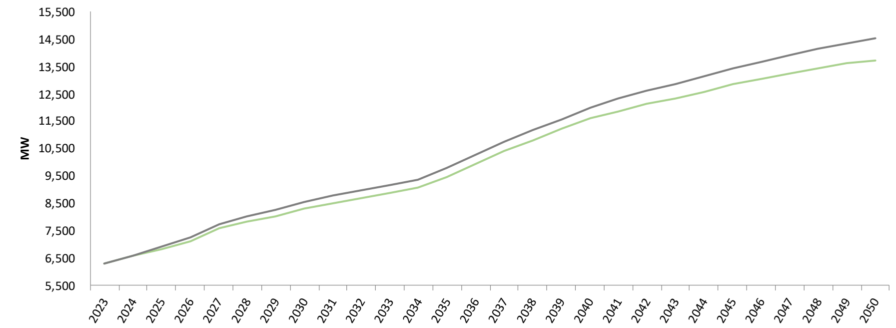


Figure 7:
Gross Peak Demand policy sensitivity

NPg RS 2024 Policy Sensitivity (with ToUT)
DFES 2024 - Holistic Transition (with ToUT)

Our approach to modelling

Building on our approach in previous years, we have prepared our own bottom-up models and bespoke scenario alongside other DFES scenarios using the same building blocks as the FES pathways.

Our methodology reflects NESO's FES outlook on future growth of energy demand and LCT deployment in a way that is specifically tailored to our region. This approach enables us to determine and understand the changes relative to NG's FES 2024 publication, as well as the latest data trends regarding key drivers.

It is worth noting that NESO's move to FES Pathways may be seen as a shift from "could happen" to "should happen" to create three net zero-compliant future energy systems. We have adopted the principles of the Pathways approach and mirror the policy positions, but remain with the terminology of Scenarios for now, as there are material differences in how we consider available network capacity.

As per our published methodology, which is shared to enable a thorough understanding of DFES outputs, we have conducted a bottom-up analysis of trends relating to the uptake of LCTs that utilises consumer choice modelling. This modelling considers drivers for the uptake of various LCTs based on techniques such as willingness-to-pay analysis and studies of real consumer groups. For each LCT, we input key assumptions from the NESO FES pathways into the consumer choice model to generate bottom-up trends that follow the overall narrative of each pathway. While our DFES trends do not exactly match the volumes reported in NESO's FES, they are quite similar. We have also factored advancement in LCTs into our approach.

Preparing our scenarios
Bottom-up analysis of trends regarding LCT uptake

Alignment
Input key assumptions from the NESO FES pathways

Detailed Modelling
Model drivers for the uptake of LCTs, factoring in data on individual buildings

Local enhancements and validation
Input data gathered by our Regional Insights team, including outputs from Local Area Energy Plans

Bottom-up trends aligned with the narrative of each FES pathway

Our DFES 2024 includes an update of forecasts for all the parameters in last year's DFES, including:

Electric cars & vans

Heat pumps and hybrid heat pumps
(including additional sensitivity with extra heat pumps to represent district heating)

Electric Heavy Goods Vehicles (HGVs) and buses

Distributed generation
(solar photovoltaics (PV), onshore wind, Combined Heat and Power (CHP), renewable engines, waste incineration, non-renewable engines, biomass)

Battery energy storage systems (BESS)

Regional insights

This year, we have enhanced our modelling by inputting data gathered by our Regional Insights team directly into our load growth model inputs. This methodological improvement puts regional intelligence at the heart of our modelling. It also enables us to ensure better internal model consistency, utilise more up to date information, and more easily separate realised projects from speculative ambition.

Specifically, we have directly inputted data regarding new build housing projections gathered from 30[4] of our local authorities into our load growth model, rather than utilising less-specific national housing stock projections data. We opted to make this change because we can get more accurate data directly from local authorities – national housing stock projections data is not updated every year and it typically lags behind national policy changes.

Our increased use of regional intelligence delivers the following advantages:

1. **The data is more current, better customised to our region and more in line with national policy changes – making it more useful for our stakeholders.**
2. **It drives internal model improvements - aiding clarity, accuracy and efficiency.**
3. **It allows us to more easily separate realised projects from speculative ambition – meaning more valuable engagements with stakeholders and improved future modelling.**

We have used the information gathered by our Regional Insights team to enhance and validate our model where we can. For example, analysis of York and North Yorkshire's LAEP revealed greater ambition regarding the uptake of LCTs than our models predicted. This additional information has been considered in our forecasting to inform the expected impacts on both our region's transition to net zero and our network.

We already factor in installation programmes for LCTs – covering over 600 new rapid chargers at motorway service areas by 2035 – and plans to decarbonise social housing stock. In future years, we will directly input even more data gathered by our Regional Insights team into our load growth models, utilising outputs from new Local Area Energy Plans as they become available to aid our model's validation and support its enhancement.

Additional changes
This year, we have also enhanced our modelling utilising data regarding:

Rollout of rapid EV charging at Motorway Service Areas (from National Highways)

New CCUS site in the Northeast, new hydrogen facilities and energy parks (from stakeholders)

4 30 out of 32 local authorities in the region

How we use regional insights

Ambitious plans are taking shape to decarbonise our communities and deliver net zero across our region. Our electricity network will be a key enabler of this ambition. As such, we need to be sure that we are building the right network, in the right place at the right time.

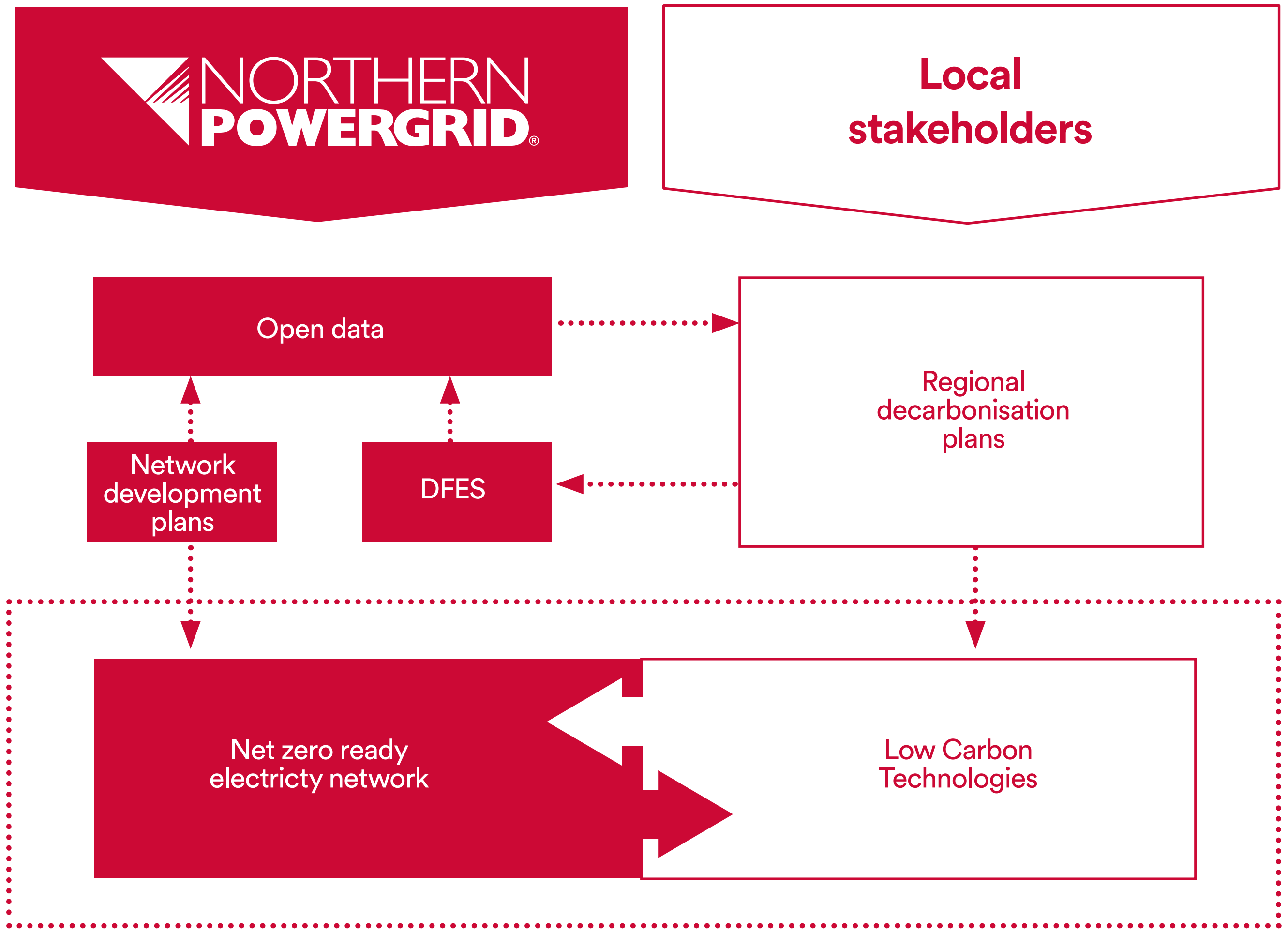
We have a dedicated Regional Insights team who have provided a wealth of data on key stakeholders' plans and ambitions for delivering net zero. Thirty – the vast majority – of the local authorities in our licence areas have engaged with us on everything from house building to Local Electric Vehicle Infrastructure (LEVI) charge point funding, and we have used that data in our modelling to improve projections and inform our plans for developing the network.

This is a two-way process, facilitated by our Regional Insights team. We are actively engaging with stakeholders, and seeking to engage with more, to gain insight into their net zero plans and how we can support them. Our team feeds intelligence from these engagements into our data – the results of which, when compiled into our models, helps local authorities and other key stakeholders better utilise our insights and open data. This aids strategic policy and business decision-making by enabling them to test key assumptions.

Our Regional Insights team have extensively engaged with key stakeholders over the past 12 months to gather additional intelligence into strategic plans and we have fed this into our DFES modelling. This modelling will feed into our network planning and development work, to support stakeholders' decarbonisation efforts.

If you are an organisation making regional decarbonisation plans, we want to work with you

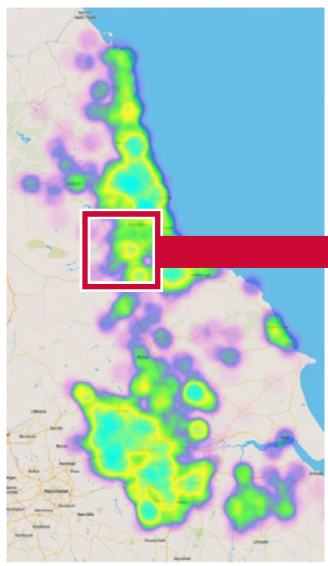
Our Regional Insights team want to hear more about your plans.
Please contact them via email at: LAEP@northernpowergrid.com



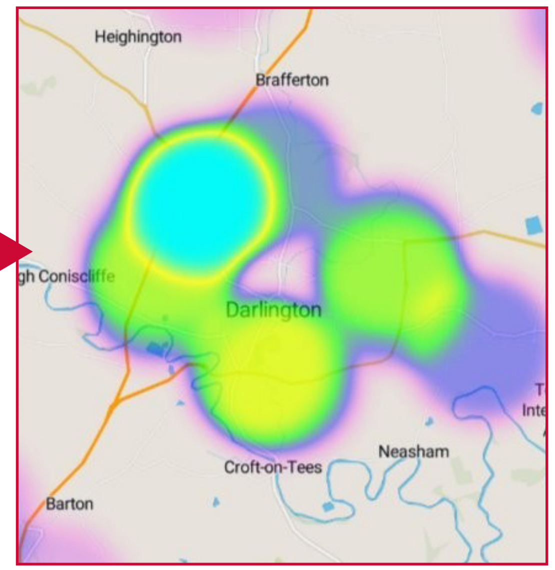
So far, our engagements have told us:

- There are plans for 330,000 new homes by 2050. This represents a 7% uplift in housing stock compared to the number reported in our DFES 2023 document and a 14% uplift overall. Notably, this includes areas that did not show significant housing growth in last year's DFES.
- There could be additional industrial and commercial activity across 350 hectares in and around Darlington in the Northeast, and significant industrial development at Dalton in Yorkshire.
- That motorway service areas will play a bigger role in our region's transition to net zero, with plans to have a total of 527 EV chargers installed there by 2035 and 996 by 2050.
- There are a number of new projects, including a new CCUS project, other hydrogen facilities, and energy parks, that have the potential to contribute significantly to our region's energy demand and generation capacity. These include a 1GW CCUS-enabled low carbon hydrogen production facility on Teesside with the potential to contribute up to 10% of the UK's target 10GW hydrogen capacity by 2030; and an energy park on the Humber, which is set to be the UK's first freeport-based energy and technology business park. There is also the potential for substantial capacity to be added through new data centres.
- There is a potential 'electric arc' steelmaking furnace planned for Teesside, which we will continue to monitor for our planning.
- Local Area Energy Plans (LAEPs) are an increasingly key source of information regarding the uptake of EVs, heat pumps and solar PV. Where available for the corresponding areas, we have used LAEP data to validate our DFES outputs.

Housing heat map



- Darlington plans include an additional 11,000 new homes compared to our previous model



It is worth noting that our Regional Insights team are monitoring new plans for community energy projects and for district heating. We will further improve our modelling of district heating, an important means of decarbonising heating, for our DFES 2025.

DFES 2024 future projections

Energy demand

Transport (EVs / eHGVs / buses)

The uptake of EVs across all scenarios accelerates through the remainder of this decade and the 2030s.

Other than our Reference scenario, the Hydrogen Evolution scenario sees the largest increase in EV ownership due to slow uptake of alternative modes of transport. However, all scenarios that achieve regional net zero by 2050 reflect a large increase in EVs, with more than 4 million EVs on our roads by 2050. That equates to roughly one per household in our region.

Electrification is also seen for HGVs and buses both in the non-hydrogen scenarios and in scenarios in which hydrogen plays a leading role in decarbonisation.

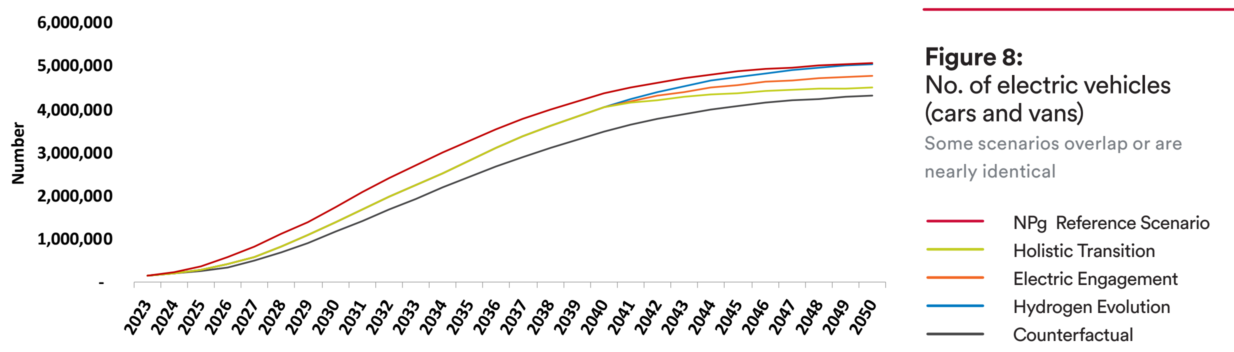


Figure 8:
No. of electric vehicles (cars and vans)

Some scenarios overlap or are nearly identical

	2025	2030	2040	2050
NPg Reference Scenario	378,060	1,751,455	4,371,931	5,075,143
Holistic Transition	305,265	1,401,426	4,064,963	4,512,390
Electric Engagement	305,265	1,401,426	4,064,963	4,781,607
Hydrogen Evolution	305,265	1,401,426	4,064,963	5,050,825
Counterfactual	258,365	1,170,968	3,491,118	4,330,477

That said, the Hydrogen Evolution scenario, in which hydrogen plays a more prominent role, sees a slower uptake of electrified HGVs and buses. However, by 2050 the numbers of electric HGVs and buses on our roads in that scenario are only marginally lower than those in our Reference Scenario and our other scenarios that achieve regional net zero by 2050.

	2025	2030	2040	2050
NPg Reference Scenario	3,636	20,913	74,156	84,316
Holistic Transition	3,636	20,913	74,156	84,316
Electric Engagement	3,636	20,913	74,156	84,316
Hydrogen Evolution	2,910	16,264	67,685	82,044
Counterfactual	2,451	13,561	62,214	84,004

Figure 9:
No. of electric buses and HGVs

Energy demand

Heating (heat pumps)

Our scenarios show very different uptake trajectories for electric heat.

Our Holistic Transition and Electric Engagement scenarios show a major acceleration from 2035 onwards due to accelerated policy support, with the gas boiler ban coming into force for existing properties from then.

Next, our Reference Scenario shows a faster uptake - supported by greater energy efficiency of, and confidence in, heat pumps - followed by a dramatic increase from 2035 as the gas boiler ban comes into play for existing properties, per the policy that was scheduled to come into force at the time we prepared DFES 2024. Since we prepared DFES 2024, the government has announced that this policy is no longer scheduled to come into force.

Our Hydrogen Evolution scenario, on the other hand, shows a much lower uptake of electric heat pumps, due to higher uptake of hybrid systems, utilising electrical energy and hydrogen in tandem.

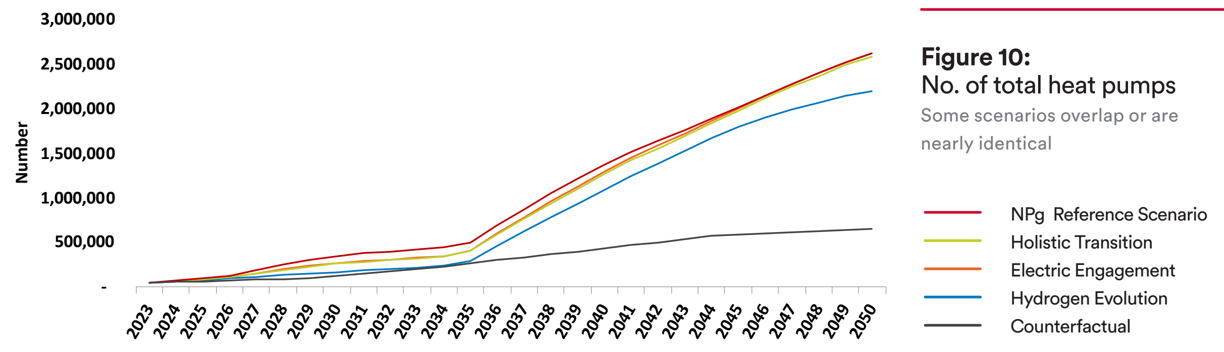


Figure 10:
No. of total heat pumps

Some scenarios overlap or are nearly identical

	2025	2030	2040	2050
NPg Reference Scenario	97,207	349,733	1,372,860	2,614,517
Holistic Transition	86,510	263,963	1,269,479	2,584,160
Electric Engagement	87,231	268,701	1,293,580	2,613,047
Hydrogen Evolution	79,374	171,463	1,090,601	2,192,379
Counterfactual	68,219	124,562	434,501	659,448

The projected residential heat pump uptake figures shown below reflect similar trajectories to the total (commercial and residential) heat pump uptake in our region. It should be noted that while many households across our region are projected to use standalone heating systems connected to our low voltage networks, others are projected to be connected to district heating networks which will also use electric power and connect to our higher voltage networks.

	2025	2030	2040	2050
NPg Reference Scenario	88,028	333,390	1,291,014	2,425,372
Holistic Transition	77,331	247,619	1,187,632	2,395,016
Electric Engagement	78,053	252,357	1,211,733	2,423,903
Hydrogen Evolution	70,453	158,410	1,024,474	2,036,470
Counterfactual	59,225	111,077	410,307	628,585

Figure 11:
No. of residential heat pumps

DFES 2024 future projections

Energy demand

Total electrical energy consumption

LCTs for transport and heat will be a key driver of our region's transition to net zero. Significant growth in the uptake of EVs and heat pumps will greatly increase electricity use, requiring development of our infrastructure and the way we manage our network to support this increased demand.

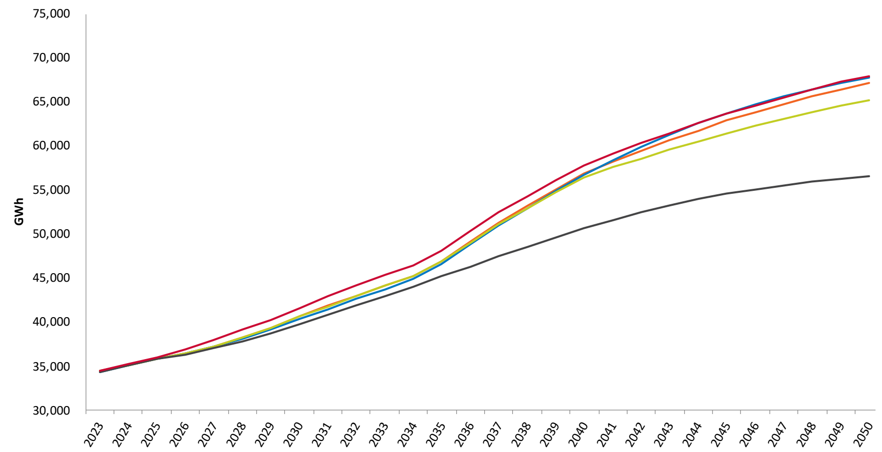


Figure 12:
Electrical energy consumption (GWh)
Some scenarios overlap or are nearly identical

NPg Reference Scenario
Holistic Transition
Electric Engagement
Hydrogen Evolution
Counterfactual

	2025	2030	2040	2050
Reference Scenario	36,033	41,630	57,732	67,948
Holistic Transition	35,786	40,605	56,386	65,120
Electric Engagement	35,796	40,650	56,845	67,109
Hydrogen Evolution	35,852	40,372	56,676	67,791
Counterfactual	35,781	39,785	50,666	56,564

We expect electrical demand to almost double by 2050 in terms of units consumed in all scenarios that achieve net zero, across our region. The Counterfactual has the lowest electrical demand of all scenarios. However, this scenario will have the highest energy demand due to less improvement in energy efficiency and significant fossil fuel use for heating, transport and industry.

Energy demand

Gross peak demand

The gross peak demand for power is often a critical parameter when evaluating future network constraints. It is expected to increase significantly in all the DFES scenarios, driven largely by the electrification of heat and transport.

There is uncertainty over the operation of large-scale energy storage, which can create new peaks on the network outside of the traditional winter peak evening. However, once a connection quotation is accepted, we reserve the capacity for it in our forecasting to better anticipate and mitigate the risk of potential future network constraints.

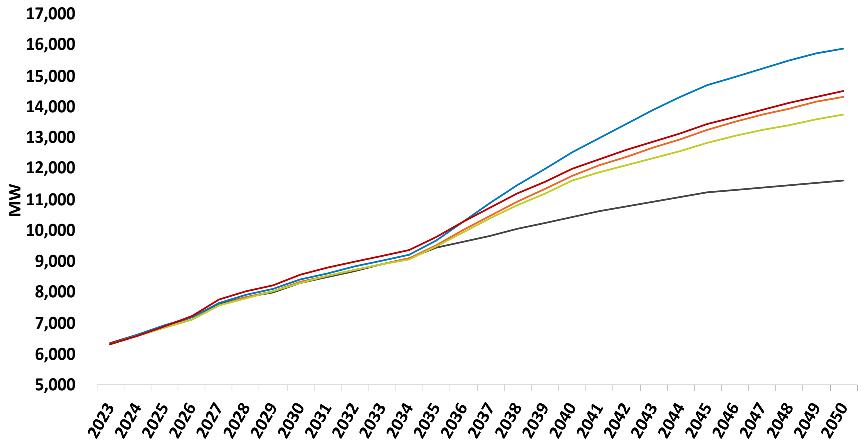


Figure 13:
Gross Peak Demand (MW), with ToUT
Some scenarios overlap or are nearly identical

NPg Reference Scenario
Holistic Transition
Electric Engagement
Hydrogen Evolution
Counterfactual

	2025	2030	2040	2050
NPg Reference Scenario	6,905	8,568	11,986	14,510
Holistic Transition	6,846	8,325	11,605	13,736
Electric Engagement	6,849	8,338	11,770	14,332
Hydrogen Evolution	6,921	8,414	12,521	15,901
Counterfactual	6,909	8,298	10,457	11,612

Other types of demand connections that we include from our pipeline are rapid EV charging (at higher voltage levels on our network), electric battery manufacturing facilities, data and logistics centres, and warehouses. We assume a larger energy load per household for new housing estates due to plans to pre-install heat pumps and EV charging infrastructure.

DFES 2024 future projections

Energy demand

Fuel switching and electrolysers

Fuel switching and the production of future low emission fuels will also increase electricity demand on our network. The process of fuel switching will drive significant increases in peak demand on our network, more than doubling from around 6,000 MW today to over 14,000 MW by 2050. The data below shows technological contributions to peak demand forecasts for our Reference Scenario, with industrial fuel switching highlighted in dark grey and electrolysers highlighted in brown.

Within this, the contributions of "hard to abate" sectors such as steelworks and petrochemicals increase steadily from 2030 onwards, as growing energy demand from fuel switching for large industries and electrolysers accelerates in the 2040s. Fuel switching impacts energy demand in all scenarios, even the Counterfactual. Electrolysers are particularly prominent for the Hydrogen Evolution scenario, with hydrogen playing a key role in our region's transition to net zero.

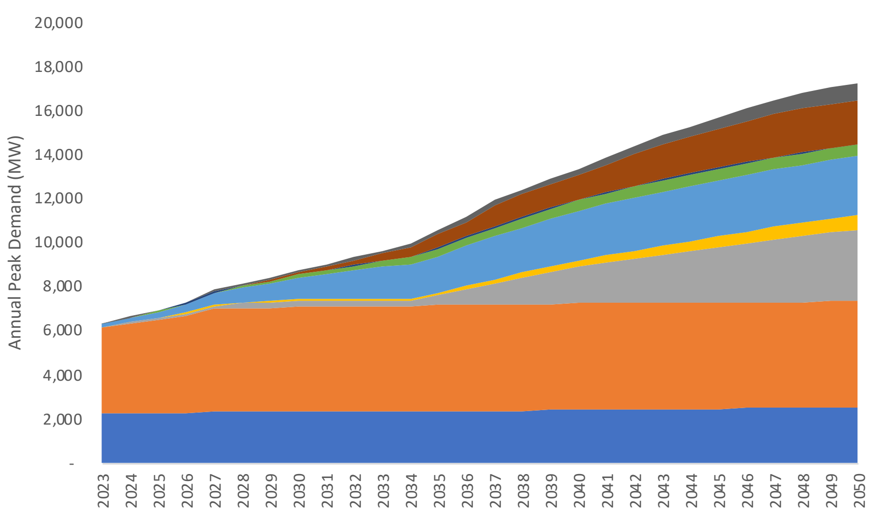


Figure 14:
NPg Reference Scenario: Breakdown of Peak demand (MW), with ToUT

	2025	2030	2040	2050
Domestic Underlying	2,295	2,322	2,403	2,537
I & C Underlying	4,235	4,799	4,835	4,806
Heat pumps - domestic	62	263	1,661	3,269
Heat pumps - I & C	39	66	298	639
EV - cars & vans	253	974	2,254	2,668
Electric HGVs	13	117	471	523
Electric Buses	9	27	63	69
Electrolysers	9	103	1,124	1,936
Large industry Fuel Switching	35	92	271	827
Total demand	6,949	8,764	13,380	17,272

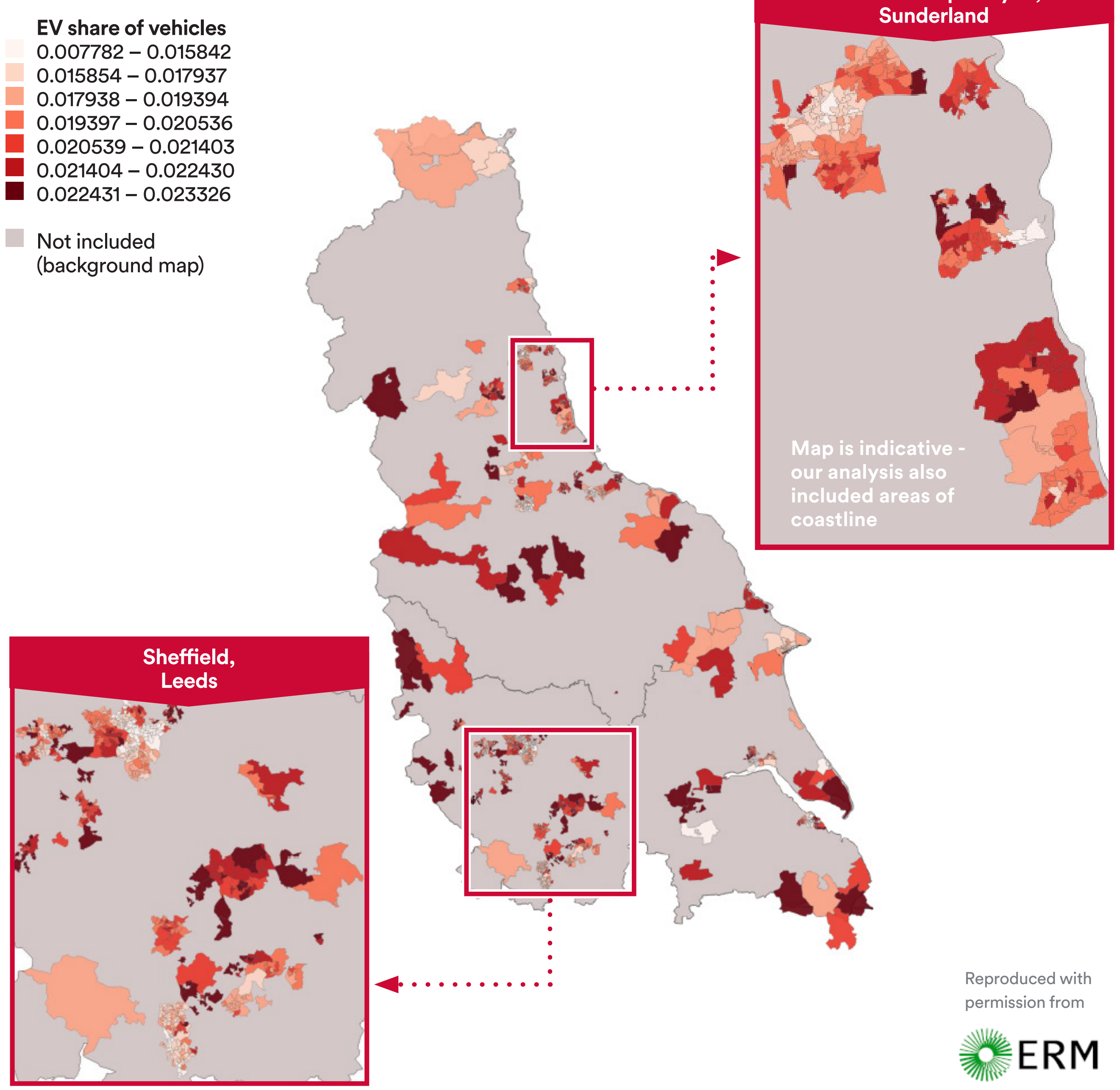
Energy demand

Just transition

Our bottom-up modelling of LCT uptake provides valuable insight into where and when our customers will adopt EVs and heat pumps. We have highlighted the quarter of the LSOAs in our region with the slowest uptake of LCTs - according to our modelling - on the map below.

This data helps stakeholders identify areas that could potentially be left behind in the uptake of LCTs, helping deliver a just transition to net zero for our region.

MSA mapping - EV chargers



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DFES 2024 future projections

Energy generation

Solar PV

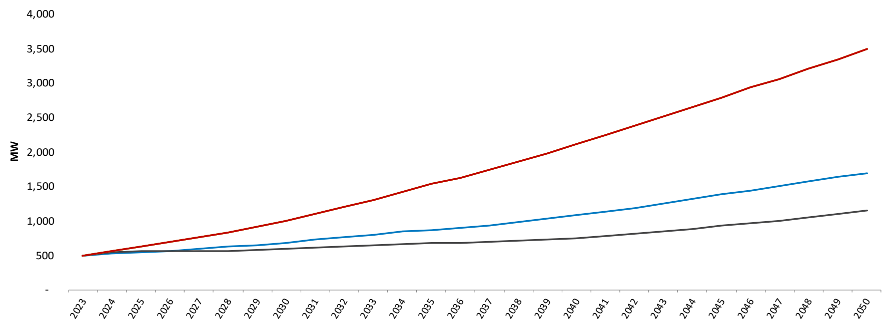

Figure 15:
Residential PV capacity (MW)
Some scenarios overlap or are nearly identical

	2025	2030	2040	2050
NPg Reference Scenario	618	992	2,106	3,498
Holistic Transition	618	992	2,106	3,498
Electric Engagement	618	992	2,106	3,498
Hydrogen Evolution	539	680	1,075	1,681
Counterfactual	554	584	751	1,151

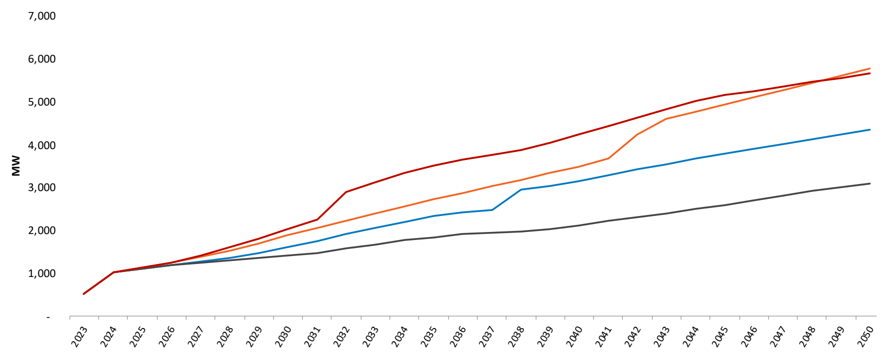

Figure 16:
Large scale PV capacity (MW)
Some scenarios overlap or are nearly identical

	2025	2030	2040	2050
NPg Reference Scenario	1,145	2,033	4,244	5,652
Holistic Transition	1,145	2,033	4,244	5,652
Electric Engagement	1,145	1,887	3,498	5,786
Hydrogen Evolution	1,116	1,624	3,154	4,352
Counterfactual	1,118	1,421	2,130	3,096

The PV sector (both domestic and large scale) shows some of the widest variations between our DFES scenarios. This is because our Hydrogen Evolution scenario requires significantly lower levels of future (electrical) energy generation compared to our non-hydrogen scenarios.

It is worth noting that our Reference Scenario and both the Holistic Transition and Electric Engagement scenarios – which favour electrification as the means to decarbonise our region – share the same forecast uptake in residential PV. This (decentralised) type of energy generation is a key driver of increasing renewable energy generation capacity regionally.

The amount of large-scale solar PV is considerable in all our DFES scenarios.

Energy generation

Wind

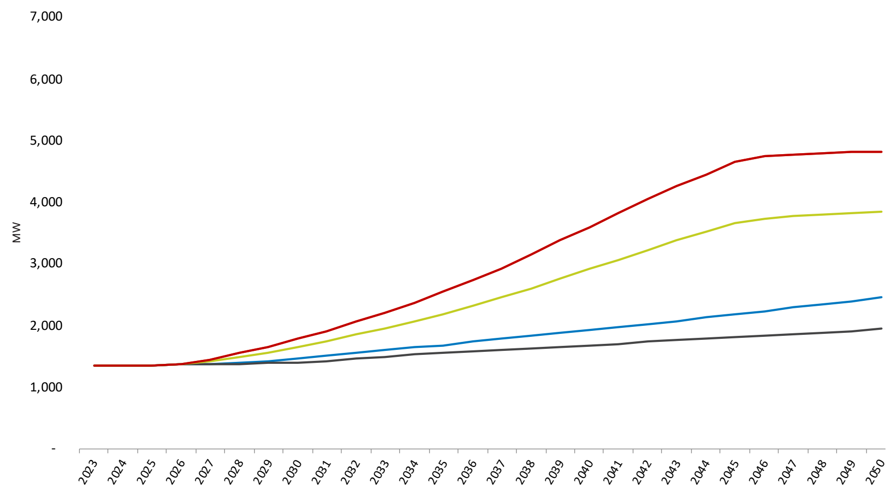

Figure 17:
Wind energy capacity (MW)
Some scenarios overlap or are nearly identical

	2025	2030	2040	2050
NPg Reference Scenario	1,355	1,778	3,595	4,808
Holistic Transition	1,355	1,651	2,908	3,842
Electric Engagement	1,355	1,778	3,595	4,808
Hydrogen Evolution	1,355	1,457	1,920	2,449
Counterfactual	1,355	1,396	1,679	1,940

Within our DFES scenarios, we assume that all future energy generated by wind power and connected to our network will be generated by onshore wind projects. This is because offshore schemes have higher capacity connections that typically suit a transmission interface.

This year, the Government lifted the effective ban on onshore wind projects across England and confirmed that schemes with a minimum generation capacity of 100MW would fall under the Nationally Significant Infrastructure Project (NSIP) regime, meaning many of them will be determined at the national, rather than local, level.

	2025	2030	2040	2050
NPg Reference Scenario	4,029	5,713	10,281	14,253
Holistic Transition	4,029	5,587	9,594	13,287
Electric Engagement	4,029	5,567	9,536	14,389
Hydrogen Evolution	3,922	4,674	6,501	8,806
Counterfactual	3,938	4,333	5,480	6,668

Figure 18:
Total Renewable DG Capacity (MW)

DFES 2024 future projections

Energy storage

Total energy storage and residential energy storage

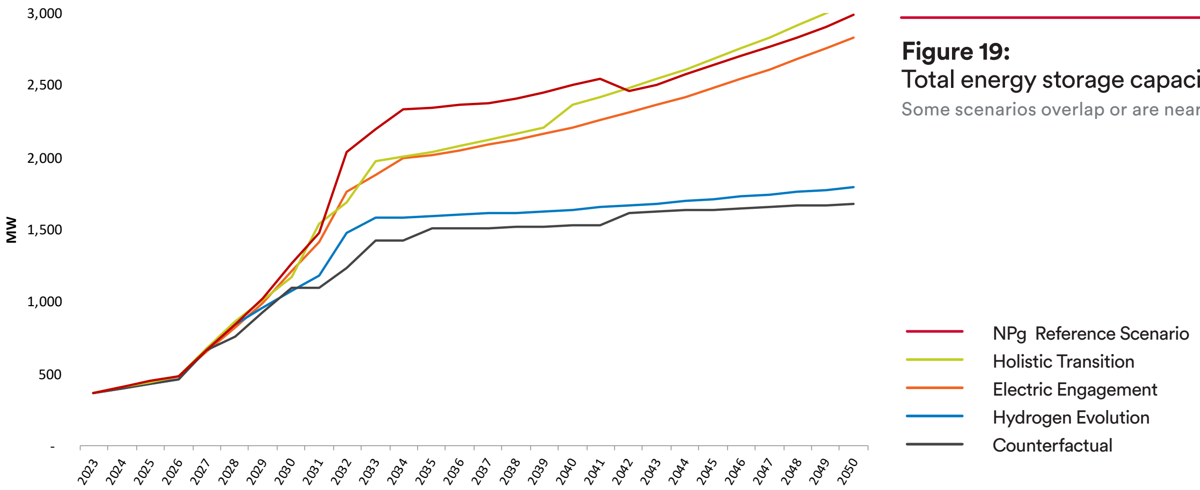

Figure 19:
Total energy storage capacity (MW)
Some scenarios overlap or are nearly identical

	2025	2030	2040	2050
NPg Reference Scenario	449	1,264	2,501	2,991
Holistic Transition	445	1,171	2,363	3,087
Electric Engagement	445	1,215	2,211	2,831
Hydrogen Evolution	430	1,081	1,642	1,799
Counterfactual	429	1,095	1,528	1,683

All DFES scenarios that achieve regional net zero by 2050 map significant growth in energy storage capacity. This increase will be made up of a combination of residential energy storage and large-scale energy storage assets.

Per the below table, only a fraction of this growth in energy storage capacity is due to an increase in the uptake of residential energy storage.

Regardless of its relative importance in relation to our region's future energy storage capacity, residential energy storage plays an important part in controlling peaks in demand on our region's Low Voltage Network.

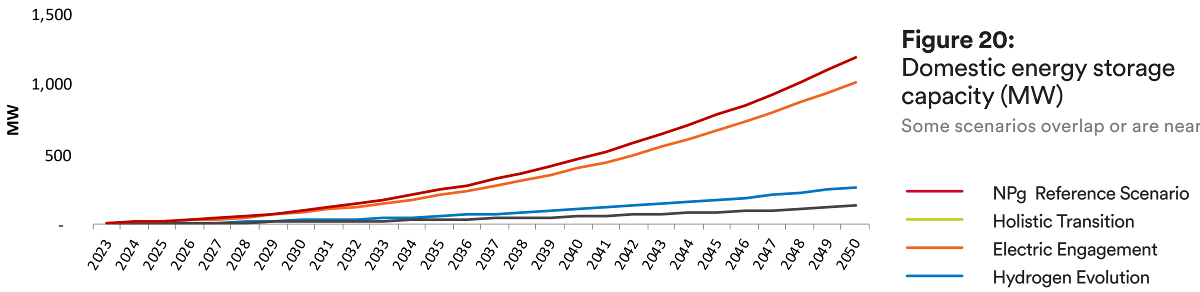

Figure 20:
Domestic energy storage capacity (MW)
Some scenarios overlap or are nearly identical

	2025	2030	2040	2050
NPg Reference Scenario	26	103	468	1,192
Holistic Transition	26	103	468	1,192
Electric Engagement	23	89	402	1,022
Hydrogen Evolution	12	32	111	268
Counterfactual	11	23	59	134

Energy storage

Large-scale energy storage

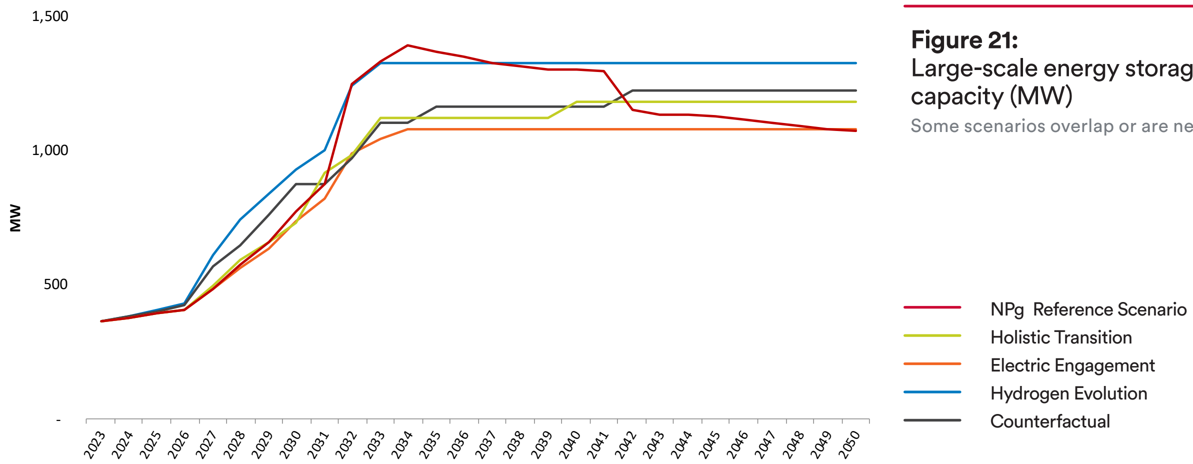

Figure 21:
Large-scale energy storage capacity (MW)
Some scenarios overlap or are nearly identical

	2025	2030	2040	2050
NPg Reference Scenario	392	774	1,305	1,071
Holistic Transition	392	732	1,179	1,179
Electric Engagement	392	739	1,081	1,081
Hydrogen Evolution	408	929	1,328	1,328
Counterfactual	402	878	1,164	1,223

Energy storage projects account for a significant amount of capacity currently in the queue to connect to the system. Storage plays a vital role as we transition from a top-down power system driven by combustion plants to a decentralised system, where most generation is provided by wind, solar and other renewable sources.

Storage represents the bridge between intermittent generation and dispatchable plant, securing our energy system and reducing the reliance on combustion plants even on still, cloudy days.

The storage we refer to in this document are generally assumed to be the "typical" battery systems that we have seen apply to connect in volume over the last seven years, from domestic to grid-scale. Other forms of storage, such as tanked hydrogen, adiabatic compressed gas, and pumped hydro, may also meet this need.

Our current queue of accepted battery storage schemes exceeds that required, and we will reflect developments in Connections Reform and Clean Power 2030 in future long-term forecasting, as national and regional policy evolve.

Glossary

CCUS: Carbon capture, usage and storage – technologies that enable the mitigation of carbon dioxide (CO_2) emissions from large point sources such as power plants, refineries and other industrial facilities, by capturing some of the CO_2 that is emitted and then using (e.g. for industrial applications) and/or storing it.

CHP: Combined heat and power – the concurrent production of electricity or mechanical power and useful thermal energy (heat) at the same time. CHP is also known as cogeneration.

Connections Reform: a UK-based project launched to address the challenges facing connections customers and update the connections application process.

Decarbonisation: The reduction, and ultimately elimination, of GHG emissions.

DFES: Distribution Future Energy Scenarios – The DNOs' scenarios outline four different credible future of energy scenarios for the next 30+ years. DFES considers regional energy demand and supply on a whole system basis.

Digitalisation: Focused digital and technology agenda that supports the integration of digital technologies to improve Northern Powergrid's everyday business activities.

Distributed generation: Embedded and distribution connected generation; these are generators connected to the distribution system, rather than the transmission system.

DNO: Distribution Network Operator – DNOs own, operate and maintain the electricity distribution networks.

DSO: Distribution System Operator – DSOs securely operate and develop an active distribution system comprising of networks, demand, generation and other flexible DER. Northern Powergrid is currently performing functions of DSO today and growing the scope and scale of this activity through time as more LCTs are connected.

Electrolyser: A device that splits water into hydrogen and oxygen using electrical energy.

ESO: Electricity System Operator – the publicly owned National Energy System Operator (NESO) is the electricity system operator for Great Britain, managing national electricity flows to ensure that supply and demand are balanced.

Electric Vehicle / EV: Vehicle propelled by an electric motor, which is powered by a battery.

FES: Future Energy Scenarios – The Energy System Operator's scenarios outline four different credible future of energy pathways **for the next 30**+ years. FES considers energy demand and supply on a whole system basis.

Flexibility: The ability to increase or decrease the production or consumption of energy at a given or requested time in order to support the wider electricity network and optimise capacity available for customers.

GW: Gigawatt – one thousand megawatts (million kilowatts) of electrical power.

GWh: Gigawatt hour – a measure of electrical energy equivalent to a power consumption of one thousand megawatts (million kilowatts) for one hour.

Heat pump / HP: An electrical device that transfers heat from a local source (air, ground or water) to the space to be heated. Typically uses three to four times less electricity than direct electrical heating due to the availability of heat from the local source. As the electricity system decarbonises, so does this sort of heat supply.

HEV: Hybrid electric vehicle – that combines a conventional internal combustion engine (ICE) system with an electric propulsion system powered by a battery.

HGV: Heavy goods vehicle – any truck with a gross combination mass of over 3,500 kg.

Hydrogen: a fuel produced by separating hydrogen from other molecules using one of a number of processes.

ICE: Internal combustion engine – a heat engine in which the combustion of fuel occurs to power a vehicle. Traditionally run on petrol or diesel fossil fuels.

Industrial fuel switching: The process of switching from traditional fossil fuels to low carbon fuels like biomass, hydrogen and clean electricity to power industry.

kW: Kilowatt – one thousand watts of electrical power.

kWh: Kilowatt hour – a measure of electrical energy equivalent to a power consumption of one thousand watts for one hour.

LCTs: Low carbon technologies – Technologies that have the ability to reduce carbon dioxide emissions traditionally associated with energy consumption (e.g., electric vehicles, electric heat pumps, solar panels).

LEVI – Local Electric Vehicle Infrastructure, a government initiative to support local authorities in rolling out EV charge points.

Licence Area: the area in which a DNO can distribute power, per its distribution licence.

LSOA: Lower layer Super Output Areas – areas comprising between 400 and 1,200 households. They usually have a resident population between 1,000 and 3,000 persons

MW: Megawatt – one thousand kilowatts of electrical power.

MWh: Megawatt hour – a measure of electrical energy equivalent to a power consumption of one thousand kilowatts for one hour.

NESO: National Energy System Operator – the publicly owned electricity system operator for Great Britain. NESO manages national electricity flows to ensure that supply and demand are balanced.

Net zero: Legally binding greenhouse gas emissions target which requires UK to reduce nearly all of its emissions by 2050 (compared to 1990 levels).

NSIP: Nationally Significant Infrastructure Project – major infrastructure schemes relating to energy, transport, water and waste. NSIPs require 'development consent' from the relevant Secretary of State.

Network constraints: Areas of the network where the demand or generation exceed the designed network capacity.

Peak demand: When the most electricity is being used on the network at any given time.

RESP: Regional Energy System Plans - plans developed by NESO to support regions' transitions to net zero. They are intended to ensure ensure the views of local stakeholders are central to the way we plan for Great Britain's net zero energy system.

Solar PV: Solar photovoltaics – solar panels.

NORTHERN POWERGRID

Contact us

Your feedback is important to us and should be sent to:
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Please contact us if you have any questions.

Direct QR link to our Open Data portal:
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