Distribution Future Energy Scenarios

Snapshot: data and future energy forecasts for our region

Infinity Bridge, Stockton on Tees

Introduction

Our lives are becoming increasingly dependent on electricity as more people switch to electric heating and transport to help cut global carbon emissions. In parallel, it is more critical than ever that we transition to reliable and resilient low carbon electricity to help protect our customers from the energy price hikes we have seen in recent months.

As the electricity network operator for the North East, Yorkshire and north Lincolnshire, Northern Powergrid powers the lives of more than 8m people and has a critical role to play in enabling decarbonisation. Planning and modelling future energy use across our region is a key part of how we manage our costs and the investment decisions that help us deliver decarbonisation in a way that is fair and just for all the communities we serve. Our annual Distribution Future Energy Scenarios (DFES) help us to make more effective and data-driven investment decisions to do this. This is a snapshot of our latest DFES data and forecasts.

It is vital that we use our DFES to plan a network that embeds resilience. We must ensure that our network is flexible, powered by renewable energy sources and supported with strong infrastructure. The five scenarios in our DFES and our related modelling of Climate Change Committee (CCC) projections reflect different and credible pathways to this future.

This year we saw communities, businesses and stakeholders across our region organise and formalise their approaches to climate action. At a national level, laws were announced that require new homes and commercial buildings to install electric vehicle (EV) charging points from next year and new government contracts for renewable energy projects will unlock 12GW of new renewable capacity – around twice the capacity of the previous contracts round.

The first four scenarios in our DFES reflect National Grid ESO's Future Energy Scenarios (FES), showcasing insights and findings at a regional level. The fifth scenario is our own best-view Planning Scenario, which would see our region secure net zero ahead of 2050.

Your feedback is critical: by combining your ambitions with our local knowledge and data-driven modelling, we can enable decarbonisation in our communities and our region. 2021 was the year we all formalised our planning – now, our DFES will help us to deliver.

Our world ...

From tiny hamlets to three of the most populous cities in the UK. Our network spans four national parks, five areas of outstanding national beauty and four heritage coasts.

This is where we live, work and serve our customers.

Purpose of the DFES Snapshot

This document provides a snapshot of our 2021 scenario-based forecasting, an essential part of our long-term planning to power our customers' lives.[1]

As a key enabler of our stakeholders' net zero ambitions, we need to consider your plans in our scenarios. We urge you to inform us early of your plans, so we can continue to develop our network to ensure it is fit for the future.

What are DFES and why have we published them?

DFES set out several credible pathways to decarbonise the whole energy system. Power generation, transport and heat are all considered. They present the underlying assumptions and potential impacts on our network. The full DFES comprise this Snapshot, a 70-page orientation document, an online tool and downloadable data sets.

Who is it for and what are the benefits?

Our DFES are for you, our stakeholders. We want you to reflect on your net zero plans and ambitions. It does not matter how big or ambitious these plans are, or how early or advanced, it is imperative we know to ensure we plan our network around your needs.

Accessing our open data

All our DFES data from 2019 onwards is openly available on the Open Innovations website.

We encourage stakeholders from all sectors to consider how the data we provide can be used to inform your low carbon plans. We are planning our 2022 DFES and your insights will directly impact our data and forecasting, helping us to shape a network that meets your needs.

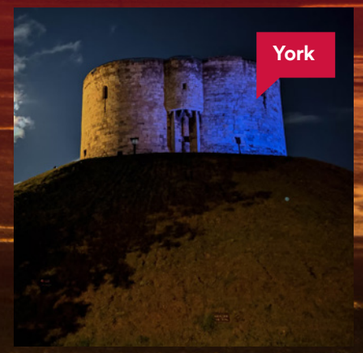
Share your thoughts about our DFES and the low carbon energy future of our region in our quick five minute survey

DFES five minute survey:
https://www.surveymonkey.co.uk/r/NDSVSC3

The visualisation tool:
odileeds.github.io/northern-powergrid/2021-DFES/

Download the data:
open-innovations.org/projects/northernpowergrid/dfes

Email:
npg.system.planning@northernpowergrid.com



1 Our DFES is published annually, with our 2021 data being the most up to date version. Our 2022 DFES will be published in December.

Net zero

It is critical that we enable net zero in a way that protects and improves quality of life for the 8m people whose daily lives we power.

There are four key questions that will determine how and when we achieve net zero:

How electrical?

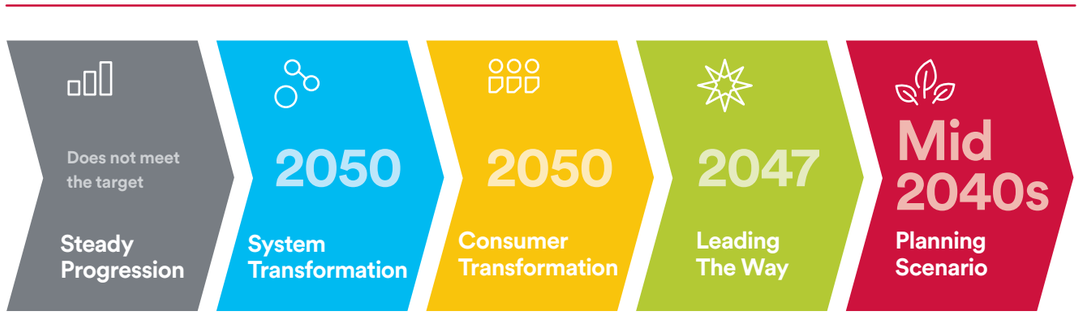
How local?

How flexible?

How fast?

The different possible answers to these questions help us to create our DFES, which model the range of credible energy futures for our region. This regional real-world modelling helps us to plan, informs how we invest in our network and enables us to facilitate the region's growth and decarbonisation ambitions.

Of the five scenarios in our DFES, two are compatible with pathways to meet net zero by 2050, two outline more ambitious pathways to reach net zero in the 2040s and one achieves net zero later than 2050:



We are now making robust decisions to ensure our network meets the needs of any scenarios and to do this our local knowledge will come to the fore more than ever.

We are particularly interested in feedback on where it maybe possible to go faster still to meet net zero and get nearer to the aspirations of our stakeholders to deliver the environmental and economic benefits of net zero emissions earlier than 2050. We are seeking your views on our plans and expectations – please see page 16 for how to talk to us.

Talk to us

Share your thoughts about the DFES and the low carbon energy future of our region in our five minute survey here

Planning Scenario vs System Transformation

Four of the five pathways outlined in our DFES offer credible and possible routes to net zero. The two scenarios that offer the most contrasting routes to net zero are System Transformation and our Planning Scenario, which we will explore here. The others, Leading the Way and Consumer Transformation, are median routes between the two, while Steady Progression involves low levels of change that would not meet net zero by 2050.

	Planning Scenario	System Transformation
	Our Planning Scenario is our "best view" that sets out the most favourable pathway to net zero for our region. It is based on our regional interpretation of the range of national scenarios currently available (National Grid ESO FES and the Climate Change Committee (CCC) scenarios in the Sixth Carbon Budget). It also takes government policy and stakeholder feedback into consideration, as well as regional characteristics.	The System Transformation scenario is our regional interpretation of National Grid ESO's System Transformation scenario as outlined in the FES[1]. The same assumptions that are used in the FES are applied to our regional data to forecast locally what this scenario would mean for us and our stakeholders.
Transportation	— High EV uptake for all vehicles including heavy goods vehicles (HGVs) and buses — Consumers are also engaged in smart charging and vehicle to grid (V2G) two-way charging	— High EV uptake for personal transportation. HGVs and buses more likely to adopt hydrogen-based systems
Heating	— High electric heat pump uptake — Some adoption of electric/hydrogen hybrid heat pumps	— Lower update of heat pumps overall but high proportion of electric/hydrogen hybrid heat pumps — Hydrogen to provide heating through existing gas networks
Energy generation	— Large increase in renewable energy across the region — High adoption of domestic solar PV and industrial scale renewable generation, as well as utility scale generation	— Large increase in renewable energy across the region, but projects tend to be more utility scale and centralised — Less overall demand for electricity so less generation required to meet dema
Energy storage	— Moderate uptake of domestic energy storage to complement domestic solar PV — Wider uptake of utility scale storage to participate in flexibility markets	— High levels of hydrogen storage — Some battery storage and smart storage systems in place but battery technology mostly focused on EV market

1 https://www.nationalgrideso.com/future-energy/future-energy-scenarios

Demand data

Transport (EVs / HGVs / Buses)

Our DFES data shows huge increases of EVs in both the Planning Scenario and System Transformation, with EV numbers peaking at 5m in the Planning Scenario by 2050 and 4.2m in the System Transformation scenario in 2040.

While EVs will provide the bulk of personal transportation in both scenarios, it is a different story for heavy vehicles like buses and HGVs. In the Planning Scenario, numbers of electric buses (e-buses) and electric HGVs (eHGVs) follow the same trajectory as regular EVs – increasing decade by decade, with the 2030s seeing the largest acceleration of uptake. However, the System Transformation scenario shows the uptake of e-buses and eHGVs to be much lower, with numbers reaching less than a quarter of that in the Planning Scenario. This is because in the System Transformation, the forecasts indicate that heavy vehicles will be powered by hydrogen, rather than electric.

Electric vehicles [1]	2020	2030	2040	2050
Planning Scenario	37328	1851101	4596745	5021138
System Transformation	37328	951624	4226193	4133725

Electric buses and HGVs [1]	2020	2030	2040	2050
Planning Scenario	32	18082	78337	90077
System Transformation	197	3204	13688	26438

1 Data is taken from Northern Powergrid's DFES Planning Scenario and Northern Powergrid's DFES System Transformation

Demand data

Heating (Heat pumps)

Both scenarios show an increase in heat pumps over the next three decades, however the Planning Scenario forecasts a much larger increase, peaking at 3.5m by 2050, compared to 1.4m in the System Transformation scenario.

The other key difference between the two scenarios is that most of the heat pumps in the Planning Scenario will be fully electric, with a small proportion of hybrid heat pumps being introduced from the 2030s and growing slightly in popularity by 2050. Hybrid heat pumps are still powered by electricity but are designed to work alongside a gas powered heating system, presumed in this case to be hydrogen.

In contrast, while there are fewer heat pumps overall in the System Transformation scenario, a greater proportion of these heat pumps will be hybrid – with nearly two thirds of the total heat pumps in 2050 designed to work alongside a gas powered heating system. This is because the System Transformation scenario predicts that hydrogen technology will mature faster, leading to hydrogen providing our heating via the existing gas network, reducing the need for electric solutions like heat pumps.

Total heat pumps [1]	2020	2030	2040	2050
Planning Scenario	31.5k	693k	2.4m	3.5m
System Transformation	35.5k	186k	772k	1.4m

1 Data is taken from Northern Powergrid's DFES Planning Scenario and Northern Powergrid's DFES System Transformation

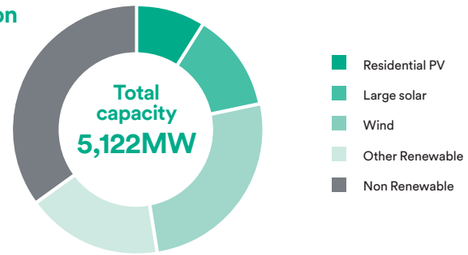
Generation data

Generation (Residential solar PV capacity/large scale solar PV/wind capacity)

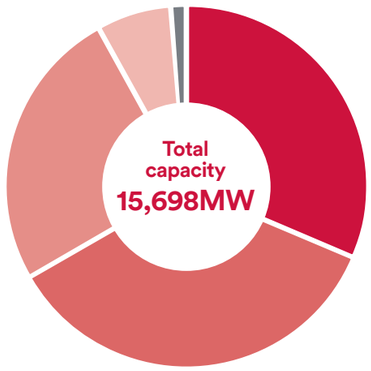
Both scenarios show a huge shift in the way we generate electricity, with fossil fuel generation providing only a very small part of the generation mix by 2050. In both scenarios, we will see a huge increase in residential solar PV, large scale solar and wind capacity – with the three sources providing the bulk of distributed generation capacity by 2050.

We also expect that the Planning Scenario will have a much higher overall generation capacity than the System Transformation scenario. The Planning Scenario overall generation capacity forecast is 15,698MW while the System Transformation predicts a much lower 9,172MW. This is because the electricity demand needs are greater in the Planning Scenario to meet the electricity demand for both electrified transport and heating systems. In the System Transformation scenario, some transport and heating systems will be powered by hydrogen, reducing demand for electricity and therefore generation demands.

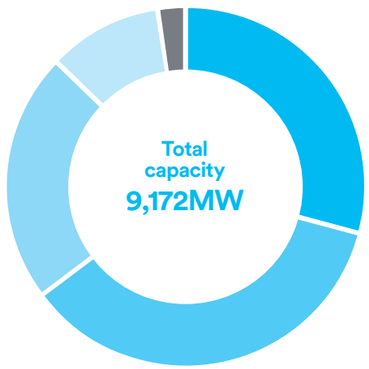
Generation mix 2021[1]



Planning Scenario generation mix 2050[1]



System Transformation generation mix 2050[2]



1 Data is taken from Northern Powergrid's DFES Planning Scenario.
2 Data taken from Northern Powergrid's DFES System Transformation scenario.

Energy storage data

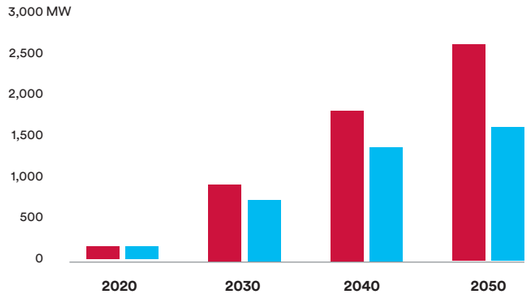
Storage capacity

Electricity storage increases at a consistent rate between now and 2050 in both scenarios, however the Planning Scenario is expected to have more storage capacity than the System Transformation scenario by 2050.

This is because the in the Planning Scenario electricity is the main source of power, which means that there will be more electricity flowing in and out of our network as we power heating systems and transportation in addition to existing electricity demand. To meet this demand our network will need to be more flexible to share and move power across our network accordingly. Energy storage provides this flexibility.

In the System Transformation scenario, heating and heavy transportation are more likely to be powered by hydrogen, lowering electricity demand. And while flexibility will still be vital for the network, energy storage capacity is predicted to be lower because of reduced demand. We do expect however that there will be high levels of hydrogen storage in the System Transformation scenario.

Storage capacity (MW)[1]	2020	2030	2040	2050
Planning Scenario	172MW	935MW	1842MW	2645MW
System Transformation	172MW	747MW	1384MW	1639MW



1 Data is taken from Northern Powergrid's DFES Planning Scenario and Northern Powergrid's DFES System Transformation

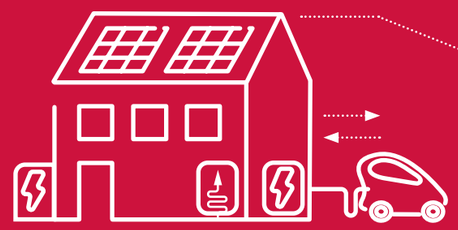
A Tale of two 2050s... Planning Scenario vs System Transformation

The Planning Scenario favours an electrical route to decarbonisation, with high levels of consumer adoption of low carbon technologies and community engagement with a decentralised and flexible electricity network.

The System Transformation scenario has high levels of consumer adoption of low carbon technologies like EVs but lower adoption of technologies like heat pumps and electric heating systems, instead relying on hydrogen-based power sources and a more centralised energy network that is similar to the one we are used to today.

PLANNING SCENARIO

SYSTEM TRANSFORMATION



Most houses will have rooftop solar PV, often accompanied by a household battery for additional storage. Electric heat pumps will provide warmth.

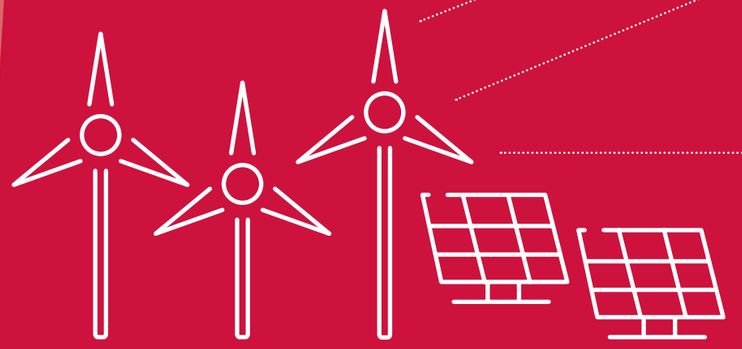
Many communities will be engaged and have invested in community energy projects

Cars and personal transportation vehicles will be electric and many households will have two-way chargers.

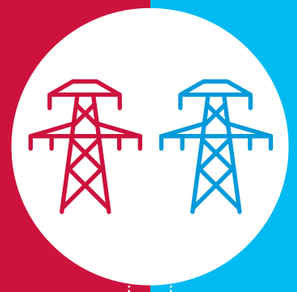
Heavy industries will be powered by electricity, often with renewable power generated on site. Industrial heat pumps will provide heating needs.

Heavy vehicles like HGVs and electric buses will be electric.

Large-scale battery storage will provide grid flexibility and back up power for when the sun is not shining and wind is not blowing.

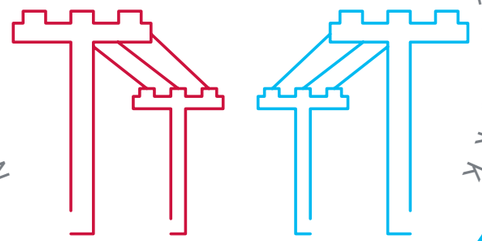


Large scale renewable developments both on and off-shore will provide clean, green power.

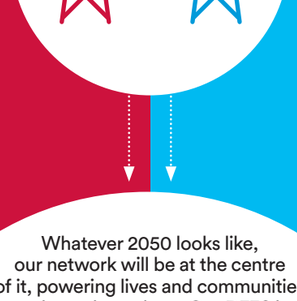


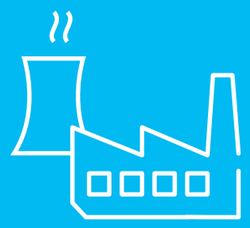
Whatever 2050 looks like, our network will be at the centre of it, powering lives and communities as we always have done. Our DFES helps us to prepare our network to meet the needs of our customers and stakeholders, no matter what technology and solutions will ultimately deliver net zero.

NETWORK

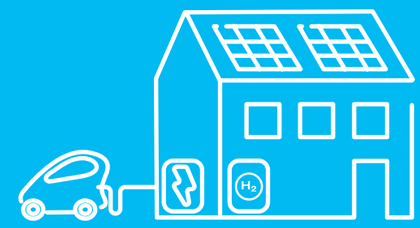


NETWORK

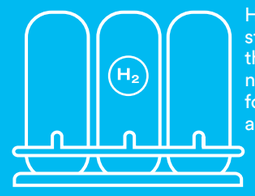




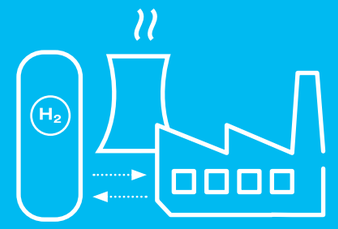
Heavy industry and manufactuing will be powered by a combination of electricity and hydrogen.



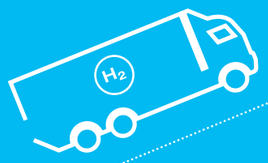
Households will still have EVs and may have domestic solar PV. Heating will more likely be provided by hydrogen via the gas network or hybrid heat pumps.



Hydrogen will be stored and used in the existing gas networks in place of fossil gas to provide a source of heating.

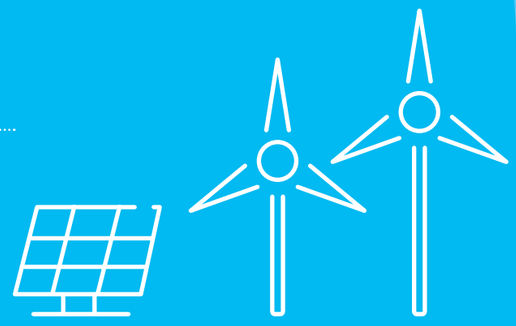


Excess renewable power will be used to create hydrogen as a replacement for fossil gas.



Heavy vehicles like HGVs and buses will be powered by hydrogen.

Renewable electricity will provide power for the System Transformation scenario but as electricity demand will be lower, there will be less generation capacity.



DFES is here for you to utilise

DFES offers localised and personalised projections of what decarbonisation pathways could look like to 2050 across the North East, Yorkshire and north Lincolnshire.

DFES is an open data tool. We make our DFES free, accessible and open to everyone so that it can provide strategic support to help our stakeholders develop and meet net zero ambitions.

Reliable data is more important than ever when it comes to planning for net zero, both for us and for our stakeholders.

Open data like our DFES can be used to:

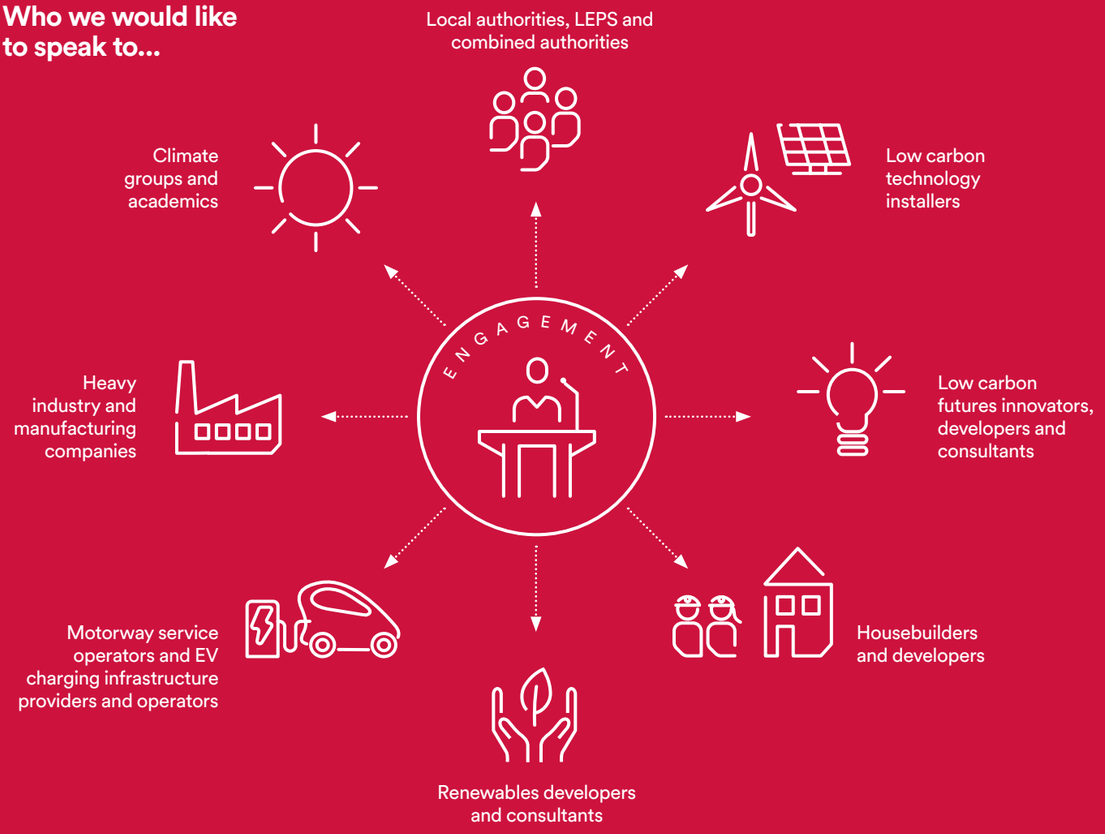
- Model your own future energy scenarios at a hyper-local level;
- Provide a strategic overview for predicted EV and heat pump numbers to help shape local area energy planning;
- Bolster funding applications for decarbonising interventions like local generation schemes; and
- Engage and educate people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

When we know about our stakeholders' decarbonisation plans, we can forecast this in our DFES data. This gives us a forward view of what our region's energy needs will look like in the future and enables us to invest in our network to support and enable these ambitions.

If you have projects in the pipeline that will require 1MW or more of network capacity – including plans for electrifying fleets of vehicles or public transport, installing EV infrastructure, new renewables projects, major housing developments or electrifying a heavy industrial site – we need to know as early as possible so that we can update the forecasts that help us plan and invest in our network.

The easiest way to share your insights and thoughts on our DFES is by completing our quick survey:
https://www.surveymonkey.co.uk/r/NDSVSC3

Who we would like to speak to...



Engaging with our scenarios

Hope Valley Climate Action case study

Stakeholders are using our DFES data to map their own pathways to net zero.

The DFES data helps us to make long-term investment decisions. It is also an open data tool that we actively encourage our stakeholders and customers to use to ensure their decarbonisation plans are aligned with the changes that are taking place.

With the support of our DFES 2020 open data, Hope Valley Climate Action (HVCA) – a grassroots climate action group in North Derbyshire – published a report into the future of household energy consumption and the benefits of tackling climate change.

To do so, they needed data. After getting in touch with our team, HVCA utilised the Open Innovations platform – where stakeholders can engage with our DFES data in a visual and easy-to-use map format – to access hyper-local data that helped refine their own forecasts and scenarios to support net zero planning in their community.

6,300
domestic buildings

13,000
population

Projected annual domestic electricity demand in Hope Valley in MWh

Year	2021	2030	2040	2050
Scenario A	22,834	32,819	49,551	60,084
Scenario B	22,834	30,680	43,865	52,449
Scenario C	22,847	26,931	40,977	51,500

Our research required detailed modelling of the future of energy demand in the Hope Valley region and for this, we needed as much data as possible. Northern Powergrid's data played a key part in our modelling and it was extremely helpful to have it presented in an accessible format.

Dawn Ward
Hope Valley Climate Action

Accessing our open data

All our DFES data from 2019 onwards is openly available on the Open Innovations website.

We encourage stakeholders from all sectors to consider how the open data we provide can be used to support their low carbon ambitions. Whether you are a car dealership planning your strategy for electric vehicle sales or a local authority seeking to plot heat pump uptake in your communities, our DFES team and open data is here for you.

You can share your thoughts on the DFES and the projected low carbon technologies in our region in our five minute survey. Your feedback will give us a clearer view of what our region's energy needs will look like and help us invest in our network to ensure it is fit for future.

DFES five minute survey:
https://www.surveymonkey.co.uk/r/NDSVSC3

The visualisation tool:
odileeds.github.io/northern-powergrid/2021-DFES/

Download the data:
open-innovations.org/projects/Northernpowergrid/dfes

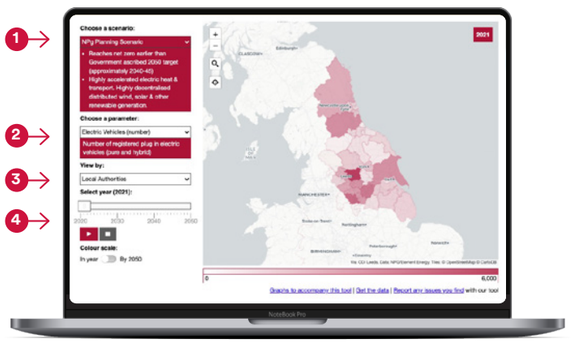
Email:
npg.system.planning@northernpowergrid.com

How to use our data visualisation tool

1 Select scenario:
- Regionalised view of National Grid ESO's FES:
  - Steady Progression
  - System Transformation
  - Consumer Transformation
  - Leading the Way
- Based on Northern Powergrid's accelerated decarbonisation pathway:
  - Planning Scenario

3 View by:
- Local authority areas
- Primary substations
- Primary substations (with local authority boundaries)

4 Scale:
- By 2050 – shades the map areas by reference to the maximum value (number or MW) in 2050 for the parameter within the boundary being viewed (substation or local authority)
- In year – shades the map areas by reference to the maximum number in the year being viewed



2 Select parameters, including;
- Electric car, bus and heat pump numbers
- Domestic photovoltaic installed capacity (MW)
- Large solar generation installed capacity (MW)
- Wind generation installed capacity (MW)
- Total renewable generation installed capacity (MW)
- Energy storage installed capacity (MW)
- Domestic underlying energy consumption (MWh)
- Industrial and commercial underlying energy consumption (MWh)
- Total energy consumption including EVs and heat pumps (MWh)
- Peak demand at primary substations (with and without customer flexibility)
- Peak utilisation at primary substations (with and without customer flexibility)
- Industrial fuel switching (including electrolyser use for hydrogen)

> **Our lives are increasingly dependent on electricity. As more people switch over to electric heating and transport to play a part in reducing global carbon emissions, this dependence is under the spotlight, as is the infrastructure that delivers electricity to homes and businesses.**

Jim Cardwell
Head of Policy Development

How to talk to us

We are happy to receive your feedback and encourage engagement from our stakeholders. To start the conversation in the first instance, email:

npg.system.planning@northernpowergrid.com

We will also be reaching out to you through:

- **Online surveys**
- **Events (virtual and in person)**
- **Polling via social media**
- **1-to-1s**