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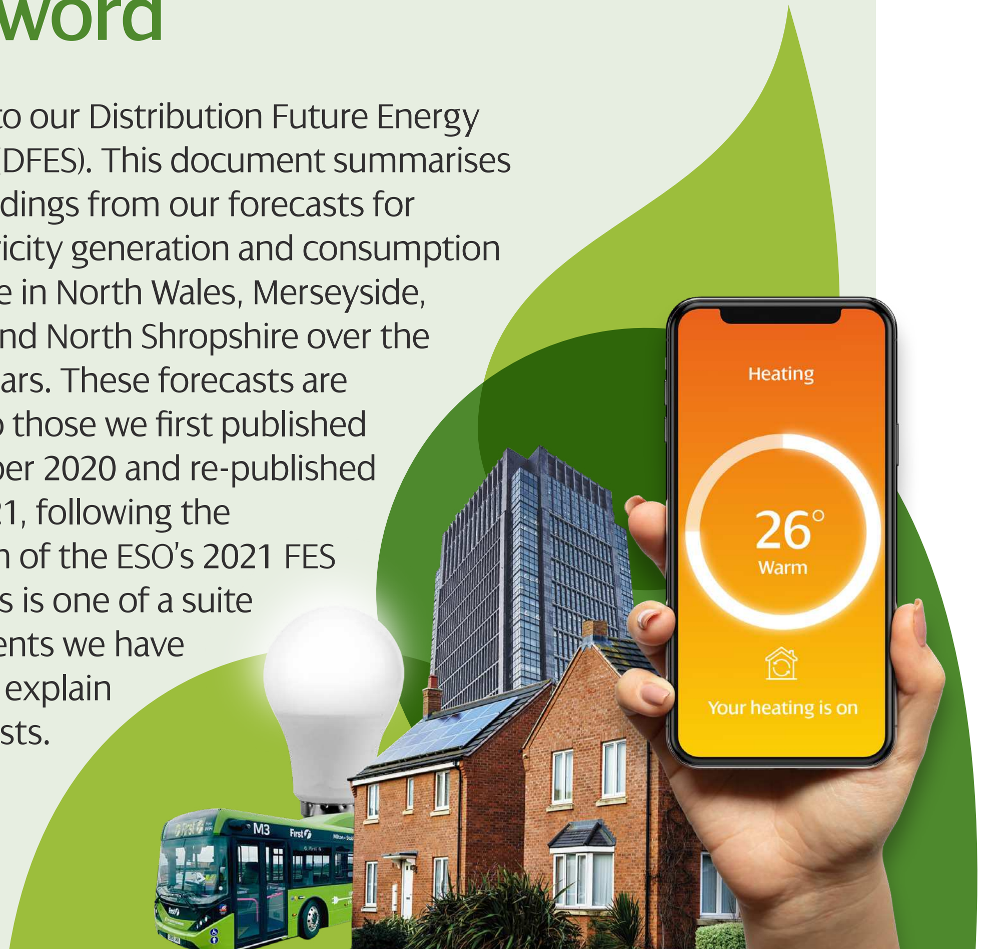
SP Manweb Future Energy Scenarios Key Findings

November 2021

1 Foreword

Welcome to our Distribution Future Energy Scenarios (DFES). This document summarises the key findings from our forecasts for how electricity generation and consumption may evolve in North Wales, Merseyside, Cheshire and North Shropshire over the next 30 years. These forecasts are updates to those we first published in December 2020 and re-published in May 2021, following the publication of the ESO's 2021 FES in July. This is one of a suite of documents we have created to explain our forecasts.



A changing landscape

The energy landscape is changing fast as the way our customer's generate, use, and interact with energy evolves. To tackle the climate emergency and deliver Net Zero carbon targets, a significant proportion of transport and building heating will need to be electrified. We are also going to see a further leap in renewable generation capacity as fossil fuel power stations close. This new demand and generation will push the distribution network beyond what it is designed for, meaning that our network will need to evolve to enable our customers' Net Zero transition. It is important that we understand the likely uptake of this new demand and generation, so we know how best to respond.

While the overall direction of travel towards Net Zero is clear, there are some areas where detailed action plans are still under development. How will local authorities turn their Climate Emergency status into action? Which communities will move faster than others?

Given these uncertainties and the ever changing energy landscape, creating a single forecast risks being misleading. Instead we set out four forecast scenarios which cover a range of credible pathways to describe the potential decarbonisation routes which our customers may follow.

Scott Mathieson
Network Planning & Regulation Director

Working together

Our main role is to provide the safe, efficient, and reliable network capacity needed to enable the decarbonisation route that our customers and communities choose. To achieve this, these DFES forecasts are used to assess future network capacity requirements, and the the RIIO-ED2 investment needed to deliver this capacity.

Given the important role of these forecasts, we need to ensure that we have correctly forecast our customers' requirements; feedback from our stakeholders is vital for this. We welcome the feedback we have already received, which has been used in these latest forecasts. However, given the rate of change in the energy landscape, it is important that this stakeholder input is not a one-off, but a regular process. We therefore look forward to continuing to engage with you and understanding your insights, so we can ensure our network continues to meet your needs.

A final note: regardless of the decarbonisation pathway that our customers end up treading, we recognise that the distribution networks are a key enabler. We are already evolving the way we design, build and operate our networks, implementing innovative solutions, and embracing new technologies. Our RIIO-ED2 business plan will deliver the capacity and capabilities that our customers need, so that we can continue to provide them with a safe, reliable, and good value electricity supply, whatever the future holds.

2 Introduction

We are SP Energy Networks. We own and operate the electricity distribution network in the SP Manweb licence area covering North Wales, Merseyside, Cheshire and North Shropshire. It is through this network of underground cables, overhead lines, and substations that 1.5 million homes, businesses, and public services are provided with a safe, economical, and reliable supply of electricity.

A safe and reliable electricity supply is key to most people's lives – we depend on it to light our homes, keep our food fresh, power our businesses, and enable our connected lifestyle. In the future, we will also increasingly rely on it to heat our homes and power our transport as we decarbonise our society.

External context

In response to the global climate change challenge, the UK Government has a legally binding target to achieve Net Zero (greenhouse gas emissions) by 2050. Last year, the UK Government announced interim emission reduction targets (68% by 2030 and 78% by 2035)[1] and published The Ten-Point Plan, and Energy White Paper. The Welsh Government also committed to reach Net Zero by 2050 at the latest, with interim targets of 63% by 2030 and 89% by 2040. More recently, the UK Government has published the Heat and Buildings Strategy and Net Zero Strategy, setting out a pathway for decarbonising heat and the UK economy. The Welsh Government has published the Net Zero Wales Plan setting out the foundations to achieve Net Zero. At a more local level, a number of local authorities have declared climate emergencies.

Given that these targets depend on switching from fossil fuel use to electricity, these targets require a significant change to the electricity distribution network.

The DFES forecasts

In order to ensure our network has sufficient capacity to meet our customers' changing electricity needs, we need to forecast what our customers' usage is going to be into the future (we forecast out to 2050). These forecasts need to cover how much electricity existing and new customers might consume (demand) and how much they might produce (generation). We call these forecasts Distribution Future Energy Scenarios (DFES).

We use this understanding of future customer needs to plan and design our network – the DFES forecasts help us understand where we might need to create more network capacity, and how our operational and maintenance activities should be undertaken. This in turn helps us calculate what financial investment is required, and to seek approval for this expenditure from Ofgem via the RIIO business plan process. The DFES forecasts are a key building block on which we have produced our RIIO-ED2 Business Plan[2] to meet our customers' needs.

DFES documents

We have engaged with a wide representation of our stakeholders to test the forecasts' data, methodology and outputs. That engagement generated a range of feedback on the forecasts, which we assessed and used to update our forecasts. This document builds on the feedback received to date.

Different stakeholders will be interested in different levels of detail, so we have created a range of documents to explain our DFES[3]. If you have any questions on these forecasts, please do not hesitate to contact us at RIIO_ED2@spenergynetworks.co.uk.

[1] https://www.gov.uk/government/news/uk-enshrines-new-target-in-law-to-slash-emissions-by-78-by-2035

[2] https://www.spenergynetworks.co.uk/pages/our_riio_ed2_business_plan.aspx

[3] https://ww.spenergynetworks.co.uk/dfes

3

Our DFES forecasts

This section summarises the key findings from our DFES forecasts.

All the forecast values in our DFES are for the SP Manweb distribution network, covering North Wales, Merseyside, Cheshire and North Shropshire; they are not forecasts for the whole of England and Wales or the UK, or the transmission network[4].

3.1 How we create the forecasts

To create this DFES, we used our December 2020 as the starting point. This December DFES was built up using the National Grid Electricity System Operator's (ESO) 2020 Future Energy Scenarios (FES), stakeholder input, and a range of other input data, such as UK and Welsh government legislation, regional ambitions and development plans, and outputs from innovation projects.

This was then updated following the publication of the ESO's 2021 FES[5]. As our December DFES already incorporated the Net Zero legislative targets and the scenario framework remains unchanged, the stakeholder feedback we received on our previous forecasts is still highly relevant. We have therefore incorporated that feedback in these DFES forecasts.

Due to the evolving energy landscape, and the uncertainties surrounding our customers' routes to Net Zero, a single forecast scenario would not provide a comprehensive view. We therefore consider it appropriate to retain the approach of creating four forecast scenarios, ensuring that a range of credible decarbonisation pathways are covered. These four scenarios represent differing levels of consumer ambition, government/policy support, economic growth, and technology development. They are described in Section 3.2.

Our approach means we can produce forecasts for all key metrics for each scenario, at a sufficiently geographically granular level, for each year out to 2050. This level of detail gives us a greater understanding of the potential timing, magnitude and location of our customers' requirements, meaning that we can make more timely, targeted and efficient interventions in the network.

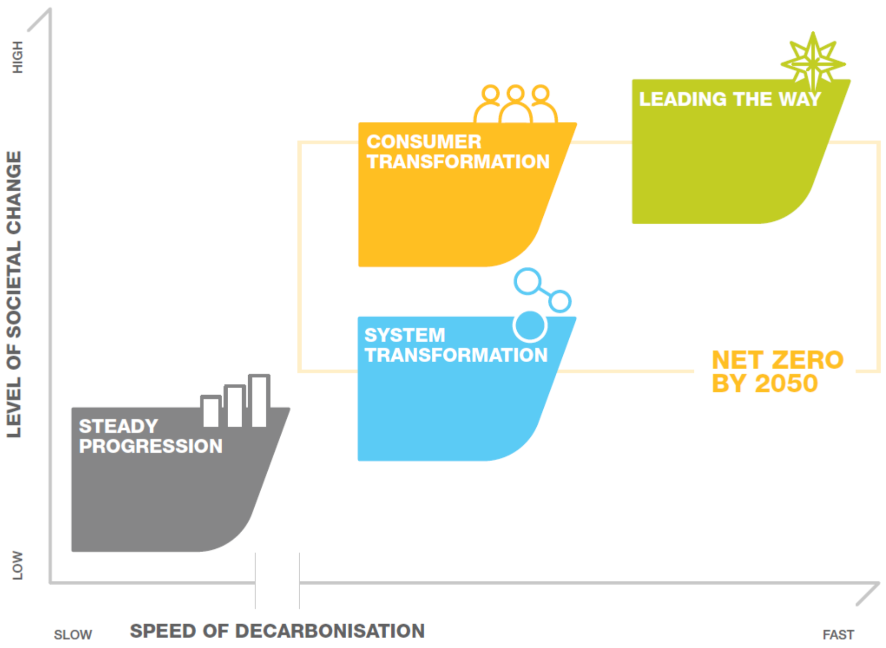
3.2 Scenarios overview

To illustrate their different representations, Figure 1 maps the four scenarios against two metrics: speed of decarbonisation (how fast low carbon technologies are adopted) and level of societal change.

[4] Only large-scale offshore and onshore generation, and very large individual demand customers, are likely to be directly connected to the transmission network. This means that these DFES forecasts will capture nearly all demand and medium-scale, smaller-scale and domestic-scale generation in North Wales, Merseyside, Cheshire and North Shropshire.

[5] https://www.nationalgrideso.com/document/202851/download

Figure 1 | Overview of the ESO's 2021 Future Energy Scenarios



In SPM Steady Progression (SP)[6]: progress is made on decarbonisation, however it is slower than in the other scenarios. While home insulation improves, there is still heavy reliance on natural gas, particularly for domestic heating. Electric vehicle take-up grows more slowly than in other sectors, displacing petrol and diesel vehicles for domestic use, however decarbonisation of other vehicles is slower with continued reliance on diesel for heavy goods vehicles. In 2050 this scenario still has significant annual carbon emissions, some way short of the 2050 Net Zero target in UK legislation.

In SPM Consumer Transformation (CT): the 2050 Net Zero target is met with measures that have a greater impact on consumers and is driven by greater levels of consumer engagement in the energy transition. For example, a typical domestic consumer will use an electric heat pump with a low temperature heating system and an electric vehicle, they will have had extensive changes to their home to improve its energy efficiency and most of their electricity demand will be smartly controlled to provide flexibility to the system. The system will have higher peak electricity demands that will be managed with flexible technologies including energy storage, demand side response and smart energy management.

In SPM System Transformation (ST): the 2050 Net Zero target is met following a pathway that has the least consumer impact to do so. This scenario includes a high use of hydrogen for heating and other energy demands. The typical domestic consumer will experience less disruption than in Consumer Transformation as more of the significant changes in the energy system happen on the supply side, away from the consumer. For example, a typical consumer will use a hydrogen boiler with a mostly unchanged heating system and an electric vehicle or a fuel cell vehicle, they will have had fewer energy efficiency improvements to their home and will have lower engagement with opportunities to use their demand to provide flexibility to the system. Total hydrogen demand is high, and it is mostly produced from natural gas with carbon capture and storage.

In SPM Leading the Way (LW): rapid decarbonisation with high levels of investment in world-leading decarbonisation technologies. Consumers are highly engaged in acting to reduce and manage their own energy consumption. This scenario includes the highest and fastest improvements in energy efficiency to drive down energy demand, with homes retrofitted with insulation such as triple glazing and external wall insulation, and a steep increase in consumer participation in smart energy services. Hydrogen is used to decarbonise some of the most challenging areas of society such as some industrial processes, with this hydrogen produced solely from electrolysis powered by renewable electricity.

[6] Source: Scenario descriptions based on the ESO's 2021 FES (https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2021/scenarios-net-zero)

3.3 Electricity demand

Understanding how electricity demand could evolve on the SP Manweb network is the first fundamental factor informing the need for network intervention to increase or manage network capacity. The main drivers of changing electricity demand are the electrification of heat and transport, i.e. increased electric vehicles and heat pumps.

Key findings 1 and 2 – Demand increases in all scenarios, and flexibility will be critical

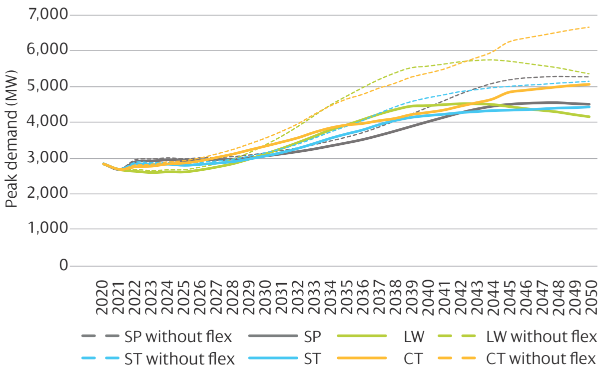
Figure 2 shows how the SP Manweb total peak demand will vary for the four scenarios. It shows this for two states:

- The dashed line assumes that no demand is flexible (i.e. it can't be shifted away from the peak demand period to less busy periods).
- The solid line assumes a degree of demand flexibility. Flexibility is relevant as it means electricity consumption can be moved from peak demand times to less busy times of the day, or to periods of high generation output. This reduces the network impact and the requirement for network interventions.

Key finding 1: All scenarios show materially increasing demand. This means that the distribution network will need intervention to provide more capacity to facilitate Net Zero.

Key finding 2: Demand flexibility can help reduce peak demand. This would deliver benefits to consumers. This means that we should all be working to enable flexibility.

Figure 2 | Electricity peak demand with and without flexibility



Key finding 3 – Demand increases in different regions at different speeds

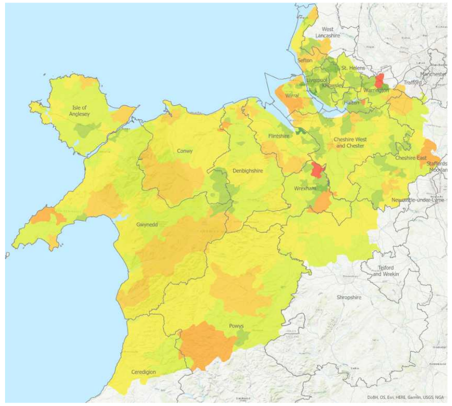
Figure 3 shows a geographically granular view on how peak demand could change from current levels for the high and low scenarios.

Key finding 3: There is clear variance in the demand changes seen between regions. This is because regions will decarbonise at different speeds and have different population densities.

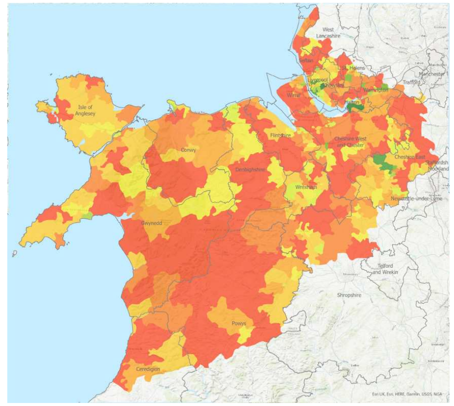
Figure 3 | Electricity peak demand changes from 2020 by primary substation area

Scale range: -6MW to >5MW

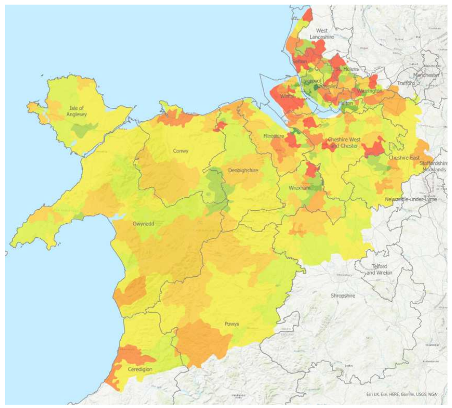
2030 – Low



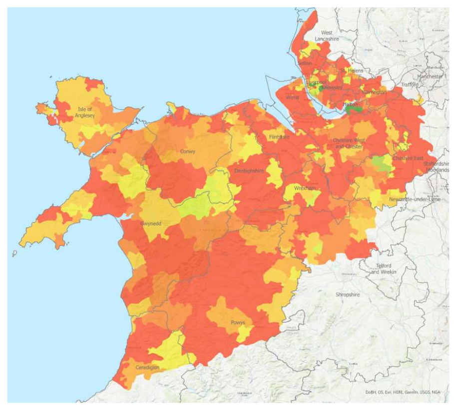
2050 – Low



2030 – High



2050 – High

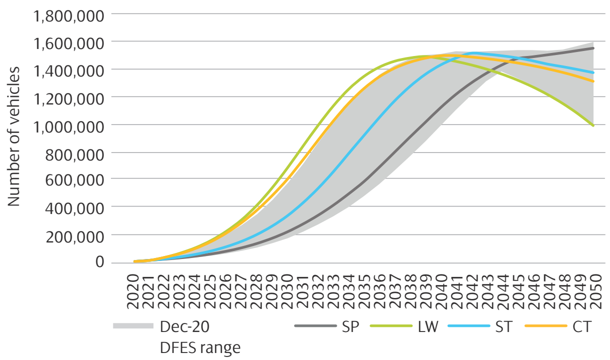


Key finding 4 – Electric vehicle growth is significant in all scenarios, but the growth occurs at different times

Figure 4 shows the forecast numbers of residential battery electric vehicles in the SP Manweb distribution network area. For comparison, the grey area shows the forecasted range (the difference between the lowest and highest scenario) from our December 2020 DFES.

Key finding 4: There is a high degree of variance in the number of electric vehicles by 2040. This variance is due to differing levels of ambition for no new petrol or diesel cars and vans. By 2050, the total number of electric vehicles depends on the level of use of public transport, shared and autonomous vehicles, cycling and walking.

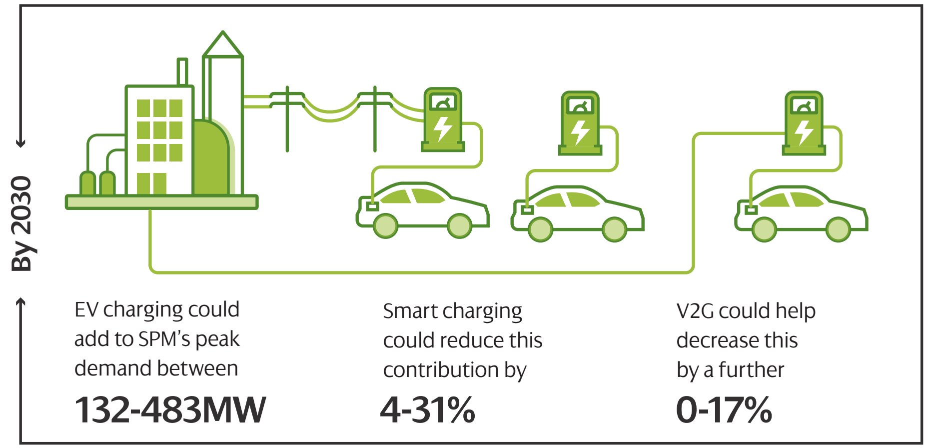
Figure 4 | Residential battery electric vehicle uptake

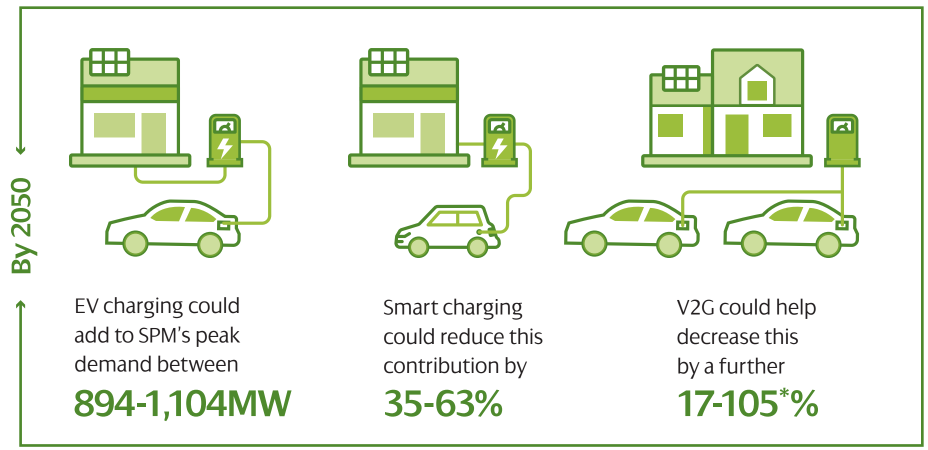


Key finding 5 – Electric vehicle smart charging must be enabled

Electric vehicle charging could have a significant impact on the SP Manweb peak demand if left unmanaged. Smart charging and vehicle to grid (V2G) are two ways to add flexibility to electric vehicle demand; they help reduce this peak demand impact by shifting electric vehicle charging to a different time of day, and enabling electric vehicles to release electricity back to the network.

Key finding 5: Enabling smart charging and other measures, which allow electric vehicles to charge in a more flexible way, will significantly reduce their impact on the network. This will enable a faster electric vehicle roll-out and deliver lower electricity bills for customers.





*The peak demand reduction above 100% means vehicle to grid has gone beyond offsetting the peak demand contribution from electric vehicles.

Key finding 6 – How society decarbonises heat could have a big impact on electricity consumption

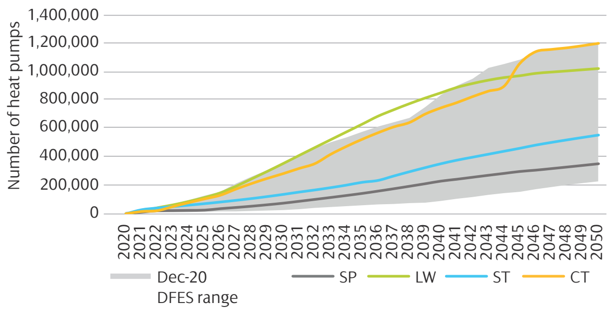
At the moment, a significant proportion of building heating is provided by natural gas or oil. This needs to change to achieve decarbonisation. There are three broad ways that domestic heating can be decarbonised: replacing natural gas with hydrogen in the gas network, district heating schemes, and heat pumps. Of these three options, heat pumps will have the greatest impact on the network given that they will increase the electricity consumption of every building.

Figure 5 shows the forecast uptake of heat pumps for the four scenarios. For comparison, the grey area shows the forecasted range (the difference between the lowest and highest scenario) from our December 2020 DFES.

Key finding 6: There is a high and enduring variance in the number of heat pumps across the scenarios. As the impact on electricity consumption is proportional to the number of heat pumps, this means that how society decarbonises heat will have a significant impact on peak demand and electricity networks.

To put this potential impact into perspective, the additional demand from heat pumps in the high uptake scenario (taking account of flexibility) is approximately 590MW. By comparison, the additional demand from electric vehicles in the high uptake scenario (taking account of flexibility) is around 333MW.

Figure 5 | Electric heat pump uptake



3.4 Electricity generation and storage

Understanding how electricity generation could evolve on the SP Manweb network is the second fundamental factor informing the need for network intervention to increase or manage network capacity. The main drivers are increased wind generation, solar photovoltaic (PV) generation, and storage.

Key finding 7 – Distributed generation increases in all scenarios

The volume of generation connected to the SP Manweb distribution network out to 2050 will be affected by the overall requirement for more generation (to meet increased demand), and the decentralisation effect – how much of that generation will be smaller-scale (and so connected to the distribution network) versus larger-scale (and so connected to the transmission network).

Figure 6 shows how the total generation and storage capacity connected to the SP Manweb distribution network will vary for the four scenarios. For comparison, the grey area shows the forecasted range (the difference between the lowest and highest scenario) from our December 2020 DFES.

To better illustrate what is driving the changes in generation, Figure 7 shows a breakdown of the generation and storage forecasts from Figure 6 by technology type, for 2030 and 2050.

Key finding 7: In the next ten years, generation capacity on our network is likely to double, reaching around 5.5GW. By 2050, our scenarios indicate there could be as much as 2-5 times more generation than today.

This generation growth is due to renewable generation and storage:

- Increases in solar PV capacity are significant across all scenarios – more than doubling the capacity this decade, and over a sixfold increase by 2050. Our forecasts show that the great majority of this growth is due to ground mounted solar PV, rather than rooftop solar PV.
- There is significant variance in the levels of wind generation across the four scenarios. Wind generation is a cost-effective, established technology, so the extent of new wind generation will likely depend on the onshore planning regime, government/policy support, and local support for individual schemes.

Figure 6 | Total installed generation and storage capacity

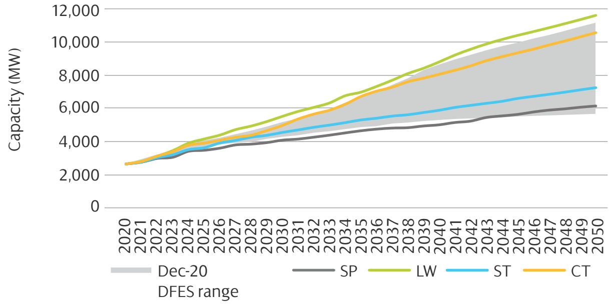
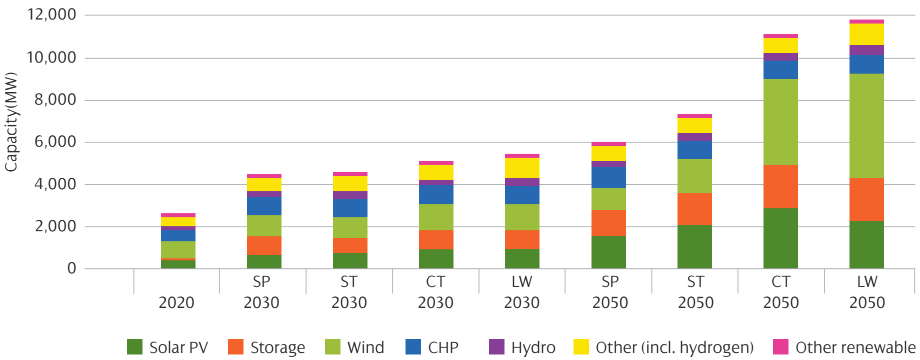


Figure 7 | Breakdown of installed generation and storage capacity by technology type



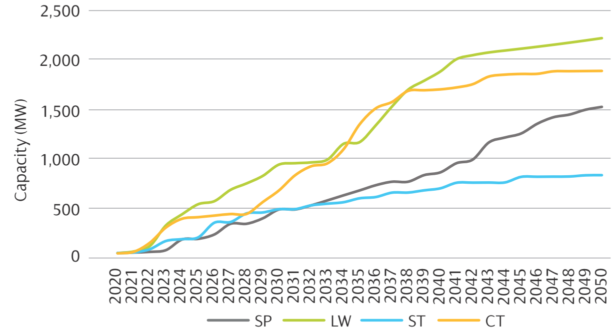
Key finding 8 – The future of storage looks strong

Electricity storage can range from large-scale pumped hydro schemes down to domestic-scale battery units. Electricity storage can help manage peak demand (by exporting to reduce local demand) and provide valuable system services (such as frequency response).

Figure 8 shows the forecast uptake of electricity storage for the four scenarios.

Key finding 8: Future increases in storage are significant across all scenarios – in the next five years there is likely to be more storage growth than in any other generation technology. Our forecasts show that the majority of this growth is due to larger-scale standalone storage, rather than domestic-scale storage at individual properties.

Figure 8 | Installed storage capacity



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Range of future pathways

The Climate Change Committee (CCC) published The Sixth Carbon Budget report in December 2020, setting recommendations for the UK's path to Net Zero.

This section provides an overview and comparison of the disaggregated national forecasts from the CCC, the ESO's 2021 FES and our SP Manweb DFES forecasts.

4.1 CCC's Sixth Carbon Budget

Carbon budgets are statutory caps for the level of greenhouse gas emissions over a five-year period, to provide a path towards achieving UK's emission reduction targets. These are a requirement under the Climate Change Act 2008[7].

The Sixth Carbon Budget[8] is the first carbon budget publication after the UK introduced a legally binding target to achieve Net Zero by 2050. The CCC developed five scenarios to explore different pathways of achieving Net Zero.

So that we can compare national FES and CCC forecasts on a like-for-like basis with our regional DFES forecasts, and so we and stakeholders can better understand what they mean for our network, they have been disaggregated to produce regionally equivalent forecasts. This was done using the common building blocks, agreed as part of the ENA's Open Networks project.

[7] https://www.legislation.gov.uk/ukpga/2008/27/contents

[8] https://www.theccc.org.uk/publication/sixth-carbon-budget/

4.2 Range of future pathways

This section provides a comparison between the DFES forecasts, the regional GSP results from the ESO's 2021 FES, and the regionally equivalent CCC forecasts for the SP Manweb network for battery electric vehicles (BEVs) and heat pumps – we have shown these two metrics as they are the main drivers of increasing demand. Forecast volumes are shown in Table 1 for each scenario at 2030, 2040, and 2050.

Table 1 | Industry forecasts for BEVs and heat pumps

Volumes (millions)		Electric vehicles			Heat pumps		
		2030	2040	2050	2030	2040	2050
DFES	Steady Progression	0.25	1.34	1.94	0.08	0.23	0.35
DFES	System Transformation	0.39	1.77	1.75	0.14	0.35	0.56
DFES	Consumer Transformation	0.68	1.86	1.71	0.28	0.75	1.20
DFES	Leading the Way	0.80	1.87	1.36	0.36	0.85	1.02
FES	Steady Progression	0.25	1.32	1.92	0.07	0.25	0.36
FES	System Transformation	0.34	1.72	1.74	0.07	0.28	0.50
FES	Consumer Transformation	0.66	1.84	1.73	0.17	0.79	1.14
FES	Leading the Way	0.71	1.82	1.34	0.35	0.85	0.97
CCC 6th Carbon Budget	Balanced Net Zero pathway	0.69	1.89	2.35	0.30	1.04	1.53
CCC 6th Carbon Budget	Headwinds	0.53	1.77	2.35	0.23	0.72	1.06
CCC 6th Carbon Budget	Widespread engagement	0.73	1.92	2.36	0.32	1.21	1.50
CCC 6th Carbon Budget	Widespread innovation	0.69	1.91	2.36	0.29	1.03	1.37
CCC 6th Carbon Budget	Tailwinds	0.69	1.91	2.36	0.28	0.94	1.15

Figure 9 shows the total volume of battery electric vehicles considered across all scenarios.

Figure 10 shows the total volume of heat pumps considered across all scenarios.

Figure 9 | Battery electric vehicle uptake comparison

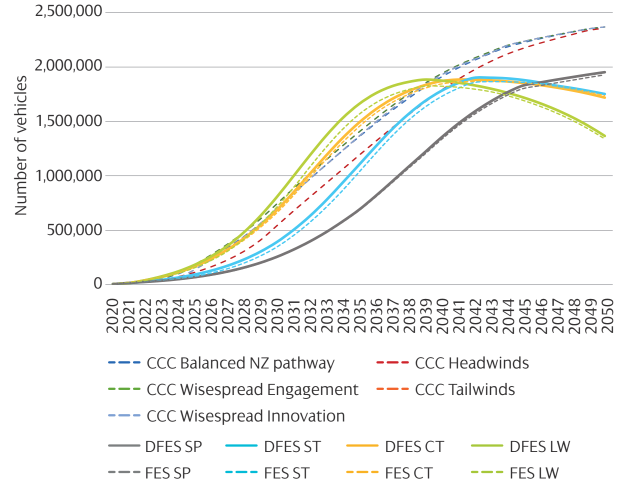
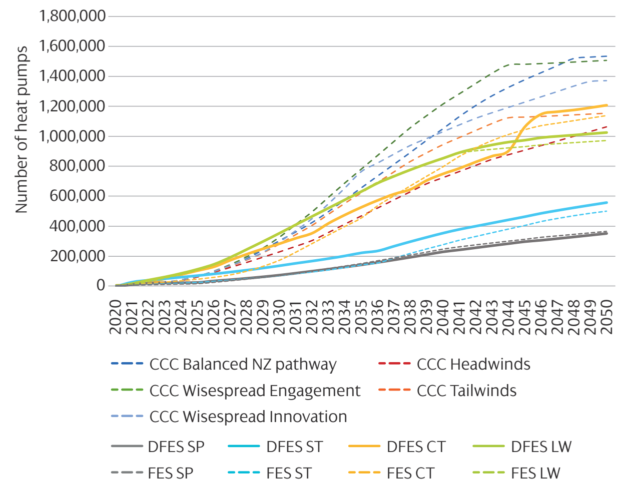


Figure 10 | Heat pump uptake comparison



5

Range of Net Zero compliant pathways

This section provides an overview of the range of Net Zero compliant industry forecasts for the SP Manweb network.

This is key to understanding the range of future possible pathways that the SP Manweb network needs to accommodate. We use this information to efficiently plan and develop our networks.

We need to develop a view of the credible range of Net Zero compliant scenarios and our baseline scenario for planning purposes. Together these help us to efficiently plan and develop our network, and we use this to develop our RIIO-ED2 business plan.

To develop this range, we considered all DFES, FES, and CCC forecast scenarios. We then discounted DFES and FES scenarios that do not achieve Net Zero or interim targets. The following scenarios were discounted:

1. Steady Progression (SP):
this scenario does not meet Net Zero and so it has been excluded.

2. System Transformation (ST):
this scenario is significantly lower than the rest of the Net Zero compliant scenarios. We consider it unable to meet UK interim emission reduction targets, and so it has been excluded.

The remaining DFES/FES scenarios (Consumer Transformation and Leading the Way) and the five CCC Sixth Carbon Budget scenarios collectively form the Net Zero compliant scenario range. This range of scenarios meets UK Net Zero legislation; the requirements of the UK Government's Ten-Point Plan, Energy White Paper, Heat and Buildings Strategy; and the Net Zero Wales plan.

Our baseline scenario details the network capacity requirements we must plan for our networks to be able to accommodate. We must also plan to have agility within our delivery strategy to meet anywhere within the low to high scenario range.

We need to develop a view of the credible range of Net Zero compliant scenarios. This is to help us efficiently plan and develop our network.

Figure 11 shows our baseline scenario and the range of the Net Zero compliant industry forecasts for the uptake of battery electric vehicles and heat pumps – we have shown these two metrics as they are the main drivers of increasing demand.

Figure 11 | Range of Net Zero compliant industry forecasts

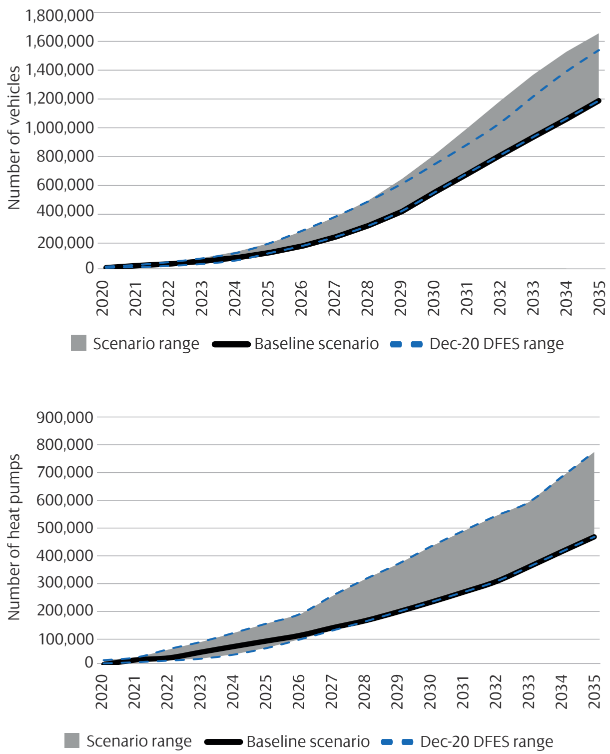
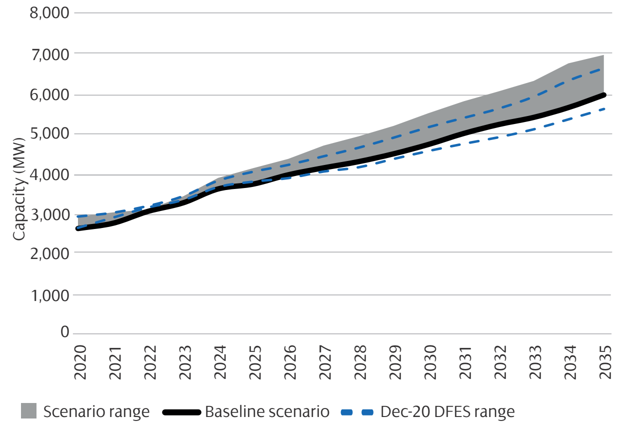
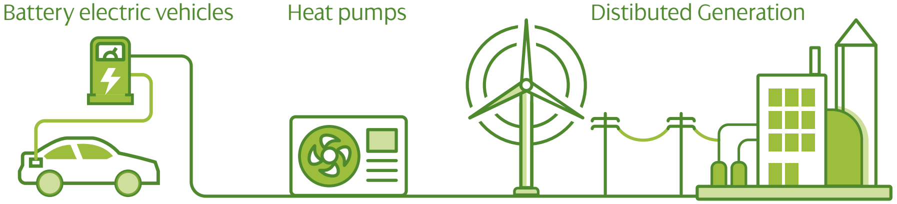


Figure 12 shows our baseline scenario and Net Zero compliant forecasts for distributed generation.

Figure 12 | Range of Net Zero compliant distributed generation forecasts





	Battery electric vehicles	Heat pumps	Distibuted Generation
Now	5,976	646	2.5GW
2030 High	0.80 million	0.43 million	+3.0GW
2030 Low	0.53 million	0.23 million	+2.3GW

SP Energy Networks
320 St Vincent Street
Glasgow, G2 5AD

Contact us

facebook.com/SPEnergyNetworks
twitter.com/SPEnergyNetwork
RIIO_ED2@spenergynetworks.co.uk
spenergynetworks.co.uk