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SP ENERGY NETWORKS

SP Manweb Future Energy Scenarios

July 2020

Contents

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1 Foreword

Welcome to our Distribution Future Energy Scenarios (DFES). This document sets out our DFES 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 published on 1st May 2020, following stakeholder feedback. 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 we generate, distribute and use energy evolves. To 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.

But while the overall direction of travel towards Net Zero is clear, there are some areas where policy decisions and action plans are still under development. How will Local Authorities turn their Climate Emergency status into action? How will UK and Welsh governments respond to the challenge of decarbonising domestic heating? 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, between them, cover a range of credible pathways to describe the potential decarbonisation routes which our customers may follow.

Working together

We do not endorse any particular scenario – our main role is to ensure that we provide the safe, efficient, and reliable network capacity needed to deliver the decarbonisation route that our customers and communities choose. It is therefore important that we make sure we have correctly understood your requirements; feedback from our stakeholders is vital to ensure this.

We welcome the feedback we have already received – this document is an updated set of forecasts, based on stakeholder feedback on the forecasts we published on 1st May 2020. 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 hearing your thoughts. Please do not hesitate to share your feedback and insights with us, 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. We are doing this so that we can continue to provide our customers with a safe, reliable and good value electricity supply, whatever the future holds.

Scott Mathieson
Network Planning & Regulation Director

2

Impact of Covid-19

Covid-19 has impacted every part of our society and the UK economy. It is still too early to be able to accurately assess the impact of Covid-19 on our DFES forecasts, as it will depend on a complex range of societal and economic factors.

Our ways of working, socialising and living have all changed. These changes have affected GB electricity consumption, reducing national demand to record low levels[1]. It is important to highlight that, during this challenging time, SPEN is focussed on continuing to provide a safe, secure and reliable supply for all our customers.

It is still too early to be able to accurately assess the longer-term impact of Covid-19 on our DFES forecasts, as it will depend on a complex range of societal and economic factors. Whilst Covid-19 is having an immediate impact on our network operations and plans, we also believe that, at some point, government and industry effort must revert to ensuring society is tackling the climate change crisis whilst protecting the vulnerable and fuel poor. If anything, our Covid-19 experience has underlined this; it has challenged how we think about resilience and how we enact our response to this imperative. In this context, electricity networks will endure as vehicles for driving forward government plans for achieving Net Zero.

In the post Covid-19 period, electricity networks also have increased importance in acting as an economic catalyst in recovery; advisors to government are recommending green economic recovery investment in infrastructure for this reason. We fully support this – we believe that investing to deliver Net Zero targets presents a critical opportunity to restart our economy, deliver much needed jobs, and inject sufficient pace into the Net Zero transition. This role our networks can play is especially important to us as we consider both the national and devolved governments that we serve.

To realise this ambition, it will be important that Ofgem continue to regulate objectively; the need to invest in our networks has never been more important than it is now.

We will keep the impact of Covid-19 under review and, as the understanding of its impact on the energy system develops, we will incorporate this into future updates. In considering the impact of Covid-19, we would note that our DFES forecasts are long-term, looking out to 2050. We assume the Net Zero legislated targets will remain, and so the need for decarbonisation is unchanged.

[1] Source: https://data.nationalgrideso.com/backend/dataset/b3c55e31-7819-4dc7-bf01-3950dccbe3c5/resource/ebd7e133-96da-4a8d-a5b6-039918717c8a/download/ngeso-covid-19-preparedness-01-07-vfinal.pdf

3 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.

3.1 The DFES forecasts

In order to ensure our network has sufficient capacity to meet our customers' changing electricity needs, we need to forecast what their electricity requirements are 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 the understanding of future customer needs that the DFES forecasts provide 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, the network regulator. In short, the DFES forecasts are the foundation on which we plan our business to meet our customers' needs.

3.2 Incorporating your views

Since our first DFES publication on 1st May 2020, 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 have assessed and used to update the forecasts; this document contains those updated forecasts. Please see Section 6.2 for a summary of the feedback we received and how we have used it.

Given that different stakeholders will be interested in different levels of detail, we have created a range of documents to explain our DFES forecasts[2]. These are:

1. "SPEN Distribution Future Energy Scenarios – Summary of Methodology". This is a document that goes into the detailed methodology to create each forecast.
2. "SP Manweb Future Energy Scenarios". This document, containing the main forecast trends.
3. SP Manweb Future Energy Scenarios – Key Findings". A short document which summarises the key findings.

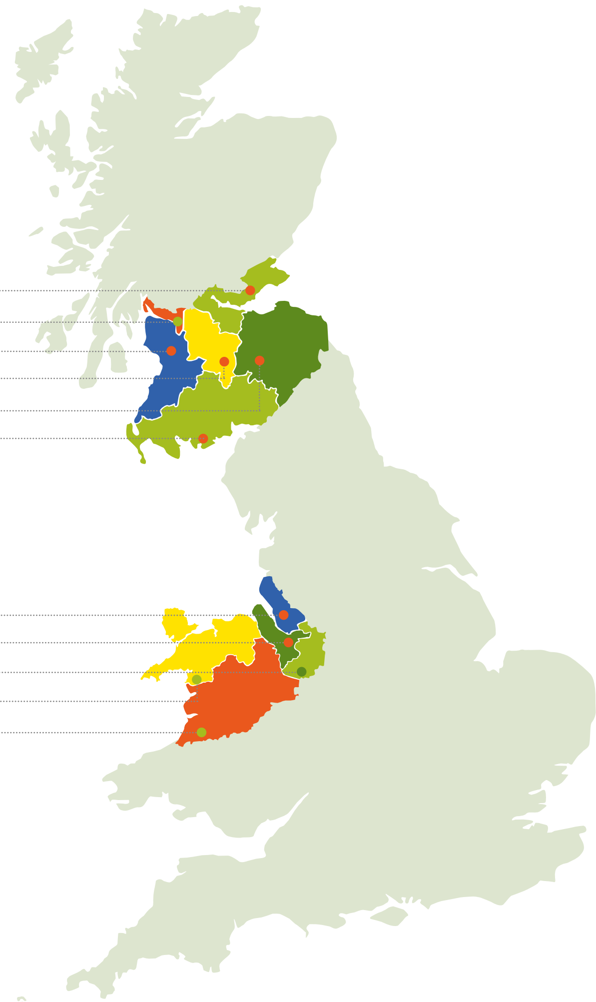
If you have any questions on these forecasts, please do not hesitate to contact us at RIIO_ED2@spenergynetworks.co.uk.

[2] https://www.spenergynetworks.co.uk/dfes

3.3 Other SP Energy Networks forecasts

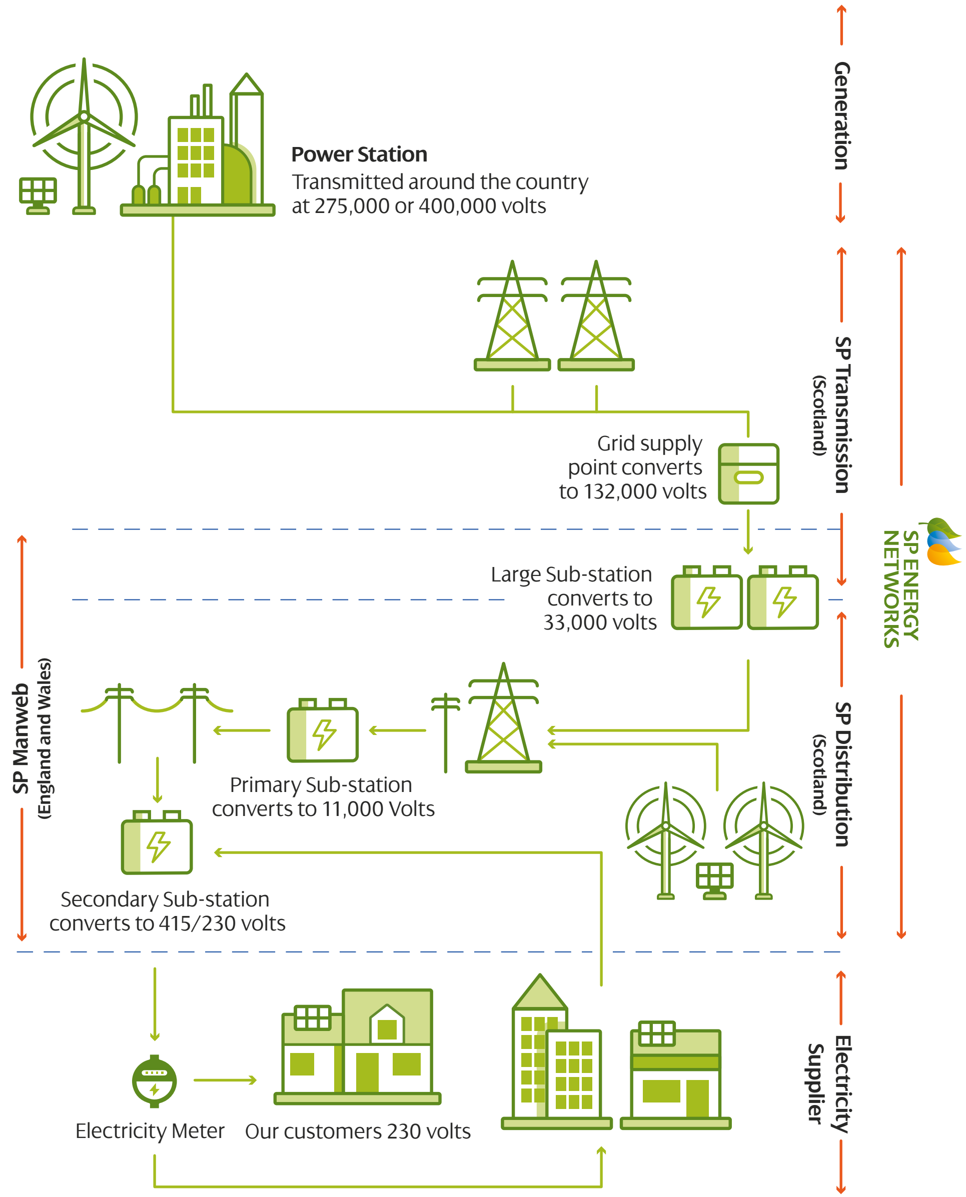
SP Manweb is part of SP Energy Networks. SP Energy Networks includes two other electricity network companies: SP Distribution, the distribution network operator for Central and Southern Scotland, and SP Transmission, the transmission network owner for Central and Southern Scotland. These two companies each have their own forecasts, which are available separately[3]. The areas of operation of SP Distribution, SP Manweb and SP Transmission are shown in Figure 1.[4]

Figure 1 | SP Energy Networks' three electricity network companies



[3] www.spenergynetworks.co.uk/userfiles/file/SPEN_Energy_Scenarios_2019_update.pdf

[4] SP Distribution and SP Transmission are shown as operating the same geographic area – this is because SP Distribution operates the distribution network in that area, whilst SP Transmission operates the Transmission network in that area.



4

External context

The UK and Welsh governments have committed to a significant change to the energy system in order to reduce greenhouse gas emissions.

In response to the global climate change challenge, the UK Government has introduced the Climate Change Act 2008 (2050 Target Amendment) Order 2019[5]. This introduces a legally binding target for the UK to become Net Zero (greenhouse gas emissions), reducing 100% of greenhouse gas emissions by 2050. This is in line with the Committee for Climate Change's publication "*Net Zero – The UK's contribution to stopping global warming*"[6]. In this same publication, the Committee for Climate Change recommends a target of at least a 95% reduction of greenhouse gas emissions by 2050 for Wales. However, the Welsh Government aims to go even further and reach Net Zero by 2050.

Building on these targets, the UK Government's Clean Growth Strategy[8] also identifies a number of ambitions which will have a direct impact on the electricity network.

Some of these ambitions include:

1. During the 2020s, roll out low carbon heating in new homes and existing off gas grid homes.
2. By 2040, phase out the sale of new petrol and diesel cars and vans.

At a more local level, a number of Local Authorities in England and Wales have declared climate emergencies. We expect this to feed into regional development plans, further impacting the electricity distribution network.

The distribution network is the key enabler to realising these targets and ambitions – regardless of forecast scenario, the distribution network will need to accommodate significantly more demand through the electrification of heat and transport, and more renewable generation to decarbonise our electricity supply. Given this key Net Zero enabling role, the importance of these DFES forecasts has never been greater.

[5] www.legislation.gov.uk/ukpga/2008/27/contents

[6] www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf

[7] https://gov.wales/sites/default/files/inline-documents/2019-08/decarbonisation-programme-newsletter-july-2019.pdf

[8] www.gov.uk/government/publications/clean-growth-strategy

5 How we create our DFES forecasts

SPM DFES forecasts use the ESO's 2019 FES as a starting point, refined with sophisticated assessments to incorporate regional factors and the legislative Net Zero targets. These forecasts have been tested with stakeholders and updated accordingly. This approach creates regional and local forecasts for demand and generation connected to the SP Manweb distribution network out to 2050.

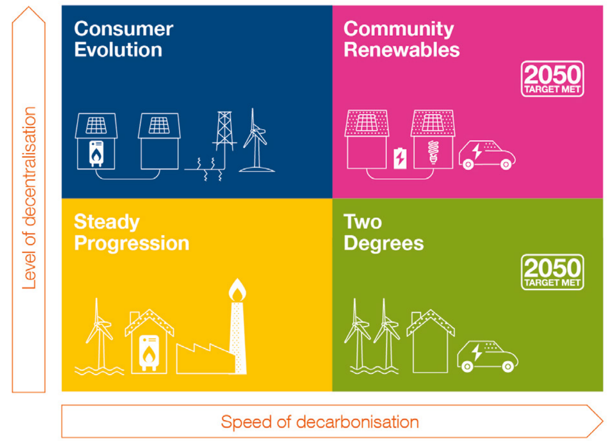
5.1 The starting point – ESO's 2019 FES

The SP Manweb DFES forecasts use the National Grid Electricity System Operator (ESO) 2019 Future Energy Scenarios[9] (2019 FES) as a starting point. These are four GB-wide holistic energy scenarios out to 2050, considering gas and electricity supply and consumption. These four scenarios are designed to represent a range of credible energy scenarios, representing differing levels of consumer ambition, government/policy support, economic growth and technology development. Each scenario can be disaggregated to show forecasts for individual metrics (e.g. electric vehicle (EV) uptake, solar photovoltaic (PV) capacity etc.). The scenarios are developed through extensive engagement with stakeholders and are widely recognised as being an industry reference point.

To illustrate their different representations, Figure 2 maps the four scenarios against two metrics: level of decentralisation (the extent to which energy generation is sited closer to consumers) and speed of decarbonisation (how fast low carbon technologies are adopted).

The ESO updates its Future Energy Scenarios annually; the most recent was published in July 2019 and is the version which these SP Manweb DFES forecasts use as their starting point.

Figure 2 | Overview of the ESO's 2019 Future Energy Scenarios



[9] https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2019-documents

5.2 Creation of the DFES

The 2019 FES provides a starting point for the SP Manweb DFES forecasts, but it is not detailed enough for our DFES forecasting needs as we can't use it to accurately predict our customers' requirements. Therefore, to create a DFES, the GB-wide ESO FES forecasts need to be significantly augmented to provide a much more regionally reflective and geographically granular view.

This is achieved using a combination of extensive top-down and bottom-up assessments, and using additional input data from:

1. UK government legislation – incorporation of Net Zero sensitivity.
2. Regional ambitions and development plans.
3. Network data we already have, for example views on near term connections of distributed generation.
4. Outputs from SP Energy Networks' EV-Up project, which provides a detailed spatial view of electric vehicle uptake.
5. Other highly spatially disaggregated sources of data (e.g. households off the gas grid).

This created our initial forecasts, which we published on 1st May 2020 for stakeholder comment. The resulting stakeholder feedback has been used as an additional input – the updated forecasts in this document reflect that stakeholder feedback (see Section 6.2 for more information).

This input data provides a much richer and more representative view. This activity was undertaken with the support of Baringa, an expert consultancy. For further details on the methodology to create the forecasts, please refer to "*SPEN Distribution Future Energy Scenarios – Summary of Methodology*" document, developed in conjunction with Baringa.

To then create geographically granular forecasts, all of the key scenario elements are spatially disaggregated to two levels of detail:

1. Grid supply point (GSP) level. There are 14 GSP areas across North Wales, Merseyside, Cheshire and North Shropshire.
2. Primary substation/substation group level. There are 341 primary substation network groups across North Wales, Merseyside, Cheshire and North Shropshire. These geographic areas cover, on average, approximately 38km^2.

The metrics we are most interested in, given they have the greatest potential network impact, are:

1. Generation technology (e.g. wind, solar PV, combined heat and power).
2. Generation scale (e.g. behind the meter generators such as rooftop solar PV).
3. Electricity storage.
4. Residential, industrial and commercial demand.
5. Uptake of electric vehicles.
6. Uptake of heat pumps (HPs).

We have retained the approach of forecasting for four scenarios, as we feel it is important to represent a range of credible pathways.

It is important to note that two of the ESO's 2019 FES scenarios (Community Renewables and Two Degrees) only met the previous 2050 target of 80% emission reduction from 1990 levels. This is because the ESO's 2019 FES was produced before the UK 2050 Net Zero target was introduced. However, as part of our data input process to create the DFES, we applied the new legislative Net Zero targets to two of our scenarios (SPM Community Renewables and SPM Two degrees).

5.3 Outputs

This combination of top-down and bottom-up assessments, additional data input and spatial disaggregation means that we can produce forecasts for all key metrics. These key metrics are forecast for each scenario at a GSP and primary substation geographic level, and 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.

We have arranged the outputs of the DFES forecasts into two main categories:

1. Those which affect electricity demand. The main drivers here are electric vehicles and heat pumps, so we show disaggregated forecasts for these. These are set out in Section 6.3.
2. Those which affect electricity generation and storage[10]. These are set out in Section 6.4.

For each metric we have forecast we include, where possible:

1. A measure of the absolute number (e.g. number of electric vehicles); and
2. Its impact on electricity demand or generation capacity (shown in MW). Demand forecasts are shown as 'peak demand'; this is because the contribution of additional demand at peak demand periods will have the most network impact – we have to plan and design our network to accommodate peak demand. Generation forecasts are shown as 'capacity'; this represents the total installed generation capacity.

For demand components (e.g. electric vehicles, heat pumps), we also consider the potential flexibility of each component. Flexibility is the measure of the capability of that component to operate at different times of day. For example, a factory process which always has to operate at the same time is not flexible, whereas an electric vehicle which could be charged at different times of the day has some 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, which in turn reduces the network impact and the requirement for network interventions – this will be to the benefit of customer.

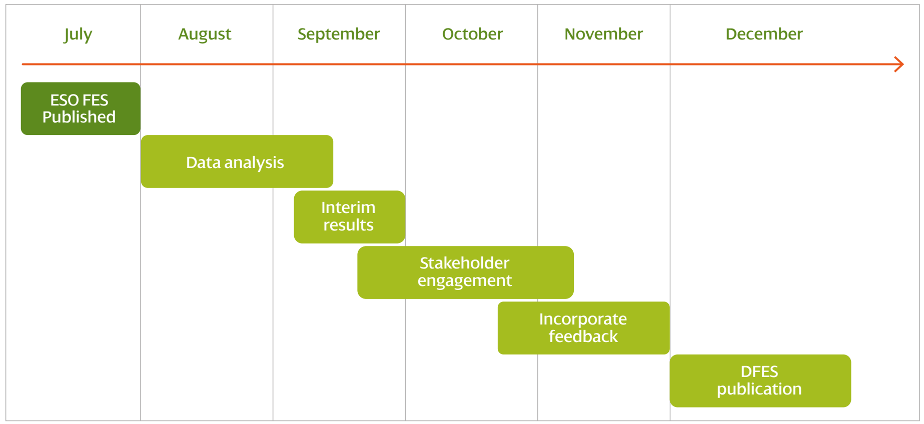
[10] From a technical perspective, storage increases both demand (when it imports electricity) and generation (when it exports), so it could have been included in either group. However, it is legally deemed to be generation, so is included within the generation forecasts.

5.4 Updating the DFES

From next year, we will update and publish our DFES forecasts annually. For each main annual update there will be the opportunity for stakeholders to provide feedback. Feedback from customers and stakeholders is vital to ensure that our DFES forecasts reflect the plans and ambitions of the communities we serve. We will consider all information we receive from stakeholders to help shape our forecasts. As these forecasts will inform the network we deliver for our customers, we also have a duty to our customers to ensure that all information included is well evidenced and credible. We will therefore consider the extent to which information we receive should be used to update the forecasts. For information relating to specific developments in the shorter-term, we will consider how developed that scheme is and its underlying drivers.

Later on this year we will also be carrying out a further exercise to update our DFES, following publication of the ESO's 2020 FES in the summer. In the meantime, if you have any further questions or feedback, please do not hesitate to email us at RIIO_ED2@spenergynetworks.co.uk. Whilst we are following a different timescale for this year, from July 2021 the annual process will be as per Figure 3.

Figure 3 | Annual process to create our DFES



6

Our DFES Forecasts

This section sets out our updated demand and generation DFES forecasts for each scenario out to 2050, following stakeholder feedback to those we published on 1st May 2020.

All the forecast values are for the SP Manweb distribution network; they are not forecasts for the whole of England, Wales or the UK, or the transmission network[11].

6.1 Scenario Overview

The SP Manweb DFES consists of forecasts for four main scenarios, consistent with the ESO's 2019 FES scenario framework. A description of each scenario[12] is provided below:

In SPM Steady Progression (SP):
the pace of the low carbon transition continues at a similar rate to today but then slows towards 2050. Consumers are slower to adopt electric vehicles and take up of low carbon alternatives for heat is limited by costs, lack of information and access to suitable alternatives. Although hydrogen blending into existing gas networks begins, limited policy support means that new technologies such as carbon capture, usage and storage and battery storage develop slowly.

In SPM Consumer Evolution (CE):
there is a shift towards local generation and increased consumer engagement, largely from 2040 onwards. In the interim, alternative heating solutions are taken up mostly where it is practical and affordable, e.g. due to local availability. Consumers choose electric vehicles and energy efficiency measures. Cost-effective local schemes are supported but a lack of strong policy direction means technology is slow to develop, e.g. for improved battery storage.

In SPM Community Renewables (CR):
local energy schemes flourish, consumers are engaged and improving energy efficiency is a priority. UK homes and businesses transition to mostly electric heating. Consumers opt for electric transport early and simple digital solutions help them easily manage their energy demand. Policy supports onshore generation and storage technology development, bringing new schemes which provide a platform for further green energy innovation to meet local needs. The key adjustments we made to accommodate Net Zero targets are a significantly higher uptake of heat pumps, higher uptake of distributed generation and electric vehicles.

In SPM Two Degrees (TD):
large-scale solutions are delivered and consumers are supported to choose alternative heat and transport options to meet the Net Zero targets. UK homes and businesses transition to hydrogen and electric technologies for heating. Consumers choose electric vehicles and hydrogen is widely used for commercial transport. Increasing renewable capacity, improving energy efficiency and accelerating new technologies such as carbon capture, usage and storage are policy priorities. The key adjustments for the Net Zero targets include a slightly higher uptake of heat pumps (hydrogen is still assumed to play a key role for heating under Net Zero compared to the SPM Community Renewables scenario), higher uptake of distributed generation and electric vehicles.

[11] 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 forecasts will capture nearly all demand and medium-scale, smaller-scale and domestic-scale generation in north Wales, Merseyside, Cheshire and north Shropshire.

[12] Source: Scenario descriptions based on National Grid's 2019 FES (https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2019-documents)

6.2 Incorporating your views

Following the publication of our previous DFES document on the 1st May 2020, we engaged with a wide range of stakeholders.

We have received feedback from Government bodies, Local Authorities, electricity and gas network companies, electricity suppliers, consumer groups, community energy groups, renewable generation developers, electric vehicle charge point operators, manufacturers, and other interested parties. This engagement included bilateral meetings, responses to our DFES consultation and feedback via surveys. We have considered all feedback in this refresh of our DFES forecasts and to inform the development of our RIIO-ED2 business plan.

6.2.1 Summary of feedback

This section provides a summary of our stakeholders' views on the SP Manweb DFES forecasts.

Our stakeholders agree the journey towards Net Zero will increase the reliance on electricity and the overall demand on the electricity network, however the rate of decarbonisation will not be geographically uniform and clusters are likely to emerge.

Electric vehicles: The majority of our stakeholders agreed that there is increased momentum in support of electric vehicles due to a range of factors. Stakeholders thought that air quality concerns, proposals to bring forward the 2040 new petrol/diesel vehicle ban, whole life costs becoming comparable to petrol/diesel equivalents, improving battery quality and range, and increasing new and second-hand vehicle choice, will support the growth of electric vehicles. One stakeholder thought that electric vehicle uptake is likely to see a knee point around 2025-2026, once the second-hand car market develops – this is in line with the high scenarios. Some stakeholders thought fleet vehicles would be amongst the early electric vehicle adopters.

Some stakeholders thought that increased home working, an increased use of public transport, and the expected development of autonomous and shared vehicles could drive a reduction in vehicle ownership towards 2050.

Stakeholders thought that some geographic areas will see a faster uptake than others, which is broadly aligned with the learning from EV-Up (see section 6.3.2). One stakeholder requested further consideration of destination charging at peak tourist locations.

Our stakeholders generally agreed that electric vehicle smart charging can provide flexibility. They broadly agreed with our forecasts that the majority of this would be from home charging; they generally did not expect much flexibility from rapid charging as this will mainly be used to charge vehicles mid-journey. A couple of our stakeholders thought that the level of smart charging is likely to be determined by the revenue opportunities it offers electric vehicle owners. Overall, most stakeholders were satisfied with the smart charging capability forecast in the scenarios.

Our stakeholders believed that, whilst flexibility from vehicle to grid (V2G) is technically possible, they did not expect it to offer material levels of flexibility within the next eight to ten years. This was for a range of reasons: most electric vehicle manufacturers currently void your warranty if you offer this service, limitations of existing battery technology, and limitations of existing charging technology. This feedback is aligned with our forecasts.

Heat pumps: Our stakeholders saw the decarbonisation of heat as an area with greater uncertainty – the different 2050 scenario forecasts reflect that uncertainty. It was generally recognised that there is no single way to decarbonise heat and there could be a combination of technologies coming into play; for example, heat pumps, district heating, bio-LPG and hydrogen. However, hydrogen was broadly seen not to be a mainstream option until the mid to late 2030s. This is consistent with the assumptions for the SPM Two Degrees scenario.

Our stakeholders were in agreement that heat pump uptake is more likely to occur in new build properties and off-gas grid properties. This was because for other property types there were concerns about costs and the ability of heat pumps to keep the space warm, given existing low levels of thermal insulation. Even though there were mixed views around the extent of the retrofits, it was agreed that a degree of retrofits will be required.

The majority of our stakeholders considered there to be little scope for flexibility from heat pumps. This is primarily because customers will naturally want their heating on when they return home from work (the timing of which typically aligns with peak demand periods), and will be reluctant to compromise on heat comfort levels. It was agreed that hot water tank storage could enable some flexibility, but the associated cost and space requirements do not make this feasible for every household. We feel that our forecast range of heat pump flexibility (0% reduction of heat pump contribution to peak demand in the SPM Steady Progression scenario to between 2.5-25% in the SPM Community Renewables scenario) reflects this feedback.

Distributed Generation: Our stakeholders were in agreement that the amount of distributed generation will significantly rise in the transition towards Net Zero, however the rate of the increase will likely depend on future policy, network changes, project economics and planning timescales.

There was a general consensus from stakeholders that wind and solar PV generation are the technologies which will lead this growth. Stakeholders thought the need for storage would grow and potentially be co-located with other forms of generation, depending on local area demand.

Rural areas are anticipated to see more renewable generation than urban areas due to space requirements, however the size of the projects should also be considered.

One stakeholder indicated that the forecast by 2050 could change depending on the level of hydrogen usage for electricity generation.

6.2.2 Updates to our forecasts

We have applied a number of updates to our scenarios to reflect what our stakeholders have told us. The table below summarises the feedback we received and explains the resulting action we have taken.

Electric vehicles	
Stakeholder feedback	**Actions we have taken**
Destination charging at popular tourist spots could be a significant challenge, particularly in remote areas.	We have updated all scenarios to incorporate the contribution from destination charging at popular tourist spots.
Smart charging is key to the integration of electric vehicles in the network. The volume of flexibility from smart charging is likely to partly depend on the level of cost savings for electric vehicle owners.	We agree that smart charging will enable flexibility to connect more electric vehicles. Our flexibility assumptions already capture the potential for considerable peak demand impact reduction due to charging electric vehicles in a more flexible way. Stakeholders did not think we should increase the levels of flexibility from smart charging, so we have not updated the scenarios.
Most car manufacturers don't cover battery degradation within their warranty if the vehicle is used for V2G services. This means V2G flexibility will likely be low. Another barrier is battery technology as battery cycling currently reduces battery life.	We agree that V2G capability will be low for the next ten years – we have not updated our forecasts as they already showed this. Our forecasts showed V2G making an increasing contribution after 2030 – we have not reduced this as we expect that rapid improvements in battery technology mean that warranties and battery technology will not be a such a barrier to V2G after 2030. We will continue to monitor further technology developments in this area for future updates.
Bus electricity consumption is expected to be around 1.6kWh/mile.	We have updated our assumptions for electricity consumption for buses in all scenarios. This change had limited impact on peak demand, as most bus charging will occur outside of peak demand periods.

Electric vehicles *continued*	
Stakeholder feedback	**Actions we have taken**
Vehicle numbers are not expected to grow from 2040, due to autonomous and shared vehicles, and increased home working.	We believe this is an area of great uncertainty. Our assumptions for autonomous vehicles are consistent with the ESO's 2019 FES. We will continue to monitor developments in this area for the production of our next DFES.
The uptake of electric vehicles may see a "hockey stick" around 2025-26 as the second-hand car market picks up.	Our EV-Up project considers different socio-economic groups and likelihood to purchase new and second-hand cars. Our SPM Two Degrees scenario already reflects that knee point, so we have not made updates.

Heat pumps	
Stakeholder feedback	**Actions we have taken**
Heating demand is likely to be less flexible than electric vehicle demand, as there is less appetite to compromise comfort levels.	Stakeholders did not think we should increase the levels of flexibility from heat pumps. We have not reduced our assumptions for heat pump flexibility in the high scenarios as we believe the current range sufficiently covers the uncertainty on this area.
ASHPs will not materialise in grade 1 and 2 listed buildings.	We have refined our heat pump allocation methodology to exclude these types of buildings. All scenarios have been updated with this refinement.

Hydrogen	
Stakeholder feedback	**Actions we have taken**
Electricity demand is expected to increase due to hydrogen production through electrolysis.	Electrolysis is one potential option for hydrogen production. Our analysis assumed that electrolysis would primarily take place at transmission level, and so will not impact distribution peak demand. We have therefore not updated our forecasts. This is an area we plan to review in detail for the production of our next DFES.

Distributed Generation	
Stakeholder feedback	**Actions we have taken**
In rural areas SPM Community Renewables may be more prevalent, whereas this would not be realistic for urban areas.	We have improved our rurality assumptions used in the allocation of the different generation technologies and storage. All scenarios have been updated with this change.
Storage is likely to develop in high energy I&C and urban areas for peak shaving.	
No large-scale solar PV and wind generation is likely to be sited in Areas of Outstanding Natural Beauty (AONBs).	We have improved our allocation methodology for generation to limit the size of the developments close to National Parks and AONBs. All scenarios have been updated with this change.
The National Development Framework for Wales has proposed designated areas for onshore wind and solar generation.	Even though the document is still being consulted on, we have refined our allocation methodology to account for these areas, when allocating solar PV and wind generation capacity. All scenarios have been updated with this change.
Non-renewable generation is likely to reduce to achieve Net Zero, as it would require negative emissions.	Two of the scenarios already achieve Net Zero. We will review the forecast of non-renewable generation following the next FES publication. This is to ensure the whole system implications are captured, therefore no updates have been made yet.
Hydrogen could be used for electricity generation in the future.	
There will be more local solar PV and wind projects. The size of projects should be considered.	Our scenarios have not been updated, as when allocating generation to all scenarios, our methodology already considered the size of the projects. Smaller local developments are assigned to primary substations whereas larger sites are considered to be connecting to the higher voltage levels and are accounted for in the GSP generation capacities.

SP Manweb Future Energy Scenarios – July 2020 29

6.3 Electricity Demand

This section sets out the forecasts for demand. The two main drivers of increased demand are the electrification of transport and heat, so we provide disaggregated forecasts for each.

6.3.1 Demand Overview

Understanding how electricity demand could evolve on SP Manweb's network is the first key factor informing the need for network intervention to increase or manage network capacity.

Electricity demand out to 2050 will be affected by:

1. energy efficiency and underlying demand trends;
2. the extent of new sources of demand, i.e. how much heating and transport is electrified;
3. the speed of the uptake of new sources of demand and when it happens;
4. the degree to which both existing and new load can be shifted or reduced at times of system peak demand (flexibility).

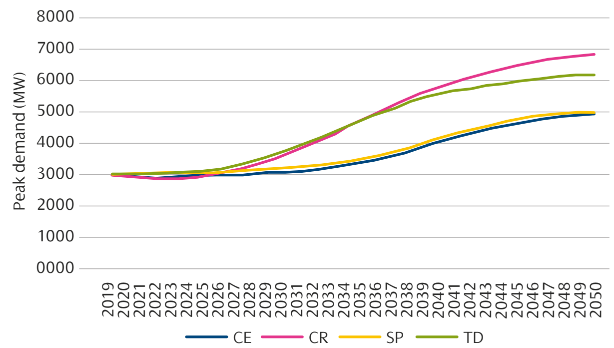
Figure 4 shows how SP Manweb's total peak demand will vary for the four scenarios, assuming that none of the demand is flexible (i.e. it can't be shifted away from the peak to less busy periods, which would have the effect of reducing peak demand).

There is material split between the scenarios. SPM Community Renewables and SPM Two Degrees are the two scenarios which achieve the Net Zero targets. Both involve a near total shift to the electrification of cars and light goods vehicles, and increasing levels of electric heating. These factors significantly increase the peak demand. In comparison, SPM Consumer Evolution and SPM Steady Progression involve less electrification of heat and transport, with more reliance on other energy vectors (e.g. petrol, diesel, natural gas) for these two activities. As a result, these two scenarios do not increase electricity peak demand to the same extent.

Figure 4 shows the 'worse case' impact, as it assumes that no existing or new demand has any flexibility. This does not reflect reality: some existing demand could shift to other times of the day and some new demand could be controlled in a smart way to avoid certain hours of the day when the distribution network is seeing more demand, for example when charging electric vehicles.

Without flexibility, demand could increase by up to 27% by 2030 and more than double by 2050.

Figure 4 | Electricity peak demand without flexibility



With flexibility, demand could increase by circa 14% by 2030 and over 40% by 2050.

Figure 5 shows how demand flexibility could reduce SP Manweb's total peak demand.

Figure 5 shows that flexibility could reduce peak demand by between 3-17% by 2030 compared to no flexibility, depending on scenario. Such a reduction will directly deliver benefits for consumers as it will require less investment in the network, resulting in lower electricity bills and fewer delays. The two more decarbonised scenarios, SPM Community Renewables and SPM Two Degrees, include a higher uptake of new sources of demand. Therefore, there are greater levels of demand flexibility associated with electric vehicles and heat pumps in these two scenarios.

To better illustrate what is driving the changes in demand, and where the demand flexibility is coming from, **Figure 6** shows a breakdown of the components of the **Figure 5** peak demand forecast for 2030 and 2050. The difference between the solid (flexible) and dashed (non-flexible) forecasts in **Figure 5** are shown by the shaded components in **Figure 6** – the shaded components represent what can be flexibly controlled.

Figure 5 | Electricity peak demand with and without flexibility

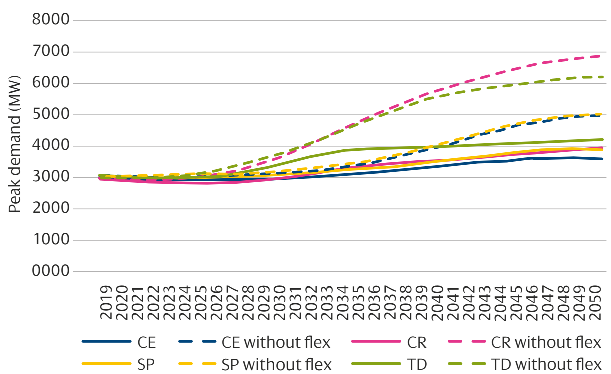
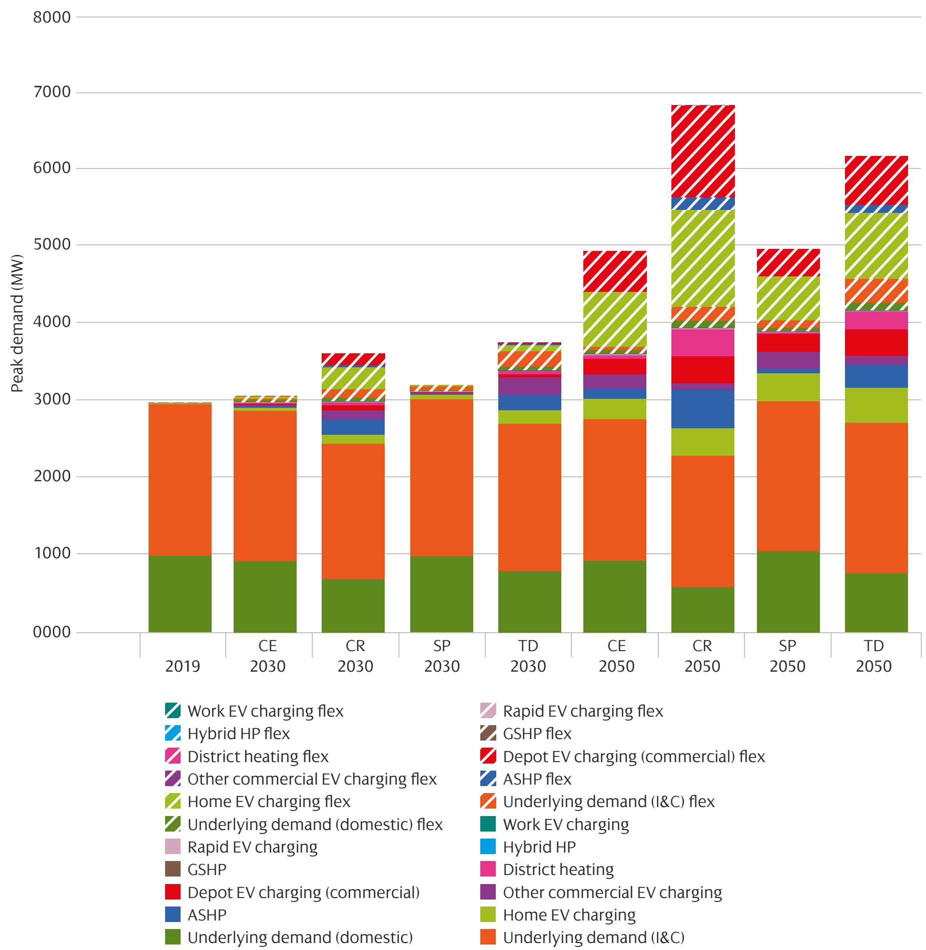


Figure 6 | Electricity peak demand breakdown for 2030 and 2050



Given the benefits of flexibility, all subsequent demand forecasts in this report assume flexibility will be available to the extent shown in Figure 5 and Figure 6 (e.g. where an electric vehicle forecast shows the impact on peak demand, those forecasts assume electric vehicle demand flexibility).

Figure 5 and Figure 6 show increasing demand for all scenarios in the medium to long term. These forecasts and trends are the total values for North Wales, Merseyside, Cheshire and North Shropshire. However different regions will see different increases in demand at different times, based on a range of factors. Figure 7 shows a geographically granular view on how the demand could change from current levels for the highest and lowest forecast scenarios.

Figure 7 shows there is clear variance in the demand changes seen in different regions.

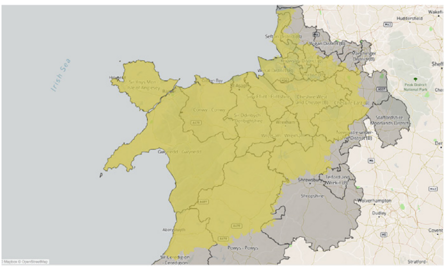
Overall demand trends:

1. All scenarios show increasing demand. This means that the distribution network will need intervention to facilitate decarbonisation.
2. Demand flexibility can help reduce peak demand and deliver real benefits to consumers. This means that we should all be working to enable flexibility.
3. The increase in demand is not geographically uniform – some areas of the network will be impacted earlier, and to a greater extent, than others.

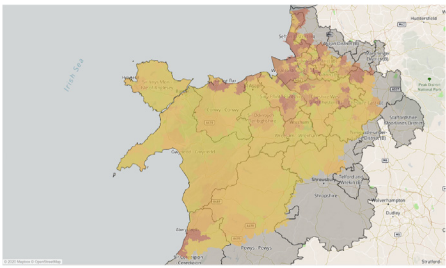
Figure 7 | Electricity peak demand changes from 2019 by primary substation area

Scale range: -3MW to >5MW

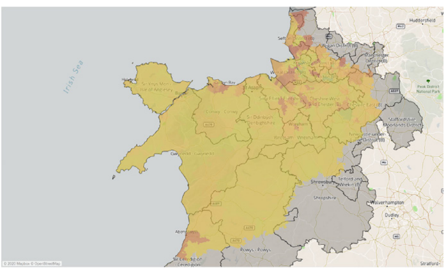
2030 – Low



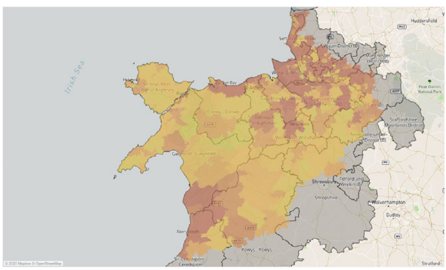
2050 – Low



2030 – High



2050 – High



6.3.2 Electric vehicles

The number of electric vehicles – both plug-in hybrids and battery electric – registered within SP Manweb's area is currently over 7,000. However, momentum in support of electric vehicle adoption is building, leading to uncertainty over how fast the rollout may occur.

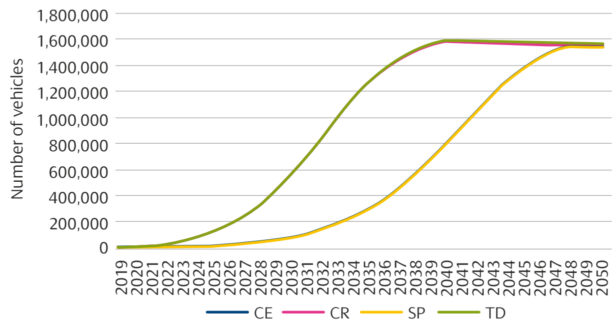
Figure 8 shows the forecast numbers of residential battery electric vehicles in the SP Manweb region.

Figure 8 shows that across the scenarios, the share of residential battery electric vehicles rises from 4,000 in 2019 to between 85,000-563,000 EVs by 2030. The reason for this high level of variance in the 2030s is that the UK has a target to phase out the sale of new petrol or diesel cars by 2040 – this is reflected in our SPM Community Renewables and SPM Two Degrees scenarios. SP Manweb's Welsh region could see between 25,000 and 165,000 residential battery electric vehicles by 2030 and SP Manweb's English region between 60,000 and 398,000. Overall for the SP Manweb distribution network area, compared to today, this would mean over 123 times more battery electric vehicles by 2030 and over 280 times more by 2035.

Our SPM Steady Progression and SPM Consumer Evolution scenarios contain a much slower uptake of residential battery electric vehicles between 2020-2035 followed by a much higher adoption from 2035 onwards, reaching around 1.6million EVs by 2048.

Whilst there is significant variance between scenarios across the 2030s and 2040s, the total number of electric vehicles by 2050 is similar across all scenarios.

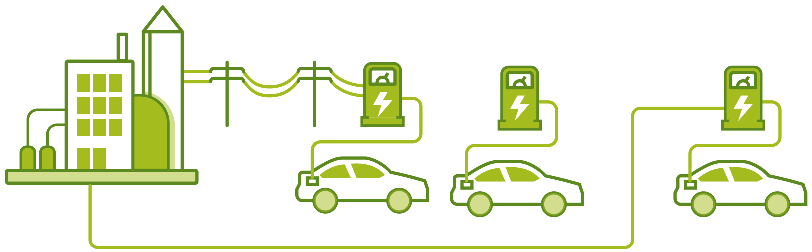
Figure 8 | Residential battery electric vehicle uptake



Widespread adoption of electric vehicles is expected to provide a significant challenge to the electricity sector due to the resultant large increases in peak demand.

Electric vehicle charging could have a significant impact on SP Manweb's peak demand if left unmanaged. Smart charging and vehicle to grid are two ways to add flexibility to electric vehicle charging; 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 to help alleviate constraints. For the highest and lowest electric vehicle adoption scenarios, Figure 9 and Figure 10 show the expected contribution from electric vehicle charging at home during peak time, and the benefits of smart charging and vehicle to grid.

By 2030

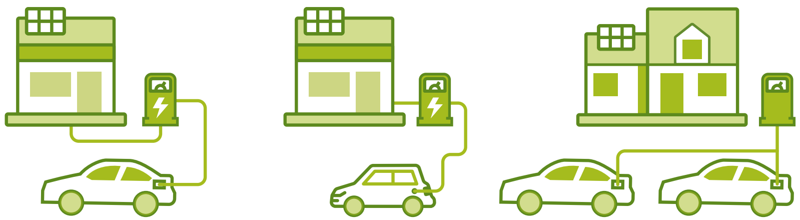


EV charging could add to SPM's peak demand between
61-225MW

Smart charging could reduce this contribution by
10-47%

V2G could help decrease this by a further
7-11%

By 2050



EV charging could add to SPM's peak demand between
547-727MW

Smart charging could reduce this contribution by
33-50%

V2G could help decrease this by a further
42-46%

Figure 9 and Figure 10 also show that the development of effective smart charging and vehicle to grid capabilities could reduce peak demand by 5-13 times by 2050 compared to not having this capability. This means that the development of smart charging and vehicle to grid could deliver significant benefits for customers.

There could be as many as 563,000 EVs within SP Manweb's network area by 2030.

Figure 9 | Home EV contribution to peak demand (high scenario)

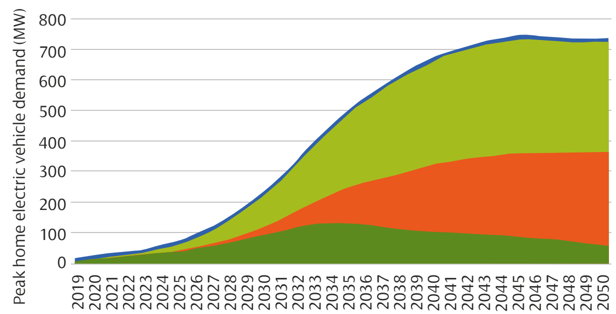
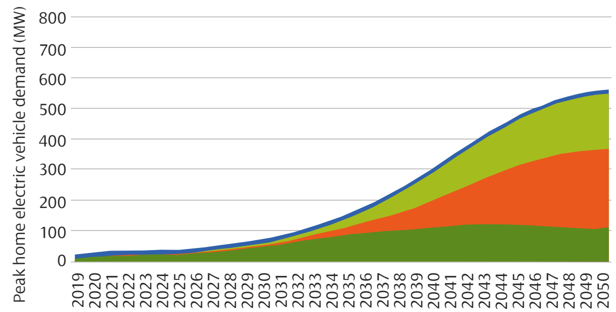


Figure 10 | Home EV contribution to peak demand (low scenario)



The degree of geographical clustering of early electric vehicle adoption will also be a key determinant of the impact on the network – if there are high concentrations of electric vehicles in certain areas then there may be insufficient network capacity in those areas.

We have used our EV-Up project to provide a highly spatially disaggregated view of where the uptake of electric vehicles is likely to be seen. To do this the model combines detailed spatial analysis to determine off-street parking availability at individual property level, and key socio-demographic information to understand the probability of specific areas to transition to electric vehicles.

We have aggregated the results to show residential battery electric vehicle roll-out forecast by Local Authority area (**Figure 11**) and primary substation area (**Figure 12**). For all Local Authorities, we only provide forecasts for the area of that Local Authority which we serve. The range of forecast values shown in **Figure 11** represents the range between the low and high forecasts.

Figure 11 | Potential range of residential battery EV uptake by Local Authority (by 2030 and 2050)

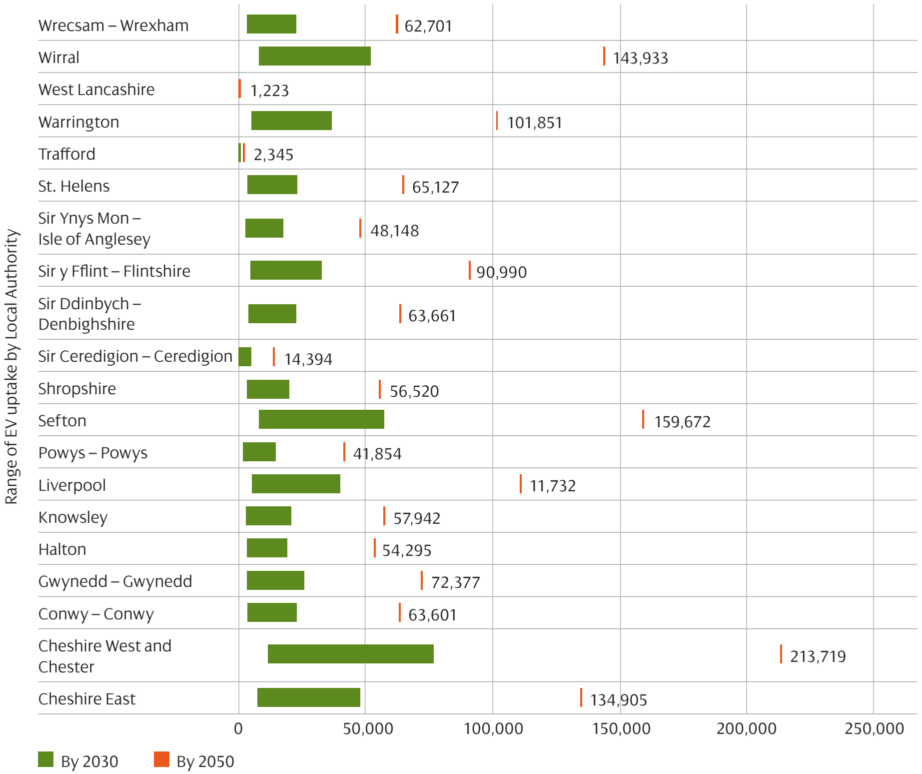
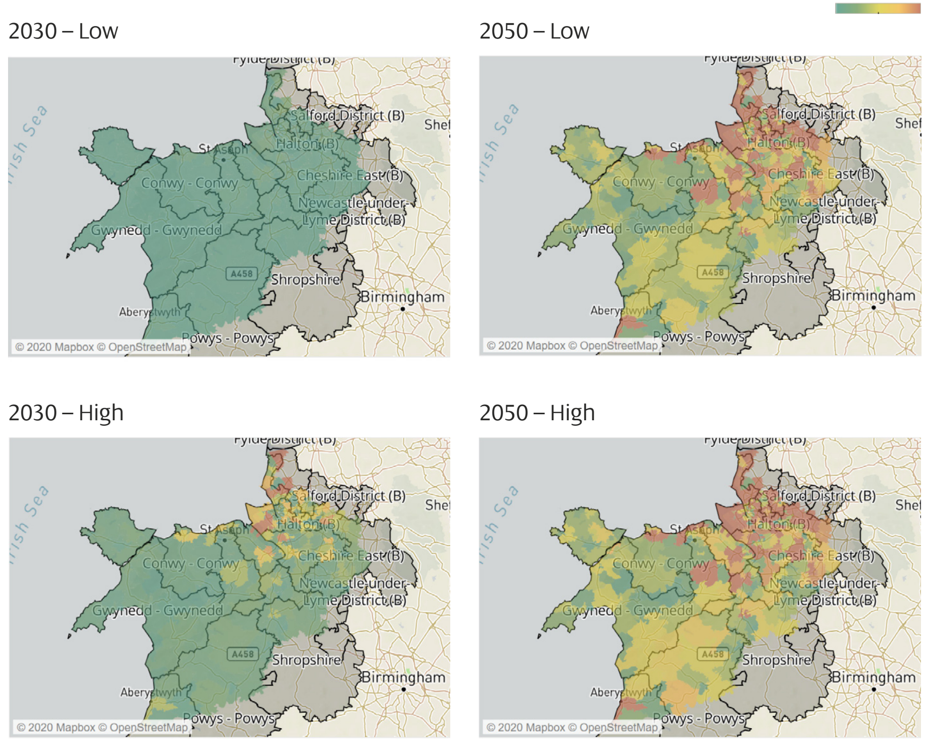


Figure 11 shows that for the English Local Authorities within SP Manweb's distribution network area, residential battery electric vehicles are predominantly found in densely populated areas such as Cheshire West and Chester, Cheshire East, Sefton and Wirral where each could see over 48,000 electric vehicles by 2030, increasing to over 135,000 by 2050.

In the Welsh Local Authorities within SP Manweb's distribution network area, residential battery electric vehicles are predominantly found in densely populated areas such as Flintshire and Gwynedd, where each could see over 26,000 electric vehicles by 2030, increasing to over 72,000 by 2050

Figure 12 | Residential battery EV uptake numbers by primary substation area

Scale range: 0 to >10,000



6.3.3 Heat pumps

Heat pumps use electricity to heat buildings or provide hot water. Heat pumps – both air source and ground source – represent another change to the future electricity demand. Deployment is currently very low, representing well under 1,000 households within a total stock of circa 1.5 million households in SP Manweb's area. Heat pumps can also take the form of hybrid systems where a gas boiler is used at times of peak demand, as well as larger scale heat pumps used for district heating.

We have forecast heat pump uptake given the potential impact they could have on the network. Figure 13 shows the forecast uptake of heat pumps for the four scenarios.

Figure 13 shows that there is significant variance between the heat pump forecasts.

Total proportion of homes with a heat pump could reach 16% by 2030.

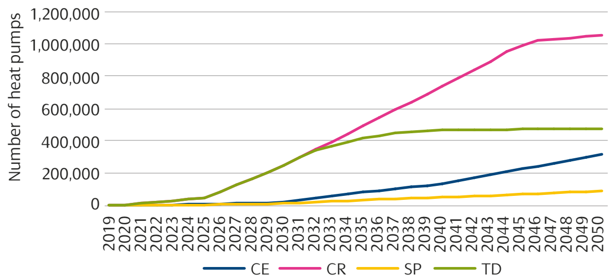
This is for two reasons:

1. The SPM Steady Progression and SPM Consumer Evolution scenarios achieve less decarbonisation overall compared to the SPM Two Degrees and SPM Community Renewables scenarios.
2. There are low carbon alternatives to small-scale heat pumps: district heating and hydrogen in the gas network being the two lead possibilities.

In SP Manweb's Welsh region, there could be as many as 99,000 electric heat pumps by 2030 and around 395,000 by 2050. In SP Manweb's English region, the number of electric heat pumps could reach over 145,000 by 2030 and over 655,000 by 2050.

Compared to electric vehicles, where the roll-out rate between scenarios is different but by 2050 the overall volumes are broadly similar, there is significant variance across the four scenarios for heat pumps. This means that there will be very different impacts on the electricity network depending on which heat decarbonisation route is followed.

Figure 13 | Electric heat pump uptake



Heat pumps could have nine times the network impact of electric vehicles.

Figure 14 shows the impact on peak demand of the high scenario forecast and the potential of heat pump flexibility. Figure 15 shows the same information for the low scenario forecast.

Figure 14 shows that the development of effective heat pump flexibility could reduce their associated peak demand contribution by up to 25% by 2050. This means that the development of this flexibility capability could deliver material benefits to network customers.

Figure 14 | Heat pump contribution to peak demand out to 2050 (high scenario)

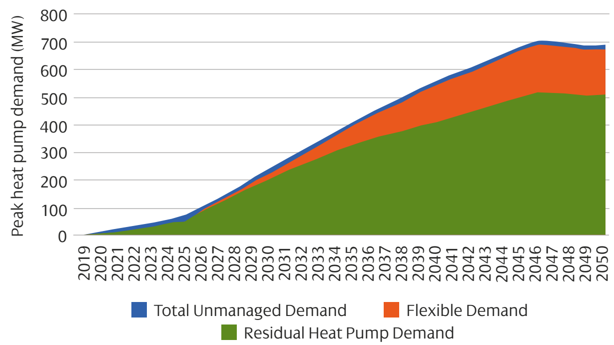
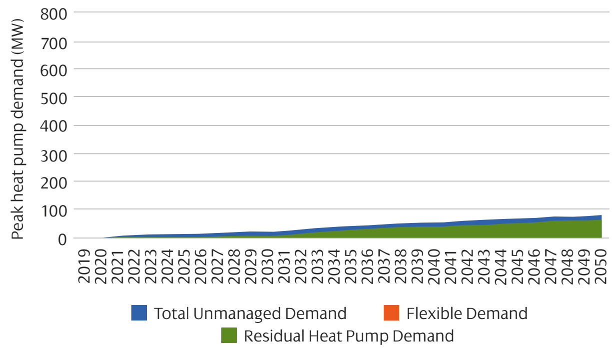


Figure 15 | Heat pump contribution to peak demand out to 2050 (low scenario)



The degree of geographical clustering of heat pump adoption will also be a key determinant of the impact on the network – if there are high concentrations of heat pumps in certain areas then there may be insufficient network capacity in those areas. Some targeting of heat pump deployment is expected; this is focused primarily on new build properties and off-gas grid properties where the economics of heat pumps look more favourable. To help identify heat pump clustering, heat pump roll-out has been forecast by Local Authority area (**Figure 16**) and primary substation area (**Figure 17**). For all Local Authorities, we only provide forecasts for the area of that Local Authority which we serve. The range of forecast values shown in **Figure 16** represents the range between the low and high forecasts.

Figure 16 shows that for the English Local Authorities within SP Manweb's distribution network area, electric heat pumps are predominantly found in areas such as Cheshire West and Chester, Cheshire East, Sefton and Wirral where each could see over 18,000 heat pumps by 2030, increasing to over 80,000 by 2050.

In the Welsh Local Authorities within SP Manweb's distribution network area, electric heat pumps are predominantly found in areas such as Flintshire and Gwynedd, where each could see over 14,000 heat pumps by 2030, increasing to over 63,000 by 2050.

Figure 16 | Potential range of heat pump uptake by Local Authority (by 2030 and 2050)

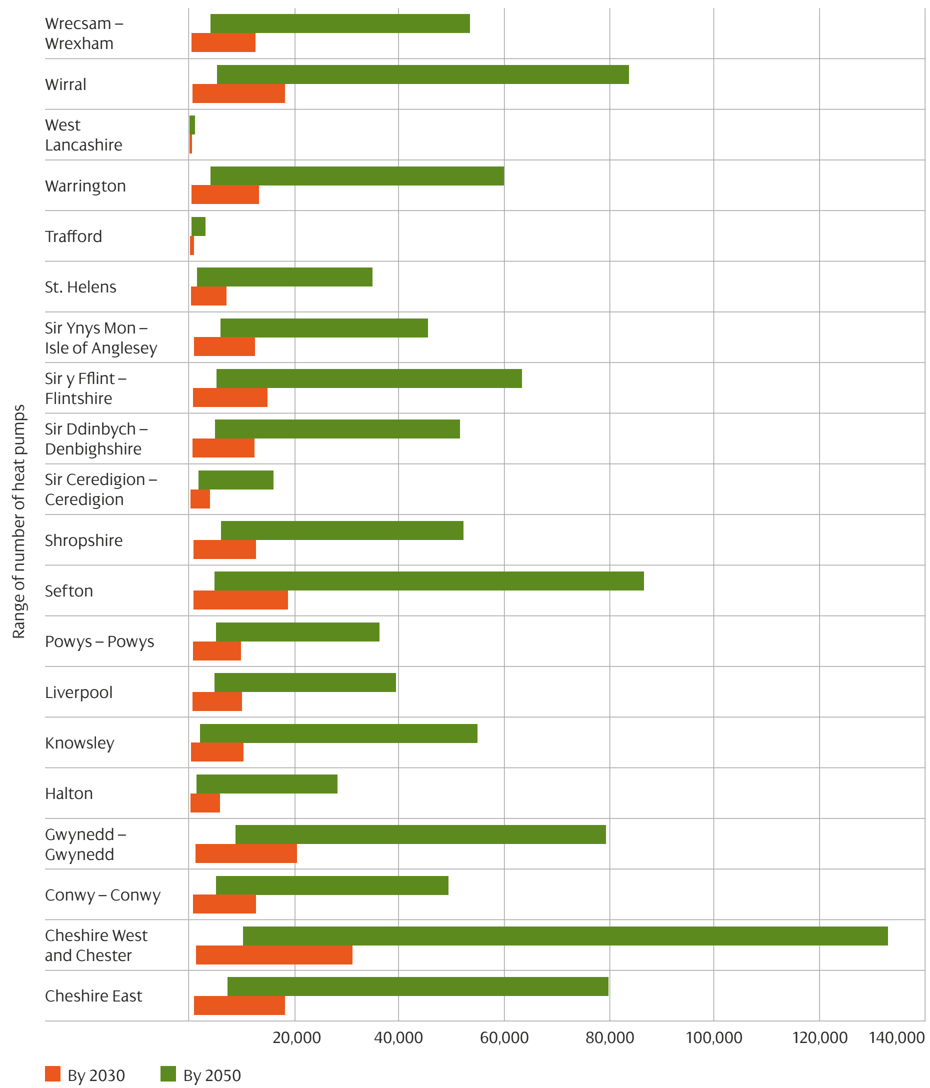
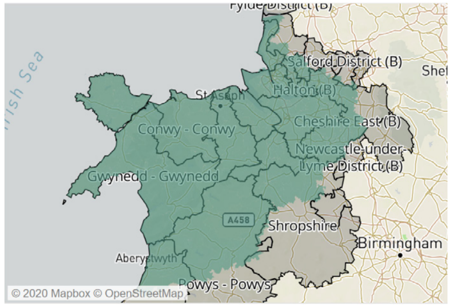


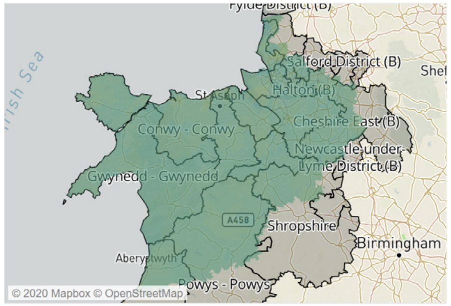
Figure 17 | Heat pump numbers by primary substation area

Scale range: 0 to >6,000

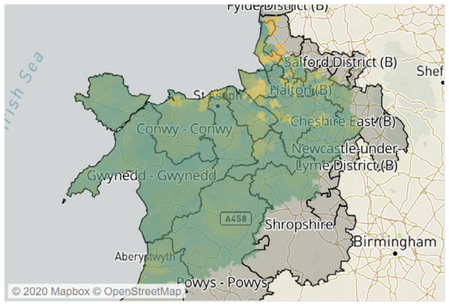
2030 – Low



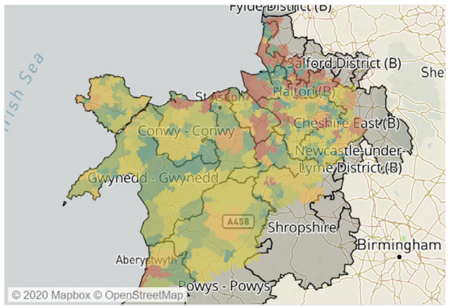
2050 – Low



2030 – High



2050 – High



6.4 Electricity Generation and Storage

This section sets out the forecasts for generation and storage. The main drivers are increased wind generation, solar PV generation, and storage, so we provide disaggregated forecasts for each.

6.4.1 Generation and storage overview

Understanding how electricity generation and storage could evolve on SP Manweb's network is the second key factor informing the need for more network capacity.

The volume of electricity generation connected to the distribution network in North Wales, Merseyside, Cheshire and North Shropshire out to 2050 will be affected by:

1. the overall requirement for more generation, i.e. how much additional generation capacity is required to supply the increase in demand.
2. 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). This is driven by generation technology, economics and government policy.

These two factors will determine the extent to which distributed generation and behind the meter generation may help to offset increases in demand (which would reduce the need for more network capacity), or may lead to greater power flows across the distribution network (which would increase the need for more network capacity).

Figure 18 shows how the total generation and storage capacity connected to the distribution network in North Wales, Merseyside, Cheshire and North Shropshire will vary for the four scenarios. There is a proposed generation hub in Mid Wales, of around 500MW, which has not been incorporated in our generation forecasts due to the current consenting position.

Figure 18 shows that our scenarios forecast the distributed generation and storage capacity in our SP Manweb region to double by 2030. By 2050, our scenarios indicate there could be as much as 2-4.5 times more generation and storage than today.

In the next 10 years, the generation and storage capacity on our network is likely to double, reaching 5.2GW.

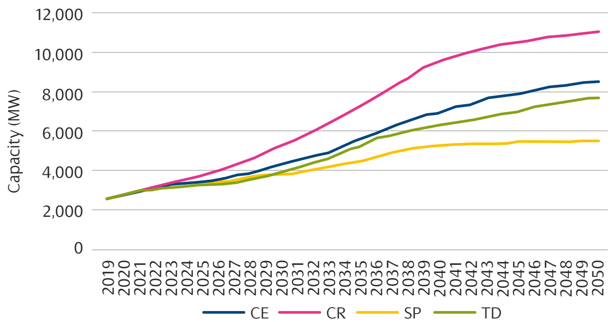


Figure 18 | Total installed generation and storage capacity

A significant increase in new generation capacity is expected in the next few years as known projects with connection requests come online. Beyond this, future growth is expected to be modest in the centralised scenarios but could more than triple the amount of small-scale generation in the two decentralised scenarios by 2030.

To better illustrate what is driving the changes in generation, Figure 19 shows a breakdown of the generation and storage forecasts from Figure 18 by technology type, for 2030 and 2050.

Figure 19 shows that significant growth is expected, particularly from renewable generation – the majority of the increase in capacity to 2030 is expected to come from wind, solar PV and storage. Given that wind and solar PV generation output is weather-dependent, it is unlikely to always occur at the same time as periods of high demand.[13] This means that the distribution network may need intervention to accommodate wind and solar PV generation capacity.

It also means that there may be greater export of power from the distribution network up onto the transmission network, and greater transfer of power across the transmission network, at times when generation output is high and demand is low.

Figure 18 and Figure 19 show increasing electricity generation for all scenarios out to 2050. These forecasts and trends are the total values for generation and storage capacity connected to the distribution network in North Wales, Merseyside, Cheshire and North Shropshire. However different regions will see different increases in generation, based on a range of factors. Figure 20 shows a geographically granular view on how the generation and storage capacity connected to the distribution network could change by 2030 and 2050 from current levels for the highest and lowest forecast scenarios. Figure 21 shows a similar representation, but only for domestic-scale and smaller-scale generation and storage capacity.

[13] This coincidence of generation and demand would have been beneficial for the network, as it tends to result in lower overall power flows and a lower requirement for network capacity.

Figure 19 | Breakdown of installed generation capacity by technology type

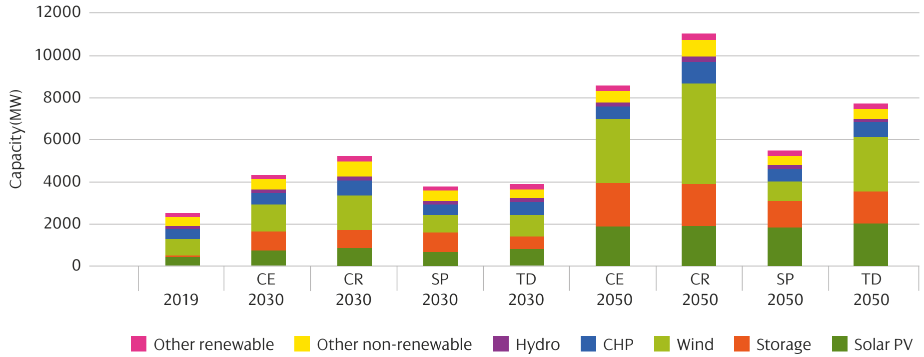


Figure 20 | Installed generation and storage capacity by GSP area

Scale range: 0MW to 2,210MW

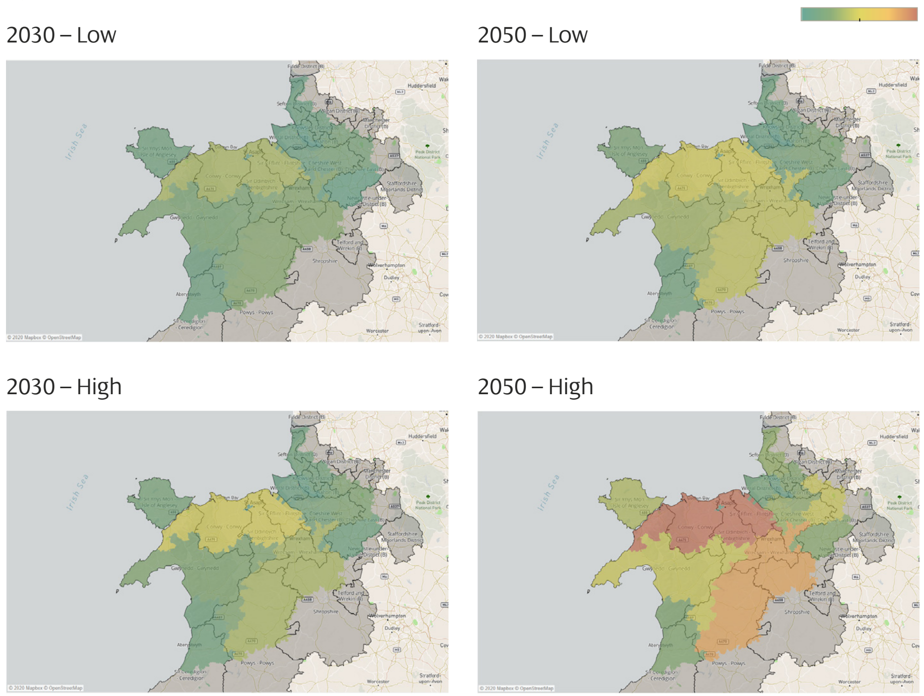
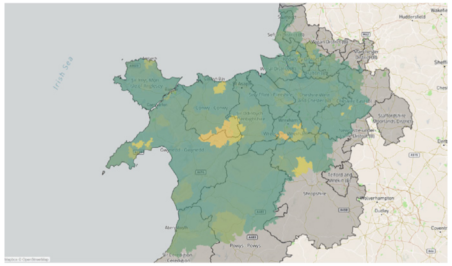


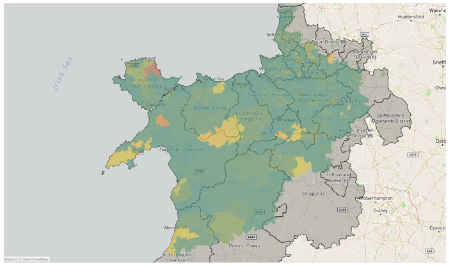
Figure 21 | Domestic-scale and smaller-scale installed generation and storage capacity by primary substation area

Scale range: 0MW to 15MW

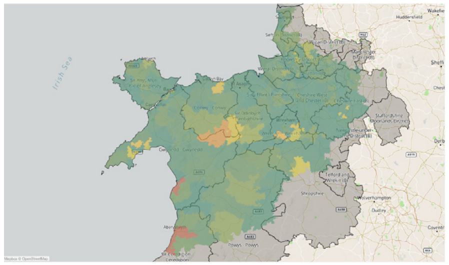
2030 – Low



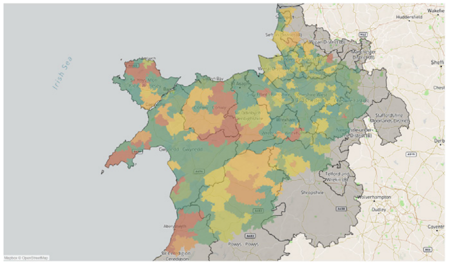
2050 – Low



2030 – High



2050 – High



Overall generation and storage trends:

1. All scenarios show a significant increase in generation and storage capacity. This means that the network will need intervention to facilitate decarbonisation.
2. Generation and storage can help reduce peak demand and deliver real benefits to consumers. This means that we should all be working to enable flexibility.
3. The increase in generation and storage is not geographically uniform – some areas of the network will be impacted earlier, and to a greater extent, than others.

6.4.2 Solar PV

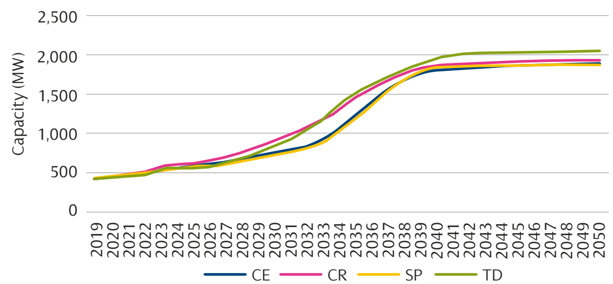
Over the past seven years, our distribution network has seen a moderate uptake of solar PV generation. This growth is likely to increase to facilitate further decarbonisation of electricity generation.

Figure 22 shows the forecast uptake of solar PV for the four scenarios. It shows future increases in solar PV capacity are significant across all scenarios, doubling by 2030 and potentially increasing five times from current levels by 2050. The increase in solar PV across all four scenarios is due to it being a low-cost and tried and tested technology, which has a lower visual and noise impact than other forms of renewable generation.

Unfortunately, the beneficial impact of solar PV offsetting peak demand on the network is likely to be limited, given that solar PV output does not currently coincide with the times of winter peak demand (as these occur in the hours of darkness).

Solar PV capacity can be split into two categories: small-scale building rooftop schemes, which are connected behind the meter, and larger-scale ground-mounted solar PV farms, which connect directly to the distribution network. Figure 23 shows a breakdown of the Figure 22 solar PV forecasts for these two categories, for 2030 and 2050.

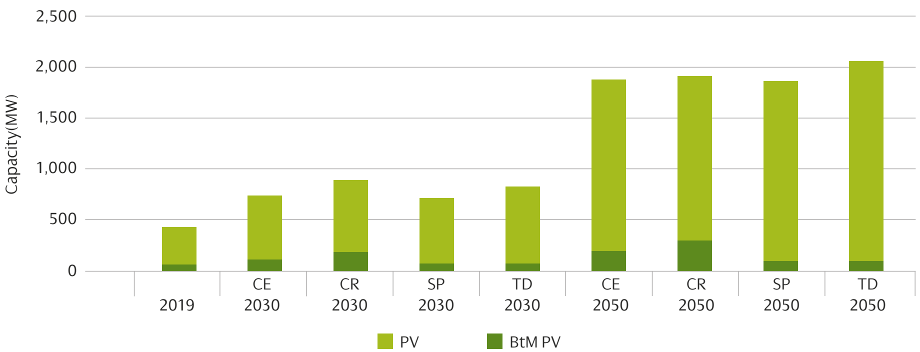
Figure 22 | Installed solar PV generation capacity



Solar PV generation could double by 2030.

Figure 23 shows that, for all scenarios, the main growth of solar PV is expected to come from larger-scale ground mounted solar PV. New capacity for behind the meter solar PV is expected to be focused in areas that have already had some uptake due to subsidy support from Feed-in-Tariffs. Larger-scale ground-mounted solar PV schemes are expected to be deployed in more rural areas, due to the additional land area needed.

Figure 23 | Distribution connected and behind the meter solar PV capacity



6.4.3 Wind

Over the last ten years, there has been steady growth in wind capacity on the SP Manweb network leading to circa 800MW of installed capacity. **Figure 24** shows the forecast uptake of wind generation for the four scenarios.

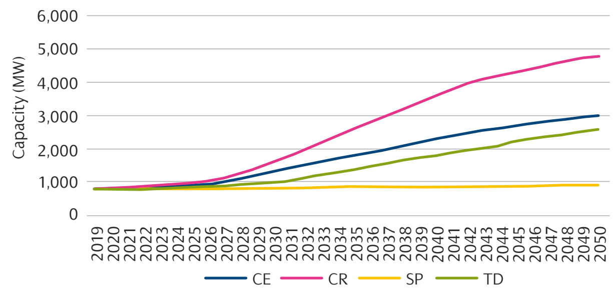
Figure 24 shows significant variance in the levels of wind generation across the four scenarios. Wind generation is a cost-effective proven technology, so the extent of new wind generation will likely depend on the onshore planning regime, government/policy support, and local support for individual schemes.

Any increase in distribution connected wind is expected to be sited in rural areas, taking advantage of more favourable wind conditions.

The beneficial impact of wind generation offsetting peak demand on the network could be limited, given that it is weather-dependent.

Wind generation could double by 2030.

Figure 24 | Installed wind generation capacity



6.4.4 Storage

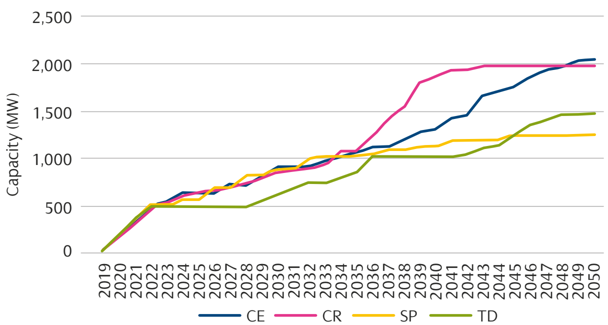
Electricity storage means any technology which can import, store and export electricity. It can range from large-scale pumped hydro schemes down to domestic-scale battery units. Electricity storage can help manage peak demand (by exporting to reduce local demand) and provide valuable system services (such as frequency response). As we move to a decarbonised system with renewable generation, storage is likely to play a valuable role in balancing that generation and ensuring system stability.

Figure 25 shows the forecast uptake of electricity storage for the four scenarios. Given the many different storage technologies and their evolving nature, we have not created individual forecasts for each technology.

Figure 25 shows significant growth in distribution connected storage capacity is expected through the 2020s and early 2030s. Beyond 2035, growth could be substantial in scenarios where there is more decentralised generation, in particular solar PV, that storage would help to manage.

Storage capacity could be over 14 times higher than today by 2030.

Figure 25 | Installed storage capacity



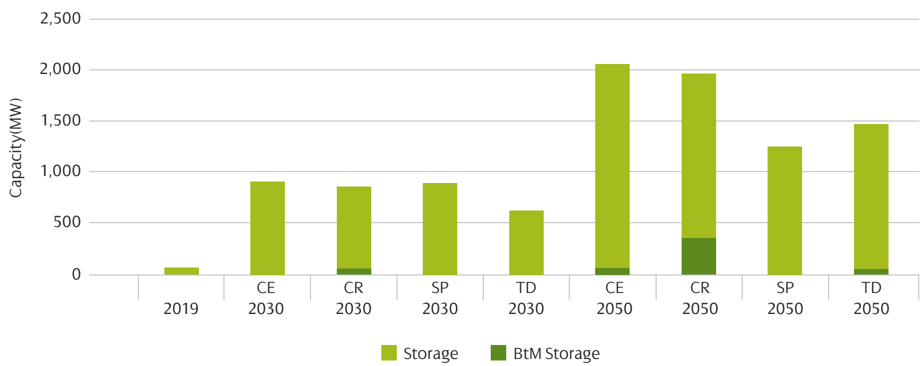
In the next five years there is likely to be more storage growth than all other generation technologies combined.

Distribution connected storage is assumed to be sited initially in areas with low network constraints (to allow services to be provided to the wider system). At different points in time, depending on scenario, the siting of storage then shifts to areas of high network constraint, as the value of providing distribution level constraint management services increases.

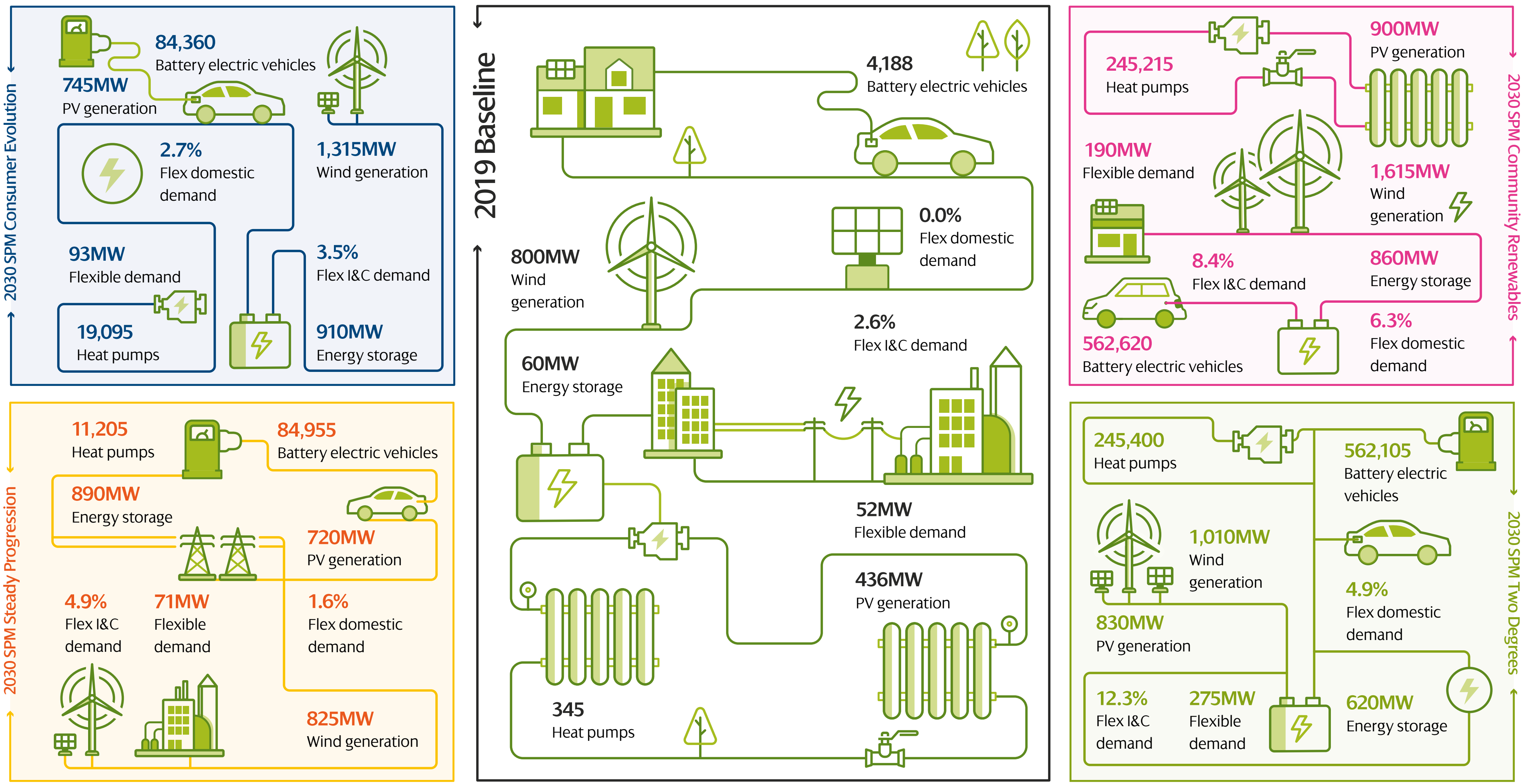
Storage capacity can be split into two categories: small-scale storage at individual properties, which are connected behind the meter, and larger-scale standalone storage, which connects directly to the distribution network. Behind the meter storage is assumed to be sited alongside rooftop solar PV installations. **Figure 26** shows a breakdown of the **Figure 25** storage forecasts for these two categories, for 2030 and 2050.

Figure 26 shows that, across all scenarios, the majority of storage growth is for standalone storage. It is worth noting that, the forecasts in **Figure 25** and **Figure 26** do not include the inherent storage capacity in electric vehicles. When plugged in, electric vehicles could be another widespread form of electricity storage – smart charging and vehicle to grid technologies would enable this capability.

Figure 26 | Distribution connected and behind the meter storage capacity



6.5 Key Figures – Changes from 2019 to 2030



7 Glossary

Behind the meter – means generation and storage which is connected within a domestic, commercial, or industrial building as part of that site's internal electricity system (e.g. rooftop solar PV panels on a domestic property). This is as opposed to a dedicated generation or storage site (e.g. a wind farm) which has no other major demands or processes within the same site.

Decarbonisation – the process to reduce the amount of carbon dioxide (CO_2) and other greenhouse gas emissions by introducing new low carbon alternatives and technologies. Much of the decarbonisation strategy is based on switching carbon energy vectors (e.g. petrol and diesel for transport, and natural gas and oil for heating) to electricity, and then using renewable generation to provide zero carbon electricity.

Decentralisation – this reflects the extent to which generation is sited closer to demand consumption (or is even undertaken by consumers themselves) via the use of smaller-scale technologies such as solar PV and local energy storage. A less decentralised system would be characterised by fewer, larger-scale generators sited further from where the electricity is ultimately consumed (demand); a more decentralised system would be characterised by more smaller-scale generators sited closer to demand.

Distributed generation – generation connected to the distribution network, as opposed to the transmission network.

Distribution network – in England and Wales this is the overhead lines, underground cables and other network infrastructure that operate at 132kV and below; in Scotland it is the infrastructure that operates at 33kV and below. The distribution network delivers electricity from the transmission network and distributed generation to end users (consumers/demand). Nearly all demand in the UK is connected to the distribution network; only very large demand users (e.g. the rail network) are connected to the transmission network. Nearly all medium-scale and smaller scale generation in the UK is connected to the distribution network; typically only large fossil fuel power stations, offshore generation, and large onshore generation are connected to the transmission network.

Flexibility – ability of a consumer or generator to change their operation (i.e. their generation/consumption levels) in response to an external signal. With the push towards the electrification of heat and transport, being able to flexibly utilise demand and generation will help minimise the amount of additional network capacity required, balance the system and provide system stability – these can all help reduce customer electricity bills.

Grid Supply Point (GSP) – the interface points between the transmission network and the distribution network.

MW – megawatt is a unit of power (not energy). It can describe both the amount of power that a demand user is consuming (e.g. "this town's peak demand has increased by 3MW due to an increase in electric vehicles and heat pumps"), and the amount of power that a generator is producing (e.g. "3MW of solar PV generation has been installed in this area").

Minimum demand – the point in the year, typically during the summer months, when our distribution network as a whole sees the lowest demand. It is an important study condition (along with peak demand) as a network with low demand can experience voltage control issues.

National Grid Electricity System Operator (ESO) – the company responsible for operating the GB transmission network.

Peak demand – the point in the year, typically during the winter months, when our distribution network as a whole sees the highest demand. It is an important study condition (along with minimum demand) as it places the greatest need on network capacity – our network must be sized to accommodate peak demand.

Primary substation – the interface points between the 33kV and 11kV networks.

SP Transmission (SPT) – the Transmission Network Owner for Central and Southern Scotland, owns the transmission network at 132kV, 275kV and 400kV.

SP Distribution (SPD) – the Distribution Network Operator for Central and Southern Scotland, owns the distribution network at 33kV, 11kV and LV into the home.

SP Manweb (SPM) – the Distribution Network Operator for Merseyside, Cheshire, North Shropshire and North Wales, owns the distribution network at 132kV, 33kV, 11kV and LV into the home.

Transmission Network – the high voltage electricity network used for the bulk transfer of electrical energy across large distances. The transmission network takes electricity from large generators (e.g. coal, gas, nuclear and offshore wind) to supply large industrial customers and the distribution network.

Vehicle to grid – this is where plug-in electric vehicles, such as battery electric vehicles, plug-in hybrids or hydrogen fuel cell electric vehicles, can flexibly alter their demand consumption, either by reducing their charging rate or exporting their stored electricity back onto the network. Like other flexibility, this can help reduce the need for new network capacity, balance the system and provide system stability – these can all help reduce customer electricity bills.

Notes

Notes

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