

2. Forecasting and Data

2.1. Forecasting for the ED1 business plan (2015-2023)

In our ED1 business plans we used national forecasts to tailor scenarios for our networks. We worked with the Centre for Sustainable Energy (CSE) to deliver the “Who’s on our wires” report. This added socio economic factors to the national growth forecasts for all Low Carbon Technologies. For example, the numbers of electric vehicles are strongly predicted to grow in areas where the social demographic suits early adoption.

This means that it is highly likely that Low Carbon Technologies (LCTs) will be clustered closely together leading to a compound effect on specific parts of the network. This work led to our targeted uprating of assets when other works take place over around 7% of our network, in locations where we could be confident of load growth.

The current population of EVs within our licence areas is matching our ED1 business plans – with EV adoption increasing at the current rate, we expect 217,000 chargers to be connected to our network by 2023.

However, to meet the requirements of the Government’s 2040 deadline for the cessation of ICE vehicles and the 70% uptake level of EV adoption given in the Government’s Road to Zero 2018 we expect that this figure could rise. Applying the National Grid Future Energy Scenario “Community Renewables” to our network forecasts could see up to 3,064,000 EVs by the end of 2030.

2.2. Developing Distribution Future Energy Scenarios (DFES)

Since 2016 we have been producing Distribution Future Energy Scenarios (DFES) at a licence area level which predict the likely impact of EVs along with other new technologies.

Our scenarios use a bottom up approach to provide future energy scenarios, at Electricity Supply Area (ESA) level, for the potential growth of distributed generation, electricity demand growth and electricity storage. These are then used to identify future constraints on the distribution network and develop strategic investment options to economically resolve those constraints, when triggered.

The analysis undertaken for each technology in the DFES involves the following four stages:

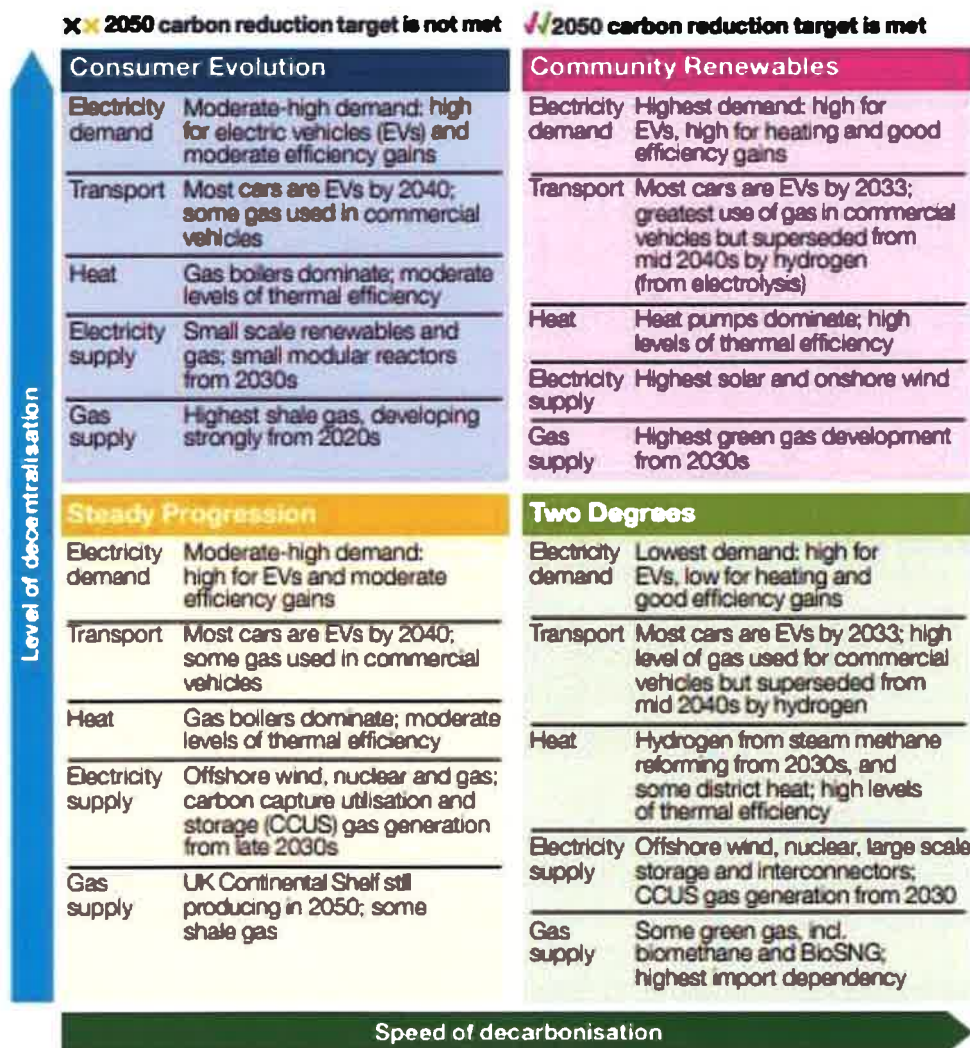
1. A baseline assessment. Technology baselines are calculated from WPD’s network connection database. This information is then reconciled with other market intelligence and external databases. In addition, further desktop research is undertaken to address inconsistencies.
2. A pipeline assessment. For technologies with significant lead times WPD’s network connection agreement database is reconciled with the BEIS planning database and market research is undertaken. This allows an assessment of which commercial projects in the pipeline may go ahead and in what timescale. Domestic

scale and demand technologies do not have an individual pipeline, but local council economic plans are reviewed to derive volumes and locations.

3. Resource assessment. Locational data from a wide range of data sources and GIS analysis is used to understand the geographical distribution, local attributes, constraints and potential for technologies to develop within the licence area and each ESA.

4. A scenario projection to 2032. The scenarios are based on National Grid's Future Energy Scenarios (FES) and interpreted for specific local resources, constraints and market conditions. Analysis of current market reports and the findings from a local consultation event is combined with interviews from developers, investors and other stakeholders.

In our latest report we have aligned our scenarios with National Grid's 2018 FES, which has the following four scenarios:



2.3. Electric Vehicle Growth Factors

National and local legislation will be key drivers of future electric vehicle growth in the licence area. The UK government has announced a ban on new petrol and

diesel sales in 2040. Derby and Leicester have both raised the potential for congestion charging.

From a consumer perspective, the key hurdle will be price. Lower running costs are not yet balancing out the up-front costs, even with the current purchase subsidy, unless drivers have a high mileage, such as use for fleet applications. There is limited evidence relating to the actual whole life savings or resale value. Increased investment and competition is needed between manufacturers to drive down costs.

Despite the current barriers, the FES 2018 presents a much higher growth projection for electric vehicles than FES 2017, reflecting the UK government's proposed ban on new diesel and petrol vehicles in 2040.

The two highest scenarios in FES 2018 (Two Degrees and Community Renewables) show a similar growth profile, with the UK electric car fleet reaching around 15 million units by 2032 rising to over 38 million by 2038.

To provide a wider profile for network analysis in this study we have amended the Two Degrees scenario to show a more explosive growth profile which sees growth accelerating ahead of the FES 2018 and then levelling by 2050. We would also assume that EV uptake in the licence area stays ahead of the national average uptake of EVs in the short and medium term but will return to national average by the end of the scenario period. This assumption reflects key factors driving early adoption such as; affluence levels, off-street parking and second car ownership along with emission reduction initiatives in and around urban centres.

2.4. Investment allocated within ED1

Within our ED1 submission we allocated £112m for socialised reinforcement attributable to LCTs. Of this over £58m was directly related to EV charging.

2.5. Forecasting local growth and pinpointing upgrades

In addition to our high level DFES work, we are working with EA technology to deliver a tool which will assess the impact on our local networks. The tool was originally developed as part of our Electric Nation project. In the project it was used to show where networks were becoming constrained as a result of local clusters of EVs.

The tool will be developed to help highlight where proactive reinforcement can help prepare the local networks for LCT connections and specifically EV connections. We will use this tool to support our business plan submissions for network upgrades.

2.6. Forecasting ED2 and informing specific ED1 plans

Our DFES is being used to target flexible solutions where they offer better value than conventional reinforcement. Load estimates will consider all demand growth but this will always include an element of EV growth. For higher voltage networks this educates and directs our reinforcement plans being considered in the next few years. For our local networks the scenarios can help refine the LCT hotspots identified by our CSE work.

3. Planning and Capacity Availability

3.1. Our expectation of EV charger installations

The size and type of charger varies with application. Smaller size chargers are expected to be seen in domestic situations where an overnight charge is likely. They may also form part of the street side car charging provision. Larger chargers will be seen at public locations such as service stations and car parks where a faster charge is required, they will also be seen where hubs of vehicles charge such as taxis.

Chargers below 7kW are likely to be accommodated on existing house services but larger installations will often require a three phase service or other upgrades.

Charge Point type and power output	Likely installation location	Specific connection requirements	Network considerations	Likely charge time for a 35kWh charge
Slow up to 3kW	Domestic	None – connects via household plug/socket	None	12 hours
Fast 3.7kW	Domestic or street side	Dedicated household circuit or on street equivalent	In some cases limited local reinforcement is required	9 hours
Fast 7kW	Domestic or street side	Dedicated household circuit or on street equivalent	Likely upgrade to service cable and local mains	5 hours
Fast 22kW	Street side or public charging location	Three phase dedicated supply point	Requirement for three phase connection and likely local mains upgrade	1.5 hours
Rapid 43kW	Public charging location	Three phase dedicated supply point	Requirement for three phase connection and likely local mains and transformer upgrade	45 minutes
Super 130kW or multiple rapid chargers	Public charging location	Supply point from dedicated transformer	In most cases a new transformer will be established	15 minutes

3.2. Estimating Connection cost and timescale

The cost and complexity of the electricity network required to support new chargers will vary with size. At a domestic level only minimal works will be required to accommodate chargers but for larger installations and hubs of multiple chargers new transformers and substations are likely. The cost and works timescale will vary with the complexity of the works as detailed below.

Charge Point type and power output	Likely installation location	Approximate connection lead-time	Network considerations	Approximate connection cost
Slow up to 3kW	Domestic	Immediate	None	None
Fast 3.7kW	Domestic or street side	Immediate in most cases	Usually none	Usually none
Fast 7kW	Domestic or street side	4 to 8 weeks	Likely upgrade to service cable and local mains	£1,000 to £3,000
Fast 22kW	Street side or public charging location	8 to 12 weeks	Streetworks and permissions	£1,000 to £3,000
Rapid 43kW	Public charging location	8 to 12 weeks	Streetworks and permissions	£3,500 to £10,000
Super 130kW or multiple rapid chargers	Public charging location	16 weeks	Streetworks, permissions and cost of land for transformer	£70,000 to £120,000

3.3. Simplifying the application processes

We have adopted the ENA application form for both EV and Heat Pump applications. This form helps customers by offering consistency across all DNOs.

3.4. Making use of existing local capacity

Our network of transformers which supply local networks from our 11kV backbone network are sized to accommodate the demands of the area they serve. We have a limited range of sizes available so often there is an inherent level of additional capacity present for future load growth. We are planning to make use of this capacity as a tool to support the early adoption of Electric Vehicles and other LCTs.

This capacity is likely to be available in urban areas with a dense spread of ground mounted transformers. In rural areas where overhead networks are employed the opportunities are somewhat less.

We predict that the majority of our larger local transformers will be able to accommodate one 35kWh charge every five days for each of the customers connected to it. This provides a charged range of around 150 miles in many EVs and it is likely that this will support the demands of home connected EV charging. The Department of Transport National Travel Survey 2017 indicated that the average annual mileage for all cars is 7,800 miles. This figure has been dropping since the early 2000s.

A 500kVA transformer is capable of supplying 4.3 million kWhs of energy every year assuming it is fully loaded. Where a unit is operating at 70% of its overall capacity this provides around 1.3 million kWhs of available energy, assuming that it is not required at times of the day when the load profile of the transformer makes it fully loaded. This capacity could support over 37,000 charging events at 35kWh. If managed to optimise the delivery of these events, they could provide one charge every five days for each customer connected.

3.5. Planning and Design Changes

When we design and extend our network we expect assets to remain in service for around 50 years. This means that we always look to predict future changes and assess how we can reasonably accommodate them in our plans and designs. Our ED1 plans looked at changes that we could make to support the adoption of LCTs.

On our cable networks, the cost of excavation and reinstatement works are a large proportion of the overall costs so rather than potentially needing to overlay cables as LCT take-up increases, we decided to increase the minimum cable size for all our new installations. Similarly when working at substations, the plant cost of transformers meant that we could increase our minimum transformer sizes with only a marginal increase in installed cost. Both of these measures, to a degree, future-proof new networks at minimal increase in cost.

3.6. Technical Changes related to Electric Vehicles

To permit the connection of electric vehicle charge points there are typically three concerns to overcome, these are thermal capacity, earthing arrangements and harmonic emissions. They are detailed below:

3.6.1. Thermal Capacity

To assist with the creation of thermal capacity within the low voltage network, we have increased the minimum size of the low voltage mains cable to have a cross sectional area of 185mm², increased the minimum size of service cables to 25mm² Copper or 35mm² Aluminum, the smallest rated ground mounted transformer to 500kVA and the smallest rated pole mounted transformer to 25kVA single phase.

3.6.2. Earthing

The earthing considerations for the connection of electric vehicle charge points are firstly the type of earthing arrangement (PME, SNE or TT) and secondly the required segregation between these different earthing types. The requirements of the Code of Practice for the installation of EV charging equipment makes the use of protective multiple earthing (PME) prohibitive and steers installations towards a TT setup. However the IET Wiring Regulations (Guidance note 7) requires segregation of a minimum of 10m between the PME and TT earthing systems. We understand that this requirement will restrict installations in the street and therefore we have recalculated the requirement using modelling specifically for a street side application. As a result we can reduce the distance so that a balanced three phase demand utilising a TT earthing system will require segregation from the WPD earthing system by a minimum of 0.3m and a single phase or unbalanced connection would require a segregation of 3.6m.

3.6.3. Power Quality

Electric Vehicle chargers use power electronics which can cause interference and damage to the electricity network. As a result of our EV Emissions project we have assessed the effect of this interference and have concluded that it is insignificant for smaller size domestic type chargers up to 32A capacity. Our planning advice for these charges is that the effect can be discounted and treated in a standardised way when designing connections, making them cheaper and quicker for customers.

The data has also been used to determine how many EVs can be connected onto a circuit subject to the impedance of the main conductor. As a result of the innovation project we have also decreased the prescribed maximum resistance of WPD mains conductors to a value of 190 m Ω .

4. Providing information to Customers

4.1. Guidance and Advice Documents published

We have already developed a guidance document for local authorities who are considering public and street side charging connections. Our "Getting Electric Vehicles Moving" guide provides details including information on the different kinds of chargers available and how charging points can be connected quickly and efficiently to our network.

<https://www.westernpower.co.uk/downloads/3220>

Our "DNO engagement for local authorities guide" provides information specifically tailored to local authority customers delivering public charging points. The guide covers some of the technical considerations related to public connections as well as offering advice on how to make applications and discuss plans with us.

<https://www.westernpower.co.uk/downloads/15766>

4.2. Guidance and Advice Documents planned

During 2019 we plan to extend our range of guides to include advice for fuel station operators and fleet users with depot locations. We will continue to review the number and content of our guides to help customers when they are considering EV options for their homes or businesses.

4.3. Capacity Indication for customers

We already offer a capacity map on our website which shows customers the level of generation capacity and demand capacity at our major substations. We plan to extend this map to show our local substations and the local scope for connection of electric vehicles.

At this local level there will always be specific considerations which can affect our ability to connect individual charge points, but this map will provide a generic view of the capacity which is available in local streets.

4.4. Connections Surgeries

Local authority customers have the opportunity to request one to one connection surgeries with our teams. At a local level they will be able to discuss plans for EV charging and how the electricity network can be adapted and uprated to accommodate future plans.

5. Stakeholder Engagement

5.1. Our Approach to Stakeholder Engagement

Our approach to engagement varies depending on the requirements of individual stakeholders. In some cases a company level strategic engagement is needed and in other cases a more local engagement is required.

We provide our front end service using locally based teams that are responsible for their own networks and the local customers connected to them. At this level a more informal engagement is the most efficient solution and complements the more formal strategic stakeholder engagement.

5.2. Business Plan Strategic Stakeholder Engagement

We have an excellent track record of stakeholder engagement across the range of topics contained within our business plans. Since 2010 they have included elements of LCT readiness and EV charging. In the early years the focus was on pragmatic steps we could take to support what was a small population of vehicles.

Our engagement sessions helped form our plans and have also informed innovation projects related to EV charging.

In 2019 our strategic stakeholder engagement will include a specific topic on EV readiness.

5.3. Strategic Engagement with local authorities

Local Authorities are taking the lead on EV charging in public areas such as car parks and park & ride sites. In 2018 we developed an EV guide for local authorities to help them with their plans.

In November 2018 we became the first DNO (Distribution Network Operator) to hold a bespoke stakeholder engagement event for local authorities. Across two events in Bristol and Birmingham we were able to share our plans with 186 local authority representatives. As a result of what we have learnt from these sessions we have been able to update our EV guide.

With the demand for EV charging at hub locations such as car parks, we will also develop trials to show how we can efficiently connect multiple EV chargers in these locations.

EV charging formed one of the themes of our more general stakeholder engagement sessions in January and February 2019.

5.4. Local Engagement with local authorities

Our strategic local authority engagement highlighted a requirement for more local engagement. Local authority customers now have the opportunity to request one to one connection surgeries with our teams. At a local level they will be able to discuss plans for EV charging and how the electricity network can be adapted and uprated to accommodate future plans.

5.5. Engagement for Fuel Station Operators

We have engaged with the Petrol Retailers Association to understand how their members are approaching the change to electricity as a road fuel. The approach is likely to vary between Motorway Service operators and A road or local road fuel filling stations.

At motorway services we expect to see hubs of four or five fast charge installations. On local forecourts we expect to see a single charger per site as the space available for additional infrastructure is more limited, especially outside of the zones controlled by liquid fuel refuelling regulations.

Shell UK already work with us as a provider of electrical insulating oils. We have used this relationship to extend our knowledge of the future plans for fuel station operators. Shell is also a charge point installer and energy supplier so has helped us develop our plans.

5.6. Engagement for housing design

Our plans to increase our house service cable designs have been included in reports compiled by the Renewable Energy Association as a part of their works to lobby government and planners. We were pleased to share stakeholder engagement with them on this subject and are continuing discussions with relevant government departments.

Our Superfast Electricity project was developed in conjunction with Pobl Housing Association and Sero Homes, an innovative Welsh based provider of Energy Positive homes.

5.7. Engagement with Vehicle Manufacturers and Transport Operators

We will use links that we have developed within our own transport fleet department to engage with manufacturers. We are already working with some of our suppliers to assess how the EV market will develop into commercial vehicles.

Our Fleet department also engages with relevant transport trade bodies to help develop our future views for wider road transport.

We have discussed the X Storage system with Nissan to understand their plans in the area of EV charging and home generation or battery storage.

5.8. Engagement with Depot Based Fleet Operators

Fleet operators who return their vehicles to a depot overnight can offer us specific benefits by charging their fleet at times which avoid our traditional evening peak of demand. Our engagement in this area so far has been with bus operators; firstly with Arriva as part of the Electric Boulevard project as an early demonstrator. This year Cardiff Bus is deploying electric buses and will establish a charging hub at one of their depots. We are working with them to support this change.

5.9. Engagement with UK Government

WPD and various other parties are involved with OLEV and BEIS in their Stakeholder engagement, this engagement has been brought about by the change to the Building Performance Regulations which the EU modified in April 2018 and will become mandatory in April 2020. WPD are ensuring that the changes to the building regulations for the introduction of EV chargers to new building should also accommodate other LCTs and provide a holistic approach.

WPD is also in discussion with the National Infrastructure Commission, who are undertaking a study on the role of DNOs with respect to role of the utility and transport infrastructure provision for new build housing.

We are also working with Catapult Energy Systems, Low Carbon Vehicle Partnership and Innovate UK for the Electric Vehicle Energy Taskforce. This has been formed at the request of Government to make suggestions to Government and industry to ensure that the GB energy system is ready for and able to facilitate and exploit the mass take-up of electric vehicles.

We have engaged with BSI and BEIS on Smart Device Standards which will allow products to communicate with each other and be controlled to manage network demands.

We have also held "brown bag" sessions for civil servants and public sector workers to share our knowledge on EVs specifically and the electricity network in general.

5.10. Engagement with Welsh Government

Our projects to demonstrate Superfast Electricity and On Street Charging have all been developed with the help of the Welsh Government. We were able to engage early with the Welsh Government and have followed their plans for decarbonisation alongside UK Government plans. The Welsh Government is also trialling the use of Hydrogen as a road fuel and we have used learning from this project to develop a balanced view of future requirements.

5.11. Engagement with Go Ultra Low Cities (GULC)

Three of the four Go Ultra Low cities, Nottinghamshire & Derby, Milton Keynes and Bristol, are within our operating area. Between them they have plans to install 410 charge points, many of which will be high capacity rapid chargers. They are all supporting free or discounted parking for EVs which is likely to increase early adoption.

Using many of the specific delivery plans listed above, we will work with each city at a local level to help them deliver their targets.

5.12. Engagement with Local Enterprise Partnerships (LEPs) and Electricity Supply Areas (ESAs)

Ensuring our future network investment plans are aligned to developments being planned at a local level is a key priority for us as a distribution business. Our Electricity Supply Areas are local areas which generally match our higher level network feeding areas. We engage with customers in a ESA to build our plans for high level network growth.

Every 6 months, under our Strategic Investment Options work, we undertake a workshop led consultation with local stakeholders from a licence area to understand their pipeline of projects and ensure we are capturing the correct data to feed into our investment strategies. We then build a bottom up vision of demand, generation and storage growth by absorbing the locally published plans and other market intelligence to enable us to study the network under future growth scenarios. This includes specific distribution data on BEV and PHEV numbers in our area.

The data that we accrue is also shared back with Local Enterprise Partnerships, local authorities and other stakeholders and has been used to inform local energy plans. To date we have shared data for around 50% of our network area and are continuing to make this information available as we update it.

5.13. Stakeholder Engagement Plans for 2019

During 2019 we expect to complete more specialist stakeholder engagement with groups related to Electric Vehicles. Our first engagement in April is a workshop to consider EV Charging Flexibility Services.

We will continue to engage with Government through BEIS and OLEV.

As our plans for Superfast Electricity develop we will engage with house builders through the Renewable Energy Association.