DSO Development

ELECTRIC VEHICLES STRATEGY

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WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

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1 Introduction

1.1 About the document

This document sets out how Western Power Distribution will ensure that drivers of electric vehicles are able to charge their vehicles in the manner convenient to them.

It describes research, development and deployment activities carried out during the current and previous electricity distribution price control periods. It also explains the rationale behind current innovation projects and business initiatives. Further, it describes future activities including the transition of early-stage solutions into business as usual practice.

This document also documents our vision for electric vehicle recharging solutions for a range of customer types. It provides detail on the roadmap to achieve this vision.

Following the ENA/Ofgem Stakeholder Engagement events held in February, we are also responding to Ofgem's request. They have asked all DNOs to publish how they are preparing for the potential rollout of EVs. These plans must include time-bound commitments to address the needs and issues of EV stakeholders that are identified at the EV meeting

Our preparations for each specific customer group are listed in Section 4 of this document and draw upon our own stakeholder engagement and that undertaken nationally. In Section 6 we also detail our time-bound commitments in the short term to accelerate readiness for the rollout of EVs.

1.2 High Level Government Objectives

Electric Vehicles (EVs) are becoming more commonplace on our roads. The trend towards them is set to increase.

The Government's "The Carbon Plan" (2011) set out the UK's objectives to reduce carbon emissions, with an 80% reduction achieved by 2050. This will be achieved through the decarbonisation of heating and transport and we need to take action to support this transition of vehicle power from carbon sources to electricity. Our electricity networks need to be ready to accept this additional demand. We build networks with a 50 year asset life so will take steps now to ensure we build the right network for foreseeable future demands.

The requirements of The Carbon Plan have been strengthened with targets to improve air quality and reduce Nitrogen Dioxide levels. These targets will all support the transition to electric vehicles.

The Government published Driving the Future in 2013 to "ensure almost every car and van is a zero emission vehicle by 2050". In July 2017 the Government announced that "it will end the sale of all new conventional petrol and diesel cars and vans by 2040". In May 2018 the Prime Minister announced a further target for 2040, that all new cars and vans should be "effectively zero emission" and in July 2018 the Road to Zero Strategy set an aspiration for "at least 50%, and as many as 70%, of new car sales and up to 40% of new van sales being ultra-low emission by 2030".
Alongside the sales targets, the Government has set a goal for the UK to be "a world leader in the development, manufacture and use of zero emission vehicles… [and] in the design, development and manufacture of batteries" in the Automotive Sector.

2019 has brought the first electric vehicle as a "What Car" Car of the Year. The Kia e-Niro took this award and What Car describe it as the first sensibly priced electric car that can fit into most people's lives. It provides a substantially longer range than almost all rivals without costing substantially more. We consider this to be an indicator to a future when there is price parity between electric and Internal Combustion Engine (ICE) vehicles. We anticipate it to become a reality in 2021 or 2022 and will create a step change in ownership models for car buyers.

1.3 Our approach to facilitate EV charging

As an electricity system operator our approach is to ensure that a suitable network exists for all charging requirements in all situations. This has many factors as charging requirements vary dependent on the type of vehicle and the owner's access to either their own or public charging infrastructure. Only 60% of car users have access to an off-street parking location which is likely to be suitable for charging.

In one sense the actual charging infrastructure is of less concern to us than our ability to provide the adequate and safe electricity connection which serves it. Our plans will vary depending on the application and we detail various different options in this section.

The principle is simple, the charging infrastructure requires higher volumes of energy and it is our job to provide the conduit for this energy.

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.

We also expect that our backbone 33kV network and transformers will be able to accommodate this level of charge point activity.

As we focus in to the specific cables which supply local streets or to the service cables which feed individual properties, there is more chance of the network becoming constrained. We are already installing larger cable assets from new and have identified areas where the proactive uprating of cable networks is appropriate.

1.4 Flexibility and Charging

We expect that flexibility will provide a key role in delivering EV charging. This is likely to provide solutions for many customer types, from domestic users to fleet users who return their vehicles to a depot overnight.

Domestic users will be able to take advantage of time of use tariffs that we expect electricity suppliers to offer in conjunction with Smart Meters. With their vehicles at home when not in use, they will be able to use managed charging to charge their vehicle at times when price signals show it to be beneficial for the wider electricity network.

Fleet users with depots are likely to make use of overnight charging to recharge their vehicles for the next working day. We expect a depot charging facility to require a larger electricity supply similar to a factory. This could cause constraint on some of our network at peak times if connected conventionally. However, we expect to have the opportunity to offer flexible connection solutions to allow charging at off-peak times without network reinforcement. This could make connections quicker and cheaper for customers.

1.5 Existing Charge Points and Capacity

We already have experience of installing charge points on our network to support the early adopters of Electric Vehicles. The table below shows the number and capacity of chargers as reported to Ofgem as part of our annual returns.

Our numbers of Fast Chargers are relatively high due to the reporting split used by Ofgem. Most of the newer domestic chargers are 23 Amp units and therefore are reported in the Fast Charge category (Total number as at March 2018).

	Number	Capacity
Slow Charge (up to 16 Amps)	2,072	7,500 kVA
Fast Charge (over 16 Amps)	4,996	39,300 kVA

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:

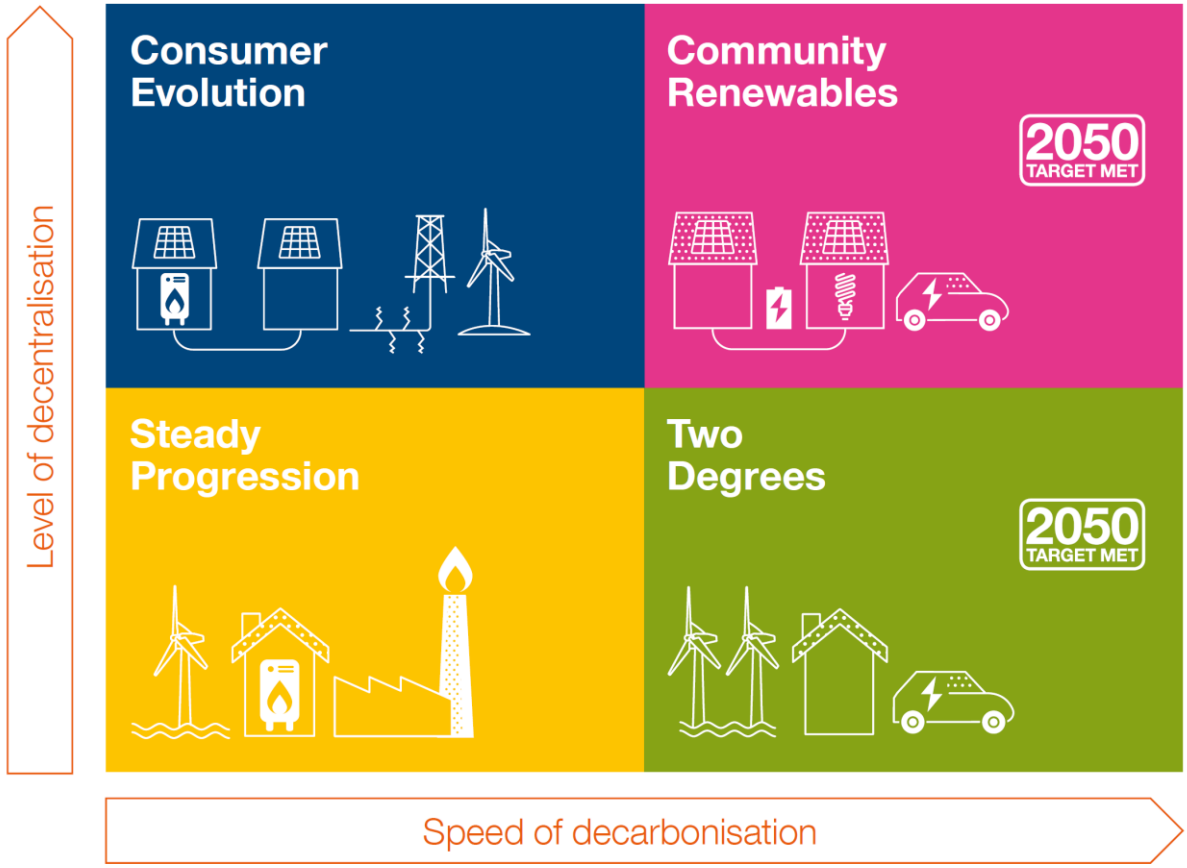
1. A baseline assessment. Technology baselines are calculated from WPD's network connection database. This information is then reconciled with other market intelligence and external databases. In addition, further desktop research is undertaken to address inconsistencies.

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 mΩ.

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.

1.2. 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.

1.3. 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.

5.8 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.

5.9 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.

5.10 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.

5.11 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.

6 Plans to support Electric Vehicle Charging

6.1 Our approach

An electric vehicle uses, on average, the same volume of electricity as a domestic house. As a network operator, we have a wealth of experience in designing housing networks and recognise the need to evolve our design methodologies to include new use cases. We will use this experience to ensure that electric vehicle charging can be accommodated in the most efficient and economical way.

Where existing network architecture is not best suited to permit electric vehicle charging we will take steps to mitigate this and, if upgrades are required, use innovative solutions to allow faster and efficient connections.

When we build new networks we will design them to be ready for the future demands that LCTs will place upon them.

6.2 Releasing existing network capacity

Our low voltage network already includes a volume of available capacity. When we establish local transformers for new developments we choose between three pre-set transformer capacities. This means that there is often capacity available between the designed demand of the network and the size of transformer which feeds it.

We predict that the majority of our larger local transformers will be able to accommodate a 35kWh charge every six 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.

We also expect that our backbone 33kV network and transformers will be able to accommodate this level of charge point activity.

We will develop a heat map of capacity at each of our local transformers. This will show which areas can offer capacity and where constraints are likely. We expect these early constraint signals to help us develop flexibility solutions which can be taken up by aggregators or signalled to customers via smart meters or time of use tariffs.

6.3 Motorway Services and Major Road Filling Stations

Through the Road to Zero Strategy and the Automated and Electric Vehicles Act 2018, there is a requirement for large fuel retailers and service area operators to provide public charging points.

Motorway Services tend to be individual developments along the motorway network or relatively large installations at motorway junctions and interchanges. In most cases these installations are supplied by bespoke high voltage connections. Where the demands of the Services increase with planned charging installations we will work with operators to enhance their main electricity supply.

Major Road Filling Stations can be located in more urban locations. They can be supplied by our local low voltage mains. As these increase their demands we will uprate low voltage mains as required. We have already established policies that allow a second point of supply to be made available on forecourts to support the charging infrastructure.

In some cases the number of charging points may mean that a substation needs to be provided at the forecourt. We are working on innovative methods of providing this network capacity for filling stations, using our Hub Charging and EV Filling Stations projects.

6.4 New Homes

The modification of Building Performance Regulations brings consultation on requirements for new homes. We have already seen an interest from some developers and local authorities to add a readiness for future charging requirements.

We already design and install mains networks which include a level of diversity, which allows for the fact that all customers do not use all of their installed demand at the same time. This means that our mains networks are able to flex to the demands placed on them and only require reinforcement when a proportion of customers have increased their demands.

The service cable, which runs from the street to an individual property, cannot make use of this diversity as it needs to provide the whole supply for that specific customer. We have already identified that increased LCT demands could require larger capacity service cables and are trialling these in our Superfast Electricity project.

We do not want today's purchasers of new properties to be faced with service upgrades in the future because we did not think ahead.

6.5 Existing Homes

Our existing networks were designed for the electricity usage assumptions at the time of installation which may have been lower than our current standards. Whilst most new homes connected from the early 1990s will have a service provision which can accommodate a normal domestic demand and the new demand of a smaller car charger, large chargers and older installations will need to be assessed.

We appreciate that the capacity of a house service is the last thing on a customer's mind when they choose an electric vehicle so are working to make this assessment and acceptance as simple as possible.

Our self-assessment project will allow charge installers a simple way of identifying the capacity of a service cable; the project will create an application which can be used across the UK and for any DNO network.

Where an existing service cable is not adequate for the requirements of an EV charger, our retro-fit Superfast Electricity project will demonstrate how this can be achieved with minimal inconvenience to individual customers.

6.6 On Street Charging

As approximately 40% of all vehicles on the UK roads don't park in an off-street location WPD are using the Road to Zero Strategy requirements to give Local Councils the ability to provide new street lighting installations or bespoke EV charging installations to their streets. This requirement will change the way WPD design connections for streetlights, which have historically been sized and connected for the relatively low demand of a single lamp head. To prepare the infrastructure required for charging we are expecting to provide bespoke street lighting mains cables in new streets. This is being developed through our On Street Charging Solutions project.

For established networks the solution will vary depending on the existing mains infrastructure. In some cases uprated services can be made available to streetlights but in other cases a more widespread scheme to uprate mains will be required. In order that we undertake these uprating works in a logical and efficient manner, we are developing triggers which will help us identify reinforcement requirements.

6.7 Depot Based Fleet Users

Where a fleet user returns their vehicles to a depot location we expect them to require a relatively large electricity supply to support their charge requirements. The connections we offer are likely to be similar in design to those for larger commercial buildings or factories, either with on-site transformers or taken at HV.

With the majority of charging for these customers taking place overnight at times of likely low demand for our network, we will offer flexible solutions such as Alternative Connections to these customers to make most efficient use of our network.

6.8 Workplace and Off Street Charging

We expect charging points to be established at workplaces and other communal locations. These may be at park and ride sites, supermarkets and retail parks. We also expect that hotels and other leisure locations may also establish charging points.

Our approach will be a mixture of the approach for motorway services and more urban fuel stations. Where the existing supply to the location is capable of supporting the additional load we will make use of this network. Where an upgrade is required we will either reinforce the local low voltage network or add additional high voltage networks based on local conditions.

We also expect third party charging sites to be developed at car parking locations. Our Hub Charging project will look at how we accommodate this demand with bespoke load centres which can be established directly in the car park areas.

6.9 Vehicle to Grid (V2G)

As part of our Electric Nation project we conducted a mini V2G trial. The flexibility which is potentially available is restricted to specific models of car at present. We are monitoring developments in this area. We are also involved in the V2GB Innovate UK project. We also helped connect the first domestic V2G charger earlier in the year with Ovo following existing industry practices.

The xStorage system provided by Nissan brings together local generation, storage and use of electricity. It uses batteries at the home and in the vehicle. Nissan has a holistic view of a better connected home environment and the electricity network will need to support this change. The system has features, such as the ability to charge or discharge batteries, which could be of use to us when managing networks which are nearing their capacity.

WPD are in discussion with an airport and other partners with a view to providing a solution to utilising the potential available to the airport to offer via the services of an aggregator frequency response to National Grid.

6.10 Smart Charging

WPD working with Pobl the Welsh Housing Association and Sero Homes on the Tonyrefail project, where all the new homes will be fitted with three phase cables alongside PV, ES, HP, EV charging and smart white goods. All are connected to a Program Logic Controller (PLC) which then takes into account all the various inputs like the demands of the house appliances, needs of the householder and signals from the network to minimise the electrical cost to the householder.

Therefore the charging of the electric vehicles is able to follow price signals and charge when demand is low, helping to smooth out daily electricity demand. This can help us manage our electricity network more efficiently and reduces the need for reinforcement.

Our Electric Nation project has shown how price can affect charging. We have already planned workshops with other industry participants to explore how the learning from Electric Nation can be developed into products and services that suppliers and aggregators may offer to their customers.

6.11 EV clustering

Our low voltage networks rely on a level of diversity between connections. Where there is a cluster of EVs this diversity can be eroded, especially where overnight domestic charging is prevalent. Our Electric Nation project has shown that the impact can be reduced by the natural spread of charging behaviour which means all EVs rarely connect each night.

In addition to the forecasting work we have done, notifications of installed chargers are being used to identify hotspots and clusters of EVs and other LCTs. Our LCT detection project will further enhance this identification to include locations where notifications were not received.

We are using this clustering information to direct our proactive reinforcement of networks.

6.12 Mitigation of local network constraints

There may be isolated locations where a cluster of new EVs will exceed the capacity of our local network. This is most likely to happen with domestic charging. We would hope that many of these will be identified with our clustering modelling. Where clusters are not identified and we have not anticipated the change in demand it could result in blown fuses and customers being inconvenienced.

Delivering an upgraded network from scratch will take a specific duration and, whilst these works are being planned and executed, it is not acceptable for our customers to continue being inconvenienced by supply interruptions.

To mitigate the demand increase we will make use of equipment developed through the Electric Nation project to manage demands within known limits. This is being further developed through the Connect and Manage project and will form the first line response to local overload situations.

Our local teams have shown themselves to be the industry leaders in response to supply interruptions and this technology will allow them to provide this same high level of service where LCTs create a specific problem.

7 Smart Solutions and Flexibility

7.1 Our approach

Flexibility is already an established network management tool for us, developed under the Flexible Power brand name. Where constraints are identified we will look at a range of solutions to rectify them, including smart and flexible solutions. Flexible Power has traditionally looked to larger customers to provide our flexibility responses; we will take the model used for these customers and adapt it to EVs and the domestic market.

Electric Vehicles can offer us a great opportunity for flexibility where they are plugged in for an extended period. This could be overnight, either at home or at a depot location. We will also consider the flexibility that may be available at Park & Ride sites or long stay car park locations.

There is less flexibility where customers require a quick and immediate charge, such as at motorway service stations, but we will review these situations as they occur.

7.2 Domestic Flexibility

The Electric Nation project has confirmed willingness for customers to accept smart charging. This flexibility will be valuable for us to facilitate the quick and efficient connection of EVs. We found that customers were relatively comfortable with a reasonable level of managed charging so long as it did not impact their lifestyle or vehicle use.

The trial did investigate how price signals might affect flexibility but we expect that smart charging solution such as those demonstrated in electric nation will be the domain of electro-mobility service providers. E-mobility service providers will include energy suppliers, market flexibility aggregators and potentially automotive companies (both manufacturers and leasing companies). We will interface with these service providers through the provision of grid capacity visibility and signals to ensure that smart charging is done in harmony with the local electricity network capacity.

As an output from the Electric Nation project we will host an EV Charging Flexibility Services Workshop in April to understand the views of different stakeholders in this area.

We are already drafting our options for flexibility in this area. We expect to develop an “active” product where we are able to pay directly for energy deferred under demand response demonstrated through metering. This could be aggregated and suppliers will have to provide us evidence of response. Alongside this we will develop a “passive” product where we can pay an annual fee for every new customer signed up for a Time of Use tariff in our constraint managed zones. We would then use the combination of a smart meter and the supplier’s price signals to help demand shift from times of WPD constraint.

We expect that this flexibility will be delivered in a hierarchy which starts with simple time of use demand shifting through supplier signals, moving on to Passive and then Active products as required. Where additional flexibility requirements are needed we could deploy active network management tools such as Connect and Manage.

7.3 Commercial Flexibility

Where larger clusters of EV charging exist, such as depots and long stay car parks, there is the potential for site operators to participate in our flexibility markets. Through Flexible Power they can already operate in constraint managed zones to assist with the more general level of network constraint. We will deliver projects which will demonstrate how flexibility can also be used to enable EV charging capacity to be made available without the need for conventional reinforcement.

Flexibility in this area will follow the format of our Alternative Connections products. At its simplest level we plan to re-create the “Timed Connection” model to allow EV charging to coexist with other conventional demands. For example where a depot facility requires charge capacity at night we may be able to provide this without reinforcement by sharing network capacity which is already present for daytime industrial use.

Our Alternative Connections then move towards a fuller Active Network Management solution where constraints are measured and customers react with constraint. This system has already been delivered at a car showroom in Lincolnshire to restrict charging at times of network peak.

7.4 Whole System Flexibility

As vehicle to grid solutions and smart charging develop we have the opportunity to make use of these flexible solutions on our network. In fact, a customer who makes use of local generation, storage and EV charging could actually reduce their impact on the network and help us avoid conventional reinforcement.

8 Projects to demonstrate EV connections

8.1 Developing a balanced portfolio of projects

Our projects are developed through our Innovation Strategy. We always look for projects which cover our three main themes of Assets, Customers and Operations. We ensure our projects retain this balance by the regular review of our Innovation Strategy which is supported by our more general Stakeholder Engagement.

In the specific area of Electric Vehicles, we have used our Local Authority Stakeholder Engagement and focused EV surgeries during our 2019 stakeholder engagement sessions to ensure our projects are providing the right blend of technical and flexible solutions.

8.2 Completed Projects

8.2.1 CABLED (2009)

We partnered with the energy supplier E.ON and Birmingham and Coventry city councils on a project called CABLED (Coventry and Birmingham Low Emission Demonstrator). The project was the UK's first ever at-scale demonstrator aimed at engaging the public about electric vehicles. Set in the heart of the Midlands motor manufacturing region the project had wide support from the automotive industry, local academia and public sector institutions.

The key objectives of the project where twofold. Firstly to engage with public about electric vehicles and understand their attitudes to recharging and journeys. Secondly to assess the electrical impact of electric vehicle recharging infrastructure on the local electricity network.

The project was funded by the Technology Strategy Board (now known as Innovate UK). It involved the DNO installing 35 charging points in city centre locations, public carparks and out of town park-and-ride facilities. Power quality recorders were installed adjacent to a proportion of the charging points to assess and measure electrical harmonics. The energy supplier partner installed over 100 smart meters in domestic properties to measure consumer behaviour.

The electric vehicles were supplied by a range of manufacturers including Mitsubishi, Mercedes smart, Tata and Jaguar Land Rover.

Key learnings from the project were:

- That harmonics and general power quality issues were less serious than feared
- That drivers of electric vehicles with more limited battery capacity should be expected to recharge frequently both at home and on street
- That DNOs are well equipped to install and connect electric car charging infrastructure in the public highway
- That carpark charging of multiple vehicles simultaneously presents challenges for local electricity network infrastructure

Learning from the project helped inform our design policies and the customer servicing approach for provision of connections. It also helped established long running close working relationships between Western Power Distribution and local authorities in the West Midlands.

8.2.2 V2G Taxi (2011)

The project set out to understand how vehicle to grid (V2G) technology could be accommodated within the electricity distribution system.

The project provided an early insight into a technology now heralded by the energy and automotive sectors as having the potential to minimise customer bills and ensure a safe and stable supply of electricity for the nation.

The project directly informed industry design standards and has fed learning into subsequent demonstration projects. These include the significant number of vehicle to grid projects currently being funded by the UK Government under Innovate UK mechanisms.

8.2.3 Electric Boulevards (2014)

Our Electric Boulevard project set out to demonstrate the UK's first ever use of inductive charging infrastructure. It also tackled the issue of recharging larger commercial vehicles. Working with Milton Keynes City Council and a range of other partners, Western Power Distribution installed inductive charging solutions at three locations across the city. The local bus operator, Arriva, converted one of its bus routes in Milton Keynes to a fully electric solution; the route used included the inductive charging loops.

The technical aspects of the project included studies into the electrical implications of installing inductive charging solutions, including the challenges of installing such infrastructure in public highway. The project proved that inductive charging is a viable and efficient way of recharging such vehicles. It also proved to be extremely reliable. The solution is still in use at the time of writing this report, and the city council has plans to convert all other bus routes in the city to pure electric with inductive charging.

We also developed solutions to enable large inductive charging units to be connected to the low-voltage network. Previously it would have been considered necessary to have an high-voltage connection. This solution means that charging infrastructure can be connected much cheaper and quicker than previously thought.

8.2.4 Smart Charging and Vehicle Telematics (2015)

Working with the bus manufacturer (Wrightbus of Northern Ireland) the project set out to take data from the vehicle telematics system to understand the state of charge of the battery system and other factors such as ancillary power use and traffic conditions. With this data we were able to estimate the recharging requirements at each charging location. By assessing local grid capacity at the times the buses were forecast to arrive, we were able to ensure that all the vehicles would return to the depot at the end of the day with no less than 20% charge.

Additional complex smart charging solution algorithms were used at the bus depot during the overnight recharging period to ensure that all buses left for their first journey with 100% charge. This was achieved using the minimum grid connection infrastructure, reducing the cost of connection and ongoing use of system charges.

Learning from this project has developed smart charging solutions which are now being tested at scale in our Electric Nation project.

8.2.5 EV Emissions (2016)

Our EV emissions project was established to check the compliance of modern electric vehicles. Electric passenger vehicles of all manufacturers currently sold into the UK market were tested. Working with the Transport Research Laboratory vehicles were tested at the Millbrook Proving Ground in Bedfordshire. They were cycled through a range of charging and discharging cycles in controlled conditions. Harmonic and power quality measurements were taken from the vehicles and the charge points.

Valuable insight was gained into the performance and compliance of vehicles with mandatory electrical emissions standards. These results are informing the refinement of the engineering standards and provided comfort that the automotive sector is designing vehicles within the limits set.

8.2.6 Alternative Connections for EV Charging (2017)

Western Power Distribution has developed a range of alternative connection solutions for customers wishing to connect new distributed generation such as solar, biomass and wind. Although initially developed for generation, the range of alternative connection solutions was adapted to cater for flexible demand, including electric vehicle recharging. During 2017 technological and process changes were implemented to our connection process. This enabled us to offer alternative connections to customers wishing to install charging infrastructure but where the cost of connection is prohibitively large. The first

alternative connection under this arrangement was made during 2018 working with a car dealership in Lincolnshire.

8.2.7 IET Code of Practice

WPD was asked by the Institution of Engineering and Technology (IET) to assist in the production of a code of practice for electrical equipment installers. The code of practice on the connection of electric vehicle charging infrastructure formed an addendum to the IET wiring regulations. Specialist technical knowledge from our policy engineers was coupled with learning from innovation projects to ensure that the code of practice was both practical and comprehensive. The code of practice sets out safety standards for the electrical earthing of equipment and means of connecting to household and business electrical wiring.

8.3 Current Projects

8.3.1 Electric Nation

At its inception the Electric Nation project was Europe's largest domestic EV charging trial with 673 participants. The project will deliver learning on how electric vehicle customers charge their vehicles at home, and better understanding of their acceptance of smart charging. It is also producing a network assessment tool for our planning engineers to assess the most appropriate means of providing capacity. It will additionally provide a longer term, more strategic view, of the overall implications for electricity network infrastructure of electric vehicles becoming mainstream.

These results include knowledge on the frequency of charging events (typically less than twice per week) and the amount of energy consumed each time (approximately 35 kWh). The project has also confirmed a consumer willingness to accept smart charging. Further we have proved that the technology to support such a solution is available and understand the degree to which we can rely upon it for network management purposes.

The final phase of the project tested consumer attitudes to time-of-use energy tariffs and the degree to which they can be relied upon to shift peak electricity demands away from the traditional teatime evening peak.

In addition to gaining an improved understanding of the potential for smart charging, the project will also inform our planning standards. In particular future assessment of diversity and maximum demand.

8.3.2 LV Connect and Manage

Low-voltage networks have traditionally been designed to accommodate household power and lighting. The network design methodology assumed natural diversity of consumption. In areas with electrical heating, such as storage radiators, the network may have been designed with an increased level of capacity.

A typical after diversity maximum demand for a domestic property is between 1.5 and 2.5 kW. A typical electric vehicle will charge at 7 kW. Whilst the domestic wiring network, and the individual network connections, will already be sized to accommodate loads of this magnitude, the upstream distribution network and substation will not be able to accommodate all electric vehicles charging at maximum capacity simultaneously.

Smart charging solutions such as those demonstrated in Electric Nation, coupled with supplier time-of-use tariffs will ensure that some diversity can be relied upon. Electric Nation also proves that there is a natural diversity benefit in challenging the behaviour of customers. Nonetheless the potential exists for the network to become overloaded in the low probability event that customers do decide to charge at the same time.

The LV Connect and Manage project is developing a solution to provide emergency overload protection for the distribution network. This is a form of Active Network Management. The solution will be deployed in areas with high concentrations of electric vehicles.

We expect smart meters, suppliers and aggregators to provide products with time signals which will attract charging away from times of system peak. Where this is successful we will not require LV

Connect and Manage as the market drivers will have correctly reacted to signals. If these time of use signals do not provide a suitable level of load management and flexibility we do need to offer a solution which will mitigate constraint on our network.

Under the LV Connect and Manage process customers will be advised that their local distribution network is at capacity at times of peak demand. They will then be offered the opportunity of waiting for conventional network reinforcement to take place, or alternatively the installation of a LV Connect and Manage domestic load controller. The domestic load controller will be able to communicate with the local substation and in the event of an impending overload situation being detected, the device will communicate with the charge point or vehicle and reduce the charging level for a short period of time.

The LV Connect and Manage solution is viewed as a last resort mechanism which would only be implemented by Western Power Distribution when all other options have been exhausted. The solution is currently been trialled within Milton Keynes and Nottingham. In addition to the control of electric vehicles the domestic load controller will also integrate with other low carbon technologies such as solar panels and home energy storage units.

8.3.3 LCT Detection

Electrical installers who fit charging equipment at customer homes are required to notify the Distribution Network Operator. Western Power Distribution also receives information on new vehicle registrations from the Driver and Vehicle Licensing Agency. We are aware that there appears to be a significant mismatch in the number of electric vehicle notifications between the two sources. Working with the Energy Networks Association we are making improvements to the notification process to make it simpler for electrical installers to tell us where charge points have been fitted. This should reduce any mismatch.

WPD are currently undertaking the project LCT Detection with Electralink and IBM. The project will identify whether it is possible to automatically locate the installation of new charging equipment through the analysis of metering data. Using artificial intelligence techniques our project partners will evaluate the potential for such a solution together along with any regulatory and privacy controls which may be necessary.

This project will provide WPD with the most up to date information on LCT take-up within the licence areas and will negate the fact that some installers are failing to advise the host DNO that they have connected LCTs it is likely that this project should also highlight non-technical losses within the licence areas.

8.3.4 Superfast Electricity – three phase services

Working with Innovate UK, Monmouthshire County Council, Wales and West Utilities, Cenex and the Welsh Government the group are in the design stage of the fitting of all LCTs to the combination of new build and retro-fit properties in Caldicot. The project will install three phase service cables at all properties in this development in Wales. The project will demonstrate how this can be achieved and, crucially, make the final part of the network resilient to LCT demands. This will avoid us having to replace cables across customer's gardens and driveways in the future, due to foreseeable LCT needs.

8.3.5 Reinforcement Planning - Forecasting and Planning Interface Tool

The Electric Nation project provided a visualisation tool for WPD planners to show the penetration of electric vehicles on the WPD geographical map background. This project, in association with EA Technology, will build on the work completed and provide visualisation of smart meter data, consumption data and network conditions.

The project will also investigate how much of this data can be automatically imported into design software to allow planners to undertake network assessments.

Once this work is completed we will assess how the tool can be further developed to help our local planners identify local constraints and design solutions for them.

A final development of the tool is considering how this information can be provided directly to customers via our website, so that they quickly and easily assess the impact of their additional demand on our network.

8.4 Future Projects

8.4.1 EV Filling Stations

Although we expect many electric vehicles to be charged at home and at the workplace, some 40% of vehicle owners do not have driveway or designated parking therefore en-route charging is also an important service for owners of electric vehicles. The connection of multiple fast and rapid chargers at a single location can require a substantial capacity to be provided. This can be costly and/or take time to deliver.

This project will explore a number of innovative solutions for the provision of network capacity for electric vehicle charging stations. This will include locations adjacent to major trunk routes as well as locations such as supermarkets and city ring-roads.

Options to be explored include increasing the voltage level at the point of connection, DC rather than AC connections, inclusion of co-located batteries and poly-phase options. This project is still at the development stage and we would therefore welcome expressions of interest from partners wishing to work with us in this field.

8.4.2 On Street Charging Solutions

This project will look at solutions for charging vehicles in residential locations on the street or at communal parking areas. We intend to work with local authorities and other regional bodies to design and demonstrate dedicated infrastructure for electric vehicle charging.

Where local authorities deploy on-street charging we will need to change the way we provide electricity supplies to street furniture such as streetlights. Conventional networks are built to provide low wattage connections to lamps only. Earthing and technical issues will also drive us to changing the connection type.

Our project will show how a bespoke low voltage mains cable can be used to provide supplies to charge points and other street furniture.

We will also establish triggers which will allow for mains cables to be uprated ready for future demands.

8.4.3 Smart Homes – EVs and Storage

This project will utilise the three phase cables installed in our “superfast electricity” project and show how a domestic installation can make use of locally generated power and storage to provide the energy required to charge an electric vehicle. The equipment could also be used to balance the network and mitigate peak demands.

This builds on our industrial and commercial storage project with Tesla which has demonstrated three new variants for the connection of batteries to the WPD system. These connection options rely on the operating mode of the battery being restricted to a defined purpose. These are self-sufficiency, supply resilience and flexibility market operation. Through this new project a further variant will be developed entailing the combination of energy storage with electric vehicle charging.

8.4.4 Smart Meter Load Control

This project follows on from our LV Connect and Manage project, which developed a domestic load controller which will ensure that the low-voltage network is not overloaded. It will demonstrate how SMETS2 smart meters can be used to control specific load within a property.

Working with an energy supplier offering specific electric vehicle tariffs, we intend to determine whether the smart meter can be used for this overload protection function.

8.4.5 Self-Assessment

When a customer chooses an Electric Vehicle their next task is to consider charging options. Where they have off street access they are likely to install a domestic charger and will need to ensure that their service cable is sufficient for the demand it will generate.

Through the Energy Networks Association this project is being developed in conjunction with the other DNOs to provide a centralised way of providing us with pertinent information about their service which will allow us to quickly assess if it is suitable to accept a charger.

8.4.6 Hub Charging Solutions

Local authorities are likely to establish charging hubs in car parks and other off street locations. These offer the advantage of being able to provide a large single point load connection to our network using a bespoke transformer. However it is also likely that the locations will not be in continual use and there will be times of the day when no charging occurs.

We are working with a transformer manufacturer to develop a low loss version of our standard units which will reduce the network running costs of these locations.

WPD already have designated sites where installation of charging hub is proposed. It will be used to charge passing vehicles and also provide the facility to charge local terrace house owners' EVs. WPD also expect that this hub approach will be used by commercial and public transport operators so will investigate how we can apply our technology to these locations.

9 Targeted Commitments in 2019 and 2020

9.1 Realising benefits

Work completed in projects only becomes fully valuable once the findings transition into business as usual. We have already made changes to our technical design and minimum cable designs but there are more changes that we expect to make as a result of projects currently underway.

The sections below detail changes we expect to make in 2019 and 2020.

9.2 2019 change - "Superfast Electricity"

Once the demonstration project for three phase service cables is complete we will have learned how to effectively use three phase in a domestic environment. With this knowledge we plan to amend our design policies to standardise on three phase service cables.

9.3 2019 change – Design capacity assumptions

For many years we have used a set of After Diversity Maximum Demand (ADMD) figures to design the backbone network that supports housing developments. It has allowed for the efficient and economic connection of traditional gas and electrically heated homes. The impact of LCTs will change this design model. We will use data from our innovation projects to calculate a new ADMD which includes allowances for EV charging and other LCTs.

9.4 2019 change – Network capacity indication

We will produce a network capacity map to indicate the capacity that is available across our network to support local EV charging. This map will be published alongside our other network maps for generation and demand capacity and will be interactive and available on our website.

9.5 2020 change – Public charging hub infrastructure

We have developed a hub charging solution to help the deployment of charging infrastructure in car parks and other public locations. With the completion of our hub charging project we will create a design specification for bespoke charging transformer deployments.

9.6 2020 change – LV Connect and Manage

Our LV Connect and Manage project will show how we can provide controls to allow EVs to charge on a network which could be constrained by parallel charging. This will be our first response to capacity issues on our network and will be used as a rapid resolution to problems whilst a more enduring solution is developed. We will establish a set of procedures so that this equipment is deployed in a consistent way by our local teams.

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