Incorporating EV in Local Planning Policy **01/05/2019**

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EVIDENCE BASE: INTRODUCING PLANNING POLICY FOR ELECTRIC VEHICLES IN NEW DEVELOPMENT

cenex

SYSTRA

INCORPORATING EV IN LOCAL PLANNING POLICY

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EXECUTIVE SUMMARY

SYSTRA and Cenex have been appointed by the West of England (WoE) sub-region unitary authorities to provide evidence to support the development of planning policy for electric vehicles (EVs) in new developments. Facilitating the uptake of EVs, as well as policy to promote active travel and the use of public transport, is essential to reduce CO_2 and other pollutant emissions from transport, in accordance with national and international policy safeguarding public health and the environment. Indeed, "*Encouraging uptake of low emission vehicles by setting more ambitious targets for installing electric car charging points"* has been recently recommended in Public Health England's "Review of Interventions to Improve Outdoor Air Quality and Public Health[1]", and it is important that clear and consistent policy to support these ambitions is developed to keep pace with market trends.

Lack of charging infrastructure is considered to be one of the main barriers to electric vehicle uptake. Provision of infrastructure in residential developments is a key priority, as research suggests that people are more likely to purchase an electric vehicle if charging infrastructure is already in place where they live, as it reduces the requirement to charge during the day. Where parking provision is on street, active electric vehicle charging should be designed into the street scene at the time of construction, providing opportunities to combine engineering works with tree planting and traffic calming measures and to avoid risk to the highway asset being dug up retrospectively. Non-residential, particularly work place charging, also has an important role to play; as battery sizes increase, people will also become even less reliant on journey charging points, and it is likely that they will rely more heavily on their home or work charging provision.

Although starting from a low baseline, the WoE sub-region's uptake of EVs is already outpacing the national average, and ambitious policy around the provision of charging points for EVs is needed to support their uptake across the sub-region.

Whilst there will be local variations in the planning policy requirements for EVs, this report provides a robust evidence base to support the creation of this planning policy in the West of England. The evidence base sets the policy background around air quality and climate change at a local and national level, provides market trends and forecasts and factors influencing the uptake of electric vehicles.

This report provides guidance on cost and recommendations for a minimum and an optimal level of EV infrastructure provision for different land use classes, taking into account the charging point technologies available. An indicative breakdown of costing gives guidance on the likely costs to be faced by developers for different levels of provision. Having a clear understanding of the costs associated with EV charging infrastructure provision can inform viability assessments, which are necessary to ensure that the policy requirements can be reasonably delivered by developers and other relevant stakeholders. The recommendations presented here are intended to give local authorities a basis on which to decide **where on the spectrum towards the optimal policy position**

1 https://www.gov.uk/government/publications/improving-outdoor-air-quality-and-health-review-of-interventions (March, 2019)

they wish to be, taking into account the different levels and types of development in their jurisdictions.

A series of planning policy recommendations are provided around the following key areas:

- Active and passive provision[2]: active charging points are essential to the uptake of EVs, whilst passive provision offers cost effective future-proofing that is able to respond over the longer term to growth in demand and technology changes.

Suggested requirements for each use class are shown in Table 1.

Table 1. Suggested requirements for active and passive provision parking standards by land use class

LAND USE CLASS	PARKING TYPE	MINIMUM REQUIREMENT	OPTIMUM REQUIREMENT
Residential Use Class	Allocated (on or off plot)	100% Passive	100% Active
	Unallocated (off-plot)	100% Passive	100% Active
	On-Street	100% Passive	75% passive / 25% Active
Retail (A Use Classes)	On-Site Parking	10% passive / 10% active	75% passive / 25% active
Employment (B Use Classes)	On-Site Parking	10% passive / 10% active	75% passive / 25% active

- Type of provision: an appropriate minimum provision should be a 7kW /32 amps power capacity to provide standard charging at home and work locations.
- Parking standards: location and design of EV bays have to be considered from planning stage to maximise the number of cars that can be served by the same charging point and so that they are not an obstacle or trip hazard to users on the roads or pavements. On-street charging provision should be designed into the street scene as part of the design and construction process.
- Future proofing: develop short term “smart charging” solutions.

This report ensures that there is a shared understanding of the requirements and evidence base across all the West of England sub-region authorities to inform their EV planning policy development.

[2] Active provision is defined as the provision of active charging points such that each user has the opportunity to charge their vehicle at the same time with a total charging time not exceeding 8 hours.

Passive provision is defined as establishing all of the associated cables, chambers and junctions to allow for charging points to be installed at a later point without the need for undertaking works that require breaking ground to install cabling retrospectively. Further funding and manual work would be required to deliver operational charge points.

1. INTRODUCTION

1.1.1 The study has been commissioned by the West of England (WoE) sub-region unitary authorities: Bath & North-East Somerset Council; Bristol City Council; North Somerset Council and South Gloucestershire Council. This study is a technical note providing evidence to support the development of EV policy within the Local Plans being developed by each authority. The West of England Electric Vehicle Policy Statement will incorporate the results from this study and sit alongside the Joint Local Transport Plan (2019-2036). The Policy Statement (which is currently being developed) will be a vision and joint stance on EV growth in the West of England.

1.1.2 This report seeks to inform the setting of planning policy for requirements of EV infrastructure in new developments across the WoE sub-region. Key aims for planning policy are to encourage the uptake of ultra-low emission vehicles (ULEVs)[3] across the WoE and create a level playing field across the sub-region. Planning policy will also need to provide future proofing for the evolution of new and upcoming technologies. This report makes recommendations based on available evidence as to how the WoE sub-region might achieve these aims.

1.1.3 In this report, SYSTRA, Cenex and the four unitary authorities have provided the necessary considerations and indicative costs for a range of potential EV infrastructure options that might be considered by planning authorities in the WoE sub-region and elsewhere for inclusion in their future policy planning. Recommendations have also been made regarding how best to take these options forward.

1.2 Scope

1.2.1 The commentary within this report considers the current landscape regarding EVs and the demand on local authorities to increase provision of EV infrastructure in their jurisdictions. Due to the costs of installing infrastructure at the build stage being lower than the cost of retrofitting existing developments, it is important that installing EV infrastructure in new developments is strongly encouraged. This transition to EVs also follows the nation's transition to electric power, as the UK moves away from a dependency on fossil fuels and in order to contribute to national targets of improved air quality and reduced greenhouse gas emissions. By reviewing other existing EV policies and standards, the report provides recommendations for the levels of provision the WoE sub-region should consider, factoring in local data on current and forecast uptake of EVs in the area.

1.2.2 The analysis provided focuses on new developments of both residential and commercial types.

1.2.3 Indicative costs to developers of implementing different policy options, such as passive and active charge point infrastructure are provided. Future proofing is a key priority, as

[3] ULEVs are vehicles with zero or near-zero tail pipe emissions which make use of electricity from an increasingly decarbonised power sector.

it is anticipated that as with other infrastructure, demands upon EV charging infrastructure will change as vehicle ranges increase, driver behaviour changes and new use cases come into play. This report therefore briefly considers new technology, the impact of this on EV infrastructure provision and how this can be incorporated into planning policy.

1.3 Considerations and Policy Options

1.3.1 Although starting from a lower baseline, the WoE sub-region's uptake of EVs is already outpacing the national average and, with the focus of this study being solely on new developments which comprise a relatively small proportion of housing stock, we recommend that the policy options taken forward from this report should be ambitious. This document provides a range of options in order to facilitate future proofing as well as increasing visible charging infrastructure on the ground today. This is in order to maximise the impact local authorities can have on the future uptake of EVs in the sub-region. It is recognised that, as all of the options put forward refer to an increase in EV infrastructure provision beyond what is currently provided, this will represent an additional cost to developers not currently factored into development plans. However, it should be noted that the costs of installing EV charging infrastructure at the new build stage are significantly lower than the costs of retrofitting existing developments, and should therefore be promoted as the more cost effective solution.

1.3.2 Options comprise minimum and optimum levels of provision of EV infrastructure for residential and commercial new developments. Each policy recommendation is validated by supporting evidence for implementation, including other local authority examples, desk-based technical research and stakeholder engagement with relevant experts, such as Western Power Distribution (WPD), the distribution network operator (DNO) of the region).

2. BACKGROUND

2.1.1 In the last few years, air quality in urban areas has become a cause for significant concern for public health. Although there has been a general trend of improvement in air quality over the past decade across the UK, particulate matter (particularly $PM_{2.5}$) nitrous oxides (NO_X) and sulphur oxides (SO_X) are still highly detrimental to public health. The UK Government has set national air quality objectives, which mostly mirror the limit values set by the European Union[4], and are largely complied with (with the exception of NO_2[5]); however, even within these legal limits, there are still significant health impacts.

2.1.2 Road transport is currently responsible for 12% of primary $PM_{2.5}$. This can shorten lifespans as it enters into the lungs and the blood and is transported around the human body, becoming embedded in organs. Those with existing heart and lung conditions, the elderly, young children and pregnant woman and their unborn babies are most at risk. Health can be impacted both by exposure to high pollution levels over short periods or exposure to lower pollution levels over long periods.

2.1.3 Road transport is also responsible for 34% of NO_X and along major roads, transport-produced NO_X accounts for 80% of tailpipe emissions[6]. Exposure to NO_x can exacerbate symptoms of those already suffering from heart and lung conditions, and even short term exposure to NO_2 can cause inflammation of the airways, increasing vulnerability to respiratory infections and to allergens.

2.1.4 In 2018, The Department of Health and Social Care's advisory Committee on the Medical Effects of Air Pollutants (COMEAP) estimated that long-term exposure to air pollution in the UK as attributed to human activity, has an annual impact on shortening lifespans, equivalent to between 28,000 to 36,000 deaths, or a loss of 328,000 to 416,000 life years[7]. The high profile given to the link between poor air quality and public health in the last few years has further added weight to the argument for a nationwide shift to EVs. Despite technology to improve the environmental performance of Internal Combustion Engine (ICE) vehicles in terms of particulate and NOx emissions, CO_2 tail pipe emissions will not decrease significantly without a full scale shift to EVs. It is important to note that PM emissions from brake and tyre wear will remain even with the transition to electric vehicles.

[4] EU Limit values on PM10: 50 µg/m-3 not to be exceeded more than 35 times a year (24 hour mean), 40 µg/m-3 (Annual mean); Particles PM2.5: 25 µg/m-3 (Annual mean) with a target of 15% reduction in concentration at urban background levels; NO_X: 200 µg/m-3 not to be exceeded more than 18 times per year (1 hour mean), 40 µg/m-3 (Annual mean) (http://ec.europa.eu/environment/air/quality/standards.htm)

[5] https://www.cibsejournal.com/news/uk-facing-record-fines-for-air-pollution/ (Accessed 21 December 2018)

[6] DEFRA Clean Air Strategy 2019

[7] DEFRA Clean Air Strategy 2019; COMEAP (2018) *Associations of long-term average concentrations of nitrogen dioxide with mortality* (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/734799/COMEAP_NO2_Report.pdf Accessed 11 February 2019)

"A 1 µg/m^3 reduction in fine particulate air pollution in England could prevent around 50,900 cases of coronary heart disease, 16,500 strokes, 9,300 cases of asthma and 4,200 lung cancers over an 18 year period." – Public Health England, Health matters: Air pollution (2018)[8].

2.1.5 In the UK, the transport sector is now the greatest contributor to national carbon dioxide emissions (the most prominent greenhouse gas associated with global climate change), a position previously held by the energy sector. In 2016, transport emitted just over a quarter of the UK's CO_2 emissions (26%)[9] and provisional figures for 2017 suggest the sector contributed over a third (34%) of such emissions in that year[10]. Road transport is the primary contributor of transport emissions and a shift to EVs has been identified as a key strategy by which the UK can decarbonise its transport sector[11].

2.1.6 In addition to their removing exhaust emissions, EVs are four to five times more efficient at converting the chemical energy in a battery into forward motion (kinetic energy) than a conventional vehicle is at converting the chemical energy in petrol and diesel into movement[12]. EV's also make use of the already significantly decarbonised electricity generation in the UK, related to the increase in renewable power[13] and the phase out of coal. According to a study by Carbone4, commissioned by the European Climate Fund (2018), an EV using European electricity in 2030 will be almost 40% cleaner over its life cycle than even the most efficient ICE vehicles, fitted with the newest hybrid technology[14].

2.1.7 The UK is legally bound by the Climate Change Act (CCA) (2008) to reduce greenhouse-gas (GHG) emissions by at least 80% from 1990 levels by 2050. On account of constraints surrounding the ability of other polluting sectors such as agriculture and industry to reduce their emissions, road transport must ideally achieve a reduction of up to 90%.

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[8] https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution (Accessed 11 February 2019)

[9] DEFRA, Call for Evidence: Brake, Tyre and Road Surface Wear (July 2018) https://consult.defra.gov.uk/airquality/brake-tyre-and-road-surface-wear/

[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/695930/2017_Provisional_Emissions_statistics_2.pdf (Accessed 18 December 2018)

[11] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/695930/2017_Provisional_Emissions_statistics_2.pdf (Accessed 15 January 2019)

[12] https://withouthotair.com/c20/page_128.shtml

[13] Wind, solar and biomass.

[14] https://europeanclimate.org/wp-content/uploads/2018/09/From-cradle-to-grave-e-mobility-and-the-energy-transition_IT_SP_UK_EU.pdf (Accessed 11 February 2019)

This implies that car, van, bus and HGV fleets would need to be almost carbon neutral or ultra-low carbon by 2050.

2.1.8 The uptake of environmentally sustainable transport innovations such as EVs is a key contributing factor to meeting the Government's stipulated emissions reduction targets. However, this is dependent on the necessary infrastructure being in place, firstly in order to reduce the UK's dependency on fossil fuels and secondly to enable owners to use and charge their EVs when required.

3. POLICY CONTEXT

3.1.1 The UK Central Government has shown commitment to facilitating the mass-market uptake of EVs through a number of recently published strategies and action plans. This is imperative to facilitate the roll out of charging infrastructure. A summary of the core governmental, national and sub-regional outputs relevant to facilitating the uptake of EVs is presented below.

3.2 Clean Growth Strategy (2017)

3.2.1 The Clean Growth Strategy sets out a plan to maximise the economic opportunities offered by the low carbon sector. The UK has performed well in meeting its past carbon budgets and, at the same time, has maintained a stable rate of economic growth. Past achievements have been mainly driven by the decarbonisation of the power and waste sector and by the movement of manufacturing to other countries such as China. To replicate this success and meet future carbon budgets, the UK needs to put further effort into the transformation of the transport system, reduction of emissions from business and industry and the decarbonisation of heat generation.

3.2.2 The strategy suggests a set of policies aimed at boosting the low carbon economy in each sector. The policies considered for the transport sector focus on the uptake of EVs, and can be summarised as follows:

- End the sale of new and conventional diesel cars and vans by 2040;
- Allocate funds to subsidise EV purchases;
- Develop the best charge point network in the world through adequate funding and devolving power to local authorities to set local requirements for provision of charging points; and
- Invest in the development and manufacturing of improved electric batteries.

3.2.3 The strategy recognises the wider benefits derived from actions undertaken to deliver clean growth, especially in transport. For example, efforts to cut greenhouse gases emissions for transport can have a positive impact on air quality, with consequent gains for public health, the economy and the environment.

3.3 Road to Zero – Department for Transport (2018)

3.3.1 Published in July 2018, the Government's Road to Zero (RTZ) strategy sets out the ambition for at least 50%, and as many as 70% of new car sales to be ULEVs by 2030, alongside up to 40% of new vans.

3.3.2 As part of the RTZ, the Government has committed to nearly £1.5 billion of investment to facilitate a comprehensive support package for the transition to ULEVs. This includes the launch of a £400 million charging infrastructure fund to help accelerate the roll out of charging infrastructure. This will support the push for charge points to be installed in new-build properties where appropriate, and fund new lampposts to include charging points. To support this, the Government's National Planning Policy Framework (updated in 2018) specifically references that applications for development should be designed to enable charging of EVs and ULEVs and that parking policies should factor in the need for provision of spaces to charge EVs.

3.3.3 To support this, the Government plan to consult on introducing a requirement for charge points for new dwellings in England where appropriate as well as ensuring local planning policies incorporate facilities for EVs via the National Planning Policy Framework, which would ensure this becomes a material planning consideration for new developments.

3.3.4 The strategy also outlines plans to target funding for consumers who wish to install a charge point in their home (Electric Vehicle Home Charge Scheme), for businesses (Workplace Charging Scheme). Funding is also available for residents who do not have a private parking space to install a charge point on street (On-Street Residential Charge Point Scheme) and for research on smart and on-street charging technology.

3.4 National Infrastructure Commission - National Infrastructure Assessment (2018)

3.4.1 The National Infrastructure Commission (NIC) was established in 2015 to provide independent, impartial advice on the UK's long term infrastructure needs. The first National Infrastructure Assessment (NIA), produced in July 2018, sets out the NIC's plan of action for the next 10 – 30 years. Central to the future viability of EVs are the following principles:

- Preparing for 100% electric vehicle sales by 2030;
- Half of the UK's power provided by renewables by 2030; and
- £43 billion of stable long term transport funding for all cities.

3.4.2 The NIA highlights the requirement for energy systems to prepare for the increase in EV uptake, with current forecasts indicating an increase of between 7% and 14% in peak electricity demand by 2030. In order to counterbalance this increase, the NIC recommends that Ofgem should take on the role of regulating the interaction between electric vehicle charge points and the electricity network immediately, ensuring that EV charging and vehicle to grid services contribute to the optimisation of the energy system.

3.4.3 Vehicle to grid technology, whereby EVs can sell power back to the grid at peak times, and recharge at off-peak times for a lower price, will aid the shift to renewable energy sources. This is because the demand for power must always be exactly matched by power generation, as the proportion of power generated renewably increases balancing the peaks and troughs in demand must be addressed by other means such as ramping up or down demand, or by bringing non-renewable power generation on or off-line or providing some form of energy storage. A network of energy storage capacity in the form of EVs can be very helpful to deal with variable output from renewable power generation such as wind and solar PV.

3.4.4 The National Infrastructure Assessment builds on the principles set out in the RTZ, and considers the interdependencies between sectors; 'urban infrastructure planning needs to be integrated with housing; the energy system needs to be prepared for an increase in electric vehicle ownership; and digital connectivity on the roads could be necessary for connected and autonomous vehicles'.

3.5 Automated and Electric Vehicles Act (2018)

3.5.1 In July 2018, the Government provided further support to the market uptake of EVs through the passing of the Automated and Electric Vehicles Act. The Act represents a significant step towards improving air quality and enhancing the availability of the electric charge points in the UK.

3.5.2 The Act sets out to improve consumer confidence in charging their vehicles, thereby facilitating greater market uptake. The Act seeks to ensure that public charge points are compatible with all vehicles, standardising how charging is paid for and setting standards for reliability.

3.5.3 Under the Act the Government will also have new powers to ensure motorway services are upgraded with sufficient provision of EV charging points. Mayors will also be permitted to request installations at large fuel retailers.

3.5.4 The aim of this document is to give more power to local authorities to increase the provision of charging points and to start a process of standardisation across the country to promote network accessibility.

3.6 National Planning Policy Framework (2019)

3.6.1 The Ministry of Housing, Communities and Local Government (MHCLG) National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are to be applied, whilst also providing a framework within which Local Plans can be produced. The NPPF was subject to several revisions in July 2018, with the transport policies contained with the document largely a reworking of the previous text. The document was further updated in February 2019.

3.6.2 Nonetheless, the document continues to recognise ULEVs as a key mode of sustainable transport, which carries the definition of 'any efficient, safe and accessible means of transport with overall low impact on the environment'.

3.6.3 What has been added from the previous National Planning Policy Framework are requirements to include charging provision in planning applications. According to the document, developments have to be 'designed to enable charging of plug-in and other ultra-low emission vehicles in safe, accessible and convenient locations' (paragraph 110).

3.6.4 In addition, policies for parking standards must "ensure an adequate provision of spaces for charging plug-in and other ultra-low emission vehicles" (paragraph 105), as was stated in the previous Framework.

3.6.5 With regard to promoting sustainable transport, the revised NPPF provides guidance on plan-making, and specifically planning policies, which should provide for large scale transport facilities and the infrastructure and wider development required to support their operation, expansion and contribution to the wider economy. Furthermore, in setting local parking standards for residential and non-residential development, the NPPF specifies the need for local authorities to set standards for EV and ULEV parking facilities, in place of simply acknowledging the need to reduce high-emission vehicles.

3.7 RAC Foundation – Development of the UK Public Charge Point Network (2018)

3.7.1 In December 2018, the RAC Foundation published a report on the development of the UK Charge Point Network (CPN). This document considered the needs of those undertaking journeys by EVs. The report also suggests how the legislation in the Automated and Electric Vehicles Act 2018 could be used to draft regulations to address many of the issues identified in the report. One of the conclusions of the report is that the CPN only represents a small part of the EV refuelling requirement: it is also essential that local councils and developers ensure that all new houses are built with provision for 7 kW EV charging in every home. In addition, new industrial and commercial units being built now should have a minimum of 25% of their parking spaces fitted with a 7kW charger.

3.8 Clean Air Strategy (2019)

3.8.1 The Clean Air Strategy sets the UK Government's approach to tackling all sources of air pollution. It states that new legislation will be created in order to bring about stronger and more coherent action against air pollution, since the current legislative framework has not driven sufficient action at a local level. This will be introduced alongside Clean Air Zones in a number of UK cities to lower emissions from all sources of air pollution through clear enforcement mechanisms.

3.8.2 The Clean Air Strategy complements three other UK government strategies: the Industrial Strategy, the Clean Growth Strategy and the 25 Year Environment Plan. From the point of view of transport, it complements the Road to Zero Strategy, focusing on promoting the use of public transport and active travel.

3.8.3 Poor air quality represents a major environmental health risk in the UK. The focus for the Government is on particulate matter, which has the potential to shorten an individual's lifespan, either through intense short periods of exposure or prolonged periods of low level exposure. Transport is a key source of primary particulate matter (12%) and the Government intends to reduce this.

3.8.4 The immediate challenge for transport is to reduce nitrogen dioxide emissions (NO_2), particularly where its concentrations are above legal limits. Currently, road transport is responsible for 80% of NO_X concentration at the roadside. The Government actively supports individual local authorities to deliver their plans to improve air quality. This includes committing a £275 million Implementation Fund to enable local authorities to take the necessary action to improve air quality, and a £220 million Clean Air Fund to help them to minimise the impact of their local plans on individuals and businesses.

3.9 West of England Air Quality and Climate Change Policies

3.9.1 The WoE authorities have, for many years, put in place ambitious climate change and air quality policies. The sub-region has significant air quality challenges with a large number of roads exceeding legal air pollution limits, as a result of road traffic. The medium-term combined WoE carbon reduction target of a 50% reduction in absolute CO_2 emissions by 2035 from 2014 levels is referenced in the West of England Joint Spatial Plan (JSP).

3.9.2 As part of its Go Ultra-Low West (GULW) programme, the sub-region aims to install around 120 new public electric vehicle charging points across Bath and North-East Somerset, Bristol, North Somerset and South Gloucestershire.

Bath & North East Somerset

Climate Change

3.9.3 Bath and North East Somerset Council adopted their first Environmental Sustainability & Climate Change Strategy in 2010. A new strategy was adopted in 2016 with the overarching carbon reduction target for the area of 45% by 2029. The strategy is in line with the Government's target to cut national emissions by 80% by 2050.

3.9.4 Actions include a local green energy tariff, energy efficiency in existing homes, supporting community energy schemes and delivering energy efficient construction projects including an award-winning sustainable office building at Keynsham Civic Centre. The Council requires new build projects to reduce regulated CO_2 emissions by 19% beyond Building Regulations.

Air Quality

3.9.5 There are 5 Air Quality Management Areas (AQMAs) in Bath and North East Somerset where levels of NO_2 exceed maximum annual average permitted (40 $\mu g/m^3$):

- Bath (since 2002)
- Keynsham (since 2010)
- Saltford (since 2013)
- Temple Cloud (since 2018)
- Farrington Gurney (since 2018)

3.9.6 An Air Quality Action Plan has been created for the first three AQMAs, while for the recently declared Temple Cloud and Farrington Gurney (AQMA) an action plan is currently in development.

3.9.7 NO_2 has implications for health and can worsen respiratory diseases. It is estimated that 12,000 people in Bath and North East Somerset suffer from asthma, and exposure to high levels of NO_2 can trigger attacks.

3.9.8 Bath is the area that faces the greatest challenge in terms of air quality. The AQMA in Bath has been in place since 2002 and, in 2017, the Government's own modelling predicted that Bath would be exceeding limit values by 2020. As a result, the Clean Air

Plan was developed to meet the UK emission standards by 2021 at latest. The main measure of the plan is the implementation of a Charging Clean Air Zone (CAZ) for Bath by the end of 2020.

Bristol

Climate Change

3.9.9 Bristol City Council has a long history of working to tackle climate change and fuel poverty; in 2015 Bristol was the first UK city to be awarded the title of European Green Capital. The Council met its goal of reducing its own emissions by 40%, five years early and now aims to cut emissions by 65% by 2020 from a 2005 baseline.

3.9.10 The recently adopted One City Plan (2019) sets an Environment Vision for 2050, when the city will be carbon neutral. A long term plan is outlined up to 2050. Actions to be taken in 2019 include:

- Establishing 35 new Electric Vehicle charge points;
- Establishing a 'City Leap Energy Partnership' to strategically develop low carbon, smart energy infrastructure; and
- Public sector organisations committing to having 30% of their fleet non-fossil fuel by 2026.

Air Quality

3.9.11 In terms of air quality, both NO_2 and particulate matter are a key concern within Bristol, with an AQMA declared since 2001. The city is currently in breach of the annual objectives for NO_2 and it is likely that the short-term hourly objective for this pollutant is also exceeded in the most polluted parts of the city.

3.9.12 In terms of the impact this has on public health, a report commissioned by BCC used the Committee on the Medical Effects of Air Pollution (COMEAP) methodology to calculate that in 2013, approximately 300 (8.5%) of deaths in Bristol were attributable to particulate and NO_2 pollution[15].

3.9.13 In the 2018 Air Quality Annual Status Report the Council committed to develop a Clean Air Plan to achieve compliance with air quality objectives in the shortest possible time. In line with Government guidance, Bristol City Council is considering implementation of a Clean Air Zone (CAZ), including both charging and non-charging measures. On the 25th January 2016, the OLEV announced that Bristol (bidding with the WoE authorities) had been awarded £7.1m of funding over 5 years to promote the uptake of EVs (including plug-in hybrids) across the sub-region.

[10] https://fingertips.phe.org.uk/search/Air#page/0/gid/1/pat/6/par/E12000009/ati/102/are/E06000025/iid/30101/age/230/sex/4 (Accessed 10 January 2019)

North Somerset

Climate Change

3.9.14 North Somerset has adopted a carbon reduction target as part of its action for climate change. Climate Local plan adopts the West of England sub-region target to cut emissions by 50% by 2035 from 2014 levels which aligns to the Climate Change Act (2008). In North Somerset, the largest percentage of emissions is from the transport sector (45%), with a roughly even split attributed to the domestic (28%) and industrial and commercial sectors (25%)[16]. Action taken by the Council to reduce CO_2 emissions include:

- Improving the energy efficiency of the housing stock;
- Investing in sustainable transport scheme (MetroBus);
- Encouraging sustainable travel choices;
- Adopting of the NSC travel plan (carbon reduction targets and shift to EVs);
- Minimising waste; and
- Reducing CO_2 emissions from education facilities and urban lighting.

Air Quality

3.9.15 The results of the monitoring for 2015, as with previous years, shows that the levels of NO_2 in North Somerset are all below the annual mean air quality objective of 40 $\mu g/m^3$. As such, no Air Quality Management Areas (AQMA's) have been declared, and consequently there is no need to introduce an Action Plan to improve air quality in the area.

When considering the impact of air quality on public health, the proportion of adult deaths attributable to particulate air pollution is 4.4%[17]. North Somerset Council has already converted 50% of its own fleet to pure EV and has employed load balancing to cope with the amount of charging sessions. It has also signed-off the work to have a 6-10 bay charging hub in Portishead Marina, which will be complete by 2019, complete with solar array and both rapid and fast charging facilities.

[16] Percentages affected by rounding.

[17] Source: Public Health Profiles https://fingertips.phe.org.uk/search/Air#page/0/gid/1/pat/6/par/E12000009/ati/102/are/E06000025/iid/30101/age/230/sex/4 (Accessed 10 January 2019)

South Gloucestershire

Climate Change

3.9.16 South Gloucestershire's Climate Change Strategy 2018-2023 sets a target to reduce CO_2 emissions by at least 80% (on 1990 levels) by 2050, in line with the 2008 Climate Change Act. To deliver the strategy, the council is developing five action plans:

- Climate Resilience;
- Carbon Emissions Reductions;
- Renewables;
- New Development; and
- Low Carbon Economy.

Air Quality

3.9.17 Although the air quality in South Gloucestershire is generally good, the annual objective for nitrogen dioxide (40 $\mu g/m^3$) is being exceeded in the following two air quality management areas:

- Kingswood – Warmley AQMA
- Staple Hill AQMA

AQMAs were originally declared in Kingswood and Staple Hill in 2010. Both these AQMAs were extended in 2012, and an Air Quality Action Plan was produced in 2012 to improve air quality in these areas. The Kingswood AQMA was extended along the A420 to Warmley in 2015, and an update of the Action Plan is in progress.

3.9.18 Revocation of the third AQMA in South Gloucestershire at Cribbs Causeway, next to the M5 motorway junction 17, is proposed as monitoring has shown the levels of nitrogen dioxide to be below the annual mean objective for a sustained period of time. Following Government instruction, a targeted feasibility study has also been undertaken on a 1.27km section of the A4174 Ring Road between the Bromley Heath and M32 Junction 1 roundabouts as this section of road was predicted to exceed the nitrogen dioxide EU annual mean limit value by government modelling. South Gloucestershire Council are part of a cross authority working group to consider how the proposed Clean Air Zones in Bristol and Bath may impact on the administrative area.

3.9.19 When considering the impact of air quality on public health, the proportion of adult deaths attributable to particulate ($PM_{2.5}$) air pollution in South Gloucestershire is similar to Bristol (at 5.2% compared to 5.3% in Bristol)[18].

[18] Source: Public Health Profiles https://fingertips.phe.org.uk/search/Air#page/0/gid/1/pat/6/par/E12000009/ati/102/are/E06000025/iid/30101/age/230/sex/4 (Accessed 10 January 2019)

3.9.20 The Council's Air Quality Annual Status Report (ASRs) includes details of the measures implemented and planned to improve air quality. These include in the current 2018 Annual Status Report:

- The upgrade of 81 Euro IV buses to Euro VI standard to reduce NO_X emissions through the Clean Bus Technology Fund (CBTF) in 2018;
- Transformation of the bus fleet into bio-methane powered buses through a £4.79m Office for Low Emission Vehicles (OLEV) funding grant;
- Entire fleet of Council pool cars switched to electric in early 2017, with OLEV funding secured to switch 20% of other fleet vehicles to electric by 2021; and
- Access funding secured to 2020, to enable the continuation of school, business and community travel planning measures to promote sustainable travel choices.
- Local Government Fund Sustainable Transport Package: sustainable travel packages– which have implemented numerous improvements to cycle and foot paths to encourage sustainable transport and connectivity to key employment areas across the WoE sub-region.

3.9.21 Better bus area fund – due to end in March 2019 but has delivered improvements over the past 5 years to bus routes across the WoE sub-region. These include bus stop improvements, bus prioritisation, CCTV monitoring schemes. Future wider sub-regional measures include:

- Public transport improvements (MetroBus, MetroWest rail);
- Cycle routes improvements (Cycle Ambition Fund); and
- Promotion of active travel

4. MARKET TRENDS & UPTAKE FORECASTS

4.1 Trends and forecasts

4.1.1 As suggested in the previous chapter, ULEVs are considered key to enabling the delivery of emission reductions and improved local air quality. In order to suitably define the minimum requirements to stimulate increased uptake of ULEVs in the coming years and decades, it is important to first look at the current market trends and uptake forecasts. These will provide an indication of what current demand is and what it is likely to look like in the future, to form the basis of the recommendations presented in subsequent chapters.

4.1.2 The two most common types of ULEV[19](defined by OLEV as 'vehicles that emit less than 75g of carbon dioxide (CO_2) for every kilometre travelled') and the focus of this report, are:

- Plug-in hybrid electric vehicles (PHEVs) - utilise both an electric motor and an internal combustion engine (ICE) giving them the ability to be recharged from the mains or refuelled using petrol or diesel.
- Battery electric vehicles (BEVs) - only use an electric motor, and derive all power from on-board battery packs, which are charged using a power cable connected to the mains.

4.1.3 The Department for Transport (DfT) licensing statistics indicate that in 2018, ULEVs accounted for 2.1% of all new vehicle registrations nationally – an increase on the 1.5% and 1.2% share respectively for the two years previously (see Figure 1). In the south west of England (i.e. including the WoE sub-region), uptake has been lower than the UK average, with EV sales in the sub-region making up a 0.68% share of new vehicle sales in 2016[20].

[19] Although there are a number of different drive and power-train configurations which have been developed, we have assumed that in the future ULEV fleet will predominantly comprise BEVs and PHEVs and therefore these are the focus of this report and analysis.

[20] https://www.westernpower.co.uk/downloads/6710 (Accessed 18 January 2019)

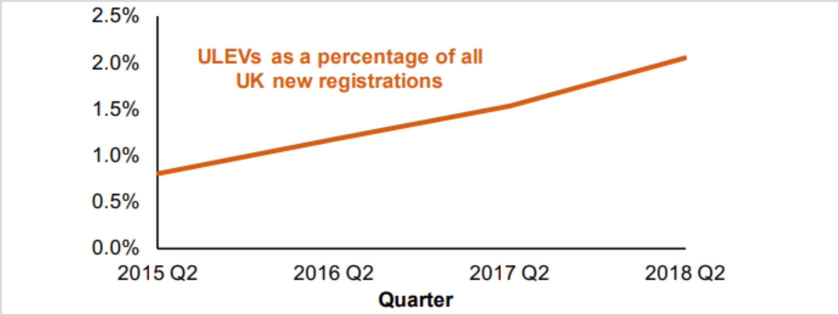


Figure 1. National ULEV registrations

4.1.4 In Q2 2018, the number of ULEVs registered nationally increased by 12,943; which is 26% greater than the increase recorded in Q2 2017 (from the previous year) and 48% greater than the increase recorded in Q2 2016. This demonstrates that the rate of uptake is increasing.

4.1.5 Looking specifically within the Go Ultra Low West (GULW) area, which includes the WoE sub-region, the number of ULEVs registered increased by 604, which is 202% greater than the increase recorded in 2017 Q2 (from the previous year) and 241% greater than the increase recorded in 2016 Q2. This puts the WoE sub-region in a positive position, having started from a lower baseline than the national average, with only 0.3% of all cars owned in the south west of England (including the WoE sub-region) being EVs. Indeed, this gap has started to narrow from Q2 2017[21].

4.1.6 Forecast EV uptake across future energy scenarios is typically revised upon an annual basis, however as with any forecast there is still a degree of uncertainty surrounding the scale and pace of the transition to EVs. The DfT provides an indicative ULEV uptake trajectory as a percentage of new car sales, which is depicted by Figure 2. It is anticipated that by 2025, ULEVs will make up 15-30% of new car sales, with a less certain future post 2025 – a result of 'significant uncertainty over some of the key drivers of the transition – including battery technology and new mobility services' (as per the DfT's Road to Zero report, 2018).

[21] https://www.westernpower.co.uk/downloads/6710 (Accessed 17 January 2019)

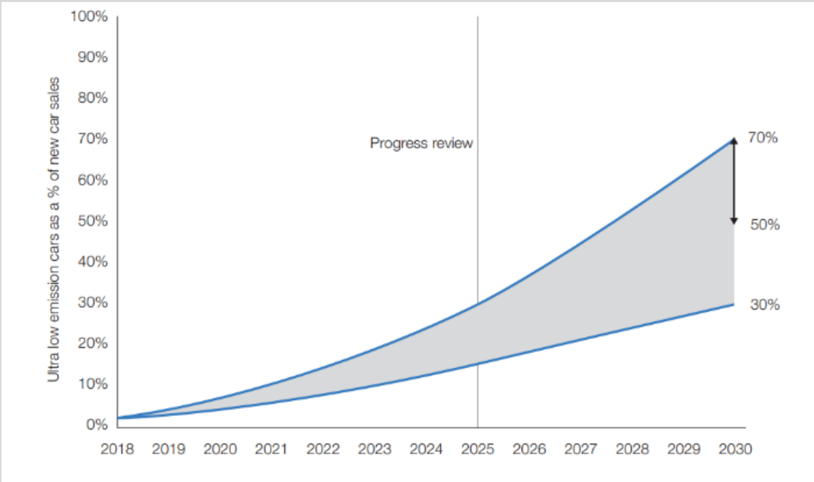


Figure 2. Projected uptake of ULEVs

4.1.7 With respect to the WoE sub-region, a 2018 study by Cenex, in partnership with the Energy Saving Trust[22], considered local uptake characteristics to present a comparison between the local and national uptake of EVs across the following three plug in vehicle (PiV) scenarios:

- ***Low:*** This represents a baseline 'business as usual' scenario where a low level of EVs are purchased by drivers in line with general UK EV uptake rates. Future uptakes have been estimated by applying a linear extrapolation to historic car grant application data supplied by OLEV.
- ***Medium:*** This scenario utilises the DfT new car registration data, with the assumption that new car registrations are currently in a downturn trend (mirroring the trend between 2009-2016). Cenex have then assumed a linear increase in EV new car registrations from 3.2% in 2018 to 10% in 2025.
- ***High:*** This scenario represents an aggressive EV uptake as required to meet the UK 2050 greenhouse gas emission reduction targets. This is the basis for the Committee for Climate Change's (CCC) central scenario.

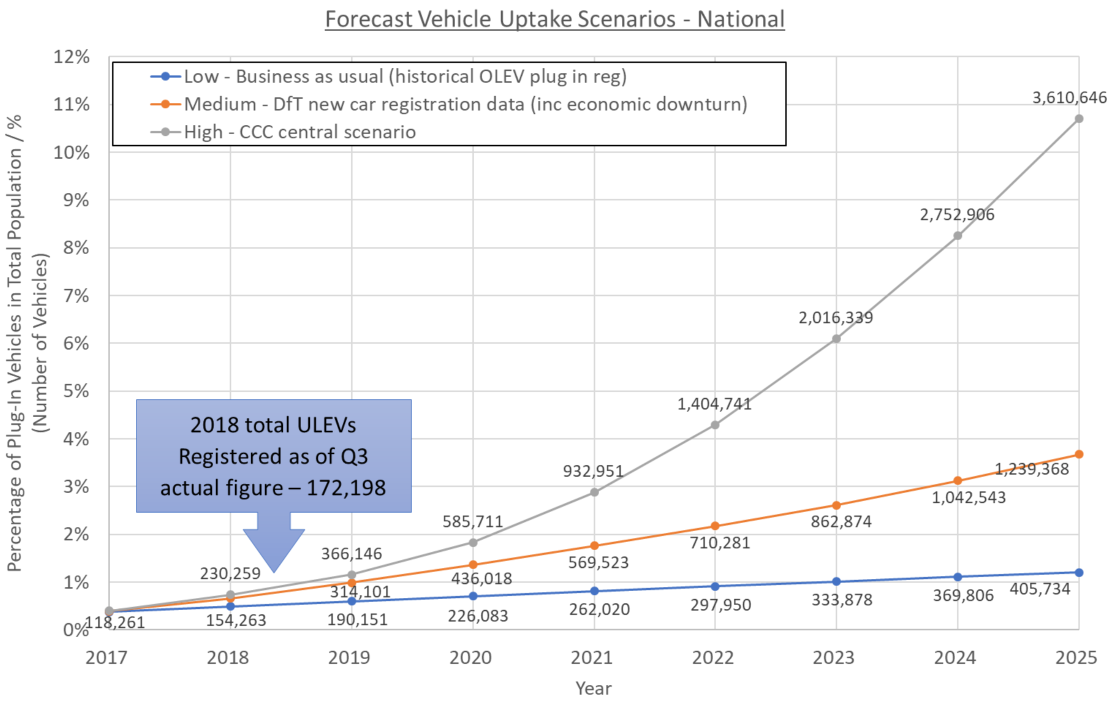
4.1.8 The resulting uptake of EVs from the three scenarios in the WoE is presented in Figure 3 (overleaf), with the total number of EVs per year shown as data labels in each scenario.

4.1.9 As shown, by 2025 the uptake of plug-in vehicles is likely to range from 1 to 11% accounting for between 8,250 and 73,500 EVs respectively within the WoE sub-region, compared to anywhere between 405,734 to 3,610,646 nationally.

4.1.10 The 2018 Cenex study also presented analysis of data from the 2017 National Travel Survey, which demonstrated that average mileage for the southwest sub-region is 18.6 miles per day (based on an average mileage per trip of 9.3 miles, compared to 6.8 miles

[22] Cenex & Energy Saving Trust (2018). Project report: Go Ultra Low West Chargepoint Infrastructure Study

nationally; and two trips per day) and that most road users would see benefits from electrification.



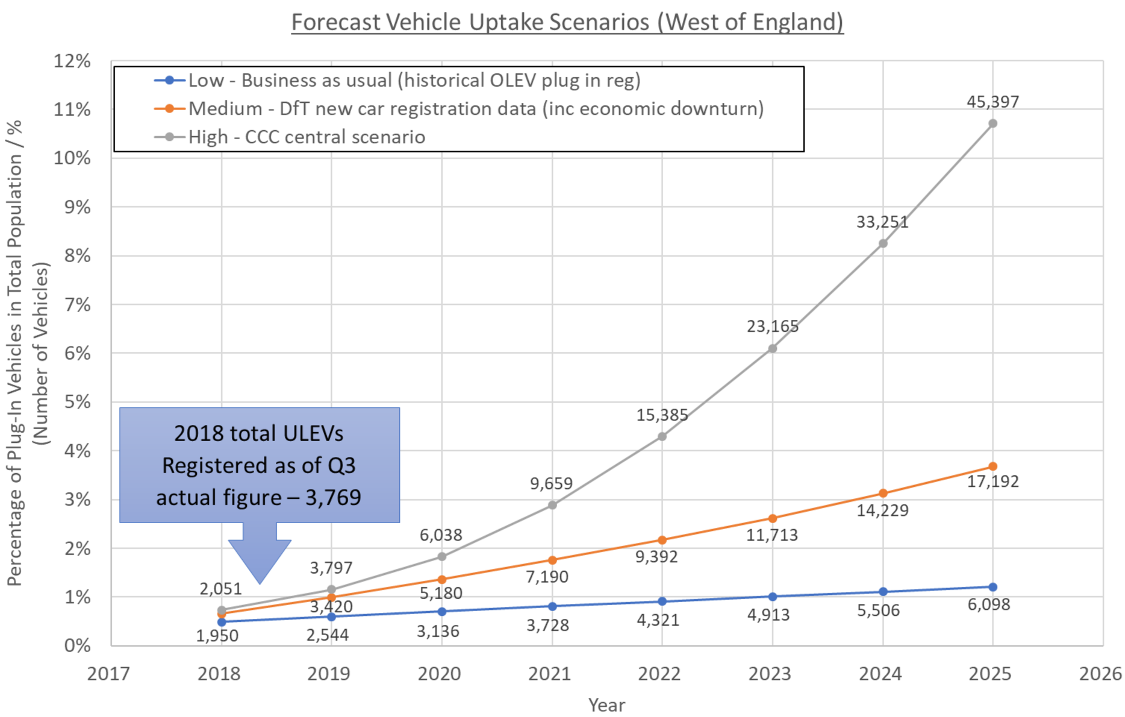


Figure 3. Forecast uptake of plug-in EVs to 2025 - national v WoE sub-region

4.2 Factors influencing EV uptake

4.2.1 The changes in UK governmental policy, strategies and available funding, alongside the manufacture of over 77 EV models (in 2018), points to an EV future. This is acting to stimulate the uptake of EVs, and to push decarbonisation of the transport sector, contributing to improved air quality. However, long waiting lists of up to 12 months are common for a range of available EV models and this could impact on the rate of uptake. This is a result of a number of factors including the fact that demand for certain new EVs coming to market, for example the Hyundai Kona, with higher ranges, has been far higher than Original Equipment Makers (OEMs) had anticipated and as a result the allocated production capacity cannot keep up. This has combined with similar supply issues with batteries (especially the rare metals that go into them).

4.2.2 The uptake of EVs is still relatively slow, particularly when considering the Government's ambition to end sales of new petrol and diesel cars and vans by 2040, with the goal that almost every car and van will be zero emission by 2050. This is partly due to the current cost and range of vehicles when compared with their petrol and diesel counterparts and the availability and visibility of charging infrastructure. The second-hand market for EVs is also still in its relative infancy and residual values remain strong due to demand outstripping supply for EVs in general, as mentioned. A 2017 AA survey found that the biggest perceived barrier to EV use was the availability of publicly accessible charging stations, indicated by 84%[23].

4.2.3 The perceived higher cost of EVs compared to ICE vehicles associated with current higher upfront vehicle costs is also a major deterrent to consumers looking at purchasing a new vehicle, despite the average lifetime costs for EVs having already fallen below that of ICE vehicles. Although this problem will solve itself in time, as the upfront cost of EVs continues to fall reaching cost parity with ICE by 2022[24], it is important prior to this to raise public awareness of the low upkeep costs (fuel, maintenance, tax and parking permit savings).

4.2.4 Although advertised EV range is notably increasing, third party testing still indicates that models can only generally cover 58 to 242 miles on a single charge, depending on the model[25]. In comparison, a new diesel estate car can reportedly cover 1,860 km on a single tank, reportedly emitting between 100 and 114 g/km of CO_2 under Euro 6 regulation (although it should be noted that a number of studies have found that new

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[23] https://www.theaa.com/about-us/newsroom/switching-from-diesel-to-electric (Accessed 12 February 2019)

[24] Green Alliance (2018). How the UK can lead the electric vehicle revolution (https://www.green-alliance.org.uk/resources/How_the_UK_can_lead_the_electric_vehicle_revolution.pdf) (Accessed 15 January 2019)

[25] https://www.which.co.uk/news/2017/10/the-truth-about-electric-car-ranges/ & http://www.petroleum-economist.com/articles/midstream-downstream/transport/2018/ev-market-accelerates-on-cost-parity (Accessed 15 January 2019)

diesel cars are still breaching real world NOx emissions targets, even under these standards, [26,27] further supporting the case for a move toward an electric fleet).

4.2.5 The question is whether consumers require such a significant range, when the majority of people travel less than 80 km on a day to day basis should be raised. For these types of journeys, an EV would meet consumer needs, providing there is access to charging facilities.

4.2.6 In addition to this, a DfT study entitled 'Public Attitudes Towards Electric Vehicles' (2016)[28] identified recharging as the most important factor deterring people from buying an electric car, with 45% of respondents highlighting this as an issue. People surveyed listed concerns about the availability of charging infrastructure, and a lack of knowledge regarding where to access them.

4.2.7 The current stock of electric vehicle chargers can broadly be classified into five main categories: slow, standard, fast, rapid and ultra-rapid chargers. The terminology is indicative of the power output and hence the amount of time required for charging a vehicle. As noted in the RAC's report[29] (Dec 2018), the charger by the roadside and the charge controller in the vehicle are in series. The maximum power input a vehicle can accept whilst charging, and the time taken to recharge the vehicle, is dictated by whichever of these has the lowest power rating. Cheaper slow chargers are typically utilised at home or workplaces, where cars are likely to be parked for longer periods. Though rapid chargers are significantly more expensive than slow chargers, they provide practical options with charging partway through a journey, i.e. at motorway service stations.

4.2.8 Research by Cenex and the Energy Saving Trust (2018)[30], looking specifically at the WoE sub-region, also identified that charging at home is the most important location for EV owners and prospective owners, particularly in the evenings. Therefore, providing infrastructure in residential areas will be crucial to ensure that the numbers of EVs in the UK continue to increase.

4.2.9 Although there is already approximately one charging point for every EV in the UK, they are unequally distributed, as depicted by Figure 4.

[26] https://www.theicct.org/publications/true-real-world-pv-emissions-rating-system (Accessed 12 February 2019)

[27] https://www.which.co.uk/reviews/new-and-used-cars/article/air-pollution-and-car-emissions/from-nox-to-co-dirtiest-and-cleanest-carmakers-revealed (Accessed 12 February 2019)

[28] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/551446/electric-vehicles-survey-2016.pdf (Accessed 15 January 2019)

[29] Development of the UK Public Chargepoint Network. Harold Dermott, RAC Foundation, December 2018.

[30] Cenex & Energy Saving Trust (2018). Project report: Go Ultra Low West Chargepoint Infrastructure Study

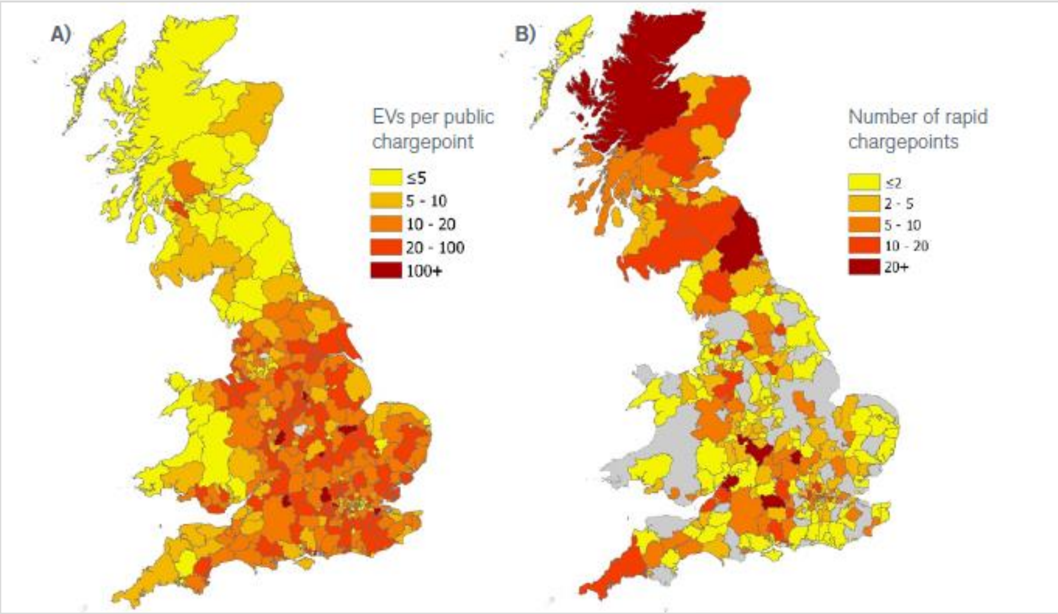


Figure 4. UK charging network

4.2.10 As reported in 'Uptake of Ultra Low Emission Vehicles in the UK' (2015)[31] produced by Brook Lyndhurst Ltd. on behalf of the DfT, the perceived lack of available charging infrastructure in localities is frequently highlighted by prospective consumers as a barrier to EV uptake. Surveys suggest that anywhere from 30% to 60% of respondents considered the network of public charging infrastructure to be insufficient, thus deterring them from considering purchasing an EV. Although many people have access to charging facilities at home, most emphasise that they would require access to public charging facilities before considering an EV.

4.3 Summary (Chapters 1-4)

4.3.1 As demonstrated, EVs currently represent a small, yet progressively growing proportion of vehicle market share. Encouragingly, Ofgem also emphasises that EVs are no longer a far-off concept, but rather a rapidly growing feature of the modern transport system.

4.3.2 EVs are ultimately valued as a future asset in the pursuit of a more sustainable transport and energy system, facilitating our daily movement needs, whilst also contributing to a reduced dependency on fossil fuel reserves, providing an energy storage function to support renewable power and helping to reduce carbon emissions.

4.3.3 Projected forecasts outline a requirement for a new infrastructure, in order to support the uptake of EVs and ensure regions do not fall behind, which could cause local authorities to miss out on potential innovation, employment opportunities and the

31 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/464763/uptake-of-ulev-uk.pdf (Accessed 15 January 2019)

capital investment to support a technology which is projected to dominate the automotive industry within the next 30 years.

4.3.4 The Government has shown its intention to support the technology. The next step will be to ensure appropriate policy filters down through the plan-making process, and to local planning policies, ensuring EV infrastructure becomes a material planning consideration for new development.

4.3.5 The National Planning Policy Framework (NPPF) is the mechanism through which the Government is starting to filter down the necessity of EV provision to local authorities and as of 2018 identifies that planning applications will need to 'be designed to enable charging of plug-in and other ultra-low emission vehicles in safe, accessible and convenient locations.' The NPPF is a material consideration in its own right.

4.3.6 As such, policy must not only respond to the requirements of the NPPF, but also to other challenges that need to be addressed, including ensuring infrastructure is robust and resilient through and beyond Local Plan periods, and that it is recognised that long term commitment to the delivery of EVs will run parallel with the need to improve air quality and the transition away from the ICE.

4.3.7 The NPPF also requires that authorities give consideration to the differences in planning required for rural and urban contexts. The following points are the most relevant when considering how policies may need to differ for rural locations:

> *'77. In rural areas, planning policies and decisions should be responsive to local circumstances and support housing developments that reflect local needs.'*
>
> *'84. Planning policies and decisions should recognise that sites to meet local business and community needs in rural areas may have to be found adjacent to or beyond existing settlements, and in locations that are not well served by public transport. In these circumstances it will be important to ensure that development is sensitive to its surroundings, does not have an unacceptable impact on local roads and exploits any opportunities to make a location more sustainable…'*

4.3.8 There can be no doubt that the NPPF is supportive of development in rural locations and recognises that communities may well share facilities. Whilst every effort in plan-making should be made to ensure that walking, cycling and public transport take precedent, there will continue to be a reliance on cars as a mode of travel. That is not to say that cars will need to be in the ownership of individuals, but that the opportunity to make trips to key facilities is reasonable and achievable.

4.3.9 In a high density urban settings, policy on EV charging will need to recognise that the trend is towards making parking communal and on-street to maximise housing density. Garages/rear courts and basements are becoming increasingly rare, as they take up valuable space and are not often used for cars in any event, due to limited storage within new houses. Building active EV charging provision into the street scene at the design and construction phase is essential to avoid risks to the highway asset being dug up retrospectively and it will provide important opportunities for combining this infrastructure with tree planting and traffic calming measures. Building active EV provision at the design and construction phase will also help to minimise disruption to the pavement and ensure that active EV charging can be provided safely.

4.3.10 It is important to recognise that development today takes different forms and that, whilst significant, the provision of suitable EV charging infrastructure as part of new developments, is essential in removing the reliance on ICE to more sustainable forms of vehicle.

4.3.11 Understanding the types of development that will come through planning is considered to be integral to the development of a sustainable and successful EV charging platform.

5. COST BREAKDOWN OF EV CHARGING INFRASTRUCTURE

5.1.1 Understanding the costs of installing EV charging infrastructure is an essential requirement in order to determine what the reasonable minimum and optimum requirements for provision in new developments might be, and therefore what standards can be set out within planning policies.

5.1.2 Costs of EV charge points can be split simply into hardware and installation. In terms of charge point hardware, the cost is typically dependent on the power rating of the unit, i.e. the higher the power output and the faster the charging time, the more costly the infrastructure. In most cases, this accounts for up to 50% of the total budget for installation. The power rating of a charge point has an almost exponential impact on the cost of EV charging hardware and, therefore, when proposing minimum requirements with respect to power rating (how fast chargers should be), it is important to base these on two key considerations: typical dwell time of vehicles at the specified location (i.e. how long the vehicle will remain stationary at a charge point) and the distance that can be travelled between charges. These considerations also influence consumer charging behaviour, whether that is 'journey charging' (where the primary reason for being at the location is to charge the vehicle, for example using a public rapid charger); or whether that is 'grazing charging' (whereby the consumer travels to a location for another reason and takes the opportunity to use a charge point at their location, e.g. in a public car park they would normally use – this tends to be 7kW chargers)[32].

5.1.3 With respect to installation, costs related to the groundworks associated with putting cabling into the ground, which could involve excavation, earthing, electrical cabling (the cost per meter for the cabling itself), signage, road markings and protective barriers. Costs of installation can vary greatly depending on a number of different factors, including:

- Distance of charge points from the existing electrical supply, as the further the distance to travel, the more excavations and length of cabling is required.
- Diameter of cabling, with thicker cabling such as that needed for faster chargers costing more.
- Ground type, with roads typically costing more to excavate than turf or soil.
- Demarcation of parking bays, if bay painting, protective barriers and signage that are not factored into installation costs.

5.1.4 A particularly relevant consideration when it comes to new developments is the cost saving associated with installing EV charge point infrastructure at the same time as other earthworks and electrical fitting is taking place, thereby avoiding additional labour costs and having to excavate the ground multiple times. This means that installing EV

[32] https://www.racfoundation.org/wp-content/uploads/Development_of_the_UK_CPN_Harold_Dermott_December_2018.pdf (Accessed 13 February 2019)

charge points at new developments will be more cost efficient than retrofitting at existing infill developments.

5.1.5 Table 2 provides the approximate minimum costs that can be expected by developers for the minimum specification of EV charging infrastructure. These costs are based on the factors outlined above and the following assumptions:

- Active provision is defined as the provision of active charging points such that each user has the opportunity to charge their vehicle at the same time with a total charging time not exceeding 8 hours (the requirement of the charging time allows for some degree of future proofing as technology adapts).
- Passive provision is defined as establishing all of the associated cables, chambers and junctions to allow for charging points to be installed at a later point without the need for undertaking works that require breaking ground to install cabling retrospectively. Further funding and manual work would be required to deliver operational charge points.
- A 7kW charger (32amp) is the minimum level required to meet the needs of EV users who typically have long vehicle dwell times, e.g. at home and work locations or park and ride sites.
- Provision of a rapid charge point (43-50kW) is likely to require installation of additional electrical supply infrastructure such as a substation. This has been confirmed by Western Power Distribution.
- Costs for a passive rapid provision would be significantly higher and it would not be a reasonable proposition to undertake the highly expensive civil work required to prepare for a rapid charger, without certainty that one would be deployed to utilise the upgraded groundworks.
- Charger types and charging times are approximately as follows, subject to vehicles being able to accept the higher power outputs:

  - Slow charging (≤3kW): utilises standard three-pin sockets. The limited power available from these sockets means that charging units experience long dwell times i.e. eight or more hours. This method of charging is not recommended as it does not meet OLEV minimum standards.
  - Standard charging (3.5-7kW): charging that occurs between 3.7kW and 7kW using an AC power source. For typical EV battery sizes (15 to 60 Kw), these charge points can provide a full charge to a vehicle within 2 to 8 hours for 3.6kW chargers and within 3 to 4 hours for a 7kW. This uses a type 2 connector.
  - Fast Charging (7-25kW): typically enables charging up to 80% in 3-5 hours for a 7kW charge point and 1 to 2 hours for a 22kW charge point. These charge points are commonly found in areas where dwell commonly ranges between 1 to 4 hours. This uses a type 2 connector.
  - Rapid Charging (43-62kW): for the majority of EVs, these chargers can provide up to 80% of the vehicles charge in 20 to 50 minutes, depending on battery size. This uses CCS and CHAdeMO connectors.
  - Ultra-Rapid Charging (120-400kW): Currently under development for faster charging methods which are more aligned with the speed of current refuelling methods (minutes).

- For all EVs when AC charging, the overall charge rate will be whichever is the lower the charge rate of the roadside charge point and the charge rate of the vehicle's on-board charger (RAC: Development of the UK Public Chargepoint Network).
- Maintenance and other costs, such as insurance and warranty following installation are not covered in full in this report. However, maintenance plans for domestic charge points are generally uncommon. The low cost of hardware means they are generally replaced rather than repaired, and that regular maintenance is not necessary. For fast public charge points, (7-22Kw) maintenance contracts run at around £100-£200 a year per point (for one site visit per year); however, there are a range of levels of service available dictating things like callout response times. For rapid public there is a similar setup to fast maintenance contracts; these are generally more expensive at £300-£1,000 per point.
- Where local authorities take on charging points as part of Section 38 Agreements, there are a range of potential management arrangements. Local authorities could procure a third party to own and manage the charging infrastructure by way of a lease or licence. Local authorities should decide if they want a fixed income or a share of the revenue for this. Alternatively, the local authority could choose to own and manage the infrastructure directly[33].
- As part of a Section 38 Agreement, developers would need to provide a plan of the proposed EV infrastructure indicating positioning, manufacturer and specifications for the equipment, also providing warranty details and maintenance requirements.
- Wireless charging has not been considered, as products are not yet ready for market. This method of charging is not considered to be a minimum requirement, particularly due to the associated 8-10% energy efficiency loss, making cable charge points preferable.
- Lamp column charging is considered a predominantly retrofit solution in instances where it is not feasible to provide floor or wall mounted charge points. More details regarding lamp column charging are provided in Section 6.3.
- In the future, costs for civil works are unlikely to change significantly, however standard hardware costs will come down as demand/production increases as a result of economies of scale. The provision of smart hardware will result in a premium, but overall prices will reduce over time. The cost of policies should be revised at least every 5 years as part of the Local Plan revision process.

5.1.6 In addition to these costs, there are also other potential variable costs which may derive from the actions of those actors involved in the charging points' delivery. These actors are typically:

- The Distribution Network Operator (DNO)
- The Energy Supplier
- The Installer
- Internal Stakeholders
- The Landlord

[33] More guidance on the options can be found: https://www.lexology.com/library/detail.aspx?g=0caa2d55-2825-4592-a499-53188a07d1dc (accessed February 2019)

5.1.7 It is recognised that infrastructure costs vary and the anticipation would be that in cost planning, the tendency would be towards lower costed solutions for infrastructure of this nature so long as it is fit for purpose. Developers will have their own expectations of building quality and, again, this will inform if they prefer a higher priced / quality item in cost planning.

5.1.8 There is an anticipation that cost consultants will be employed to assist larger developers in understanding the larger complex costing implications. We consider that any development exceeding 10 dwellings or 1000m^2 for non-residential development will be classed as major development.

5.1.9 For smaller developments, a mid-range price based on the current market values for infrastructure has been taken, although year on year there will be changes in price based on demand, availability and inflation that will require consideration.

5.1.10 Depending on the business model chosen for the development, costs will be distributed among different stakeholders. The ownership model after installation will also affect the distribution of operation and maintenance costs.

5.1.11 The policy introduced in the WoE sub-region will need to take into account whole plan viability, considering EV policy alongside other climate change policies, affordable housing and wheelchair accessible housing, etc.

5.1.12 In order for the WoE sub-region Unitary Authorities to ensure that they develop policy that can be reasonably delivered by developers, it will be necessary to carry out viability assessments of the costs associated with EV charging infrastructure provision to ensure that development opportunities are not suppressed and that policies do not undermine the deliverability of the Local Plan. This is set out in NPPF (2019):

> *'57. Where up-to-date policies have set out the contributions expected from development, planning applications that comply with them should be assumed to be viable. It is up to the applicant to demonstrate whether particular circumstances justify the need for a viability assessment at the application stage. The weight to be given to a viability assessment is a matter for the decision maker, having regard to all the circumstances in the case, including whether the plan and the viability evidence underpinning it is up to date, and any change in site circumstances since the plan was brought into force. All viability assessments, including any undertaken at the plan-making stage, should reflect the recommended approach in national planning guidance, including standardised inputs, and should be made publicly available.'*

5.1.13 Table 2 provides a detailed breakdown of EV infrastructure costings that can be used in WoE sub-region viability assessments. This includes a detailed estimate of how much councils can 'expect' developers to pay per dwelling towards the cost of installing EV infrastructure.

5.1.14 It is also necessary to consider retrofit costs, as infill development may require additional infrastructure to meet power requirements. These costs are outlined in Table

3 and will also be subject to viability assessments by councils to ensure that any relevant policy incorporated into the Local Plan is viable.

Table 2. Indicative cost breakdown of electric vehicle infrastructure

INSTALLATION TYPE	KEY ASSUMPTIONS	COST FOR DEVELOPERS	COST BREAKDOWN	TOTAL COST TO DEVELOPER
Passive: 7kW domestic	Cabling and RCD to enable post occupancy installation of 7kW 32amp OLEV compliant wall mounted domestic charge point. Home owner to purchase and install charge point.	Sufficient power provision RCD and cabling	Per property cabling and Residual Current Device (RCD) approximately £200 Sufficient power provision to enable 7kW, 32 amp charging – dependent on development location and size costs estimated from zero to £300 per property UK Govt. grants from OLEV are currently available for domestic charge point installation when a plug-in vehicle is purchased/leased https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/710071/evhs-guidance-for-customers-v-2.2.pdf Grant covers 75% cost up to max of £500	£200 to £500 per unit of charging infrastructure. These costs are based on the range of infrastructure available and not reflective of multiple installations based on scale of development. Whilst some cost savings may be achievable for a larger number of installations the consideration for minimum cost to developers is as follows: 1 dwelling - £350 10+ dwellings - £300 per dwelling 100+ dwellings – £200 per dwelling 500+ dwellings - £200 per dwelling
Active: 7kW domestic	Cabling, RCD and 7kW 32amp OLEV compliant wall mounted domestic charge point.	Sufficient power provision RCD and cabling	Per property cabling and RCD approximately £200 Wall mounted OLEV compliant smart 7kW charger £500 - £1,500 Installation circa £300 Sufficient power provision to enable 7kW, 32 amp charging – dependent on development location and size costs estimated from zero to £300 per property	£750 to £1,500 per unit of charging infrastructure. These costs are based on the range of infrastructure available and not reflective of multiple installations based on scale of development. Whilst some cost savings may be achievable for a larger number of installations the consideration for minimum cost to developers is as follows: 1 dwelling - £1,125 10+ dwellings - £1,000 per dwelling 100+ dwellings – £750 per dwelling 500+ dwellings - £750 per dwelling
Passive on street and car parks 7kW publicly accessible	Cabling only no groundworks.	Sufficient power for whole development and on street cabling	Cabling to enable ground or wall mounted charge points to be installed at designated locations. Cable costs approx. £40-£50 per metre. Sufficient power provision to enable 7kW, 32 amp charging – dependent on development location and required number of charge points. Cost guide zero to £300 per charge point.	£40-£50 per metre Cost guide zero to £300 per charge point

Active: On street and car parks 7kW, 32amp	Option 1 Cabling and all groundworks but not including charge point or ancillaries Option 2 Charge point, signage, protective barriers, ground markings	Sufficient power for whole development and on street cabling, groundworks, feeder pillars and ancillaries.	**Cabling to enable ground or wall mounted charge points to be installed at designated locations**. Cable costs approx. £40-£50 per metre. Sufficient power provision to enable 7kW, 32 amp charging – dependent on development location and required number of charge points. Cost guide zero to £300 per charge point. **Hardware costs:** Wall mounted dual type 2 7kW - £1,200 to £2,700 Ground mounted dual type 2 kW - £1,700 to £5,000 **Installation:** Wall mounted approximately £500 Ground mounted approximately £2,500 **Component costs:** Excavations - £120 (turf) to £250 (road) per metre (could be reduced if installed in tandem with pavement installation). Earthing - £300 to £500 per dual unit Signage - £75 - £100 Road markings - £75 - £150 per bay Protective barriers £150 - £300 per charge point DNO connections if required up to £2,500 **Traffic regulation orders if required** (these will not be required for car parks on private land). Third party charge point operator and hardware providers could either own and operate the equipment or operate under a concession with revenue share. This could reduce or remove cost to developer and/or provide additional revenue stream. This will be location and development specific and based on potential business case.	Cost for installed dual (2 vehicle) charging From £2,000 to £10,000 per unit for developments where chargers can be connected to existing cabling. Where possible, such as in multi-storey car parks, installing a wall mounted unit could reduce the lower estimate to around £1,000. Groundwork only costs £500, to £3,000 per dual unit
Active on street 22kW (Fast)	As above	Sufficient power and three phase cabling	As above. **Hardware costs:** Wall mounted dual type 2 7kW - £1,800 to £4,000 Ground mounted dual type 2 kW - £3,000 to £5,000 Installation costs similar to 7kW however cabling and DNO costs could be higher. **Estimated installation costs:** Wall mounted approximately £1,000 Ground mounted approximately £3,000	Cost for installed dual (2 vehicle) charging From £3,000 to £12,000 per unit Groundwork only costs £1,000, to £5,000 per dual unit

Active on street 43-50kW (Rapid)	Rapid charger with three connectors for CCS, ChaDeMo 50kW DC and type 2 43kW AC	Sufficient power, ideally located near substation	**Hardware costs:** Ground mounted £15,000 to £30,000 Estimated installation costs: £20,000 to £50,000 Power provision and DNO costs can vary significantly and cost from £2,000 - £30,000 Installations taller than 1.6m will be a planning consideration. Private sector operators may be interested in installing and owning hardware if they deem the location to have a large customer base.	£50,000 to £80,000 per unit

Table 3. Retrofit Direct Network Operator costs for retrofit (infill) solutions

SMALL (UP TO 70KVA)	MEDIUM (200KVA – 1,000KVA)	LARGE (ABOVE 1,000KVA)
NUMBER OF CHARGE POINTS		
1-3 Fast or 1 Rapid	10-50 Fast, 4-20 Rapid or 1-6 Ultra-Rapid	50+ Fast, 20+ Rapid or 6+ Ultra-Rapid
APPROXIMATE CONNECTION TIME		
8-12 Weeks	8-12 Weeks	6 Months +
APPROXIMATE CONNECTION COST		
£1,000 - £3,000	£4,500 - £75,000	£60,000 - £2 million
OTHER CONSIDERATION AFFECTING COST		
• Street work costs	• Street work costs • Legal costs for easement and wayleaves	• Street work costs • Legal costs for easement and wayleaves • Planning Permission • Space for a substation

6. PLANNING POLICY RECOMMENDATIONS

6.1.1 The aim of this section is to provide informed recommendations on how to ensure EV infrastructure provision is delivered through planning in order to facilitate the uptake of EVs in the WoE sub-region.

6.1.2 The study uses the evidence presented in previous chapters to present the optimal policy for promoting EV uptake along the high trajectory, as well as minimum requirements to ensure a level of future proofing for the years and decades to come. It recognises that a lack of existing charging infrastructure is a key barrier to uptake (as identified in Section 4).

6.1.3 The recommendations presented here are intended to give local authorities a basis from which to decide **where on the spectrum towards the optimal policy position they wish to be,** taking into account the different levels and types of development in their jurisdiction.

6.2 Provision of active and passive infrastructure

Background

6.2.1 According to National Travel Survey data, the average car trip length in the south west of England is relatively low, at 9.3 miles. This suggests that the travel habits of the population of the WoE sub-region are well suited to the use of EVs, particularly as charging infrastructure provision increases.

6.2.2 As previously stated, by 2025, the uptake of plug-in vehicles is likely to range from 1-11%, accounting for between 8,250 and 73,500 EVs respectively within the WoE sub-region, compared to 3,462 EVs in Q2 of 2018. Even the low end of this forecast would mean an additional 4,788 EVs in the sub-region which will likely all require some provision of home (residential) charging.

6.2.3 Based on these figures, it is clear that active provision of EV charging infrastructure is required in order to support the uptake of EVs. Additional passive provision should be provided in instances where active provision is not provided in order to 'future proof' and meet future demand forecasts, while taking advantage of the reduced costs of installing EV infrastructure at new developments as opposed to retrofitting existing developments.

6.2.4 In addition to this, from the Cenex and Energy Saving Trust study (2018), we know that the opportunity to charge a ULEV at home is often a deciding factor in whether or not a prospective buyer will purchase a ULEV, as it reduces the requirement to charge during driving hours and enables the driver to ensure their vehicle starts the day fully charged. In the same study, those people who do own EVs, indicated their preference to charge at their home (see Figure 5) and therefore residential provision of infrastructure must be a priority. This is an opportunity for policy makers to positively influence vehicle type purchases.

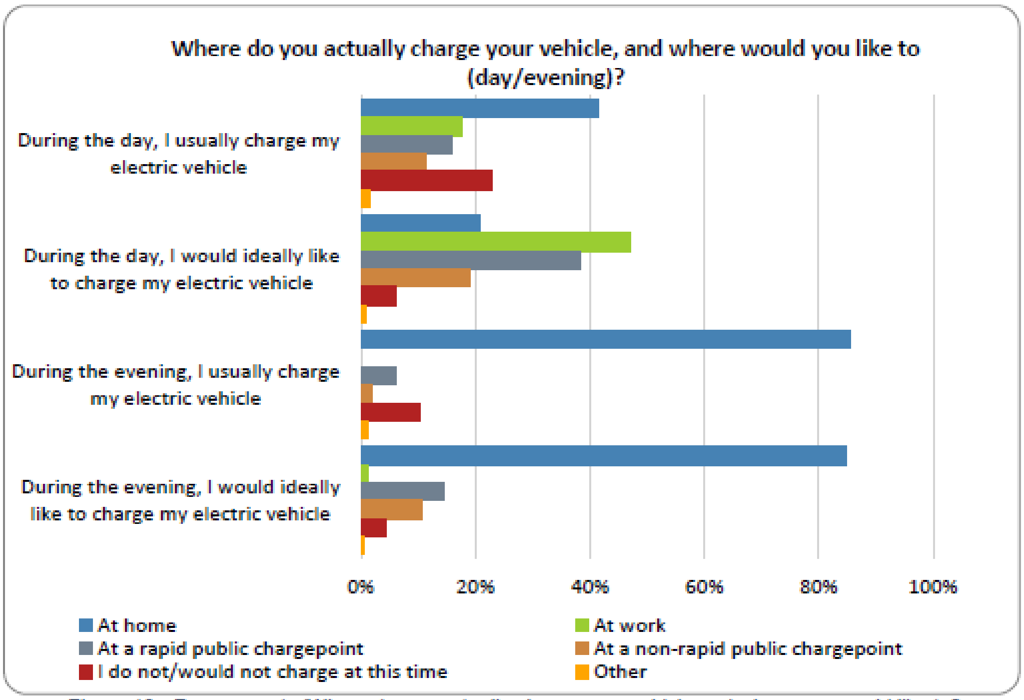


Figure 10 - Responses to 'Where do you actually charge your vehicle and where you would like to?

Figure 5. Responses to 'where do you actually charge your vehicle and where would you like to?[34]

6.2.5 As battery sizes increase, people will also become even less reliant on intermediate or 'journey' charge points, and it is likely that they will rely more heavily on their home charging provision. Therefore, we suggest that provision at residential developments is particularly important and applies both to on- and off- street parking scenarios. The trend of high-density residential is to provide more (if not all) parking on-street where the push is to maximise housing density. Developers of new streets (as part of Section 38 Agreements) will need to be required to future-proof the ability for ducting and design to supply EV charging on street as part of the planning process. For on-street, it will be crucial to build active provision into the street scene at the design and construction phase.

6.2.6 Active provision at 'work' locations should also be an important consideration. In the short-term, this will provide people with early generation EVs with lower ranges with additional charges over the period of a day. In the longer-term, work locations will continue to be required particularly supporting those with unallocated residential parking as well as increasingly providing grid balancing functions.

6.2.7 In order to understand current minimum provision across the country, a review of other local authorities has been carried out, and Table 4 provides examples of planning requirements of different councils and local authorities.

[34] Cenex & Energy Saving Trust (2018). Project report: Go Ultra Low West Chargepoint Infrastructure Study

Table 4. Examples of planning requirements from across the UK

COUNCIL/ LOCAL AUTHORITY	RESIDENTIAL	COMMERCIAL, INDUSTRIAL & RETAIL, OTHER	SOURCE
Lancaster	Houses: One electric vehicle-dedicated charging point per house with garage or driveway Flats: At least 10% of parking bays should be provided with dedicated electric vehicle charging points. All other parking spaces to be provided with passive wiring to allow future charging point connection.	Other Development (<50 Bays): At least two parking bays should be marked out for use by electric vehicles only, together with charging infrastructure and cabling. Other Development (>50 Bays): Further dedicated bays totalling 4% of the total provision. Should be dedicated freestanding weatherproof chargers.	Lancaster City Council, Planning Advisory Note: Electric Charging Points for Vehicles (September 2017)
Leeds	Residential sites require one charging point per unit (dwelling with dedicated parking) or one charging point per 10 spaces (unallocated parking) Specifications for parking bays design and charging point technology are given.	Filling stations provide Mode 4 Multi Standard charge points. Large Car Parks: The EVCP's should be considered at an early stage of planning for large car parks because the electrical supply may be significant. A load balancing system could be investigated.	Leeds City Council, Parking SPD, additional Guidance on Electric Vehicle Charging Points (October 2018)
West Midlands	One charging point per unit (houses with dedicated parking) One charging point per 10 spaces (unallocated parking)	Commercial/Retail: 10% of parking spaces (this may be phased with 5% provision initially and a further 5% trigger) Industrial: 10% of parking spaces (this may be phased with 5% provision initially and a further 5% trigger) To prepare for increased demand in future years, appropriate cable provision for increased provision should be included in scheme design and development in agreement with the local authority.	West Midlands Low Emissions Towns and Cities Programme, Planning good practice Guide (May 2014)
Merseyside	Houses: All houses with at least one off-street parking space or garage One charging point per house (in most cases a domestic 13a socket fixed to an internal or external wall, will cost less than £100) Flats: At least one or 10%, (whichever is the greater) parking spaces must be marked out for use by EVs only, together with an adequate charging infrastructure and cabling for each marked bay.	At least one or 10%, (whichever is the greater) parking spaces must be marked out for use by EVs only, together with an adequate charging infrastructure and cabling for each marked bay.	Merseyside "parking standards" for development – Ensuring Choice of Travel SPD (April 2008)
Knowsley	All dwellings with one or more dedicated parking spaces, and at least fifty percent of communal parking bays should be provided with electric vehicle charging points		Knowsley Council, New Residential Development Supplementary Planning Document (May 2018)
Rugby	For developments of 10 or more dwellings:	For major developments:	Rugby Borough

COUNCIL/ LOCAL AUTHORITY	RESIDENTIAL	COMMERCIAL, INDUSTRIAL & RETAIL, OTHER	SOURCE
	one charging point per dwelling and one charging point per 10 unallocated parking spaces. Passive charging points are to be provided for dwellings. These ensure cabling is provided for owners to install the correct socket for their vehicle. Active charging points are required for unallocated spaces.	one charging point per 10 spaces to include one charging point for every 10 disabled car parking spaces	Council, Local Plan Post-Examination Hearing Main Modifications (2018)
Worcestershire	Passive charging point provision required in houses with dedicated parking. For developments without allocated parking one active charging point should be provided every 10 spaces by the developer. Installed in 10% of allocated parking spaces of residential development		Worcestershire Regulatory Services, Technical guidance Note for Planning (August 2017)
London	All residential car parking spaces must provide infrastructure for electric or Ultra-Low Emission vehicles. At least 20% of spaces should have active charging facilities, with passive provision for all remaining spaces.	Offices: Operational parking requirements should be considered on a case-by-case basis. All operational parking must provide infrastructure for electric or other Ultra-Low Emission vehicles, including active charging points for all taxi spaces. Hotel and leisure uses: All operational parking must provide infrastructure for electric or other Ultra-Low Emission vehicles, including active charging points for all taxi spaces.	Mayor of London, The New London Plan – Draft showing minor suggested changes (July 2018) (Policies T6.1 – 6.5)
Oxford	For every 10 residential homes built there should be at least one ‘rapid charge’ EV charging point installed. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made.	Every 1000m^2 of non-residential development there should be at least one ‘rapid charge’ EV charging point installed.	Guidance for Developers, South Oxfordshire District Council (2017)
Milton Keynes		0-20 car spaces: 0 spaces 21-50 car spaces: 1 space, 1 electric charge point 51-100 car spaces: 2 spaces, 2 electric charging points 1 space and 1 charging point per 100 car parking spaces thereafter 10% of car parking provision to have passive provision to allow conversion at a later date	Milton Keynes Council, Parking Standards, Supplementary Planning Document (January 2016)
Salford, Manchester	New development shall make provision for electric vehicle charging infrastructure, using dedicated charge points specifically designed for charging all types of electric vehicle, in accordance with the following standards (unless superseded by higher standards adopted at the Greater Manchester level): For dwellings with a garage or driveway, at least one dedicated charge point per dwelling For residential developments with shared parking	For non-residential developments, the provision of at least one dedicated charge point per 1,000m^2 gross internal floorspace, with a reduced requirement being permitted where it can be demonstrated that the specific characteristics of development would result in lower levels of demand for electric vehicle charging	Salford City Council, Revised Draft Local Plan (2019)

COUNCIL/ LOCAL AUTHORITY	RESIDENTIAL	COMMERCIAL, INDUSTRIAL & RETAIL, OTHER	SOURCE
	areas, the provision of at least one dedicated charge point per ten dwellings		
Stratford-on-Avon	Minimum 7Kw electricity cabling to the charging point(s). One electric vehicle charging point (ECVP) per dwelling with a garage or driveway. One charging point per 10 spaces of communal parking. Nots: (a) If less than 10 spaces = 1EVCP, between 11-20 spaces = 2 ECVP etc.) (b) To prepare for increased demand in future years, appropriate electricity capacity and cable provision should be included and 'future proofed' in scheme design and development in agreement with the local authority. (c) Phased provision of EVCPs may be acceptable in certain circumstances.	Minimum 7Kw electricity cabling to the charging point(s). One charging point per 10 spaces of parking Notes: (a) If less than 10 spaces = 1EVCP, between 11-20 spaces = 2 ECVP etc.) (b) To prepare for increased demand in future years, appropriate electricity capacity and cable provision should be included and 'future proofed' in scheme design and development in agreement with the local authority. (c) Phased provision of EVCPs may be acceptable in certain circumstances.	Stratford-on-Avon District Council, Draft Development Requirements Supplementary Planning Document (March 2018)

6.2.8 As discussed in the preceding chapters, uptake of EVs in the WoE sub-region is currently above the national average, but starting from a lower baseline. Therefore, there is reason to be ambitious when it comes to minimum provision of infrastructure, especially passive infrastructure, which futureproofs EV growth and undertakes invasive works during construction rather than retrospectively with additional cost and disruption.

6.2.9 This also strengthens the argument that there will potentially be greater demand for active provision in new developments as residents in the WoE purchase EVs more quickly than elsewhere in the UK.

6.2.10 In this study, we consider the land use classes of development that can be considered as requiring minimum standards for EV charging facilities. Other forms of development will require justification and this should be presented in the form of an EV infrastructure statement when submitting any major planning application.

6.2.11 For these policies the following definitions apply:

- ***Active Provision*** – Ideally, the provision of active charging points will be such that each user has the opportunity to charge their vehicle at the same time with a total charging time not exceeding eight hours (the requirement of the charging time allows for some degree of future proofing as technology adapts).
- ***Passive Provision*** – Establishing all of the associated cables, chambers and junctions to allow for charging points to be installed without the need for undertaking works that require breaking ground to install cabling retrospectively.

6.2.12 Due to the costs of installing infrastructure at the build stage being lower than the cost of retrofitting existing developments, it is important that installing active and passive EV infrastructure in new developments is strongly encouraged both for off and on street parking scenarios. Planning policies need to require residential developers to construct EV charging on street for both allocated and unallocated parking at the design and construction phase of new residential streets and footways as part of Section 38 Agreements. Policies may wish to distinguish between developments providing new roads and infill developments.

6.2.13 Table 2 provides budget costs for EV infrastructure installation. It indicates that the minimum cost to provide passive infrastructure at the outset is approximately £200 to £350 per unit, depending on the number of units and site layout. The corresponding cost to provide active infrastructure at the outset for on plot parking is approximately £750 to £1,500 unit depending on the number of units and site layout.

Policy Recommendations

6.2.14 A breakdown of the minimum active and passive provision at different development types is shown in Table 5, with further considerations on subsequent pages. It refers to various terms, which are defined below:

- ***On-Plot Parking*** – Where a dwelling has car parking within its individual plot (or title) boundary.
- ***Off-Plot Parking*** – Where a dwelling relies on car parking outside its individual plot (or title) boundary which is within the development site boundary.
- ***Allocated Parking*** – Parking assigned to the occupiers of a specific dwelling.
- ***Unallocated Parking*** – Parking for use by occupiers of any dwelling within a development site.
- ***Passive EV Parking*** – Provides cabling during construction (usually underground) to enable the future provision of active EV charging points. This largely removes the need for invasive works to convert passive to active EV parking.
- ***Active EV Parking*** – Includes all cabling (associated with passive parking) plus ground- or wall- mounted EV charging points. This can either be provided at the outset during construction (cabling plus charging points) or later on utilising the passive infrastructure provided during construction. If passive infrastructure was not provided during construction, retrofitting is required which usually involves disruptive and invasive works to provide the necessary cabling. Converting passive to active in an on-street setting can be detrimental to the use of the pavement.

Table 5. Active and passive provision parking standards by land use class

LAND USE CLASS	PARKING TYPE	MINIMUM REQUIREMENT RESIDENTIAL		OPTIMUM REQUIREMENT RESIDENTIAL	
		STANDARD	NOTES	STANDARD	NOTES
Residential Use Class	Allocated (on or off plot)	100% Passive	• **Passive Provision Rationale:** Aligns with Central Government Policy, which aims to dramatically increase the sale of ULEVs over the next 20 years. This growth would likely focus on EVs and would be supported by ensuring the necessary EV charging infrastructure is in place at residential developments at the outset. This approach reflects the preference for 'at home' charging, as demonstrated by Figure 5. Providing passive EV charging infrastructure at the outset is cost-effective as it is relatively cheap to install during construction, as opposed to retrofitting post-construction, which is far more costly and disruptive for residents. A 100% passive provision would be low cost for developers, futureproof EV uptake, and unlike active provision, would not require ongoing maintenance should EV uptake be slow. • **Active Provision Rationale:** New build buyers would have the opportunity to have an EV charge point installed during the sales / construction process. If not fitted at the outset, an EV charge point could be retrofitted by a suitably qualified electrician with minimal time / cost implications due to the passive infrastructure already being in place. • **EV Installation Type:** Cabling and RDC to enable subsequent installation of 7kW 32amp OLEV compliant wall or ground mounted charge point. This specification of charger would suffice for residential use, as vehicles would typically be charged overnight (2-8 hours depending on the vehicle and charger). • **Upfront Cost to Developer:** £200 to £500 per unit with this typically falling at the lower end of the range, subject to the size of the development with a larger development able to negotiate lower unit / labour costs. • **Retrofitting Cost to Homeowner:** £350 budget cost for a single dwelling. To be commissioned by the homeowner (on-plot parking) or Management Company (off-plot parking).	100% Active	• **Passive Provision Rationale:** The minimum standard is that passive provision should be provided for all residential units with allocated parking. • **Active Provision Rationale:** Application sites in areas with an established high EV uptake (or forecast high uptake) would require an active charge point from the outset. As there is a minimum 100% passive space requirement, providing active provision from the outset would have a significantly lower net cost than retrofitting post-construction. The main difference in approach is that future residents would not (directly) pay for a charge point, with the cost borne by the developer during construction. Installation of an active charging point removes a barrier to the resident purchasing an EV in that the charger is already there, removing the time and additional expenditure of purchasing a charger. • **EV Installation Type:** Cabling, RDC and 7kW 32amp OLEV compliant wall or ground mounted charge point enabling overnight charge. • **Upfront Cost to Developer:** £750 to £1,500 per unit, with this typically falling at the lower end of the range, subject to the size of development. Of note is a proportion of this cost would relate to the infrastructure required for passive installation, so the true net cost for providing active provision at the outset is less. • **Retrofitting Cost to Homeowner:** N/A. **Running Costs:** Would vary depending on whether the charging points are managed and maintained by the residents / management company or a third party provider on a pay as you go basis. If the latter, the running costs would be minimal, as the EV charging points would be maintained by the third party and users would pay for electricity directly.

			• **Running Costs:** If all spaces remain passive then the running costs would be zero. Assuming there would be demand for active spaces, the running costs would vary depending on the EV charger manufacturer servicing / maintenance requirements and usage by residents. Electricity usage for on-plot EV charging would be paid directly by residents. Off-plot parking could be paid out of the development management fees for communal electricity demand; however, there would be a case for this being managed by a third party. This party would install and maintain the EV charging points, and would charge residents on a pay as you go basis.		
	Unallocated (off-plot)	90% passive and 10% active	• **Passive Provision Rationale:** Providing passive EV charging infrastructure from the outset is cost effective as it is relatively cheap to install during construction, as opposed to retrofitting post-construction, which is far more costly and disruptive for residents. Hence, a 90% passive provision is suggested, which aligns with other Local Authorities such as Lancaster and Merseyside. **Active Provision Rationale:** The 10% provision is mindful of Central Government policy to aim for higher EV use. However, a lower proportion of EV parking spaces is proposed to minimise the impact on parking capacity. This provision is, however, comparable to that in other Local Authorities. Caution is required, as EV spaces would need to be managed to ensure charge points are available and not used for parking by ICE vehicles. This would effectively reduce the capacity of such car parks for 'general' parking, which could be an issue as parking demand in most residential car parks is high. If sufficient demand for EV charging materialised the Management Company would arrange for additional active charge points to be retrofitted by a suitably qualified electrician with minimal time / cost implications due to the passive infrastructure already being in place. Passive-to-active conversions would be a charge borne by the residents via their management charge. • **EV Installation Type:** For passive, cabling and RDC to enable subsequent installation of 7kW 32amp OLEV compliant wall or ground mounted charge point. For active, cabling, RDC and 7kW 32amp OLEV compliant wall or ground mounted charge point which	100% Active	• **Passive Provision Rationale:** The minimum standard is that passive provision be provided for all residential units with unallocated parking. • **Active Provision Rationale:** Application sites in areas with a high EV uptake (or forecast high uptake) would require an appropriate charge point. Due to the minimum 90% passive / 10% active requirement, the higher active provision would have a significantly lower net cost than retrofitting post-construction. • **EV Installation Type:** Cabling and RDC to enable subsequent installation of 7kW 32amp OLEV compliant wall or ground mounted charge point, which would enable a full charge to be achieved overnight. • **Upfront Cost to Developer:** £2,000 to £10,000 budget cost for dual charge point. • **Retrofitting Cost to Homeowner:** N/A. • **Running Costs:** Would vary depending on whether the charging points are managed and maintained by the residents / management company or a third party provider on a pay as you go basis. If the latter, the running costs would be minimal, as the EV charging points would be maintained by the third party and users would pay for electricity directly.

			would enable a full charge to be achieved overnight. • **Upfront Cost to Developer:** Cabling at £40 to £50 per metre. • **Retrofitting Cost to Homeowner:** £2,000 to £10,000 budget cost for dual charge point. Whether this would be commissioned by the homeowner or Management Company would depend on the individual dwelling / development circumstances. • **Running Costs:** Would vary depending on whether the charging points are managed and maintained by the residents / management company or a third party provider on a pay as you go basis. If the latter, the running costs would be minimal as the EV charging points would be maintained by the third party and users would pay for electricity directly.		
	On-Street	100% passive / 0% active	• **Passive Provision Rationale:** If there is no on-site parking it is essential provision is made at the outset during construction for on-street EV charging to ensure costly and invasive works are not subsequently required in the public highway. This approach is especially relevant to infill development that can lead to increased parking pressures on the public highway and planning may reasonably accept a mixture of on-street and off-street parking solutions. If development is brought forward with on-site parking then it should follow the same principles as outlined above for development with on-site parking. • **Active Provision Rationale:** New build buyers would have the opportunity to have an EV charge point installed during the sales / construction process. If not fitted at the outset, an EV charge point could be retrofitted by a suitably qualified contractor, simplified by the passive infrastructure already being in place. Whether active EV charging is provided by the developer via a Section 38 / Commuted Sum process, via the Local Authority funded by Government grants or by private energy company would be very much site dependant. Due to the various mechanisms for providing on-street EV charging it is suggested that there is a 100% passive provision with active provision judged on a site by site basis depending on resident demand at the outset, local demand for EV charging and the Local Authority's preferred approach to providing this infrastructure.	75% passive/ 25% active	• **Passive Provision Rationale:** If there is no on-site parking it is essential provision is made at the outset during construction for on-street EV charging to ensure costly and invasive works are not subsequently required in the public highway. This approach is especially relevant to infill development that can lead to increased parking pressures on the public highway and planning may reasonably accept a mixture of on-street and off-street parking solutions. If development is brought forward with on-site parking then it should follow the same principles as outlined above for development with on-site parking. • **Active Provision Rationale:** The direction that high-density residential is going is to provide more (if not all) parking on street. Garages, rear parking courts and other private parking areas (e.g. basements) will become less and less relevant as they are costly and take up space, reducing the residential density that is desired in urban locations. Developers of new streets (as part of Section 38 Agreements) will need to be required to future-proof the ability for ducting and design to supply EV charging on street as part of the planning process. Active charging points built into the development at the time of construction where new roads are being constructed will ensure that these are planned features of the street scene and will minimise the disruption and potential impact on pavements where it is essential that EV infrastructure does not cause obstruction that may inhibit use of the pavement. Active provision for infill development where charging provision needs to be retrofitted on to

			• **EV Installation Type:** Cabling and RDC to enable subsequent installation of 7kW 32amp OLEV compliant wall or ground mounted charge point. • **Upfront Cost to Developer:** Cabling £40 to £50 per metre. • **Retrofitting Cost to Homeowner:** £2,000 to £10,000 budget cost for dual charge point. Whether this would be commissioned by the homeowner or Management Company would depend on the individual dwelling / development circumstances. Government funding is available, which typically favours areas with limited off-street car parking, with applications typically made to Local Authorities who decide on the allocation of grants, thus significantly reducing the cost to residents. • **Running Costs:** If all charge points remain passive, then the running costs would be zero. • If made active, the running costs would vary depending on whether the charging points are managed and maintained by the local authority/management company or a third party provider on a pay as you go basis. If the latter, the running costs would be minimal, as the EV charging points would be maintained by the third party and users would pay for electricity directly.		existing streets will be more challenging. • **EV Installation Type:** Cabling and RDC to enable subsequent installation of 7kW 32amp OLEV compliant wall or ground mounted charge point. • **Upfront Cost to Developer:** £2,000 to £10,000 budget cost for dual charge point. • **Running Costs:** If all charge points remain passive, then the running costs would be zero. If made active, the running costs would vary depending on whether the charging points are managed and maintained by the/local authority/management company, or a third party provider on a pay as you go basis. If the latter, the running costs would be minimal, as the EV charging points would be maintained by the third party and users would pay for electricity directly.

An illustration of the cost implications for these policies on residential development, compared to the typical approach of the local authorities (identified in Table 4) of 10% - 20% active provision, is provided in Figure 6 for off-street provision, using a 10 dwelling residential development as an example.

Figure 6. EV policy cost options for a 10 dwelling residential development with off street parking

These figures are based on the following cost assumptions, which are discussed in detail in Table 5:

- Average cost of passive provision: £300 per unit (total cost subject to the size of development, with a larger development able to negotiate lower unit / labour costs).
- Cost of active provision: £1,450 per unit starting price, going down to £1,000 (total cost subject to the size of development). Costs of infrastructure required for passive installation included.

LAND USE CLASS	PARKING TYPE	MINIMUM REQUIREMENT NON-RESIDENTIAL		OPTIMUM REQUIREMENT NON-RESIDENTIAL	
		STANDARD	NOTES	STANDARD	NOTES
Retail (A Use Classes)	On-Site Parking	10% passive / 10% active	• **Passive Provision Rationale:** Providing passive EV charging infrastructure at the outset is cost effective, as it is relatively cheap to install during construction, as opposed to retrofitting post-construction, which is far more costly and disruptive for customers and would affect footfall. 10% passive provision would be relatively cheap for developers, provide a degree of futureproofing for EV uptake, and unlike active provision, would not require ongoing maintenance should EV uptake be slow. • **Active Provision Rationale:** There is already a growing number of retailers providing active EV charge points, so policy should reflect this trend, supporting it and encouraging uptake by all retailers / retail units providing on-site car parking. Passive spaces can be later upgraded by a suitably qualified contractor, a process simplified by the passive infrastructure already being in place. **EV Installation Type:** Cabling and RDC to enable installation of 7kW 32amp OLEV compliant wall or ground-mounted charge point. This reflects the likelihood that charging in retail car parks will be 'grazing', and that the main charging will be undertaken at home. Should rapid charging points be required by the occupier, these are likely to be provided and maintained by a third party. • **Upfront Cost to Developer:** Cabling £40 to £50 per metre. • **Retrofitting Cost to Retailer:** £2,000 to £10,000 budget cost for dual charge points. Whether this would be commissioned by the occupier or site management company (if a retail park) would depend on the individual circumstances. • **Running Costs:** The running costs would vary depending on the EV charger manufacturer servicing / maintenance requirements and usage by customers as well as whether this is free or pay as you go.	75% passive / 25% active	• **Passive Provision Rationale:** Providing passive EV charging infrastructure throughout the site at the outset is cost effective as it is relatively cheap to install during construction, as opposed to retrofitting post-construction which is far more costly and disruptive for customers and would significantly affect footfall as it would affect the entire car park for a longer period of time. • **Active Provision Rationale:** Retail is likely to be a common place for 'grazing' charging as referred to in the RAC: Development of the UK public charging network report 2018 where customers will go to shop and to charge dwelling for sufficient time for a top up of their battery. Passive spaces can be later upgraded by a suitably qualified contractor, simplified by the passive infrastructure already being in place. • **EV Installation Type:** Cabling and RDC to enable installation of 7kW 32amp OLEV compliant wall or ground mounted charge point. This reflects the likelihood that charging in retail car parks will be 'grazing' and that the main charging will be undertaken at home. Should rapid charging points be required by the occupier these are likely to be provided and maintained by a third party. **Upfront Cost to Developer:** Cabling £40 to £50 per metre. • **Retrofitting Cost to Retailer:** £2,000 to £10,000 budget cost for dual charge point. Whether this would be commissioned by the occupier or site Management Company (if a retail park) would depend on the individual circumstances. • **Running Costs:** The running costs would vary depending on the EV charger manufacturer servicing / maintenance requirements and usage by customers and whether this is free or pay as you go.
Employment (B Use	On-Site Parking	10% passive /	• **Passive Provision Rationale:** Providing passive EV charging infrastructure at the outset is cost effective as it is relatively	75% passive /	• **Passive Provision Rationale:** Providing passive EV charging infrastructure throughout the site at the outset is cost effective as it is relatively cheap to

Classes)		10% active	cheap to install during construction, as opposed to retrofitting post-construction which is far more costly and disruptive for employees / occupiers. • **Active Provision Rationale:** The 10% provision is proposed to minimise the impact on parking capacity, however this provision is comparable to other Local Authorities. As with unallocated residential parking, caution is required as EV spaces would need to be managed to ensure charge points are available and not used for parking by ICE vehicles. This would effectively reduce the capacity of such car parks for 'general' parking, which could be an issue as parking demand in most workplace car parks is high. If sufficient demand for EV charging materialised the occupier or Management Company would arrange for additional active charge points to be retrofitted by a suitably qualified electrician with minimal time / cost implications due to the passive infrastructure already being in place. It is expected that an employment use would as a matter of course provide the necessary infrastructure to fulfil its commercial requirements i.e. taxi or car hire companies facilitating their fleet to be charged on site, rather than being reliant on third party infrastructure. • **EV Installation Type:** Cabling and RDC to enable subsequent installation of 7kW 32amp OLEV compliant wall or ground mounted charge point. At workplaces where people typically park for eight hours standard EV charging would suffice. • **Upfront Cost to Developer:** Cabling £40 to £50 per metre. • **Retrofitting Cost:** £2,000 to £10,000 budget cost for dual charge point. Whether this would be commissioned by the landowner or Management Company would depend on the individual dwelling / development circumstances. • **Running Costs:** If all spaces remain passive then the running costs would be zero. Assuming there would be demand for active spaces, the running costs would vary depending on the EV charger manufacturer servicing / maintenance requirements and usage by employees. Electricity usage would be paid either by employees or the company depending on their particular policy / employee	25% active	install during construction, as opposed to retrofitting post-construction which is far more costly and disruptive for employees. 75% passive provision would be relatively cheap for developers, futureproof EV uptake, and unlike active provision, not require ongoing maintenance should EV uptake be slow. A high level of passive provision allows for future services such as vehicle-to-grid and load balancing as the proportion of on-site renewable energy generation increases. • **Active Provision Rationale:** Workplace charging falls into two categories: employee charging and visitor charging. For employee charging, with a typical dwell time of seven to nine hours, and assuming an average commuting drive to work of 9.1 miles (DfT, 2018c, Table NTS0403), 7 kW charge points would be ideal (RAC Report). There are two benefits of this approach which are providing charging for employees and visitors and providing storage for the grid, whilst accepting that some employees may only be able to charge at 3.6 kW (due to the on-board chargers fitted to their cars), many will still be able to charge at 7 kW, and the future trend is likely to be towards 7 kW on-board chargers (RAC Report). This provision reflects the data in **Figure 5** which highlighted that over 40% of EV owners would like to charge their vehicle at work during the day. This provision also reflects forecast EV uptake by 2030, which policy should be mindful of as it tends to have a 5-7 year lead-in. In 2018 Cenex and SYSTRA produced a study *'Plugging the Gap: An Assessment of Future Demand for Britain's Electric Vehicle Public Charging Network'* produced for the Committee on Climate Change. It sets out three new car / van sales scenarios for EV uptake by 2030 which are a barriers scenario of 40%, central scenario of 60% and maximum scenario of 65%, so provision should be mindful of this. • **EV Installation Type:** Cabling and RDC to enable subsequent installation of 7kW 32amp OLEV compliant wall or ground mounted charge point. At workplaces where people typically park for eight hours standard EV charging would suffice. • **Upfront Cost to Developer:** Cabling £40 to £50 per metre. • **Retrofitting Cost:** £2,000 to £10,000 budget cost for dual charge point. Whether this would be commissioned by the landowner or management company would depend on the individual dwelling / development circumstances. • **Running Costs:** This would vary depending on whether the charging points are managed and maintained by the occupiers / management company or a

			benefits.		third party provider on a pay as you go basis. If the latter, the running costs would be minimal as the EV charging points would be maintained by the third party and users would pay for electricity directly. The owner / site management company may decide it is commercially beneficial to outsource these facilities to a third party, who would be responsible for installation and maintenance. Employees and visitors would then pay for their electricity directly.

An illustration of the cost implications for these non-residential policies, is provided in Figure 7, using the examples of provision of 10 charging points at a retail car park, a multi-storey car park and on-street.

Figure 7. EV policy cost options for the provision of 10 charging points in retail, multi-storey and on-street car parks

These figures are based on the following assumptions:

- Retail car park: £7,000 total cost of passive provision (10m cabling), £1,800 cost of one ground-mounted point.
- Multi storey car park: £3,500 total cost of passive provision, £1,000 cost of one wall-mounted point.
- On-street: £4,000 total cost of passive provision, £1,800 cost of one ground-mounted point.
- Upgrade costs are not included.

Strategic developments – including Transport Hubs and Airports

6.2.15 Strategic developments are typically large, often complex sites, providing a variety of land uses, including transport hubs and airports, which invariably come with unique challenges. An example of this is the potential expansion of Bristol Airport, which was submitted for planning consideration in 2018.

6.2.16 Development of a strategic nature is clearly complex, but there must be an acceptance that strategic sites must identify their infrastructure requirements for EV at the earliest stages of planning to establish the requirements for changes to the wider network and cost of installation coming forward, for example in a statement of requirement to WPD. As such all developments of this nature should be required to present a strategy for EV parking that responds to the wider implication of demand on existing substations and other relevant infrastructure.

6.2.17 EV infrastructure would be a requirement at strategic sites, and for residential, retail and employment land uses, provision would follow the various Local Authority emerging EV standards. For other strategic sites such as airports, rail and bus stations that do not fall under these use classes, a more pragmatic approach is required to reflect their unique characteristics and wider range of parking demands such as:

- **Staff and Contractors Parking** – especially for contractors / companies who operate an EV fleet. It is envisaged that EV provision in staff / contractor car parks at strategic sites such as airports, rail and bus stations would be similar to any other employment site, and consequently it is prudent that EV provision should reflect those standards.
- **Short-Stay Visitors Parking** – perhaps for people picking-up or dropping-off friends / family who might take the opportunity to 'graze', via a standard charge or rapid charge, if available. The characteristics of short stay parking would likely mirror retail parking. Whilst the driver is not necessarily shopping, they are undertaking a short duration visit and might take the opportunity to 'graze' if the opportunity is there.
- **Long Stay Visitors Parking** – people parking who travelling by air or rail for the day, or perhaps for longer on holiday. Long stay parking at strategic sites may in practice be problematic. It is likely long-stay users (≥1 day) might like the opportunity for a 'trickle' charge for the duration of their stay (perhaps from a standard 7kW charger in a park and ride car park or lamp column charger in an airport car park) but there is the issue of how this would be monitored to avoid cars being connected to chargers for the duration. Consequently, the practicality of providing EV charging for long-stay car parking should be carefully considered.
- **Private Hire Vehicles and Taxi Parking** – strategic sites, and especially airports, rail and bus stations, inevitably experience a high volume of such vehicles, however provision for PHVs, taxis and car clubs would be guided by the commercial operator's preference and practicality of accommodating potentially large EV vehicles charging on-site. It is likely PHV and taxi companies operating EVs would prefer to use their own charging infrastructure at their depots.
- **Car Club Spaces** – operators would be required to provide and maintain a charging point in association with their parking bay.

6.2.18 This demonstrates that in instances like this, a 'one size fits all' policy would not give local authorities the control and influence required to ensure the planning process could adequately consider these matters.

6.2.19 The requirements at strategic sites such as airports, rail and bus stations, for example, will differ, hence each would be required to present their own EV strategy which would likely focus on staff / contractors, short-stay, long-stay, PSVs / taxis and car club EV parking.

6.2.20 We also accept that the complexity of these tasks is challenging and that experience and expertise in this field is somewhat limited. Developers should be encouraged to enter into pre-application Planning Performance Agreements (PPA). In these instances the PPA can assist local authorities in ensuring they have resource to consider these more complex issues.

6.2.21 The RAC Foundation paper (2018)[35] recommends that commercial and industrial units provide 25% of their parking spaces with 7kW chargers. This will support the need for 'grazing' charging facilities.

6.2.22 As technology evolves, EV charging points at commercial and industrial units might be increasingly important to support 'Vehicle to Grid' charging in conjunction with other technologies such as solar panels and incentivised management of electricity usage to avoid peak periods. The potential for a high volume of EV's parking during the day and such land uses typically occupying relatively large plots with large roofs makes them suitable for such strategies.

6.3 Type of Provision

Background

6.3.1 As the proportion of EVs within the UK car fleet has increased, charger technology has advanced and there are now a range of options available on the market. Charge points are primarily defined by the power (in kW) which they can produce and therefore the speed at which they can charge an EV. Charge points should be appropriate for the vehicles they will be charging as the various charge rates available are not universally compatible with all EV vehicles. There are four types of EV charging currently available – slow, standard, fast and rapid:

- ***Slow charging (≤3kW):*** utilises standard three-pin sockets. The limited power available from these sockets means that charging units experience long dwell times i.e. eight or more hours. This method of charging is not recommended as it does not meet OLEV minimum standards.
- ***Standard charging (3.5-7kW):*** charging that occurs between 3.7kW and 7kW using an AC power source. For typical EV battery sizes (15 to 60 Kw), these charge points

[35] https://www.racfoundation.org/wp-content/uploads/Development_of_the_UK_CPN_Harold_Dermott_December_2018.pdf (Accessed 18 January 2019)

can provide a full charge to a vehicle within 2- 8 hours for 3.6kW chargers and within 3- 4 hours for a 7kW. This uses a type 2 connector.

- ***Fast Charging (7-25kW):*** typically enables charging up to 80% in 3-5 hours for a 7kW charge point and 1-2 hours for a 22kW charge point. These charge points are commonly found in areas where dwell commonly ranges between 1-4 hours. This uses a type 2 connector.
- ***Rapid Charging (43-62kW):*** for the majority of EVs, these chargers can provide up to 80% of the vehicles charge in 20 to 50 minutes depending on battery size. This uses CCS and CHAdeMO connectors.
- ***Ultra-Rapid Charging (120-400kW):*** Currently under development for faster charging methods which are more aligned with the speed of current refuelling methods (minutes).

6.3.2 Following engagement with WPD, it is understood that installation of fast and rapid chargers in one location results in a lot of demand being placed on one specific point of the electricity network, making it more vulnerable to failure. Typically, existing substations have a capacity of 50-80kW and would therefore not be able to support an influx of multiple fast and rapid chargers on new developments. WPD have confirmed that any more than one or two new rapid charge points would require a new substation, thus significantly escalating the costs of installing the infrastructure.

6.3.3 On the basis of charging times, the associated costs of increasing charging speed, and considering vehicle dwell times in residential locations (long periods, typically over 4 hours) and commercial e.g. retail locations (shorter periods, potentially 20 minutes to 3 hours), it is feasible to suggest that an appropriate minimum provision should be 7kW /32amps to provide standard charging at home and work locations.

6.3.4 As provision of rapid charging is significantly more costly than standard charging, and demand is so variable depending on the location and consumers' trip purposes, it seems reasonable to suggest that this is not a minimum requirement at new developments. However, it is worth recognising that increasingly rapid charging is being viewed as a business opportunity for third parties distinct from property owners or developers. One such example is the announcement in November 2018 that Volkswagen will be partnering with Tesco to offer 2,500 standard and rapid speed charge points (to be installed by the charging network operator Pod Point) across 600 stores nationwide[36].

6.3.5 In terms of the different types of charge points, indoor/undercover EV charging tends to favour wall-mounted units, which take up a small amount of space and can be fed using cabling on the surface of walls and ceilings. For central areas within a floor however, floor mounted-charge points may need to be used as wall space is not available. Floor-mounted charge points are most commonly used outdoors, particularly for on-street charging. It is important to ensure that the mounting method selected does not result in a trip hazard or obstacle to pedestrians that may be using the area. Compared to other methods of EV charging provision, wall- and floor-mounting are deemed the most cost effective. Wireless charging infrastructure is, at present, not a viable option due for the

[36] https://insideevs.com/volkswagen-tesco-pod-point-charging-uk/ (Accessed 18 January 2019)

WoE sub-region Unitary Authorities due to extensive costs and lamp column charging is difficult due to positioning of lamp columns, as discussed below.

6.3.6 Although inductive (wireless) charging is attractive to motorists as it does not require a cable to connect between the vehicle and the charge point, there is a notable efficiency penalty of 8-10% compared with cabled charging. In addition, the infrastructure is not widely available on the market and, therefore, costs are largely unknown and a rapid roll out in the near future would not be possible.

Lamp Column Charging

Lamp column charge points represent an innovative solution to provide on-street charge points and are now being trialled in London. They can be an option where residents do not have access to off-street parking and have not been able to secure a standard floor mounted charge point, perhaps due to limited footway widths.

Lamp columns provide a DNO connection, where a socket can be easily installed to retrofit the lamp column. Compared to floor mounted chargers, lamp columns are cheaper and easier to install and have less visual impact, since they take advantage of street furniture already in place.

Lamp column charge points are typically a retrofit solution best suited to locations where lamp columns are located at the front of the footway (nearest the road).

As they feed off the existing electricity supply, they only provide a slow charge of 3kW and are therefore less efficient than 7kW floor/wall mounted charge points.

In the WoE sub-region, a number of UA's have policies which require lamp columns to be located towards the back of the footway, away from the road, to avoid vehicle strikes.

As a result of their location of lamp posts at the back of the pavement (away from the road) there are extensive installation costs associated with the necessary groundworks and installing of a satellite bollard adjacent to the road.

Costs for running charge points from lamp columns located at the back of the pavement can be between £1000 – £2000 extra on top of the approximate £1000 for a Ubitricity[37] type lamp column conversion.

There is also the risk of insufficient electrical capacity to enable satellite charge points, and therefore a cabling upgrade may be required alongside in addition to the potential for further substation implications. This would further add to the costs and complexity of the installation.

[37] https://www.ubitricity.co.uk/

New developments should be providing active/passive provision sufficient to meet present and future demand and, therefore, there should not be the need for additional lamp column chargers.

Policy Recommendations

- Minimum power provision must be sufficient to enable 32amp / 7kW charging of up to two vehicles at the same time.
- Infrastructure should be OLEV compliant, i.e. not three pin socket.
- Rapid charging infrastructure is not a minimum requirement at new developments however it could be explored as a commercial opportunity in which a third party effectively runs and manages the chargers on a site.
- As per national guidance, charge points are required to be 'smart' as defined in the Automated and Electric Vehicles Act 2018 (Section 15, p9)[38]:

  "The requirements that may be imposed under subsection (1) include requirements relating to the technical specifications for a charge point, including for example the ability of a charge point—

  (a) to receive and process information provided by a prescribed person,
  (b) to react to information of a kind mentioned in paragraph (a) (for example, by adjusting the rate of charging or discharging),
  (c) to transmit information (including geographical information) to a prescribed person,
  (d) to monitor and record energy consumption,
  (e) to comply with requirements relating to security,
  (f) to achieve energy efficiency, and
  (g) to be accessed remotely."

6.4 EV Charging Parking Standards

Background

6.4.1 In order to deliver the provision outlined in Table 5, it is necessary to consider EV parking and charging bay requirements. As uptake of EVs increases, there will be more demand for EV designated charging bays, both in residential and commercial developments. This is more of a challenge in urban areas, where space is finite and a significant proportion of residential parking is off-plot/on-street.

6.4.2 EV charging bay locations tend to be located in relatively close proximity to a metered power supply or passing underground low voltage mains cable. With respect to design of EV bays, fast and rapid charge points with two or three sockets or tethered plugs are installed in front of, and in between, two parking bays at the edge of a pavement or in a location where pedestrians will not encounter charging cables in their way. This

[38] http://www.legislation.gov.uk/ukpga/2018/18/pdfs/ukpga_20180018_en.pdf (Accessed 22 February 2019)

positioning allows two vehicles to be served from one charge point without causing a trip hazard. This layout works for parking perpendicular to the pavement and parallel to the pavement in on-street locations.

6.4.3 In car parks where there are no pavements and vehicles park nose-to-nose, charge points should be placed where there is the potential to serve any two of the four adjacent parking bays. Charge points must be protected from vehicular damage by a crash barrier. Adequate ventilation space is also required when installing charge points inside a building or under a canopy. Ground mounted units are required in locations where there is a pathway between a parking space and where a wall mounted charge point would be located. This is in order to avoid causing a trip hazard.

6.4.4 British Standard on the design of buildings (BS 8300) currently poses a challenge to any charge point controls, display and sockets or tethered plugs placed at a height outside of 0.75 metres - 1.2 metres above the ground.

Policy Recommendations

- The provision of EV charging bays is based on the figures set out in Table 4 and will differ depending on the location of the development and whether parking is on- or off-plot.
- EV charge points and passive provision for future charge points must be shown on a layout plan as part of new development proposals.
- In urban settings parking should be designed into the street scene in all but the outermost locations. Bristol's adopted Urban Living SPD illustrates how parking can be designed into the street scene[39].
- Planning policy recommendations for on-street parking should include the installation of active charging points with consideration of the increased risk of retrospective installation of active charging points – i.e. newly constructed footways and infrastructure being excavated / opened up and trenched retrospectively, harming the longevity of the asset. Where not planned-in at the design phase, this increases the likelihood of health and safety risks from trailing cables.
- EV charge points must be protected from vehicle strikes and should be positioned such that they are not an obstacle or trip hazard to users on the roads or pavements.
- EV charging bays should only be available to EVs. These should be clearly signed and marked as EV-only.
- All disabled parking bays should have an EV charge point. Alternatively, EV charging bays should be accessible to disabled drivers.
- Time restrictions of one hour should be considered for rapid EV charge points, to minimise excessive dwell time and maximise the opportunity for use.

[39] https://www.bristol.gov.uk/documents/20182/34520/Urban+Living+SPD+Making+successful+places+at+higher+densities.pdf

- Car park management policies may be required to ensure that all necessary signage associated with charge points and charging bays is provided. For private sites, both residential and commercial, it is likely that there will need to be a written policy with appropriate signage in order for the operator to issue penalty charge notices. This could be captured as part of the travel plan process as a planning requirement.
- Developers will need to commit to the enforcement of EV parking spaces on private un-adopted land by their parking management companies.
- For large car park developments, provision for EVs will depend on use case. This must be considered at an early stage of planning due to the impact on local power supply.
- Good practice principles for designing the layout of on-street charging bays should be followed, such as:

  - Angle of charge point and height of controls: position the charge point at 45 degrees to maximise accessibility (for disabled as well as non-disabled users). As with parking meters, the controls should be at a height which permits access by wheelchair users.
  - Street clutter – feeder pillar: to minimise street clutter incorporate feeder pillar(s) into modified (wide-based) signpost housing (or where possible use charge point with integrated feeder pillar).
  - Effective footway width – feeder pillar: where separate feeder pillar is used locate so as to not obstruct access to charge point or pedestrian movement on footway – consider locating at back of footway.
  - Sign plate location: where possible, locate sign plate on existing signpost/lamp column or on wall (assuming integrated signpost/feeder pillar not used).
  - Kerbside obstructions – charging cable: locate feeder pillar no more than 0.45 metres from kerb line to minimise extension of charging cable.
  - Contact details – feeder pillar: feeder pillar to show EV supplier contact details.

6.5 Future proofing EV infrastructure provision

Background

6.5.1 As manufacturing and ownership of EVs increases, demand for EV charging infrastructure will likely change and the provision of technology will need to adapt accordingly.

Battery Size

6.5.2 In particular, the current trend towards increasing battery sizes for new EVs (resulting in higher vehicle ranges) means that a greater amount of energy will be required in order to fully charge EVs. Charging technologies are already adapting to this, with chargers being developed with greater power capacity and resulting in faster charging.

6.5.3 According to a report by Cenex and the Energy Saving Trust (2018)[40], based on the battery size projections reported by manufacturers, by 2020 up to 60% of all new vehicle sales (including taxis) could be EVs with an operational range of 350 to 450 km and an average range of 399 km on a full charge. These are likely to increasingly utilise DC (rapid) charging over AC (slow) charging, particularly at public charge locations.

6.5.4 In addition to this, DNOs, like WPD, are already considering three phase electricity supply infrastructure, as contained in their 2018 Losses Discretionary Reward report[41] and picked up in a Renewable Energy Association report (2018)[42], in order to support the increased demand for EV charging at home on top of electric heat pumps (increasingly being installed at new developments as part of a move away from gas heating in homes). This is likely have implications for the costs of installing sufficient power supply at new developments in the future. Any planning policy will need to be in line with changes to DNO standards.

6.5.5 Within the Renewable Energy Association (2018)[43] paper there is commentary relating to the feasibility, cost and benefits associated with a three phase power supply and the statement *"WPD are planning a three phase trial in a 'green' low carbon housing development in South Wales. If this is successful and effective WPD the company design policy will be to make all housing estates three phase'*. WPD are looking at changing their standards by the end of 2019 based on the success of current projects.

Smart Charging & Vehicle to Grid

6.5.6 EV charging represents a new source of electricity demand that neither buildings nor local low voltage distribution networks were designed to manage when they were first built. Small numbers of EVs on slower chargers can easily be accommodated, however large numbers charging at peak hours will have a significant impact on the peak demand at individual sites and for the entire local network. As a result, DNOs will need to ensure that networks can cope with the extra demand. Figure 8 shows the constraints already facing the WPD network.

[40] Cenex & Energy Saving Trust (2018). Project report: Go Ultra Low West Chargepoint Infrastructure Study

[41] Western Power Distribution – Losses and Discretionary Reward (2018)

[42] https://www.r-e-a.net/resources/pdf/324/REA_EV_Three_Phase_Report_FINAL-PDF-01-08-18-hi-res.pdf (Accessed 18 January 2019)

[43] https://www.r-e-a.net/resources/pdf/324/REA_EV_Three_Phase_Report_FINAL-PDF-01-08-18-hi-res.pdf (p14). (Accessed 18 January 2019)

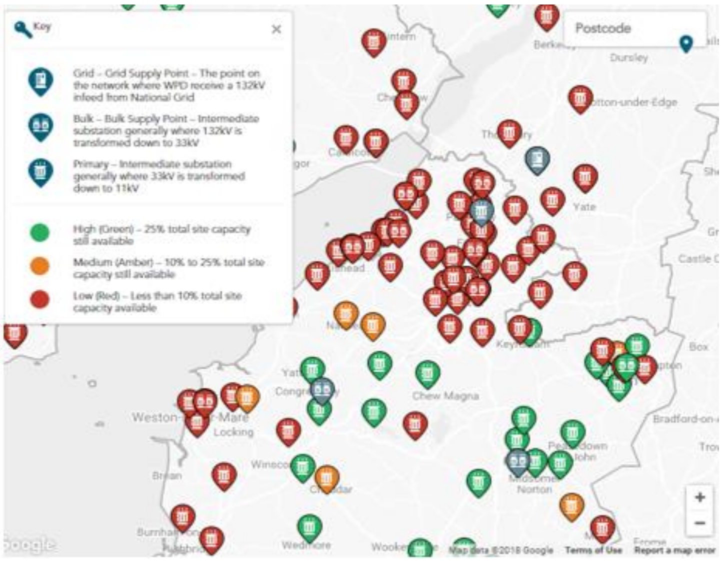
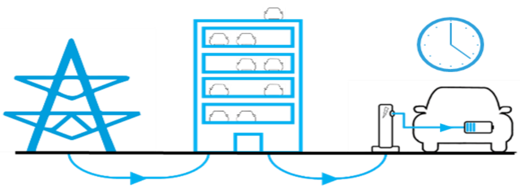


Figure 8. WPD network capacity map

6.5.7 Over time, it is likely that costly upgrades will be needed to meet the new peak demand, but in the short term this could be addressed through better utilisation of existing capacity. 'Smart' charging and Vehicle-to-Grid (V2G) are two key tools for addressing this (see Figure 9 and Figure 10 for definitions).

Figure 9. Smart charging definition

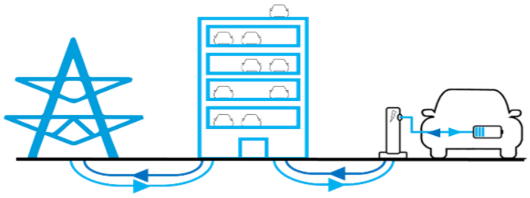


'Smart' Charging: The ability for electric vehicle supply equipment (EVSE) to control the timing of charging and the power output level in response to a user-defined input or signal. However, energy flow is single directional (EVSE to vehicle).

6.5.8 EV smart chargers, which enable 'managed' charging, are commercially available and enable users to have greater control over their charging. They also provide a method for accessing third party services. Smart chargers can vary in their functionality; however, at a minimum, smart chargers tend to include scheduling of charging and local load balancing – enabling multiple charge points on a site to be managed to limit their combined electricity demand. Smart charging has the potential to be used by DNOs to enable dynamic demand shifting to provide energy services including:

- Time of use (TOU) tariff optimisation.
- Peak demand shaving.
- Vehicle to Grid charging.
- Network constraint management.
- Simple renewable optimisation.

Figure 10. Vehicle-to-Grid definition



Vehicle-to-Grid (V2G): A system whereby plug-in electric vehicles, when connected to electric vehicle supply equipment (EVSE), can provide bi-directional flows of energy.

6.5.9 As well as smart charging, research projects are currently investigating the opportunity for providing Vehicle-to-Grid (V2G) chargers. V2G will allow energy to be discharged from the EV back into the building or local network. This could be used to 'store' cheap energy within the EV for use to meet the general building demand later on, or to export electricity back to the network at times when demand on the network is higher than the available supply. As this technology is still in the early phase of development, it is still unclear as to the implications on current charging infrastructure. However, one opportunity for future proofing is creating passive provision which could be converted into V2G charge points in the future.

Policy Recommendations

- Planning policies and costs for EV infrastructure should be reviewed at a minimum of five year intervals as part of the Local Plan revision process, or at a point of entry of new technology into the market, e.g. Vehicle to Grid.
- Uptake of EVs in the WoE sub-region and, where possible, usage of EV charge points should be measured to assess whether supply of provision meets demand.
- Passive provision should be provided as a default at all new developments where active provision is not yet provided.
- All charge points should use 'smart' technology so that that they can be controlled externally by the DNO when required, i.e. when demand for electricity is greater than supply.

7. CONCLUSION

7.1.1 The purpose of this study has been to inform the setting of planning policy requirements of electric vehicle infrastructure in new developments across the WoE sub-region. Planning policy should stimulate the uptake of ULEVs. It should also be future-proofed for the evolution of new and upcoming technologies.

7.1.2 This report has explored the policy context and local background situation for EVs, as well as looking at market trends and uptake forecasts for the vehicles themselves. Currently EVs represent a small, but progressively growing vehicle market share. In the WoE specifically, the increase in the number of ULEVs registered in Q2 2018 was 202% greater than the increase recorded at the same time the previous year, which is again significantly faster than the national average. Research by Cenex and the Energy Saving Trust[44] suggests that, by 2025, the percentage of EVs in the vehicle population of WoE could range from 1 – 11%. With such potential variability in the uptake of EVs, it is imperative that new developments are future proofed to ensure that there is the capability to meet future demand.

7.1.3 Current costs and ranges of EV, as well as the associated charging infrastructure are the largest barriers to increased uptake of EVs, and home charging is considered the most important necessity for EV users[45]. Therefore, providing infrastructure in residential areas will be crucial to ensure numbers of EVs in the WoE sub-region continue to increase.

7.1.4 The NPPF is the mechanism through which the Government is starting to filter down the necessity of EV provision to local authorities and, as of 2018, planning applications need to be 'designed to enable charging of plug-in and other ultra-low emission vehicles in safe, accessible and convenient locations'. The NPPF also requires that authorities give consideration to the differences in planning required for rural and urban contexts.

7.1.5 There is a clearly a need for further guidance on planning for EV provision and for consistency across authorities so, on the basis of the research undertaken in this study, we have provided recommendations identifying the likely costs associated with infrastructure provision and the planning policy recommendations related to active and passive provision, type of charging provision, EV parking standards and future proofing of EV infrastructure provision.

EV Charging Infrastructure Costs

7.1.6 Costs for EV charge points are split into:

- Hardware: largely dependent on the power rating of the unit i.e. the higher the power rating and faster the charging time, the more costly the infrastructure.

[44] Cenex & Energy Saving Trust (2018). Project report: Go Ultra Low West Chargepoint Infrastructure Study

[45] Cenex & Energy Saving Trust (2018). Project report: Go Ultra Low West Chargepoint Infrastructure Study

Therefore, dwell time and the distance that can be travelled between charges are important considerations when deciding on the power rating of charge points to install; and

- Installation: costs related to groundwork associated with laying cables, which can vary greatly depending on distance from the existing electrical supply, diameter of cabling and ground type. Costs for demarcation of parking bays, if required, protective barriers and signage also need to be considered.

7.1.7 Our summary of the minimum likely cost to developers associated with different type of provision is as per Table 6, with more detail in Chapter 5 of the report:

Table 6. Summary of Indicative EV Infrastructure Costs

INSTALLATION TYPE	TOTAL COST TO DEVELOPER
Passive: 7kW domestic	£200 - £500 per property
Active: 7kW domestic	£750 - £1,500 per property
Passive: On street 7kW publicly accessible	£40 - £50 per metre (cabling only)
Active: On street 7kW, 32 amp	For installed dual (2 vehicle) charging from £2,000 - £10,000 Groundworks only cost £500 - £3,000 per dual unit
Active: On street 22kW (Fast)	For installed dual (2 vehicle) charging from £3,000 - £12,000 Groundworks only costs £1,000 - £5,000 per dual unit
Active: On street 43-50 kW (Rapid)	£50,000 - £80,000

7.1.8 In addition to these costs, there are other potential variable costs which may derive from the actions of actors, such as the DNO, the energy supplier and the landlord, who are involved in the delivery of charge points. Depending on the business model chosen for the development, costs, including those for operation and maintenance, will be distributed amongst different stakeholders.

Planning Policy Recommendations

7.1.9 Drawing together the research on market trends and uptake forecasts, as well as a review of existing policies across the UK and stakeholder engagement with Western Power Distribution, we have made a number of policy recommendations on EV infrastructure provision at new developments.

- The analysis provided focuses on new development of both residential and commercial uses.

7.1.10 Evidence for the planning authority that developers have made provision for sufficient power supply at the development to support EV provision, as well as other low carbon technologies provided for the development, could be provided in the form of the specification document sent to the DNO.

7.1.11 It is important to have objective and robust policy that holds up to scrutiny or challenge if it is deemed to be too heavy-handed. As such, we consider the use cases of development covered in this report to be broadly acceptable for the policies as suggested, but we would guide planning authorities to secure bespoke solutions for strategic sites.

7.1.12 Other specific use cases of development will require justification, and this should be presented in the form of an EV infrastructure statement when submitting any major planning application.

7.1.13 The policy recommendations can be summarised as follows:

Active and Passive Provision

- The optimal provision is considered to be 100% active provision, as this would ensure that EV infrastructure is available for use as soon as development is complete and therefore facilitate a quicker uptake of EVs. Application sites in areas with an established high EV uptake (or forecast high uptake) would require active provision from the outset.
- The minimum provision should be 100% passive provision, as this would align with Central Government policy to dramatically increase the sale of ULEVs over the next 20 years whilst avoiding an excess of provision in the short term. Passive provision can safeguard the growth of EVs without costly and disruptive works later being required. However in the case of on-street charging it is imperative that a proportion of active charging is built into the design and construction of the street scene.

7.1.14 We have also provided recommendations in line with standards already introduced by other local authorities. These are equivalent to 10% or 20% active provision. In addition to this active provision, in line with the minimum provision recommended, we have included passive provision at 90% and 80% respectively.

7.1.15 Due to the costs of installing infrastructure at the build stage being lower than the cost of retrofitting existing developments, it is important that installing passive EV infrastructure in new developments is strongly encouraged.

Type of Provision

- Minimum power provision must be sufficient to enable 32 amp / 7kW charging of multiple vehicles at the same time.
- Infrastructure should be OLEV compliant, i.e. not three pin socket.
- Rapid charging infrastructure is not a minimum requirement at new developments however could be explored as a commercial opportunity in which a third party effectively runs and manages the chargers on a site.
- As per national guidance, charge points are required to be 'smart' as defined by the Automated and Electric Vehicles Act (2018).

EV Parking Charging Standards

- The provision of EV charging bays is based on the figures set out in Table 4 and will differ depending on the location of the development and whether parking is on- or off-plot.
- A number of recommendations have been made about EV parking charging standards covering their location, provision for disabled parking bays and time and use restrictions.
- Car park management policies may be required to ensure that all necessary signage associated with charge points and charging bays is provided. For private sites, both residential and commercial, it is likely that there will need to be a written policy with appropriate signage in order for the operator to issue penalty charge notices. This could be captured as part of the travel plan process as a planning requirement.
- For large car park developments, provision for EVs will depend on use case. This must be considered at an early stage of planning due to the impact on local power supply.
- Good practice principles for designing the layout of on-street charging bays are also recommended, which include the angle and height of EVCP controls, street clutter and effective footway width, sign plate location, kerbside obstructions and provision of EV supplier contact details.

Future Proofing EV Infrastructure Provision

- Planning policies and the costs of EVs should be reviewed at a minimum of five year intervals, or at a point of entry of new technology into the market, e.g. Vehicle to Grid.
- Uptake of EVs in the WoE sub-region and, where possible, usage of EV charge points should be measured to assess whether supply of provision meets demand.
- Passive provision should be provided as a default at all new developments where active provision is not yet provided.
- All charge points should use 'smart' technology so they can be controlled externally by the DNO when required, i.e. when demand for electricity is greater than supply.

7.1.16 More detail on the benefits and any relevant delivery considerations of these recommendations is provided in Chapter 6 of this report. The aim is that these represent informed recommendations to ensure that appropriate EV infrastructure is delivered through the planning process, in order to facilitate the uptake of EVs in the WoE sub-region. Trip data and forecast EV trends indicate that the WoE sub-region is well suited to EVs, and that the introduction of these low emission vehicles will contribute to air quality benefits in the area. Therefore, we have put forward evidence-based challenging minimum provision recommendations in this report.

GLOSSARY

TERM	DESCRIPTION
AC	Alternating current.
Amp or Ampere	A measure of electrical current.
AQMA	An area where air pollutant concentrations exceed/are likely to exceed the relevant national air quality objectives. AQMAs are declared for specific pollutants and objectives.
Battery EV or BEV	An EV solely propelled by an electric machine (motor) powered by a traction battery (typically with Lithium ion chemistry). Power for air conditioning and heating is also derived from the traction battery. BEVs are usually conductively charged from the energy grid when stationary.
Capacity	Capacity, in the context of this guide, refers to the amount of energy (in Amps) that can be safely drawn from a circuit without damaging it or items that are attached to it.
Car club	An organisation (public or private) that owns, leases or gathers vehicles from owners to hire out to vetted and subscribed club members on an hourly basis. Members of large private car clubs usually gain access to a vehicle using an RFID card held to the RFID reader in the windscreen.
CHAdEMO	CHArge de Move (charge for moving), also referred to as CHAdEMO is a trade name for a Japanese-originated rapid DC EV charging protocol with a special connector called the Japan Electric Vehicle Standard (JEVS) G105. The layout of the JARI JEVS/G105 plug and socket can be found in EN62196-3. The JARI JEVS/G105 connector is rated to 600 Volts and 200 Amps.
Charge point	The upstand or wall unit to which an EV is plugged into encompassing one or more sockets or tethered plugs, the user interface, access control, energy metering and circuit protection.
Combined Charging System, CCS Combo 2	A connector plug and socket and communication protocol package developed/packaged by the Society of Automotive Engineers (SAE). In the EU the Combo 2 connector combines the earth, proximity and pilot pins of the Type 2 plug with two DC specific pins on an added lower section of the plug. The layout of the Combo 2 plug and socket can be found in EN62196-3. The Combo 2 connector is rated to 850 Volts and 200 Amps.
DC	Direct Current.
Department for Transport or DfT	UK Government department tasked with road, rail, sea and air transportation policy and incentives.
Electric Vehicle or EV	Typically an Ultra-Low Emission Vehicle (ULEV) with emissions of less than 75g CO_2/km. Propulsion is provided partly or fully by an electric machine (motor) powered by an on-board traction battery and/or ICE generator. Most EVs can partially recharge their traction battery utilising regenerative braking performed by the electric machine.
Energy	Energy, in the context of this guidance, means electricity.
Fast charging	Typically 4-6 hours to charge a 24 kW traction battery (100% SOC) utilising Mode 3 charging

TERM	DESCRIPTION
	from a single or three phase dedicated circuit using an EV specific charging connector such as a Type 2 (7 pin) or J1772 (5 pin) plug and socket combination on the vehicle side and a Type 2 (7 pin) plug and socket combination on the Charge point side. Typically 16 or 32 Amps single phase AC energy for 6 and 4 hour charging times, respectively. Please note that 32 Amps three phase AC energy can charge compatible vehicles in 1-2 hours.
ICE	Internal Combustion Engine
Installation	Installation, in the context of this report, refers to the fitment and commissioning of Charge point equipment and any required ancillary items including: crash barriers, signage, parking bay markings, concrete plinths, cable ducting or trunking and circuit protection devices.
kW	A unit of electrical power.
KWh	A unit of energy storage in an EV traction battery. It refers to the capability of the battery to provide the rated power in kW in one hour at 1C (capacity rating).
KVAs	A volt-ampere (VA) is the voltage times the current feeding an electrical load. A kilovolt-ampere (kVA) is 1000 volt-amperes. Electrical power is measured in watts (W).
Local Authority or LA	Borough, City or County Councils funded by the UK taxpayer tasked with civic duties to maintain public assets and services for residents and visitors to/in their jurisdiction.
Mode 1 charging	Typically AC EV charging using a domestic or industrial connection on the energy grid side (i.e. BS1363-1 three pin domestic or EN60309-1 three/five pin Commando connections in the UK) without a pilot signal and up to 16 Amps and 250 Volts single phase or 480 Volts three phase only. The connection utilises the power and protective earth conductors.
Mode 2 charging	Typically AC EV charging using a domestic or industrial connection on the energy grid side (i.e.BS1363-1 three pin domestic or EN60309-1 three/five pin Commando connections in the UK) with a pilot signal between the EV and an in-line control box (the “brick” placed 30 cm from the plug) and RCD protection either in the control box or as part of the cable assembly (i.e. the RCD could be integrated into the plug that connects to the Charge point). AC energy should not exceed 32 Amps and 250 Volts single phase or 480 Volts three phase. The connection utilises the power and protective earth conductors.
Mode 3 charging	Typically AC EV charging using a dedicated charging cable and connectors (e.g. a J1772 or Type 2 plug on the EV side and a Type 2 plug on the Charge point side of the cable; as defined in EN62196-2). The pilot signal conductor extends between the EV and the Charge point. Typical charging currents range from 13 Amps single phase to 32 Amps three phase for cables that are detachable from the Charge point. Rapid chargers utilise the Type 2 tethered plug at 63 Amps three phase. The level of charging current depends on the Charge point output and the EV’s on-board charger.
Mode 4 charging	Typically for DC EV charging using a dedicated connector tethered to the charge point connected to the energy grid AC supply. The charging circuitry is off-board and can be found within the charge point. The pilot signal conductor extends between the EV and the Charge point. Typical rapid charge point DC energy output ranges from 20 to 350 Amps and 400 to 600 Volts depending on the charge point, the connector type and the EV.
OLEV	The Office for Low Emission Vehicles, a Government department formed of staff from the Department for Transport (DfT), the Department for Business, Innovation and Skills (BIS) and the Department for Energy and Climate Change (DECC). OLEV is tasked with providing policy and monetary incentives to reduce emissions from UK road transport.

TERM	DESCRIPTION
Permitted development rights	Permitted development rights are derived from the Town and Country Planning Order (General Permitted Development) 1995 as amended. A permitted development right means that planning permission for the specific alteration to a property or installation need not be sought from the relevant Local Authority as long as the conditions set out in the relevant statutory instrument pertaining to the alteration are adhered to.
Plug-in	Refers to the feature of an EV allowing it to be plugged into the energy grid to charge its traction battery and provide power to the air conditioning or heating when stationary (without depleting the traction battery).
Plug-in Car and Van Grants	Monetary Point of Sale incentives provided by OLEV to encourage the uptake of Plug-in EVs.
Plug-in Hybrid EV or PHEV	Typically an EV with both an electric machine (motor) and Internal Combustion Engine that can provide propulsion in parallel with each other. The vehicle typically bears a smaller traction battery than a BEV which can be charged by the ICE generator and by plugging it into the energy grid when stationary.
Power supply	The electricity grid source of energy for one or more charge points at a defined location. Typically formed of a fused, metered connection with a distribution board to which charge point circuits are attached to.
Rapid charging	Typically up to 1 hour to charge a 24 kWh traction battery (0-100% SOC; 30 minutes to 80% SOC) utilising Mode 3 or Mode 4 charging for AC and DC energy rapid charging, respectively. Rapid chargers typically have tethered plugs of the JARI JEVS/G105, Combo 2 (both DC) and Type 2 (AC) varieties. Please see the specific glossary descriptions for each connector type.
Slow or Standard charging	Typically 8-12 hours to charge a 24 kWh traction battery (0-100% SOC) utilising Mode 1 or Mode 2 charging from a dedicated circuit and a standard domestic or industrial single phase AC plug and socket (BS1363-1 or EN60309-1). Typically 10-13 Amps single phase AC energy.
Traffic Regulation Order or TRO and Traffic Management Order or TMO	A Traffic Regulation Order is an order created by a highway authority (i.e. a Local Authority) outside of London that allows restrictions to be put in place on traffic and parking. Traffic Regulation Orders are borne out of the Road Traffic Regulation Act 1984 and the Traffic Management Act 2004 (as amended) formed by Government. There are three types of TRO and TMO including permanent, experimental and temporary orders. Traffic Management Orders are synonymous to Traffic Regulation Orders with one exception, TMOs usually apply in London.
Type 2	Type 2 is a reference to the dedicated EV charging plug and socket adopted by the UK and EU for AC EV charging. It is defined in the EN62196-2 standard. It holds seven pins/ferules and is capable of delivering single or three phase AC energy (depending on the Charge point/EV that it is connected to). It is rated to handle 63 Amps per phase on a three phase connection or 70 Amps on a single phase connection. It can be found as part of cable assemblies carried in EVs or permanently attached to a rapid charger. Most public Charge points offering AC energy up to 32 Amps per phase accept the Type 2 plug. Some EVs also possess Type 2 sockets, but with an inversion of the gender so that the two ends of the EV charging cable are Type 2 compliant, but of different genders.
UK EVSE	The UK Electric Vehicle Supply Equipment Association (http://ukevse.org.uk/) formed of Charge point suppliers, Charge point test equipment suppliers and Charge point Network Operators (CPNOs). UK EVSE holds quarterly Executive meetings discussing industry relevant issues and solutions and Government funding. The group is membership based and self-governing. Cenex operates as the secretariat.

TERM	DESCRIPTION
ULEV (Ultra low emission vehicle)	ULEVs are vehicles with zero or near-zero tailpipe emissions which make use of electricity from an increasingly decarbonised power sector.
Volt	A measure of electrical potential difference between the live and neutral (or ground) conductors in a circuit.

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