CEC EV Charging Infrastructure Strategy

Strategy Report

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Working for a brighter future together

Cheshire East Council

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CEC EV Infrastructure Strategy

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Contents

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Abbreviations

Abbreviation	Meaning
AEVA	Automated and Electric Vehicles Act
BEV	Battery Electric Vehicle
CCC	Committee on Climate Change
CEC	Cheshire East Council
CO_2	Carbon Dioxide
COP	Conference of the Parties
DNO	Distribution Network Operator
EPBD	Energy Performance in Buildings Directive
E-REV	Extended Range Electric Vehicles
EV	Electric Vehicle
FCEV	Fuel Cell Electric Vehicles
HGVs	Heavy Goods Vehicles
ICE	Internal Combustion Engine
IEC	International Electrotechnical Commission
IMD	Index of Multiple Deprivation
kWh	Kilowatt Hours
LA	Local Authority
LCV	Low Carbon Vehicle
LGVs	Light Goods Vehicles
N_2O	Nitrous Oxide
NCR	National Charge Registry
OSCP	Open Smart Charging Protocol
OZEV	Office for Zero Emission Vehicles
PHEV	Plug-in Hybrid Electric Vehicle
PIV	Plug-in Vehicle
PM 2.5	Particulate Matter 2.5
SAE	Society of Automotive Engineers
SMMT	The Society of Motor Manufacturers and Traders
TRO	Traffic Regulation Order
UK	United Kingdom
V2G	Vehicle to Grid
VAT	Value Added Tax
WPD	Western Power Distribution

Executive Summary

Why develop an electric vehicle infrastructure strategy for Cheshire East?

The UK is facing a climate emergency and is committed to reducing greenhouse gas emissions to net zero by 2050 in response to recommendations from the Committee on Climate Change. The Council noted that Parliament had declared a climate emergency in May 2019 and committed to becoming carbon neutral by 2025. Additionally, the Council is committed to improving air quality as outlined in the 2018 Air Quality Action Plan. The biggest contributor to climate change and air pollution with Cheshire East is road transport. Macclesfield, Knutsford, and Wilmslow have the highest emissions from road transport in the borough. This is indicative of a relatively high car use and low public transport use relative to other areas; 43% of households in Cheshire East have 2 or more cars against a UK average of 29%. This will be increasingly important considering an expected 15% growth in population. Although significant activity to decarbonise will be led nationally, the Council has a role to play in aiming to minimise the carbon intensity of our transport system.

Enabling the transition to electric vehicles is anticipated to make a significant contribution to meeting these aims. The Council has already invested in providing a number of electric vehicle charge points however there are key gaps in current provision within Cheshire East. Notably, there is a lack of provision in the east of the borough including the Macclesfield area, and other gaps in provision in towns and rural areas. The current supply of charge points is likely to be insufficient to support the future uptake in electric vehicles.

Electric vehicles have zero tailpipe emissions and this strategy will also support Cheshire East's aims to improve air quality as set out in the Cheshire East Air Quality Management Plan (2018). The UK government's ultimate vision as set out in "The Road to Zero Strategy" published in July 2018 is that every new car and van sold in the UK should be zero emission by 2040, and that the entire UK road fleet should be effectively decarbonised by 2050. However, on the 18th of November the government brought forward the timeframe to 2030 through the following steps:

- Step 1 will see the phase-out date for the sale of new petrol and diesel cars and vans brought forward to 2030.
- Step 2 will see all new cars and vans be fully zero emission at the tailpipe from 2035 (ending the sale of Plug-in Hybrid electric vehicles).

EVs are an alternative to petrol and diesel vehicles which reduce emissions, particularly in congested urban areas where stopping and starting, idling and over-revving of petrol/diesel vehicles in queues produces high concentrations of emissions. EV use an electric drivetrain to provide power to the wheels rather than carbon-based fuels, so they generate zero exhaust emissions and less noise whilst driving. In spite of the increased electricity requirement, EV have a lower whole-life carbon footprint than petrol/diesel vehicles and given the UK's progress towards and remaining plans for greener electricity generation these benefits will increase further in the future. EV also produce less noise pollution and encourage a smoother driving style than petrol/diesel which increases driving efficiency by reducing the power

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required per km driven and causing lower particulate emissions from brake and tyre wear.

There are a range of actions that are needed to decarbonise transport such as increasing the numbers of people walking, cycling and using public transport as set out in Cheshire East's Local Transport. Transitioning the remaining vehicle fleet to EV will have an important role to play in complementing this modal shift.

Objectives of the Strategy

Through engagement with industry stakeholders, Cheshire East officers, and a review of relevant data, strategies and policies, the following objectives for the strategy have been set:

- To support the uptake of electric vehicles by individuals, businesses, and organisations within Cheshire East
- To contribute towards improved air quality and reduced carbon emissions from transport
- To guide the provision of infrastructure that is safe, easy to use and represents good value for money both on installation and throughout its life
- To help ensure infrastructure makes a positive contribution to the streetscape through sensitive placement and appearance, avoiding any negative impacts on other road users, particularly pedestrians
- To seek to overcome inequalities in infrastructure provision, enabling our communities to transition to electric vehicles in a timely way
- Supporting electric vehicles in the context of a wider transport system that encourages mileage reduction, active travel and public transport

The above objectives have guided the development of this strategy and will continue to guide implementation of the key measures set out within it.

The Current Situation

Buying and driving an EV can feel intimidating for many people and there is a general lack of awareness about the benefits and practicalities of driving an EV.

Range of vehicles – one common perceived barrier to driving an EV is the real world range of vehicles before recharging is needed. Approximately 64% of the plug-in vehicle models available in UK have a battery capacity of less than 20 kWh which equates to less than 80 miles, however this includes plug-in hybrid vehicles that have predominately petrol engines to extend the vehicle range. However, all the new models announced to reach the market beyond 2020 are battery electric vehicles with capacities above 30 kWh equating to 120+ miles. This demonstrates the trend towards increasing battery capacity, intended to meet consumers' demand for increased range per charge and to tackle the continuing reports of range anxiety by potential adopters.

New buyers of EV are experiencing much greater range than the early adopters upon which much research was based. Ranges have gone from less than 100miles to 200+miles. 250 miles electric range is more than adequate for the vast majority of

UK drivers daily driving requirements which are below 20 miles per day, meaning they don’t need to recharge every day. Even company car users whose annual mileage is quoted as 17,500 miles typically don’t exceed 70 miles daily so electric range should be adequate for most daily mileage requirements.

Charging of vehicles – one of the most often cited barriers is the lack of charging infrastructure. All plug-in vehicles require infrastructure to recharge their on-board batteries, by connecting the vehicle to an external electricity supply, most commonly the electrical grid or to an electrical storage facility. Currently, there is a range of charging infrastructure types and connectors which differ across vehicle manufacturers and models, however all manufactures (with the exception of Tesla) are working towards the Open Smart Charging Protocol meaning charging types and connectors will become standardised in the coming years.

Plug-in vehicle charging technology is evolving rapidly. Prior to 2016 most technology charged at 3kW alternating current (called slow charging), which was adequate to fully recharge most batteries (typically up to 24kWh) overnight. With the development of vehicles came fast 7kW alternating current charging, and with the introduction of higher capacity batteries, direct current fast, rapid, and ultra-rapid charging technology has since become available that (providing the vehicle is compatible) recharges vehicles much quicker.

Approximately 80% of vehicle charging is currently conducted at home locations where energy costs are lower, with top up charging taking place when required at destinations or on-route.

Uptake of EVs in Cheshire East

Figures from the Department for Transport and National Chargepoint Registry show that 2,119 plug-in vehicles were registered in Cheshire East in the third quarter of 2020. At this time there were 33 publicly available chargepoints at 80 outlets. This meant there was a total of 64 vehicles per charge point and 26 vehicles per outlet. Forecasts suggest that if current progress continues 5,776 ULEVs could be licensed in the Cheshire East area by 2025. We believe that significant changes are likely in battery technology to greatly increase energy density, battery life and vehicle range around 2025. This trend coupled with reaching price parity between EV and petrol / diesel could have a major impact on Plug-In Vehicle demand and a more rapid pace of transition to EV is anticipated from approximately 2025 onwards.

Current Charging in Cheshire East

Key to developing a forward-looking strategy for electric vehicles is understanding the current level of charging infrastructure in Cheshire East.

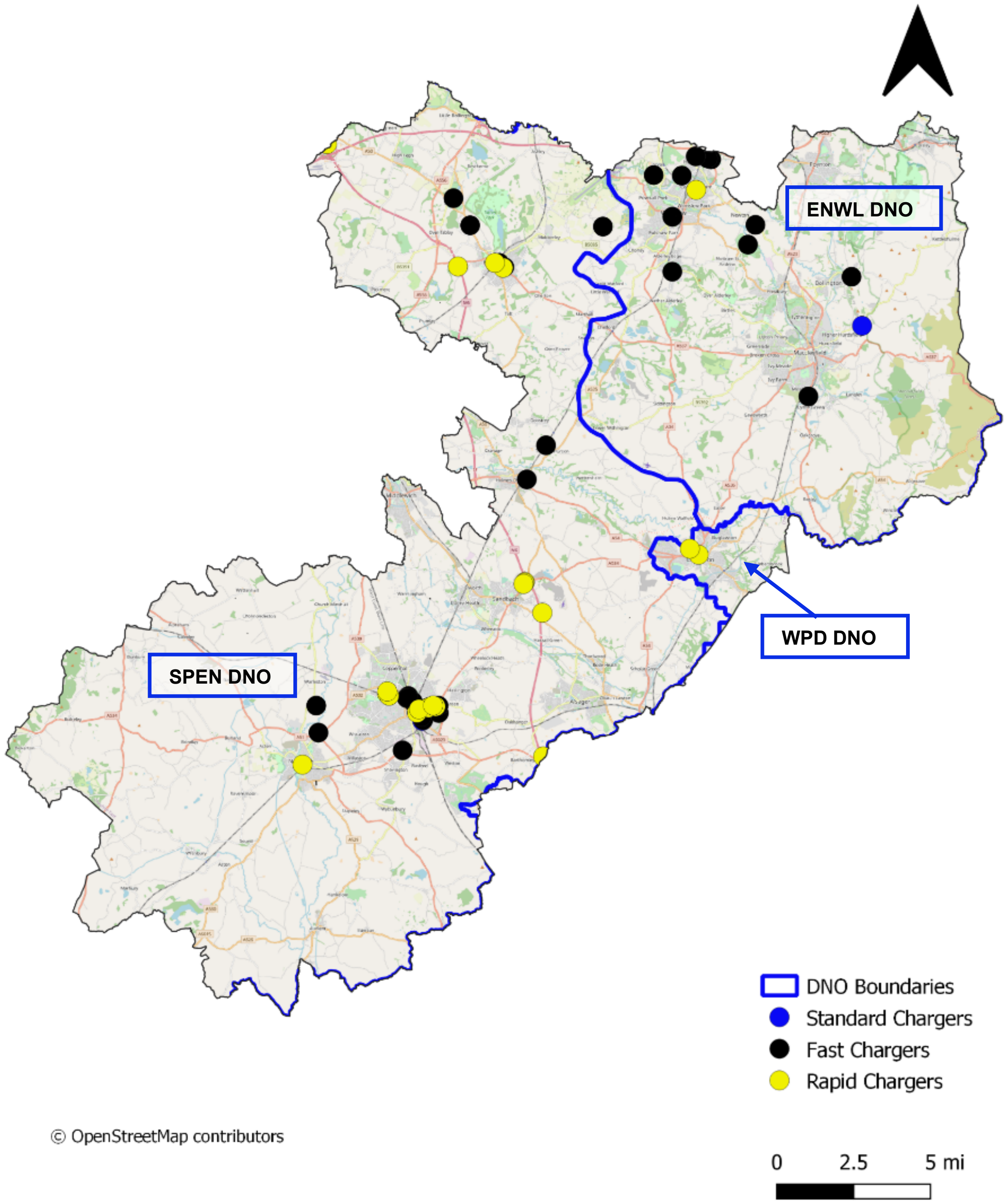

Figure Existing Charging Infrastructure and DNO boundaries

The existing charging infrastructure in Cheshire East includes Sandbach motorway services, which are currently served by the Ecotricity network and feature two rapid chargers on each side of the motorway. A survey of rapid chargers in Cheshire East also revealed that the private sector is installing chargers including some KFC, Morrisons, Lidl, Sainsburys, Shell and BP locations, as well as other establishments such as hotels and a health club.

There is a notable lack of charging infrastructure in the east of the borough and the Macclesfield area in particular, with no ‘rapid’ chargers and few ‘fast’ chargers in operation at the time of writing. Initial discussions with the District Network Operators for Macclesfield and Congleton have also identified these areas as having constrained capacity in the electricity network which may limit the ability to provide EV charging infrastructure.

The Plug-In Vehicle per outlet ratio in Cheshire (26) is above the UK average of 16 (at time of writing in February 2021). However, this figure is substantially lower than other comparative areas such as Dorset, Cheshire West and Chester, and East Riding of Yorkshire, where current ratios vary between 49 to 64.

Analysis has also been conducted to understand areas of Cheshire East that have high concentrations of flats and terraced houses in which residents are unlikely to have the ability to recharge electric vehicles. This type of housing is located in the denser urban areas, including Macclesfield, Crewe, Nantwich, Knutsford, and Wilmslow.

Measures Proposed in this Strategy

A number of measures are proposed in this strategy to support the transition to electric vehicles in Cheshire East as set out below.

<table>
<tr><th>Measure</th><th>Short term
(0 – 2 years)</th><th>Medium term
(2 -5 years)</th><th>Longer term
(5+ years)</th></tr>
<tr><td>Providing charging points in car parks at key destinations (e.g. Town Centre, train stations, retail parks, major employment sites).</td><td>✓</td><td colspan="2" rowspan="5">Continuous monitoring of charge point usage and commercial provision to determine when / if further phases of Council-led charge points are required</td></tr>
<tr><td>Providing on-street charging points to support residents with limited access to parking provision and home charging with a focus on off-street car parks and consolidated on-street community hubs.</td><td>✓</td></tr>
<tr><td>Providing on-route charging points to serve the Major Road Network.</td><td>✓</td></tr>
<tr><td>Providing off-street charging points to support residents with limited access to parking provision and home charging.</td><td>✓</td></tr>
<tr><td>Introduce charge points for the Council’s own fleet and grey fleet.</td><td>✓</td></tr>
</table>

Measure	Short term (0 – 2 years)	Medium term (2 -5 years)	Longer term (5+ years)
Continuous engagement and joint working with the District Network Operators (Scottish Power Electricity Networks, Electricity North West, Western Power Distribution) to bring forward cost effective charge points and strategic strengthening of the power network, particularly in Macclesfield and Congleton where capacity is constrained. There is also an opportunity to investigate how distributed renewable energy solutions such as solar power may contribute to addressing power constrictions.	✓	✓	✓
Engage with taxi industry and providing charging infrastructure for taxis in convenient locations.	✓ (focusing on rapid chargers)	✓ (focusing on rapid chargers)	✓ (potential for wireless inductive chargers)
Engage with bus operators and consider providing charging infrastructure for buses.		✓	✓
Encourage and where possible support the introduction of commercially provided charging forecourts.	✓	✓	✓
Introduce charge points for HGVs should appropriate technology come forward.			✓

Site Selection

This strategy assesses potential locations for providing future EV charge points against a framework of investment criteria including:

- The contribution to serving residential, destination and on-route charging needs;
- Site security and ambient surveillance levels;
- Cost effectiveness of connection to the electricity network;
- Avoiding conflicts with commercially provided charge points e.g. at supermarkets; and
- Projected uptake of electric vehicles in the surrounding area.

This framework was used to assess potential locations in Council car parks, in Principal Towns and Key Service Centres and at Local Service Centres, plus a number of on-street locations with limited off-street parking. The results provide a

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high degree of confidence that there is a reliable basis for determining quick wins in Cheshire East that are deliverable, affordable and likely to meet the needs of local users. This assessment framework can be updated to inform future phases of work in subsequent years.

Commercial Models

The strategy sets out a range of commercial models that are available to the Council to deliver EV charging infrastructure. The preferred approach is one that retains an element of control over the location of sites and their operation whilst working collaboratively with the private sector to leverage investment funding and access up-to-date technologies throughout the life of a contract or concession.

Next Steps

As part of the next phase of work, site selection for delivery of charge points will be considered further with the aim of providing a balanced network in a timely way to support demand for charging. This will draw on evidence contained in this strategy, detailed cost estimates of connecting to the electricity network, and discussions with stakeholders.

1. Introduction

Cheshire East Council is committed to reducing carbon emissions and improving air quality as outlined in the *Cheshire East Borough Council Air Quality Action Plan (AQAP) (2018)*. CEC noted that Parliament had declared a climate emergency in May 2019 and committed to being carbon neutral by 2025 and work to encourage all businesses, residents, and organisations in Cheshire East to reduce their carbon footprint. This EV Charging Infrastructure Strategy has been developed to directly support CEC's aim of reducing carbon emissions by accelerating the transition to electric, and supports the ambitions outlined within the Cheshire East Local Transport Plan 4 Strategy.

1.1 Structure

Following this introduction, this strategy consists of the following chapters:

- **Chapter 2: Policy Review –** A review of current national, regional, sub-regional and local policy and legislation in relation to electric vehicles and charging infrastructure
- **Chapter 3: Technology Review –** A review of electric vehicle and charging technologies
- **Chapter 4: Cheshire East EV Charging Baseline –** A review of background data regarding of EVs in Cheshire East, including key trends and future likely developments and demographic data
- **Chapter 5: Strategic Priorities** – Outlines the measures to be implemented as part of this strategy, including consideration of sequencing and future uncertainties
- **Chapter 6: Prioritising Charging Locations –** Sets out the proposed locations for charging infrastructure in car parks, as well as leading areas for consideration of on-street residential charging points
- **Chapter 7: EV Charging Commercial Models –** Details potential options for how charging infrastructure can be delivered and maintained, alongside analysis underpinning these options
- **Chapter 8: Next Steps –** Outlines a high-level timeline of recommended measures and key strategic actions to be taken

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2. Policy and Legislation Review

There are many policies and strategies at national, regional, sub-regional and local levels that are creating an increasingly supportive framework for the transition to EV as outlined in the following sections. Selected key examples are summarised in this chapter, helping to set out the policy and legislative foundation for this strategy.

2.1 Recent National and International EV Developments

During November 2020, the UK Government made announcements on new domestic (UK) policy with reference to the climate challenge. These announcements also feed into the UK's hosting of the 26th United Nations Climate Change Conference of the Parties (COP26) in Glasgow in November 2021. The detail behind these announcements are not yet final, but the implications of the broad announcements in relation to EVs and specifically Cheshire East is set out here.

The prevailing strategy of the UK government up to November 2020 regarding emissions was to commit to reducing greenhouse gas emissions by at least 80% of 1990 levels by 2050 through the Climate Change Act 2008[1]. It's now net-zero by 2050, and 6th carbon budget requires a 78% reduction by 2035. The inclusion of shipping and aviation will also mean a focus on domestic emissions such as transport. The UK's transport sector has made the least contribution to a reduction in emissions to date (<2%), making it a prime target for future regulation.

The European Union's Directive for Alternative Fuels Infrastructure requires Governments to adopt national policy frameworks for infrastructure roll-out. The UK Government has also committed to achieving at least these goals following its departure from the EU. Grams of CO_2 per km driven is the primary measure used by the EU to enforce improvements in new car and van fleet emissions. EU regulations enable fines on vehicle manufacturers based on their average new car sales emissions. The current maximum threshold for new car sales is 135g CO_2/km driven, reducing to 95 g CO_2/km from 2021. The EU recently announced even tighter targets for new cars and vans to be achieved by 2030 through its Clean Mobility package.

The UK Government's ultimate vision is that every new car and van sold in the UK will be zero emission by 2030. The UK's current objectives are set out in "The Road to Zero Strategy" published in July 2018[2] . To this end, the UK's Committee on Climate Change (CCC) targeted the Ultra-Low Emission Vehicle (ULEV) market to reach 9% share of new vehicle sales by 2020 and 60% by 2030. The UK did indeed exceed its 2020 target, with Battery Electric Vehicles (BEVs) and Plug-In Hybrid Electric Vehicles (PHEVs) totalling 10.7% market share in December 2020.[3]

1 UK Government, https://www.legislation.gov.uk/ukpga/2008/27/contents

2 UK Government, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

3 Society of Motor Traders and Manufacturers (SMMT), December 2020, https://www.ezoomed.com/blog/ev-knowledge/uk-new-car-registrations-smmt-december-2020/#:~:text=in%20the%20UK.-,UK%20New%20Car%20Registrations%20SMMT%20December%202020%20(credit%3A%20SMMT),cars%20were%20registered%20in%202020

For the first time, Ministers, and representatives from some of the world's largest and most progressive car markets have come together to form a new Zero Emission Vehicle Transition Council. Hosted by the COP26 President, Alok Sharma, the Council met to discuss how to accelerate the pace of the global transition to zero emission vehicles. These Ministers and representatives have agreed to collectively address some of the key challenges in the transition to ZEVs, enabling the transition to be faster, cheaper, and easier for all. The Council was made up of Ministers and representatives from California, Canada, Denmark, European Commission, France, India, Italy, Japan, Mexico, Netherlands, Norway, Spain, South Korea and Sweden, the United Kingdom.

Following the Council meeting, a joint statement was released stating that road emissions currently account for over 10% of global greenhouse gas emissions, and emissions are continuing to rise. Therefore, the rapid transition to zero emissions vehicles is vital to meeting the goals of the climate Paris Agreement. The globe is currently not on track and consequently the pace of the transition needs to dramatically increase. In addition to greenhouse gas emission reductions, this transition will generate job and growth opportunities, improve air quality, improve public health, boost energy security, and assist in balancing electricity grids during the transition to clean power.

The joint statement stressed the importance of the roles of cities and regions in helping to determine the pace of the global transitions to zero emissions vehicles. The Zero Emissions Vehicle Transition Council stated its aims to act as a forum to coordinate global efforts to overcome strategic, political, and technical barriers, accelerate the production of zero emission vehicles, and increase economies of scale. Specific opportunity areas for collaboration include aligning the future of the road transport sector with the Paris Agreement goals, ensuring the transition to zero emissions vehicles is global, ensuring the lifecycles associated with zero emissions vehicles is sustainable and inclusive, and coordination innovation efforts. The final and most relevant to this strategy is ensuring that enabling infrastructure is in place, including EV chargepoints.

2.2 Key National Strategy and Policy

The following key UK strategies and policies help to set the foundation for EV growth and promotion in Cheshire East:

- *End of sales of new petrol and diesel cars by 2030 (2020)* – Step 1 will see the phase-out date for the sale of new petrol and diesel cars and vans brought forward to 2030. Step 2 will see all new cars and vans be fully zero emission at the tailpipe from 2035 (ending the sale of Plug-in Hybrid electric vehicles).

- *Policy paper: Government vision for the rapid charge point network in England*, published (2020) − The following are key applicable extracts:

    - By 2023, the aim is to have at least 6 high powered, open access charge points (150 - 350 kilowatt capable) at motorway service areas in England, with some larger sites having as many as 10-12. The government is confident this will be more than enough to meet demand from electric vehicles by this date. These high-powered charge points are able to charge up to 3 times faster than most of the charge points currently in place and can deliver around 120-145 miles of range in just 15 minutes for a typical electric vehicle.

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- By 2030, it is expected that the network to be extensive and ready for more people to benefit from the switch to electric cars. We are planning for there to be around 2,500 high powered charge points across England's motorways and major A roads.

- By 2035 it is expected there will be around 6,000 high powered charge points across England's motorways and major A roads.

* *Decarbonising Transport: Setting the Challenge (2020)* − Sets out in detail what Government, business, and society will need to do to deliver the significant emissions reduction needed across all modes of transport, creating a pathway to achieving carbon budgets and net zero emissions across all modes of transport by 2050.

* *Emerging DfT Buses Strategy and Electric Bus Towns Fund (2020)* – The DfT has invited expressions of interest from local authorities to receive significant capital funding to transition local bus fleets to EVs.

* *Highways England Road Investment Strategy 2&3 (2020)* – Documents present the long-term vision for what the Strategic Road Network should look like in 2050, and the steps to help realise this alongside an investment plan. The document notes that the rise of electric vehicles is essential to achieving the target of net-zero carbon emissions by 2050, but also has the potential to encourage increased travel on our road network as the costs of driving fall.

* *Climate Change Commission's (CCC's) Sixth Carbon Budget (2020)* − Sets the limit on allowed UK territorial greenhouse gas emissions over the period 2033 to 2037. It is the CCC's duty under the Climate Change Act to advise on it by the end of 2020, following which it must be legislated by the middle of 2021. A chapter in associated Methodology Report focusses on surface transport and recommends a swift and sharp increase in EV infrastructure to facilitate EV take up.

  - Reduced demand − Around 10% of the emissions saving in the Balanced Pathway in 2035 comes from changes that reduce demand for carbon-intensive activity. Particularly important in these scenarios are slower growth in flights and reductions in travel demand. Reduced demand can result from reduced miles travelled and modal shift to lower-carbon modes. While changes are needed, these can happen over time and overall can be positive for health and well-being.

  - Surface transport is currently the UK's highest emitting sector. In the CCC's Sixth Carbon Budget Balanced Pathway, options to reduce emissions, including take-up of zero-emission technologies and reduction in travel demand, combine to reduce surface transport emissions by around 70% to 32 Mt CO_2e by 2035 and to approximately 1 Mt CO_2e by 2050 (See illustration in Figure 2-1 below).

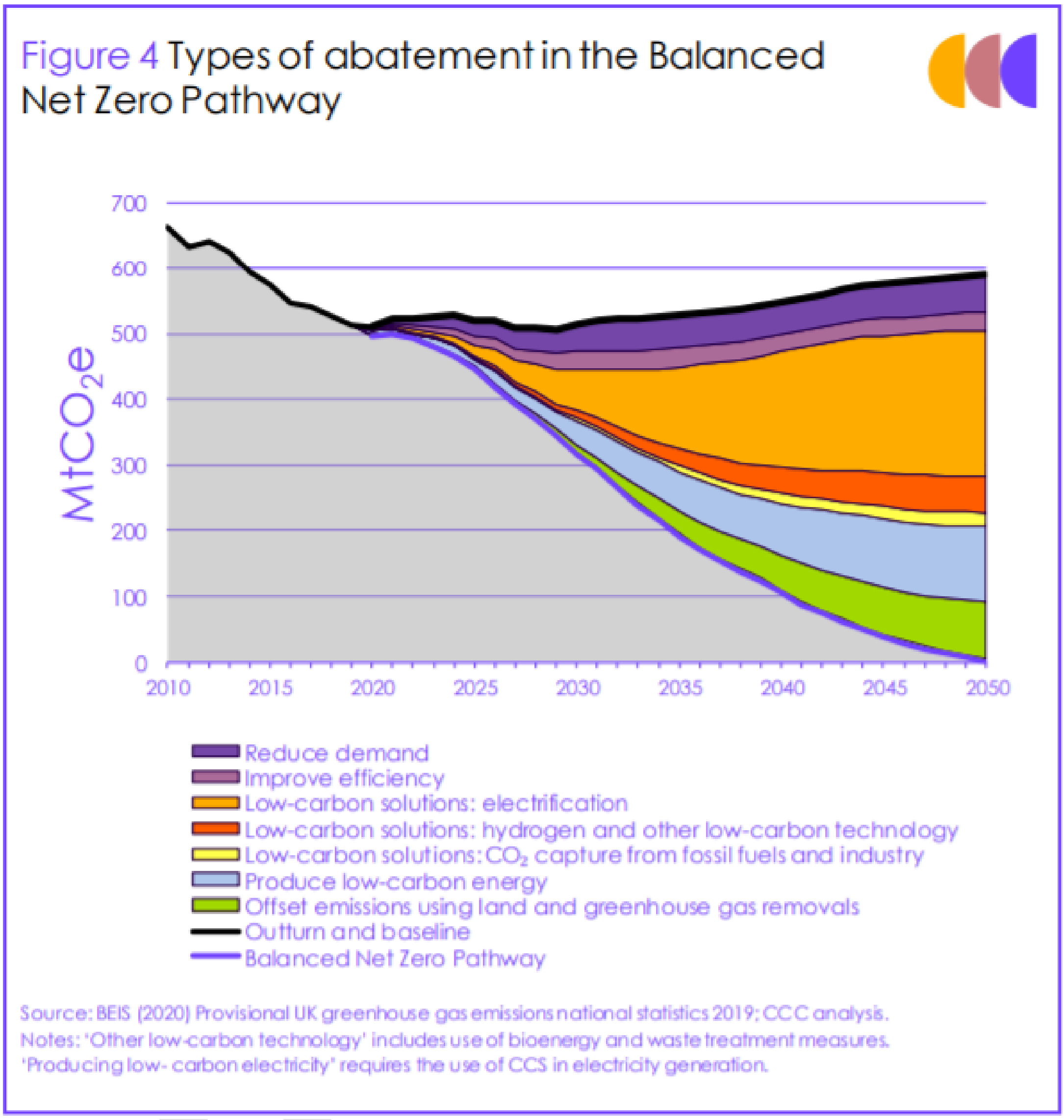

Figure 2-1 Sources of abatement in the Balanced Net Zero Pathway for the surface Transport sector (UK CCC)

- *National Planning Policy Framework (2019)* – Local parking standards for developments should consider adequate provision for EV charging in safe, accessible, and convenient locations.

- *Planning Practice Guidelines Paragraph 008 (2019)* – Planning conditions and obligations can be used to secure air quality mitigation, including infrastructure to promote modes of transport with a low impact on air quality, such as EV charging points.

- *DfT's Future Mobility: Urban Strategy (2019)* – Sets out the Government's strategy for tackling the challenges of urban mobility, including through a £400m funding package for EV charging points.

- *Energy Saving Trust's 'Positioning charge points and adapting parking policies for electric vehicles' (August 2019)* – Provides guidance on the installation of charge points along footways and the use of parking bays. Recommends a clear footway width of 1.5m and placement of chargers at the front of pavements to avoid tripping hazards and away from areas with significant other street furniture. Alternatively, kerbs should be built out to maintain footway accessibility.

- *Committee on Climate Change (2019)* – In June 2019, the Government passed new laws to support a target of net zero emissions by 2050 in response to recommendations from the Committee on Climate Change (CCC).

- *DEFRA Clean Air Strategy (2019)* – Sets out the Government's plan to tackle all sources of air pollution, making our air healthier to breathe, protecting nature and boosting the economy.

- *Future Mobility Zones (2019)* – Outlines the Government's commitment to fostering experimentation and trialling through launching four Future Mobility Zones with £90 million of funding. The zones aim to demonstrate a range of new mobility services, modes, and models. They focus on significantly improving mobility for consumers and providing an exportable template to allow successful initiatives to be replicated in other areas.

- *Automated and Electric Vehicles Act (2018)* – Promotes the development and deployment of autonomous and electric vehicles, through large-scale investment in electric charging points and new rules ensuring vehicle compatibility, payment standardisation and guaranteeing reliability.

- *OLEV Road to Zero Strategy (2018)* – Outlines the ambition that every new car and van sold in the UK should be zero emission by 2040, and that the entire UK road fleet should be effectively decarbonised by 2050. However, on 3rd February 2020 the government brought the ban on new ICE car sales forward to 2035 which also prohibits the sale of new hybrid vehicles. This target was further strengthened in November 2020 to end new ICE car sales in 2030 (PHEVs in 2035).

- *DfT Future of Mobility: Urban Strategy (2018*) – This strategy sets out the approach that Government will take to seize the opportunities from the changes happening in urban transport. It sets out the benefits which the Government aims for mobility innovation to deliver and the principles that will help to achieve this.

- *Air Quality Plan for Nitrogen Dioxide (NO_2) in the UK (2017)* – Sets out how the UK aims to reduce roadside nitrogen dioxide (NO_2) through a requirement for development of local plans for interventions in targeted areas where the problem is most severe.

- *Clean Growth Strategy (2017)* – Outlines how the government intends to implement its industrial strategy, focussing on clean growth and lower carbon emissions. It notes that the low carbon economy is predicted to grow 11% a year from 2015-2030, with transport a key sector in delivering this growth.

- *UK Industrial Strategy: Building a Britain fit for the future (2017)* − Sets out how the Government plans to build 'a Britain fit for the future' through helping businesses create better, higher-paying jobs with investment in the skills, industries, and infrastructure of the future. A key 'grand challenge' is decarbonising the economy to enable clean growth and capitalising on the opportunities to develop world leading skills and businesses in the field of future mobility.

- *Driving the Future Today: A strategy for ultra-low emission vehicles in the UK (2013)* – Lays out the Government's strategy for every UK car and van to be ultra-low emission by 2050, supported by greater roll-out of EV charging points than envisaged in 2011.

- *Carbon Plan (2011)* – Sets out the Government's plan of action for reduction of carbon emissions, including noting the importance of transport in meeting this goal.

- *Making the Connection: The Plugged-In Vehicle Infrastructure Strategy (2011)* – Sets out principles for where and when the Government envisaged electric vehicles would be charged. This would primarily focus on overnight at homes and vehicle depots, reducing demand for electricity during the daytime and the need for expenditure on infrastructure.

- *Manual for Streets 2 (2010)* – Highlights the need to design footpaths to ensure accessibility and safety but does not address charging point placement specifically.

- *Climate Change Act (2008)* – Commits the UK to reducing emissions by at least 80% by 2050. This has since been amended to include a target of net zero emissions by 2050 (2050 Target Amendment – Order 2019).

The electrification of transport should also be seen as part of a package of policies to support the decarbonisation of transport including demand management through sustainable and active travel (such as cycling and walking promotion), and the potential adoption of alternative fuels including hydrogen, more likely focussed on heavier utility vehicles.

2.3 Regional Strategy and Policy

The following regional strategies and policies contribute towards the foundation for EV growth and promotion in Cheshire East:

- *Cheshire & Warrington Draft Transport Strategy* – Improved accessibility will be essential for the unlocking of strategic and wider development sites for housing and employment as well as relieving the many congested areas of our local and strategic transport networks. The Strategy notes that working with partners to explore technical and digital innovations will assist with the management of the existing network, with an increased uptake in EV supporting this aspect of the strategy.

- *Cheshire & Warrington Energy and Clean Growth Strategy* – Sets out the energy challenges facing the sub-region and how, in collaboration with industry and key public-sector partners, the challenge of delivering 'affordable energy and clean growth' can be met. The Strategy notes that the LEP has a role in promoting low carbon technologies as a key factor in making new development sustainable, such as providing EV charging infrastructure.

- *Cheshire and Warrington Local Industrial Strategy* – Outlines what evidence suggests are the strengths, weaknesses, threats and opportunities for the Cheshire and Warrington economy and how the UK's Industrial Strategy can be implemented within the sub-region.

2.4 Local Strategy and Policy

The following existing local strategies and policies help set the foundation for EV growth and promotion in Cheshire East:

- *Cheshire East Local Transport Delivery Plans (2020)* – Outline the issues and options for each of the 11 town areas in Cheshire East and were consulted on between December 2020 and March 2021. Measures to support the uptake of EVs are included in the reports for each town area.

- Enabling the transition to EV will contribute to the following priority outcomes identified in the Council's *Corporate Plan (2020)*:

  - *GREEN - through proposals that would improve EV charging provision across the Borough, the Council will further encourage the early adoption of electric vehicles which will positively contribute both to our response to the climate emergency and also to reducing the incidence of air quality problems, especially in urban areas.*

  - FAIR – the proposals are intended to create greater consistency and availability of access to EV charging, removing some of the long-standing barriers to purchase and use of electric vehicles within the Borough.

- *Cheshire East Council Environment Strategy 2020-2024 (2020)* – Outlines the council's response to their climate emergency declaration and becoming carbon neutral by 2025. The strategy highlights the commitment to producing this EV Infrastructure Strategy to outline the ambition to increase electric charging infrastructure provision and seek funding opportunities and initiatives which encourage the uptake of electric vehicle usage.

- *Cheshire East Carbon Neutrality Action Plan (2020)* - outlines the approach the Council will take to decarbonise its operations set out in the Environment Strategy, including a target to decrease fleet and grey fleet emission by approximately 30% by 2025. This will require electrification of the fleet and provision for business travel, which will both benefit from and impact on wider EV charging strategies, and has been informed by reviews conducted by the Energy Savings Trust;

  - *Cheshire East Council Fleet and ULEV Review (2020)* – Outlines a benchmark of the greenhouse gas emissions and energy costs of the road transport fleets and provides a series of recommendations for creating a ULEV fleet.

  - *Cheshire East Council EVCI Review (2020)* – Addresses the potential capacity to introduce charging infrastructure at CEC workplace sites and provides a series of recommendations for introducing charging on council sites.

  - *CEC Grey Fleet Review (2020)* − Covers the environmental impact and financial cost of grey fleet travel by Cheshire East Council employees and provides recommendations to improve grey fleet management.

- *Cheshire East Local Transport Plan 4 (LTP4) (2019)* − outlines a long-term strategy for travel and transport within Cheshire East. The LTP4 was adopted during October 2019 and covers the period of 2019 to 2024. The LTP4 includes

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a high-level parking strategy that highlights the potential to install on-street charging points, alongside the wider roll out of EV infrastructure.

- *Draft Economic Strategy for Cheshire East (2019)* – outlines that the UK Industrial Strategy predicts that the clean growth/low carbon economy is estimated to grow by 11 per cent per year through to 2030 (four times faster than the rest of the economy) and could deliver between £60 billion and £170 billion of export sales of goods and services by 2030. The sector in Cheshire East is sizable with over 5,000 employees and £0.5bn in sales as far back as 2011, the Council will support the further development of this sector, working with the Local Enterprise Partnership to deliver the Energy Strategy and clean growth aspects of the Local Industrial Strategy, supporting innovation by all businesses, promoting energy and climate resilience, and accelerating market development of energy and low carbon technologies such as heat and power networks and smart technologies. This will help to realise an ambition to create a competitive and sustainable economy while reducing rather than increasing overall carbon emissions.

- *Cheshire East Council Air Quality Action Plan (AQAP) (2018)* – Outlines the action Cheshire East Council will take to improve air quality between 2018 and 2023. Road traffic contributes to poor air quality across the borough, which has led to the creation of several AQMAs in Cheshire East that are subject to specific targeted measures to reduce air pollution. The AQAP also recommends a holistic integrated approach including a focus on low emission transportation.

    - An updated AQAP will be published by the council at the end of 2021.

- *Cheshire East Council Low Emission Strategy (LES) (2018)* – The LES includes several recommended policy measures for improving air quality in the borough including planning measures to promote LEVs.

    - To encourage the uptake of electric vehicles in the CEC area, one “rapid charge” point will be provided per 10 residential dwellings and/or 1000m2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be provided. Development proposal should also consider discounted on- and off-street parking for LEVs and dedicated LEV.

- *Cheshire East Council Local Plan (2017)* – The Local Plan is the Statutory Development Plan for Cheshire East and is the basis for determining planning applications. This Local Plan Strategy document sets out the overall vision and planning strategy for development in the borough and contains planning policies to ensure that new development addresses the economic, environmental, and social needs of the area. It also identifies strategic sites and locations that will accommodate most of the new development needed.

    - The Policy CO 2 outlines that to enable business growth through transport infrastructure the council will support new developments that are (or can be made) well connected and accessible by:

      vi. Providing recharging points for hybrid or electric vehicles in major developments in order to reduce carbon emissions.

- *Publication Draft Site Allocations and Development Policies Document (2019)* – outlines a specific set of requirements for developers in INF3 which states that for major developments one charge point should be installed for each new dwelling (new build or change of use) and one charging point for every five parking spaces for non-residential purposes. This reflects the governments proposed approach.

2.5 Summary

This review has shown that there is support for Cheshire East Council's transition to electric vehicles at all spatial levels, and an increasingly supportive policy and legislative framework is emerging. Specific aspects of the above policies and strategies have also informed later chapters of this document covering the evidence base and option development.

3. Technology Review

This chapter summarises the various electric vehicle and charging technologies available, as well current trends in the development of this technology.

Throughout this chapter, and indeed the wider strategy, the term 'EV' is used for simplicity even though in most cases only plug-in EVs are referred to. In general, EVs that use an electric drivetrain to power the wheels produce lower tailpipe emissions, less noise and encourage a smoother driving style than ICE vehicles. EVs have additional benefits in urban areas where stopping and starting, idling, and over-revving of ICE vehicles in queues produces high concentrations of emissions.

3.1 Electric Vehicle Trends

The UK is facing a climate emergency and consequently is committed to reducing greenhouse gas emissions by at least 80% from 1990 levels by 2050 through its Climate Change Act 2008. However, in June 2019 the government passed new laws tightening this target to net zero by 2050[4] in response to recommendations from the Committee on Climate Change (CCC). Currently there is a major industry / purchasing shift from diesel to petrol engines as diesel is now categorised as 'dirty'. Both have environmental impacts and deleting both options (in combination with uptake of other sustainable options such as active travel and public transport) will improve both air quality and carbon emissions.

Diesel engines emit less CO_2 and greenhouse gases than petrol engines. This happens because of the particular type of fuel and the internal efficiency of the diesel engine. More specifically, the fuel used in diesel engines has a higher compression ratio than petrol and it also performs better than petrol engines. As a result, less fuel is used to travel the same distance, thus reducing CO_2 emissions. Most estimations indicate that diesel engines emit about 10% less than the petrol engines of the same category. However, petrol results in lower emissions than diesel in terms of many other sources of pollution, such as fine particles (like PM10 and PM2.5), NO_2 and NOx.

Carbon dioxide (CO_2) is the main component of greenhouse gas emissions, which traps heat in the atmosphere causing global climate change. The transport sector currently generates the highest proportion of CO_2 emissions in the UK, due to the increasing miles driven by Internal Combustion Engine (ICE) vehicles that burn carbon-based fuels and consequently emit CO_2 from their exhausts. The transport sector has made the lowest contribution to UK greenhouse gas emission reduction, only achieving a 4.6% from 1990 to 2019[5], making it a prime target for future regulation.

Nitrous oxide (N_2O) is also a contributor (as is methane) to climate change, but CO_2 is the largest contributor, and is therefore the main focus of legislation to reduce its impact. Nitrous oxide is released naturally from soils and water bodies as part of

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[4] https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future/energy-white-paper-powering-our-net-zero-future-accessible-html-version

[5] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/875485/2019_UK_greenhouse_gas_emissions_provisional_figures_statistical_release.pdf

microbial processes. The two major man-made sources are from agriculture and manufacturing, however, it is also released from power stations and road transport.

An important note is that fine particle emissions (PM 2.5) also originate from brakes and tyres. EVs have the benefit of regenerative braking to increase engine efficiency and reduce particulate emissions from braking compared to ICEs, but tyre wear will be similar to ICEs. This is why reducing total vehicle use is the best long-term option for clean air.

EVs are an alternative to ICE vehicles using an electric drivetrain to power the wheels rather than carbon-based fuels, so they generate zero exhaust emissions whilst driving. EV uptake in the UK is still at the early adopter stage led by relatively affluent, environmentally conscious buyers who are keen to adopt new technologies and reduce their personal transport impacts. Research shows that EV consumers prefer to charge at home overnight or at work during the day, which suggests a low current demand for public recharging services. Most early EV adopters have off-street parking enabling them to charge at home overnight, although this capability is greatly curtailed in some residential areas. However, vehicle consumers generally value “refuelling” convenience very highly, so a failure to roll-out sufficient public recharging facilities may curtail future mass-market EV uptake. Indeed, surveys of both EV and non-EV drivers still identify the need for greater availability of public charging facilities as a key requirement for growing EV adoption. However, it is important to note that due to the short and decreasing timeframe before ICE vehicles are banned, we will soon most past early adopters. Accordingly, this strategy considers plausible future scenarios for wider EV uptake and infrastructure requirements to support this.

The government reflects this need for charging provision in its “Road to Zero Strategy” and can now legislate to require its provision using the “Automated and Electric Vehicles Act” (AEV Act). A caveat to prevailing thought is that early purchases were generally to people with an identified charging provision. New buyers of EV are experiencing much greater range than the early adopters upon which much research was based. Ranges have gone from less than 100miles to 200+ miles. A new situation has arisen where large-scale private finance is going into rapid charge hubs to maintain the current behaviour of going to a fixed point to ‘fill up’. With such a low national population of battery electric vehicles projected to be circa 162,000 by the end of 2020 (SMMT) which is 0.46% of the UK car population, the normalising of driver behaviour is some way off. What is known, however, is that there will have to be a mix of provision, though the ratios of the type of chargers and charger numbers are yet to be established. Currently there is provision for a national network but no detailed Government strategy to achieve one.

3.2 Electric Vehicle Technologies

EVs use an electric drivetrain to provide power to the wheels rather than carbon-based fuels, so they generate zero exhaust emissions and less noise whilst driving. In spite of the increased electricity requirement, EVs have a lower whole-life carbon footprint than ICE vehicles and given the UK’s progress towards and remaining plans for greener electricity generation these benefits will increase further in the future. EVs also produce less noise pollution and encourage a smoother driving style than ICEs, which increases driving efficiency by reducing the power required per km driven and causing lower particulate emissions from brake and tyre wear.

3.2.1 EV Terminology

UK policy is technology neutral, encouraging the development and uptake of all forms of transport to reduce urban air pollution and greenhouse gas emissions. Ultra-Low Emission Vehicles (ULEVs) is the vehicle definition currently targeted for road transport emissions reduction – however, there are many acronyms used to refer to vehicles that are capable of emitting lower emissions than pure ICE vehicles.

Only those electric vehicles that plug into an electricity supply to recharge the battery are relevant to the EV recharging infrastructure discussed in this 'EV Charging Infrastructure Strategy'. As discussed below, the specific vehicles that require EV charging points are Plug-In Vehicles, or PIVs, incorporating Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). By 2030, sale of new HEVs (the only EVs that do not plug-in) will have been banned, so the simplified term 'EV' will by then refer only to BEVs and PHEVs. For simplicity, this document refers to 'electric vehicles' (EVs) rather than Plug-In Vehicles (PIVs), though charging infrastructure is only required for PIVs rather than for all EVs.

Figure 3-1 below shows different types of electric vehicles, with only the three contained within the red box being of relevance in terms of EV charging infrastructure.

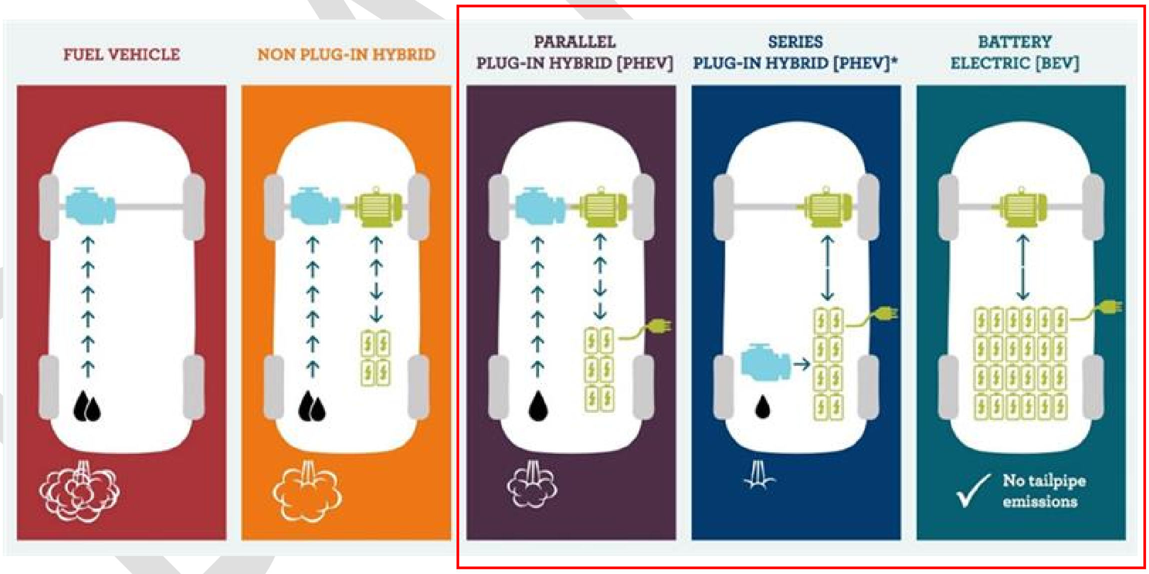


Figure 3-1 Vehicle Types (source: Better NZ Trust)

A brief explanation of each of these terms for different types of electric vehicles is provided below.

- **Electric Vehicles (EVs)** – EVs are vehicles driven by an electric motor and powered by a battery, which can be plugged into an electricity source to recharge. Full EVs have no combustion engine, and therefore zero tailpipe emissions, producing 0 grams CO_2/km when driven – these pure EVs are sometimes referred to as Battery Electric Vehicles (BEVs). Hybrid Electric Vehicles (HEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) are the other main forms of EVs.

- **Plug-In Vehicles (PIVs)** – A collective term used to cover all vehicles that can be plugged into an external electrical outlet to recharge their battery. PIVs form a subset of ULEVs, which includes both BEVs and PHEVs. All PIVs require recharging infrastructure to recharge their batteries, so understanding this category's needs is key when planning charging networks. Statistics for total licensed PIVs by local authority are published quarterly. However, UK targets do not focus on PIVs but rather on 'Ultra-Low Emission Vehicles' (ULEVs), a more relative term that can be redefined as emission standards improve.

- **Hybrid Electric Vehicles (HEVs)** – Hybrids use more than one form of on-board energy to achieve propulsion, usually a petrol or diesel engine plus electric motors and a battery. Some hybrid vehicles use the electric motor to make more efficient use of petroleum fuel, but the motor cannot power the vehicle alone. Other hybrids operate using petrol/diesel or electric power alone, although usually only for short distances due to the size, weight, and cost of the two powertrains required. The controversial 'self- charging hybrid' falls into this category. Consultation is ongoing to as to whether these vehicles will be banned post 2030. This is an important point as a favourite of mini-cab and private hire drivers is the Toyota Prius hybrid.

- **Plug-in Hybrid Electric Vehicles (PHEVs)** – Plug-in hybrids combine a plug-in battery and an electric motor with an ICE, either of which can be used to drive the wheels. The means of propulsion therefore dictates the amount of tailpipe emissions produced. All PHEVs plug-in to recharge their battery. Hybrids that use a series drivetrain only receive mechanical power from the electric motor, which is run by either a battery or a fuel-powered generator. In hybrids with parallel drivetrains, the electric motor and internal combustion engine can provide mechanical power simultaneously.

In addition to the main terms listed above, for clarity a number of additional EV-related terms are defined below.

- **Ultra-Low Emission Vehicles (ULEVs)** – This term is used in the UK to refer to any motor vehicle emitting extremely low levels of emissions, currently set at 75g CO_2/km driven or less. UK targets are set for ULEV uptake and statistics are reported quarterly at local authority level.[6]

- **Alternative Fuel Vehicles (AFVs)** – These are vehicles that run on substances other than solely conventional petroleum gas or diesel. Alternative fuels include electric, solar, biodiesel, ethanol, propane, compressed air, hydrogen, liquid natural gas and liquid petroleum. All types of EVs are AFVs. Because this term focuses on the way a vehicle is propelled rather than its emission levels, there is no guarantee that an AFV is necessarily less polluting than a conventional ICE.

- **Extended Range EVs (E-REVs)** – These are plug-in hybrids where only the motors can be used to drive the wheels. In most respects the vehicle behaves like an EV, recharging the battery using an external supply, but a small combustion engine is also available as an on-board generator to recharge the battery if required. This vehicle type may be on its way out of use though, with BMW recently having removed its only E-REV model from its range in favour of larger capacity EVs.

[6] https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01

Fuel Cell Electric Vehicles (FCEVs) – These are vehicles that use a fuel cell, instead of or in combination with a battery, to power the electric motor. The fuel cells generate electricity to power the motor, generally using oxygen from the air along with compressed hydrogen. Hydrogen must be stored and transported from the production site to the refuelling station, making it an expensive infrastructure solution. While FCEVs are not considered within this study, they have been included in this section to complete the EV offering. If FCEVs come into wider usage over the next few years, they will be able to benefit from the EV charging network assuming the same types of power adapters are used.

3.2.2 EV Technology Roadmaps by Vehicle Type

The UK Automotive Council has developed long-term technology roadmaps[7] for electric passenger car, bus, and commercial vehicle technology, representing the vision of vehicle manufacturers to 2040. These roadmaps show electric drivetrain technology as a focus area for passenger cars and light vans to 2050, given the drivers towards reducing emissions. Ignoring early teething issues in terms of specific vehicle types being brought to market, it is likely that charging infrastructure will be required for the majority of vehicles in the overall fleet for the next several decades. The roadmap nuances across the different vehicle types are described in more detail below.

Cars

The passenger car technology roadmap applies to private consumer vehicles, taxi and private hire fleets, car share, individual business, and pool cars. Many EVs are now available to support these use cases with many more models scheduled for release by manufacturers in the coming years. However, this increasing model choice must be widely promoted to encourage consumers to consider adoption due to various concerns outlined later in this strategy.

Vans

Light vans can also make use of EV and hybrid technologies, providing an important opportunity for reducing urban emissions from local delivery solutions and business vans. New van sales have a higher average emission target than cars, of 147g CO_2/km by 2020. However, relatively few EV van models are currently available in the UK and only in very low volumes. Manufacturers such as Nissan, Renault and Citroen offer EV vans and have recently been joined by new models from LDV and Mercedes, with Ford, VW and LEVC announcing models coming soon to the UK.

Heavy Duty Commercial Vehicles

Heavy duty commercial vehicles remain a challenge for EV technology primarily due to their weight, payload and range requirements. Several companies are now investing in alternative technology solutions to reduce emissions from heavy freight, with some focussing on creating all-electric powertrains and hydrogen FCEVs while others are adding self-driving features and new fleet logistics systems to standard rigs to improve efficiencies and emissions.

[7] https://www.automotivecouncil.co.uk/technology-group-2/automotive-technology-roadmaps/

Buses

A variety of EV technologies are already used on buses, including battery electric, hybrid, plug-in hybrid, hydrogen fuel cell and biomethane models, enabling operators to choose appropriate low carbon technology solutions to meet their needs. The UK Government has provided funding towards the deployment of low emission buses through the Department for Transport's Low Emission Bus schemes and Clean Bus Technology fund. There are two main types of electric bus − those that take power continuously from a source outside of the bus whilst travelling (e.g. overhead wires), and those that use energy stored on-board (usually in batteries). Hybrid electric buses use a combination of ICE and electric propulsion.

3.3 EV Availability

Since only vehicles that plug-in to charge the battery are relevant to recharging infrastructure, in this section we provide a summary of current plug-in car availability in the UK.

There were 47 plug-in car models available on the UK market (as of April 2019): 22 plug-in hybrids (PHEV) and 25 full battery electric models (BEV) as shown in Figure 3-2. A further 11 models were set to launch in 2019, with another 25 announced beyond then, all of which are BEVs. There are no new PHEVs in the pipeline, and many PHEVs previously available in the UK were discontinued in 2019, highlighting the manufacturers' continuing shift in focus from PHEV to BEV in line with tightening EU new car sales emissions targets.

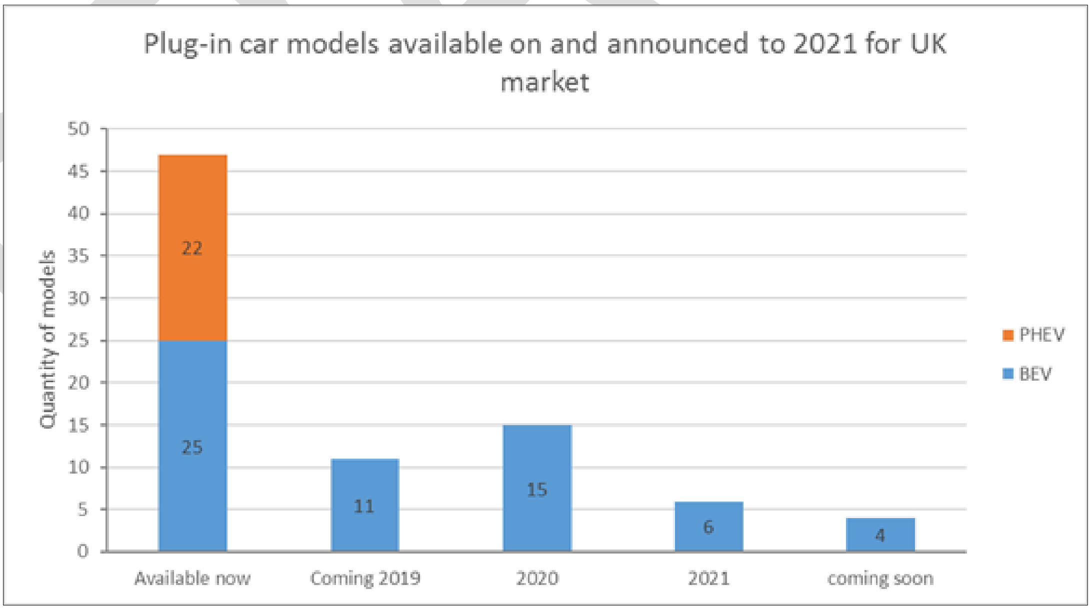


Figure 3-2 EV Plug-in cars available or announced to 2021 for UK (data from EV database) [8]

In contrast to the future BEV focus, the majority (68%) of plug-in EV sales in the UK to date have been PHEV according to the European Alternative Fuels Observatory (EAFO),[9] as shown in Figure 3-3. This existing fleet of PHEVs will continue to need

[8] https://ev-database.uk/

[9] https://www.eafo.eu/

charging facilities going forward. The recent dominance of PHEVs in the UK market is similar to most European countries – however, other countries such as Norway and the Netherlands have seen the opposite due to their more favourable BEV incentive schemes. It will be interesting going forward to see how the UK's split between BEVs and PHEVs changes following the recent changes to UK vehicle incentives in favour of BEVs and the lack of new PHEV models coming to market.

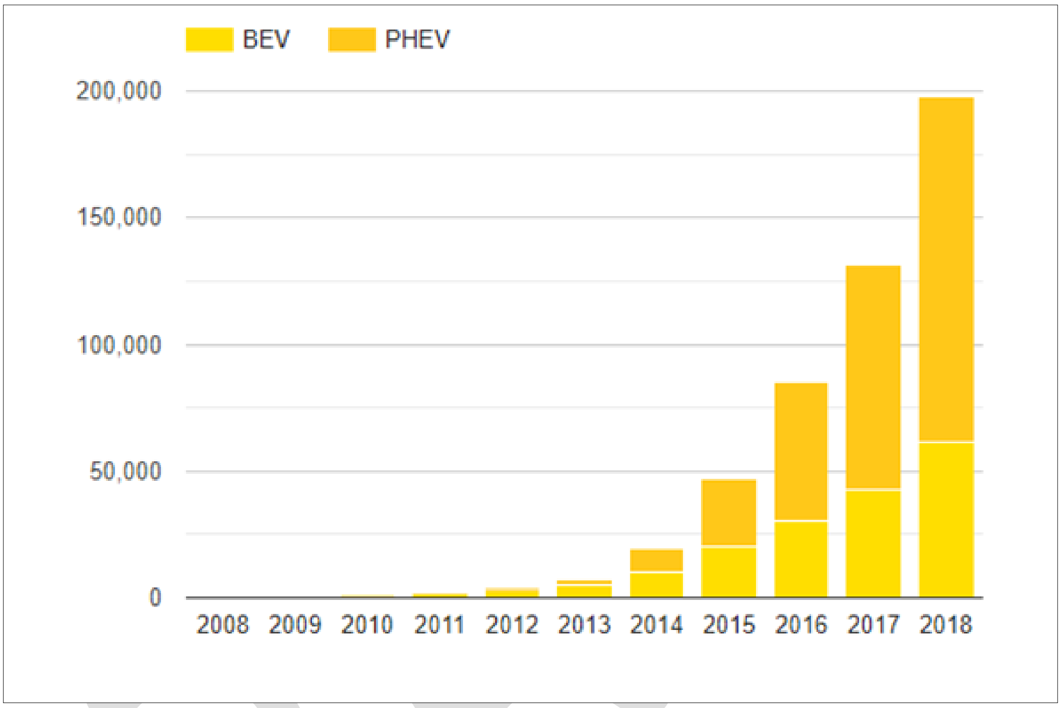


Figure 3-3 BEV v PHEV sales in the UK to 2018 (chart reproduced courtesy of EAFO)[10]

EV model prices generally remain high as summarised in Figure 3-4, although estimates provided by EV Database suggest a concentration of new BEV models coming by 2021 priced at under £40K with battery capacities up to 60kW.

[10] https://www.eafo.eu/countries/united-kingdom/1758/summary

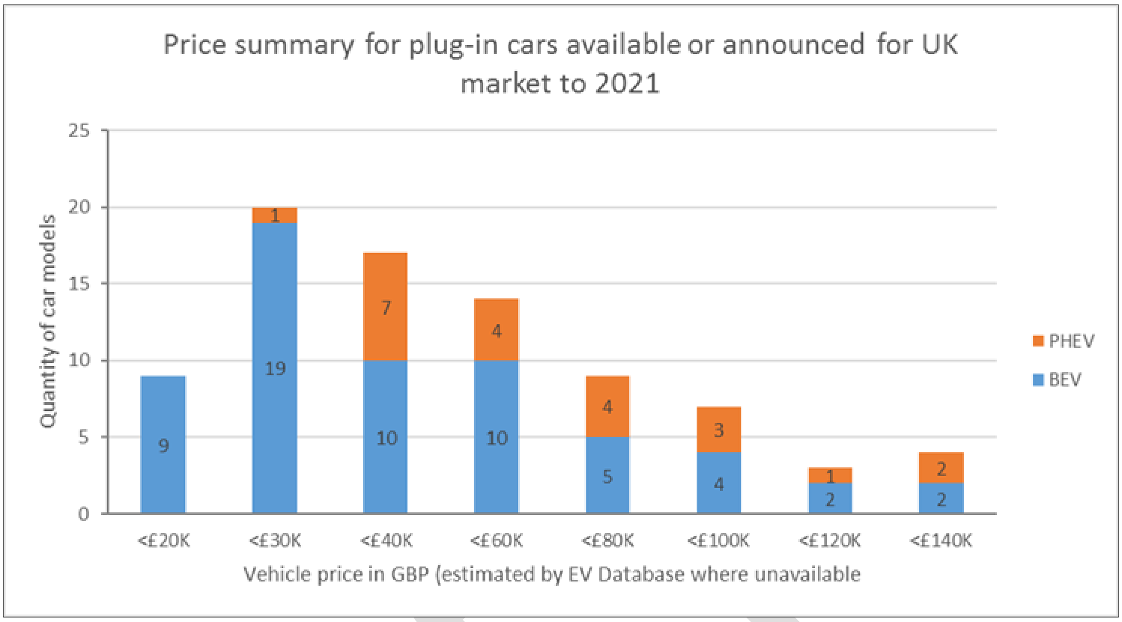


Figure 3-4 Prices for EV Plug-in cars announced to 2021 for UK (data from EV Database)

The second-hand EV market is still very small, making up less than 0.2% of auction sales in 2018,[11] and most independent second-hand dealerships leave this limited EV market to the franchised dealers. Second-hand dealers report the usual concerns about lack of recharging infrastructure alongside poor real range and value for money as reasons for this. However, the Go Ultra Low campaign supported by Energy Savings Trust and others has sought to dispel these myths, and continuing regional awareness raising activities are required to get the message out. One likely influence to boost sales of EVs is the future adoption of clean area zone charges, being considered for a number of the UK's larger cities, including Greater Manchester.

3.3.1 Battery Capacity

Some 60% of the EV plug-in models available on the UK market as of April 2019 had a battery capacity of less than 20 kWh, as shown in Figure 3-5. However, it is important to note here that all the PHEV models sit in this category. Nonetheless, all the new models announced to reach the market by 2021 are BEVs with battery capacities above 30 kWh, as shown in Figure 3-6. This demonstrates the trend towards increasing battery capacity, intended to meet consumers' demand for increased range per charge and to tackle the continuing reports of range anxiety by potential adopters.

[11] https://www.motortrader.com/surveys/market-report-electric-vehicles-used-market-10-10-2018

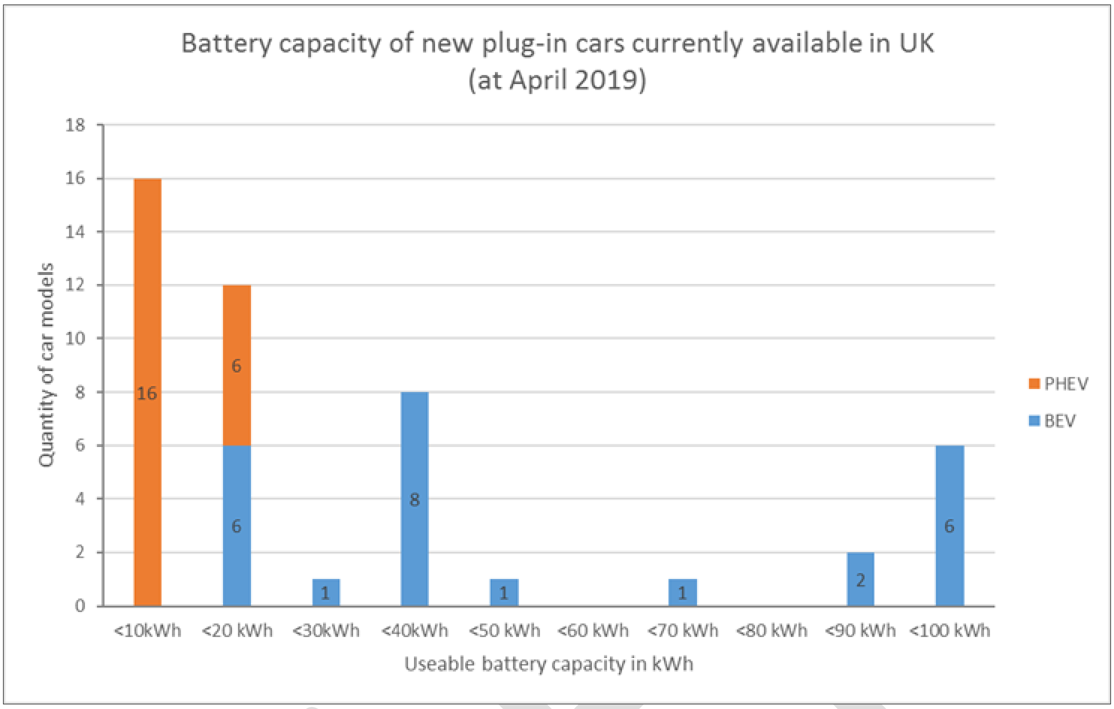


Figure 3-5 Battery Capacities of Plug-in Cars Currently Available in the UK (using data from the EV Database)

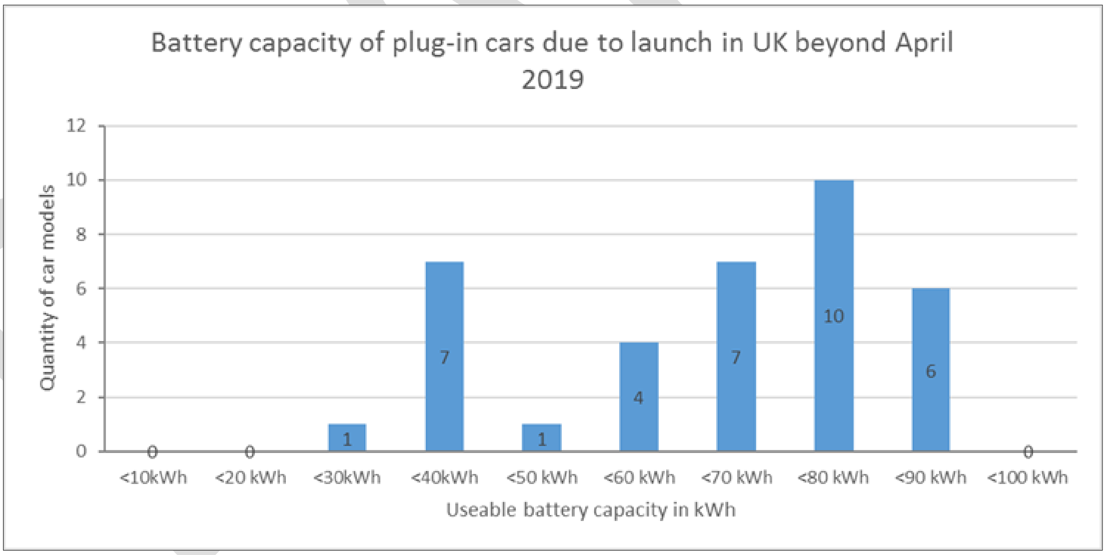


Figure 3-6 Battery capacities of plug-in cars yet to launch in the UK (using data from the EV Database)

Although the quoted range on a full battery varies by EV plug-in model, and in practice also varies with driving style and conditions, the examples in Table 3-1 below provide some context regarding range for some currently popular EVs.

Table 3-1 Examples of battery capacity and range of currently popular EVs

EV Model	Battery Capacity	Range
Renault Zoe R110 ZE40	41/50 kWh	160/200 miles

Nissan Leaf	40/62 kWh	140/250 miles
Hyundai Kona	39 kWh	155 miles
BMW i3 120 Ah	37.9 kWh	145 miles
Tesla	60/100 kWh	300/400 miles

The following vehicles due to become available on the UK market in 2021 show that both battery capacity and maximum range is increasing:

- Mercedes-Benz EQV − A potential range of 252 miles of range with a price around £70,000.
- Lexus UX300e − A potential range of 196 miles of range with a price around £43,000
- Mazda MX-30 − A potential range of 130 miles of range with a price around £25,000
- BMW 1X3 − A potential range of 285 miles of range with a price around £not available
- Volkswagen ID3 − A potential range of 205 miles (48 kWh), 261miles (58 kWh), 342 miles (77 kWh) of range with a price from £32,000
- Volkswagen ID4 − A potential range of 323 miles of range with a price around £55,000
- Nissan Ariya − A potential range of 310 miles of range with a price around £not available
- Skoda Enyaq iV − A potential range of 316 miles of range with a price around £30,000
- Hyundai Ionic 5 − No pre-released details
- Kia 2021 EV − A potential range of 310 miles of range with a price around £ not available

3.3.2 EV Charging Capabilities

EV charging technology is evolving rapidly. Prior to 2016, most EVs charged at 3kW AC (called slow charging), which was adequate to fully recharge most batteries (typically up to 24 kWh) overnight. Then with the development of vehicles with 7kW on-board chargers came fast 7kW AC charging, and with the introduction of higher capacity batteries, the 11kW and 22kW AC fast charging technology has since come to market. Figure 3-7 illustrates the AC recharging capabilities of the EV plug-In models for the UK to 2021. This figure demonstrates the low power charging capabilities of PHEVs. When combined with the fact that PHEVs also have lower capacity batteries (Figure 3-5), along with the lack of new PHEV models due to arrive on the market (Figure 3-6), the implication is that PHEVs do not appear likely to contribute heavily towards demand for public charging facilities in the near future compared to BEVs.

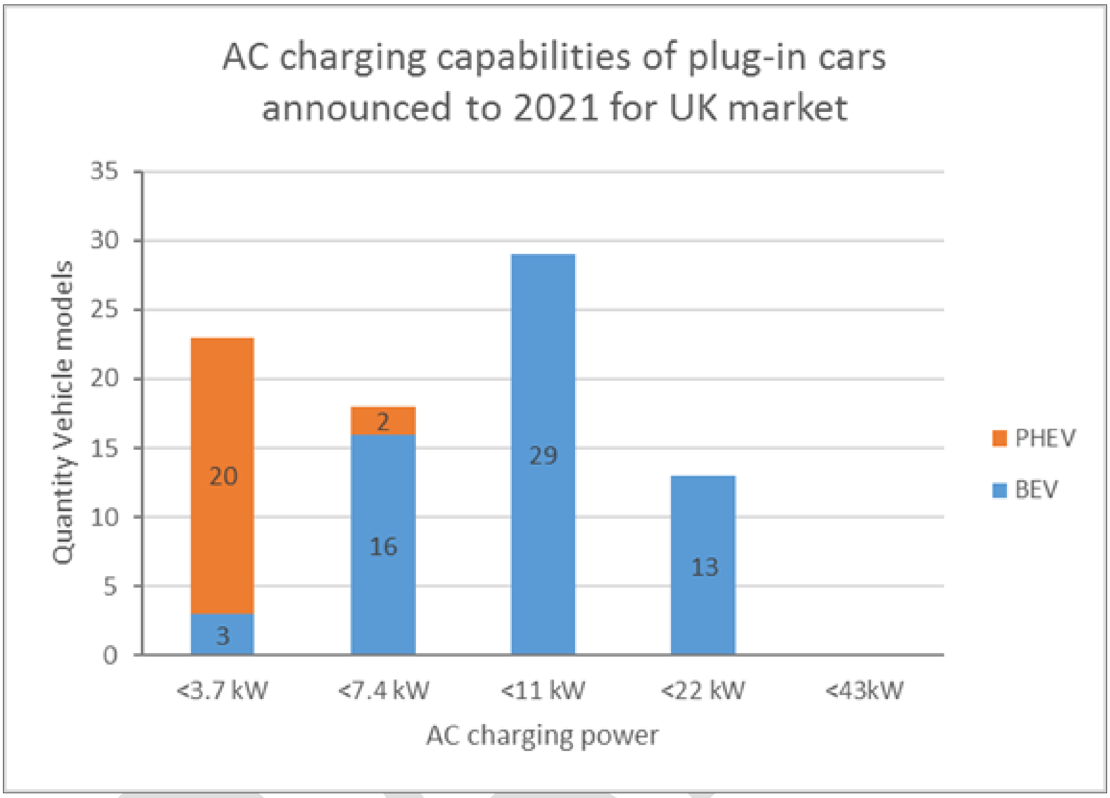


Figure 3-7 – AC Charging Capabilities of PIV in the UK (data from EV database)

Rapid charging DC technology developed in parallel with AC technology, giving consumers a faster method to recharge. However, only some plug-in models were equipped with this capability prior to 2016. In contrast, all new plug-in models due to be available in UK to 2021 are rapid charge capable. Most vehicle manufacturers now use the CCS or CHAdeMO DC socket/plug for rapid charging. Only legacy Renault Zoe cars now use the 43kW AC rapid charging system, and Renault has recently changed to CCS DC rapid charging for future plug-in models. In parallel, Tesla developed its own Supercharger technology to suit their bespoke battery solution, charging their vehicles at 120kW power. Tesla superchargers were the first examples of high-power chargers to appear in the UK, but they can only be used by Tesla vehicles.

The latest development in charging technology introduces charging at powers between 100kW and 350kW DC, referred to as ‘high-power charging’ − but few such plug-in vehicles are currently available in the UK, and most of these are currently high-priced executive cars. The majority of high-power charging solutions use the CCS DC socket/plug; however, a few have maintained the CHAdeMO socket/plug. The roll-out of high-power chargers at 150kW+ for public use is now beginning in the UK, and most are designed to also deliver 50kW DC charges to rapid chargeable vehicles to combat the current lack of high-power charging demand.

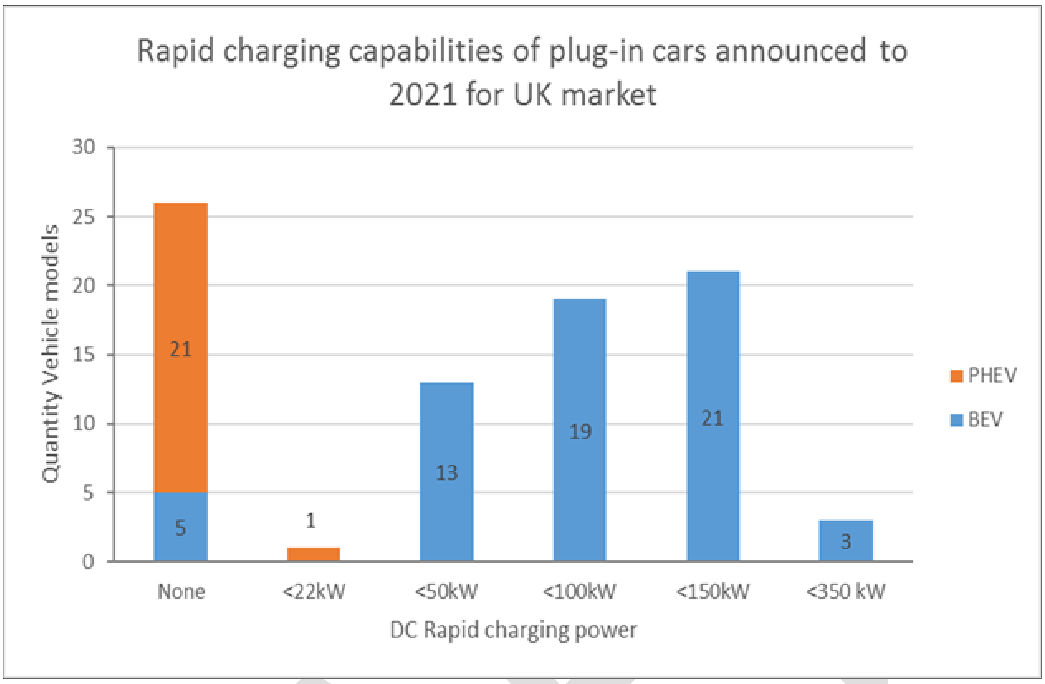


Figure 3-8 Rapid Charging Capability of PIV for UK to 2021 (using data from EV database)

Figure 3-8 illustrates the rapid recharging capabilities and Figure 3-10 shows the rapid charging connectors associated with the UK plug-in models to 2021. This shows the trend towards increasing rapid charging powers to provide acceptable recharging times for higher capacity batteries, addressing consumers' concerns over the comparative convenience of recharging over refuelling. Figure 3-9 illustrates the future prominence of the DC CCS connector for rapid charging, which falls in line with the minimum public charging requirements set out in the EU's Alternative Fuels Directive (2014).[12]

[12] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=en

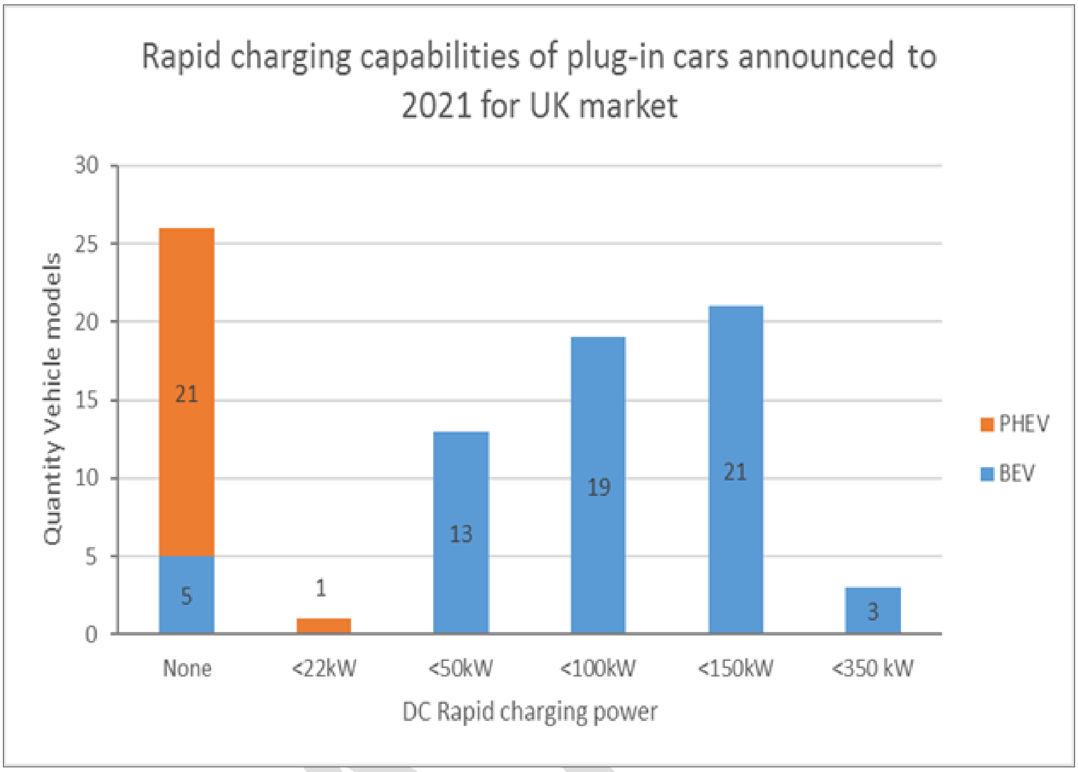


Figure 3-9 Rapid Charging Capability of PIV for UK to 2021 (using data from EV database)

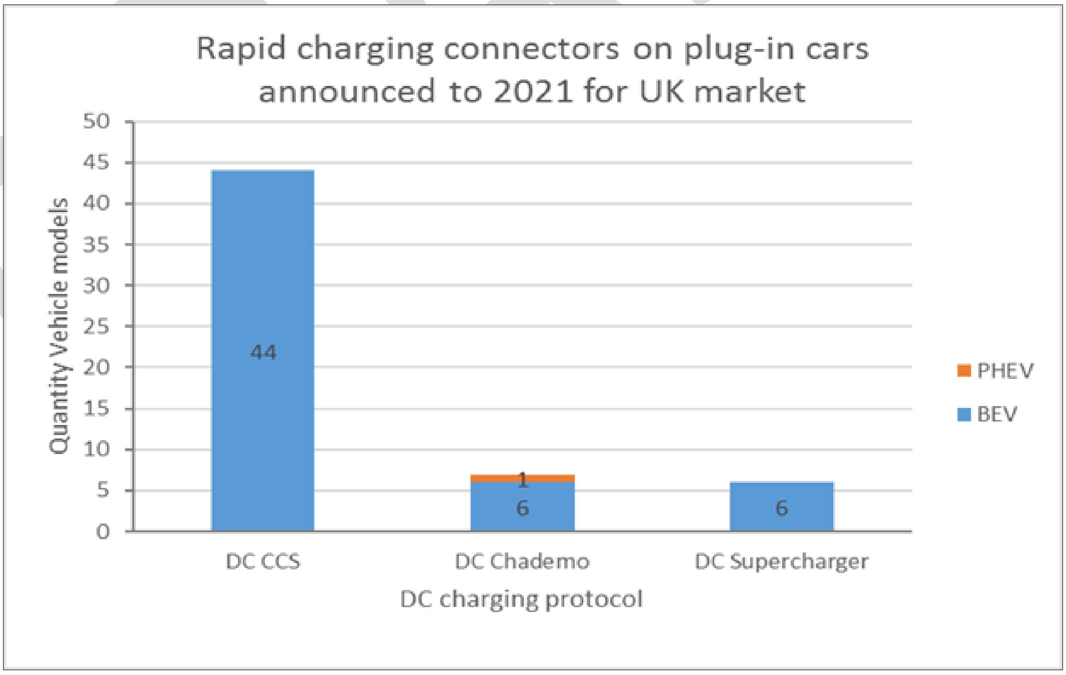


Figure 3-10 Rapid Charging Connectors for PIV in UK to 2021 (using data from EV database)

It is important to note that only 55% of all plug-in vehicles sold in the UK to date can be rapid charged, so slow and fast AC charging solutions will continue to be required in the UK to support the recharging needs of the existing EV fleet. Of those rapid chargeable plug-in vehicles currently on UK roads, approximately 70% require the CHAdeMO connector, so new rapid chargers installed over the next 5 years will require both DC CCS and CHAdeMO connectors. However, it appears the rapid 43kW AC connector will have very low and declining demand going forward.

3.3.3 Plug-in Vehicle Supply Constraints

Consumers currently report long waiting times for plug-in vehicle (PIV) purchases, and there have been instances of models removed from sale for periods in the UK due to an excess of demand over supply. These unconfirmed reports further reduce consumer confidence in this nascent market where many consumers still perceive plug-in vehicles to be inferior to ICE vehicles in terms of price and utility. They also hamper the effects of efforts to raise awareness of the benefits of PIVs, and speculation and negativity in the press further hinders the transition from ICE to lower emission vehicles.

The lack of production capacity is a global issue, originating in vehicle production plants and battery production facilities across the world. Vehicle manufacturers are in unprecedented territory, facing a demand for product transition at global government level based on emission reduction requirements. Indeed, the EU has set increasingly stringent regulations and associated fines to drive vehicle manufacturers to reduce the emissions of new car and van sales in Europe. However, the technology trajectory is still uncertain, the associated costs and plant changeover timelines are high, and both battery technology and supply are a key determinant. This presents major financial and reputational risks for vehicle manufacturers since one of the key constraints (batteries) is out of their control.

The UK Government is also concerned about the strength of the automotive industry, as it is an important contributor to UK employment, exports and GDP. Nissan introduced the Leaf in 2011, manufacturing all European volumes of battery and vehicle at its UK plant. The first model had a limited 24 kWh battery, which was a risk with the limited charging infrastructure available at that time. However, this led the way in Europe and was soon followed by Renault, Mitsubishi, BMW, VW and Tesla, and higher battery capacities are now becoming the norm. These market leaders are only now beginning to increase PIV model range but have yet to make significant volumes to satisfy the potential demand across the whole of Europe. Many vehicle manufacturers have made little or no significant impact on EV availability to date, although there is much talk in the press about new models to come with little evidence of significant production volumes for the UK.

The current lack of production volume is posing a problem for both legislators and supporting businesses. The UK government has responded by offering purchase incentives for ULEVs since 2011; however, these have been reduced over the last 3 years and now apply only to the cleanest PIVs available. More favourable incentives in countries such as Norway have driven PIV demand to such an extent that vehicle manufacturers could be confident to redirect large percentages of European PIV production volumes there. Norwegian vehicle incentives include exemptions from the country’s 25% Value-Added Tax (VAT) on vehicle purchase, free parking and ferry use, as well as use of bus lanes. These were complemented by the introduction of municipal charging facilities and a national network of rapid chargers. The UK does not at present hold such an incentive-based allure for the limited PIV supply, even though it is the second largest vehicle market in Europe. In addition, the use of incentives would have limited effect if there is a supply constraint.

The availability and cost (though less so than a few years ago) of Lithium-ion (Li-ion) batteries are limiting factors in PIV supply. Consequently, vehicle manufacturers are considering whether to make or buy the batteries for their models. Tesla has chosen to manufacture its own batteries and has launched associated energy business opportunities. Nissan set up its own European battery manufacturing facility to guarantee early supply for its vehicle production, but this has recently been sold. Most PIV manufacturers chose to rely on battery suppliers; however, battery manufacturing capacity within Europe is currently a small proportion of global volume, and Chinese companies own the majority. Li-ion technology is also limited in terms of the opportunity to increase energy capacity and reduce cost, so new technologies are required to achieve a step change as PIVs take over the vehicle fleet. Appropriate volume-ready technologies are not forecast to reach the PIV market until 2025 to 2030, and many new battery manufacturing plants will then be required to supply the PIV volumes required to meet European targets, requiring significant investment and long-range planning. There is therefore still a substantial risk that PIV supply will stand in the way of achieving transport emission reduction targets in the UK.

Once the low battery volumes are split between European countries based on likely PIV sales, and then further by region, this leaves very low supply volumes likely for each local authority area until production capacity increases significantly. Regions and LAs have little or no control over vehicle manufacturers' PIV allocations and compete against major cities such as London and Paris. However, meaningful incentives such as grants supported by public charging facilities and financial dis-incentives such as Low Emission Zones have been shown to increase demand in some countries, leading to increased proportion of PIV volumes produced by manufacturers such as Tesla and Nissan. In Norway, for example, incentives were very significant initially however this level of incentive has not been matched anywhere else.

3.4 EV Charging Technology

Although 'electric vehicle charging points' are often discussed as the technology that is required to allow EVs to recharge, there is a lot of other technology involved in the process. This section explains the need for recharging infrastructure, and summarises the technologies used in the UK.

3.4.1 The need for recharging infrastructure

All Plug-in Vehicles (PIVs) require recharging infrastructure to recharge their on-board batteries, by connecting the vehicle to an external electricity supply, most commonly the electrical grid (the electricity transmission network) or an electrical storage facility. Electric Vehicle Supply Equipment (EVSE) is the collective term used to refer to all equipment used to deliver energy from the grid to a PIV. EVSE includes plugs, sockets, conductors, power outlets and devices that allow communication between the recharging apparatus and the vehicle.

All PIVs require some form of EVSE to recharge their batteries, situated at suitable locations, over a suitable duration and at appropriate times of day or night to meet users' requirements. In a departure from the driver's expectation, built up from years of filling with diesel/petrol, the vehicle dictates how power is drawn from the grid and therefore controls the speed of recharge, not the EVSE equipment. Consumer preferences and habits also have a role to play in recharging behaviour, and many consumers still consider current recharging durations as a limitation of PIV. However, different recharging equipment types are now available to suit different use cases. Consumer preferences have not yet been established, which is a challenge when planning a service such as a charging network.

There is much debate about who should provide recharging infrastructure, and several different solutions have now been implemented by public and private organisations in the UK and across Europe. There are many stakeholders interested in recharging infrastructure, for many different reasons, making it a complicated marketplace with often conflicting objectives.

There are two clear types of market operators − the first group believes that every house should have a domestic or on-street charger, while the second group believes that rapid charge hubs in central locations are the way forward. The answer is that both are correct up to a point. What no one yet knows is the likely split between home, workplace, destination and in-transit charging that UK EV users will seek over the next decade or more.

3.4.2 Charge Points

The most well-known element of EVSE is the charge point – also called a charging post, charging point or charging station. There are many specifications of charge point in the marketplace, differentiated by power output, communication protocol, type, and number of charging outlets. They can typically be installed mounted onto a wall or as free-standing units installed in the ground. Most ground mounted charge points can be installed with retention sockets to ease swap out for future maintenance, repair, or replacement. Figure 3-2 provides a summary of the different types of charge point currently available in the marketplace.

Table 3-2 Types of EV Charge Point

Common Charge Point Names	Power Output (kW)	Current / Supply Type	Socket / Plugs	Charging Duration (24kW battery)	Use Cases
Slow	<7	AC	Type 2 Socket	6-8 hours	Destinations
Fast	7 – 22	AC	Type 2 Socket	4-6 hours	Destinations
Rapid	43 -50	AC	AC – Type 2	30 minutes to 80%	On-route
		DC	DC – CHAdeMO		
		DC	DC – CCS Captive cables with plugs attached		
High Power	100	DC	Tesla 120kW	TBC depending upon vehicle	On-route
		DC	CCS 150kW+		

Charge point design is evolving rapidly. Six years ago, only single outlet 3kW AC slow charge points were available. This suited early EVs, which were only capable of drawing a 3kW power supply. The earliest charge points provided a standard domestic socket for a 3-pin plug but concerns over long plug-in times led to development of the now globally recognised Type 2 socket. Then with the emergence of vehicles with 7kW on-board chargers came fast 7kW AC single-phase charge points, with three-phase 22kW alternatives, multiple outlets, and power sharing capabilities.

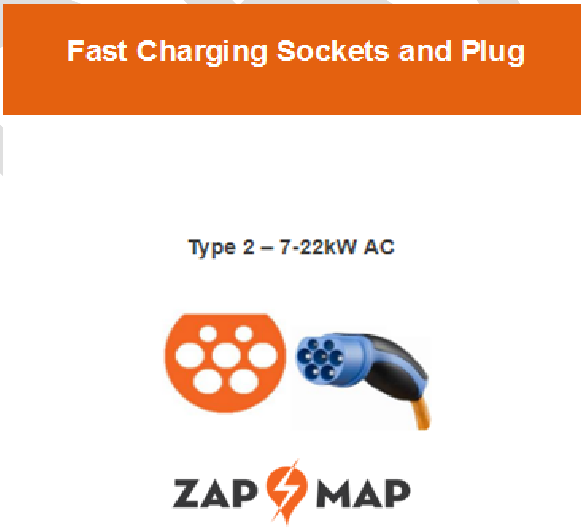
This was followed by the development of rapid chargers rated at 50kW, which were initially only suited to a few PIV models, but now have multi-standard variants widening their use to most rapid charge-enabled vehicles. In parallel, Tesla developed its own bespoke Supercharger technology supplying their vehicles at 120kW.

Tesla superchargers were the first examples of high-power chargers to appear, but they could only be used by Tesla vehicles. The wider roll-out of 150kW+ charge points for public use is now beginning, but the few vehicles designed to draw such high-power are high-priced executive models. To combat this business model limitation, high-power charge points are designed to be backwards compatible, so they can also deliver 50kW DC charges to rapid chargeable vehicles.

3.4.3 Charging connectors

The International Electrotechnical Commission (IEC) standard 62196 specifies the plugs, sockets and outlets required for conductive recharging, covering charging modes, connection configurations and safety requirements for the operation of EV and recharging facilities. EV recharging connectors are specialised for automotive use.

PIV cars and light vans are supplied with a charging cable used to connect the vehicle to slow or fast charge points. This cable has a plug specific to the vehicle on one end, and a suitable plug on the other end to connect to slow/fast charge points in the UK. Some vehicles have separate charging sockets for slow/fast and rapid charging solutions, whilst some manufacturers have standardised around one vehicle-side socket for all charging solutions. Figure 3-11 and Figure 3-12, taken from the Zap-Map website, show the variety of charging connectors (plugs) and sockets used for the different types of PIVs in the UK.



Charging cables are typically supplied with a Type 2 plug to connect to slow and fast charge points in the UK.

Charging cables are also available fitted with standard UK 3-pin plugs intended for infrequent use where Type 2 charging solutions are not available, incorporating power protection limiting delivery to 3kW due to the risk of 3-pin plugs overheating when delivering power over prolonged periods.

Figure 3-11 Type 2 socket and plug for slow and fast charging in UK

Rapid and high-power chargers do not use the cable supplied with the vehicle. Instead, these chargers are fitted with tethered cables and connectors that plug directly into the vehicle due to the high power being delivered. There are four socket/plug formats used for rapid and high-power charging in the UK, as shown in Figure 3-12.

Most vehicle manufacturers use the CHAdeMO or CCS DC socket/plug for rapid and high-power charging. Only Renault retains the 43kW AC system. Tesla's 120kW supercharger socket/plug was designed to suit their bespoke battery solution. Tesla provides superchargers for public use.

Figure 3-12 Sockets and plugs for rapid and high-power charging in UK

3.4.4 Charging Protocols

The charging protocol governs how the vehicle communicates with the recharging equipment, and potentially through the charge point with a wider network of equipment and services such as payment systems, energy, communications, and other services. The use of the Open Charge Point Protocol (OCPP) is promoted as the best way to enable the functionality required for widely available and accessible recharging networks of the future. If all vehicle and charging manufacturers adopt the same communications protocol, then the global recharging network will become accessible by all PIV drivers, be flexible to needs of various stakeholders and cost less to run as new developments are shared easily and quickly. The use of a common protocol can enable communication between any recharging equipment and any wider system in the future.

The latest version available for use is OCPP 2.0, but version 1.6 is most commonly specified in procurement exercises in the UK currently and has been adopted across most of Europe, the USA and Asia. Most slow and fast chargers intended for public use in the UK are now OCPP compatible, but some old charge point models are not upgradeable and therefore risk becoming obsolete. This highlights the need to consider future proofing in recharging infrastructure deployment plans.

A further development, the Open Smart Charging Protocol (OSCP), could enable direct communication between the electrical grid operator and the charge point. This potential functionality is highly valued by grid operators who need to monitor and control peak loading and timing implications for peak demand management, in order to maintain electricity provision for all.

3.4.5 Smart charging

Electric mobility will become an integral part of the UK's smart energy environment because the electrification of transport is key to decarbonising the economy. So smart charging solutions are a key enabler of a sustainable recharging market in the UK. Smart charging could benefit both consumers and electricity networks by incentivising consumers to shift recharging demand to less expensive periods when there is plentiful clean, renewable electricity available, in turn reducing the need for expensive electricity network reinforcement.

Regular (non-smart) charging commences as soon as the PIV is plugged in, drawing the maximum amount of power available from the supply until the battery is fully charged. For large fleets, this could overload the available power supply causing practical power outages on-site and financial penalties from the energy supplier. Alternatively, smart charging allows the monitoring and management of the charging session to enable remote control of when, for how long and how rapidly the PIV recharges. Smart charging uses the OCPP charging protocol (v1.6 and beyond) to maximise charging flexibility and to mitigate the need for high-cost power supply upgrades. Although smart charging increases recharging infrastructure cost somewhat, it can provide multiple benefits:

- **Power peak reduction:** schedule and automatically control each vehicles' charging cycle to avoid peak power demand times and avoid exceeding maximum power supply capacity.

- **Reduce investment costs:** make optimal use of the existing power supply by controlling the charging speed of each charge point to prioritise specific vehicles and balance the available power across chargers to ensure each vehicle is fully charged ready for the next shift's activity.

- **Energy cost reduction:** cost-effectively schedule charging times to take advantage of time-of-use energy tariffs to reduce operating costs.

- **Increase flexibility:** use prioritised load balancing to deliver only the energy required to suit each vehicles' next shift requirement, and allow for extended shifts, increased range, late start/finish times, etc.

- **Demand response:** respond instantly to dynamic energy pricing and accelerate or reduce the energy consumption of the fleet accordingly to reduce operating costs.

- **Integration of batteries and renewable energy sources:** use stationary batteries as energy stores, charging them from renewable generation sources and/or when energy cost is low, and subsequently use that stored energy to recharge vehicles when energy costs are high.

- **Reduce manual labour:** removes the time-consuming and error-prone need to manually plug/un-plug vehicles at specific times.

- **Improve PIV battery health:** smart charging results in slower charging over the battery's life-cycle, preserving its state of health and reducing long-term operating costs and environmental impacts.

There are currently three levels of smart charging available:

- Basic load balancing distributes the available power capacity equally between all charge points to prevent overloading and high energy costs at peak times.

- Scheduled/static load balancing can also optimise charging schedules to take financial benefit from time of use energy tariffs.

- Dynamic load balancing can combine both static and dynamic data such as bus routes, next day plans and dynamic energy pricing to ensure the entire fleet is charged in time for individual departure at the lowest cost.

3.5 Emerging Wireless / Induction Charging Technology

It is clear that the EV industry has seen substantial technological development in recent years. Another advancement already in train is induction, or wireless, EV charging. Induction charging is fairly simple − electricity is transferred through an air gap from one magnetic coil in a transmitter pad to a second magnetic coil fitted to a receiver pad on the vehicle. All that is required is that the vehicle is positioned in the right place so that the coils are aligned, and charging will begin.

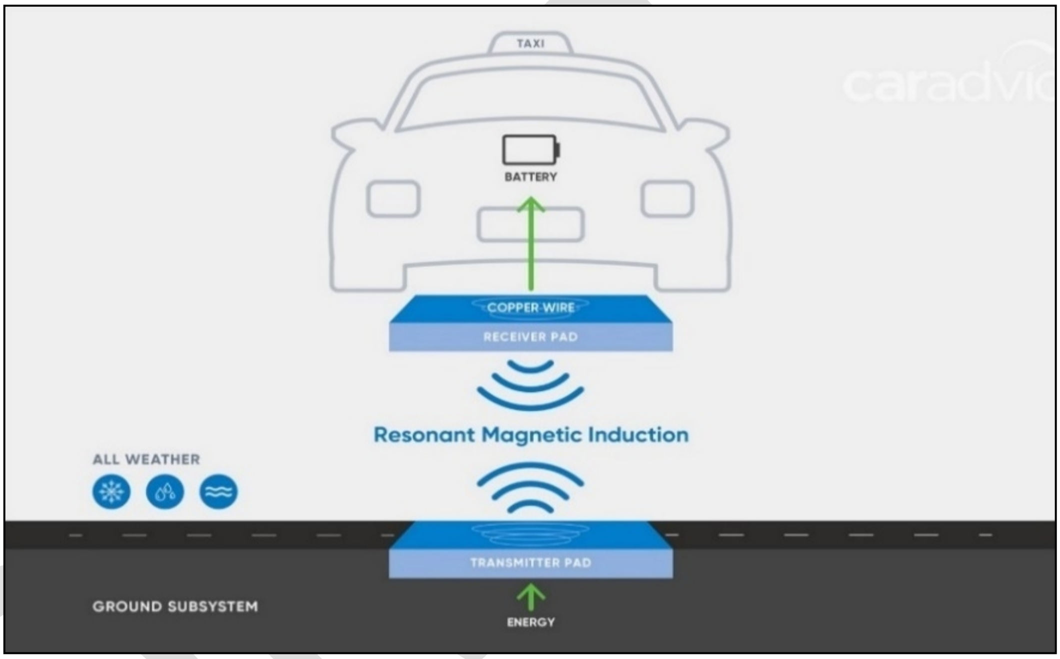


Figure 3-13 Induction charging

Wireless EV charging via magnetic resonance technology delivers the same power, efficiency levels and charge speeds as conventional plug-in charging methods. Charging can be done through water, snow, ice, concrete, granite, etc, without any concerns regarding cable connections. Most Level 1 or 2 consumer plug-in EV chargers operate in the 88% to 95% efficiency range end-to-end, from grid to the battery. Leading wireless EV charging technologies today operate in that same range, at 90% to 93% efficiency.

Wireless charging also makes always-available bi-directional charging possible. Making EVs available as local on-demand energy storage is critical as utility companies look for an increased mix of renewables in the electrical grid. Bi-directional charging, otherwise known as vehicle-to-grid (V2G) technology, can help utilities handle increasing peak demand. For V2G to work seamlessly, the cars need to always be available on demand, and the reality is that most owners don’t plug in when their battery is well-charged. Wireless V2G solves that as whenever the vehicles are parked, that stored power is available, and provides a new source of value for the EV owner. Wireless charging will be crucial in the successful introduction of autonomous vehicles.

3.5.1 Induction Trials

A number of trials of induction charging are currently underway:

- **England, Nottingham:** Wireless charging for electric taxis waiting in their rank is to be trialled in Nottingham. The UK Government is putting £3.4m towards fitting five charging plates outside the city's railway station. The six-month pilot project will see 10 electric taxis fitted with the necessary hardware, and the scheme could be rolled out more widely if successful. Officials said electric vehicles were 'vital' to improving city air quality and making charging convenient was key. The Department for Transport said wireless charging was more convenient and avoided the clutter of cable charging points. (*Source: BBC News online)*

- **Scotland, Edinburgh:** Heriot-Watt University, located near Edinburgh, Scotland, is planning a trial of wireless charging using electric delivery vans. It is a joint project with the City of Edinburgh Council and Flexible Power Systems (FPS), and will involve specially adapted vans, with charging equipment from Momentum Dynamics. Innovate UK provided funding for the trial. The trial will also explore the concept of charging hubs, which could be shared among multiple fleet operators. "The project is testing the sharing of charging hubs among logistics, retailers, local government and university-owned commercial vehicles," said FPS Managing Director Michael Ayres. "These charging hubs require high use to be economically viable. The project uses powerful wireless charging to shorten the time vehicles need to be in the charging hubs." (*Source: The Scotsman)*

- **Germany, Cologne:** In the German city of Cologne, an inductive (wireless) charging project for taxis is being set up called the Taxi Charging Concept for Public Spaces (TALAKO, based on the German title). This is part of the SMATA feasibility project, launched in October 2020. For the new TALAKO project, six LEVC (London Electric Vehicle Company) electric taxis are to be converted for inductive charging. LEVC is responsible for making the famous London electric taxi cabs specially developed for the taxi industry. The vehicle has an electric range of 130 km and a range extender on board to extend the range by 500 km if necessary. When the Cologne project is in operation, six vehicles will be able to charge simultaneously. *(Source: electrive.com)*

- **Norway, Oslo:** Jaguar Land Rover will provide 25 Jaguar I-PACE models to Cabonline, the largest taxi network in the Nordics. The brand's performance SUV has been designed to enable Momentum Dynamic's wireless charging technology, making it the ideal vehicle to drive the initiative. A team of engineers and technicians from both Momentum Dynamics and Jaguar Land Rover were engaged to help in testing the solution, and Cabonline signed up to operate the fleet as part of Oslo's ElectriCity programme. Taxi drivers need a charging system that does not take them off route during their working hours. Multiple charging plates rated at 50-75 kilowatts each are installed in the ground in series at pick-up-drop-off points. This allows each equipped taxi to charge while queuing for the next fare. The system, which uses no cables and is situated below ground, requires no physical connection between charger and vehicle, engages automatically and provides on average 6-8 minutes of energy per charge up to 50kW. *(Source: jaguarlandrover.com)*

It is not clear at this time how the COVID-19 pandemic may have affected the progress of these trials.

3.5.2 Wireless Induction Charging Capability of EVs

Most, if not all, of the top vehicle manufacturers have stated that they are likely to offer wireless charging capability in the future. However, wireless charging is yet to be built into any model of PIV to date. BMW had planned to offer this technology on its 530e plug-in hybrid saloon back in 2018, but this decision was reversed, and the current generation battery does not support it. In Germany, it was a €3205 (£2700) option for consumers.

It is difficult at this time to ascertain when this technology would be likely to be introduced. Availability of relevant infrastructure will surely play a major role in determining possible introduction.

Further thoughts to be answered or considered regarding wireless / induction charging:

- If wireless charging is initially offered as an aftermarket add-on, then the required vehicle retrofit may have an impact on both vehicle warranty and insurance. The cost of installing the required infrastructure may suggest that installation will only be feasible as a hub consisting of multiple charging bays rather than single charge points in and around cities.

- The chicken and egg scenario − will car manufacturers want to introduce this option on vehicles if insufficient infrastructure exists? Likewise, will anyone want to introduce the infrastructure if no vehicles exist to use it? The vehicle manufacturers had to 'invest' in the current EV charging infrastructure, so are they likely to want to do it again?

- To go mainstream, wireless charging will need international standards. The Society of Automotive Engineers (SAE) recently announced the first global standard for wireless EV charging, which could help accelerate the technology's rollout. The standard, SAE J2954, applies to inductive charging systems up to 11 kilowatts. As with existing SAE standards for other charging methods, J2954 will harmonise new systems, allowing for increased interoperability between hardware and vehicles from different manufacturers.

4. Cheshire East EV Baseline

This section describes the existing levels of EV uptake, the level of charging infrastructure and electricity supply network in Cheshire East, as well as a comparison against the EV charging progress being made by similar local authorities within the UK. In order to inform potential future locations of charging infrastructure, this section also presents a review of the key factors that can influence charging demand in Cheshire East, including areas of limited off street parking, household type and income levels across the borough, as well as commuter journey patterns.

4.1 Cheshire East PIV Uptake

Since the volume of PIVs registered in an area drives the demand/viability for recharging services, we have summarised the current vehicle statistics for the Cheshire East area using the latest available DfT data, which reports vehicle uptake by LA area to Q3 2020. We would like to make it clear at this point that charging services are those which include domestic chargers. Research on the embryonic EV market has not yet established the longer term ratio charging which will be undertaken between home, work, destination and in transit. This ratio determines the viability of any charging network either private or public. For the purposes of this report we have used the following demographic data.

Table 4-1 shows PIV uptake to Q3 2020 in the Cheshire East area. The table is arranged in order of PIV registered as a percentage of all vehicles in the area and presents Cheshire East and UK overall figures for comparison. PIV registration is slightly below the national average but as ratio where 100% is full adoption comparing 0.87% with 0.97% is not significant.

Table 4-1 Cheshire East PIV Adoption

District / Area	Total Cars & Light Goods Vehicles registered 2019	Total PIV registered Q3 2020	PIV as % of vehicles registered Q3 2020
Cheshire East	243, 432	2, 119	0.87%
UK	36, 620, 814	355, 872	0.97%

Table 4-2 summarises the population and vehicle density figures for Cheshire East and the UK, gross Disposable Household Income (GDHI) and percentage of dwellings without off-street parking. Lack of off-street parking space in residential areas limits the ability of PIV drivers to recharge their vehicles at home and suggests the requirement for more public charging facilities in the future as PIV uptake rises. However, the nomis website dwelling data is not available at Cheshire East districts level, so we have been presented only the Cheshire East figures here.

Table 4-2 Relevant Demographic Data for Cheshire East

District / Area	Estimated Population Mid-2019	Vehicles / head of population	% of Terraced homes and flats unlikely to have off street parking	£ GDHI
Cheshire East UA	384, 152	0.634	10.89%	£24, 524
UK	66, 796, 807	0.55	22.07%	£21, 109

Table 4-2 demonstrates that Cheshire East has a higher than average number of vehicles per head, a higher gross disposable household income per head, and the area's percentage of dwellings without off-street parking is far lower in comparison with the UK average. This last fact suggests that most PIV drivers may be able to charge at home. Since UK PIV adoption is still in the Early Adopters profile of affluent consumers, it is therefore likely that most Cheshire East early PIV adopters will be able to charge at home in the short to medium term. As PIV uptake grows towards the UK's objectives and where Cheshire East residents without off-street parking adopt PIV there is likely to be a demand for public charging facilities.

4.1.1 ULEV Targets

The UK's Committee on Climate Change (CCC) has targeted the ULEV market to reach 9% share of new car and van sales by 2020 and 60% by 2030. The related total ULEV registration targets for the UK by those dates are:

- 680, 000 ULEV licensed by 2020.
- 4, 600, 000 ULEV by 2025.
- 13, 600, 000 ULEV by 2030.

However, no systematic ULEV targets have yet been set for UK regions or LAs to enable comparison of their relative performance against these UK goals. Therefore, we have calculated proportionate targets for the Cheshire East area as relevant percentages of the CCC's targets for 2025 and 2030 in order to compare progress. The percentage used reflects the Cheshire East area's contribution to the 2020 total UK vehicle fleet. First forecasts were calculated for the areas' total vehicle fleet by 2025 and 2030 as shown in Table 4-3.

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Table 4-3 Calculated total vehicles forecasts and corresponding ULEV forecasts

District / Area	Total Vehicles as of % of UK Total	2020		2025		2030	
		Total Vehicles Forecast	ULEV Target	Total Vehicles Forecast	ULEV Target	Total Vehicles Forecast	ULEV Target
Cheshire East	0.65%	243, 730	4, 436	272, 592	30, 009	311, 125	88, 723
UK	100%	52, 027, 922	680, 000	84, 868, 992	4, 600, 000	120, 614, 162	13, 600, 000

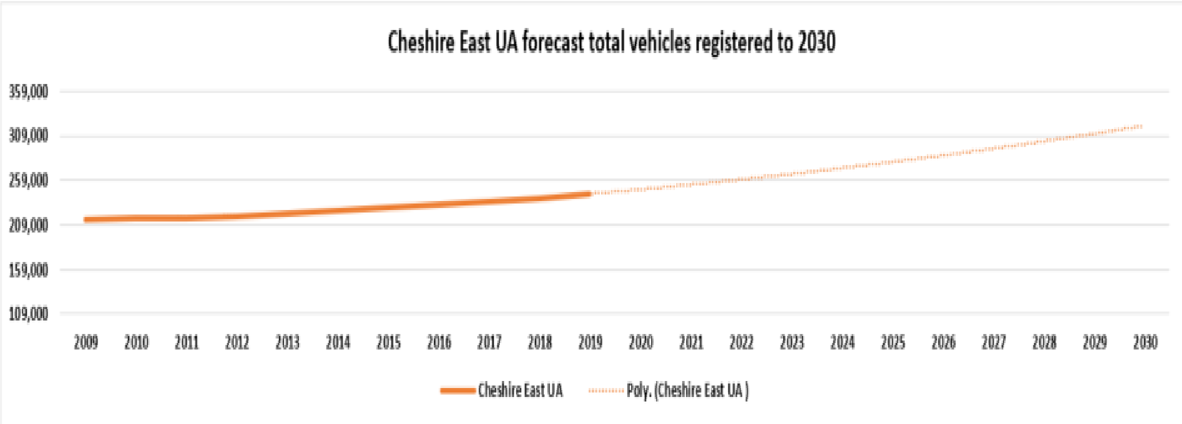

Figure 4-1 Cheshire East total vehicles forecast to 2030

Error! Reference source not found. forecasts how the number of ULEV may increase in the area based on historical uptake to date. Forecasts suggest that if current progress continues 5,776 ULEVs could be licensed in the Cheshire East area by 2025. We believe that significant changes are likely in battery technology to greatly increase energy density, battery life and vehicle range around 2025. This trend coupled with reaching price parity between EV and petrol / diesel could have a major impact on Plug-In Vehicle demand and a more rapid pace of transition to EV is anticipated from approximately 2025 onwards.

Table 4-4 Registration Projections Post 2020

PIV	Baseline	Do nothing scenario			20% increase scenario		
Area	Q3 2019	Q4 2020	Q4 2025	Q4 2030	Plus 20%	Plus 20%	Plus 20%
Cheshire East	2, 119	1, 841	5, 717	14, 552	2, 210	6, 860	17, 462

Looking at the CCC targets for Q4 2025 (30,009) and Q 4 2030 (88,723) it is clear from Table 4-4 that without a serious step change CEC will not hit the targets by a significant margin.

4.2 Existing Charging Infrastructure / Electricity Supply Network

The National Charge Point Registry (NCR) is the official UK database of information on public charge points. It was established by the UK Government in 2011 to provide a public database of all public-funded charge points across the UK, in support of the Government's objective to promote the use and sales of ULEVs. They also encourage privately funded chargers available for public use to be registered on this database, but this is not compulsory. Another useful source of information on charging infrastructure is Zap-Map.com, a mapping application that builds on NCR data but includes other data as well in a very user-friendly format.

Zap-Map was the first major driver-facing development made using the NCR. Zap-Map was originally a static source of information for drivers to use to locate charge points in a required area. Each charge point is identified by a colour coded pin on the map, with further information available in dropdown boxes specifying its quantity and type of outlets, its operator, address, and cost to use. It also enables drivers to report on the status of outlets which was created as an early method of sharing more "real-time" information about status (in or out of service). However, since then network operators have begun to make agreements with Zap-Map so that live status information can also be provided through Zap-Map. Drivers find this single source of information particularly useful when moving between areas and network operators.

Zap-Map cannot enable access and therefore use of charge points, so drivers still require an appropriate access tool (Tag, RFID card, App, contactless card in some cases) to begin and end charging transactions, which is provided by the Network Operator of each charge point.

Figure 4-2 illustrates recent Zap-Map data from different regions of England. This data suggests the North West region is comparable to other regions outside of the populous South East, namely the West Midlands, East of England and South West.

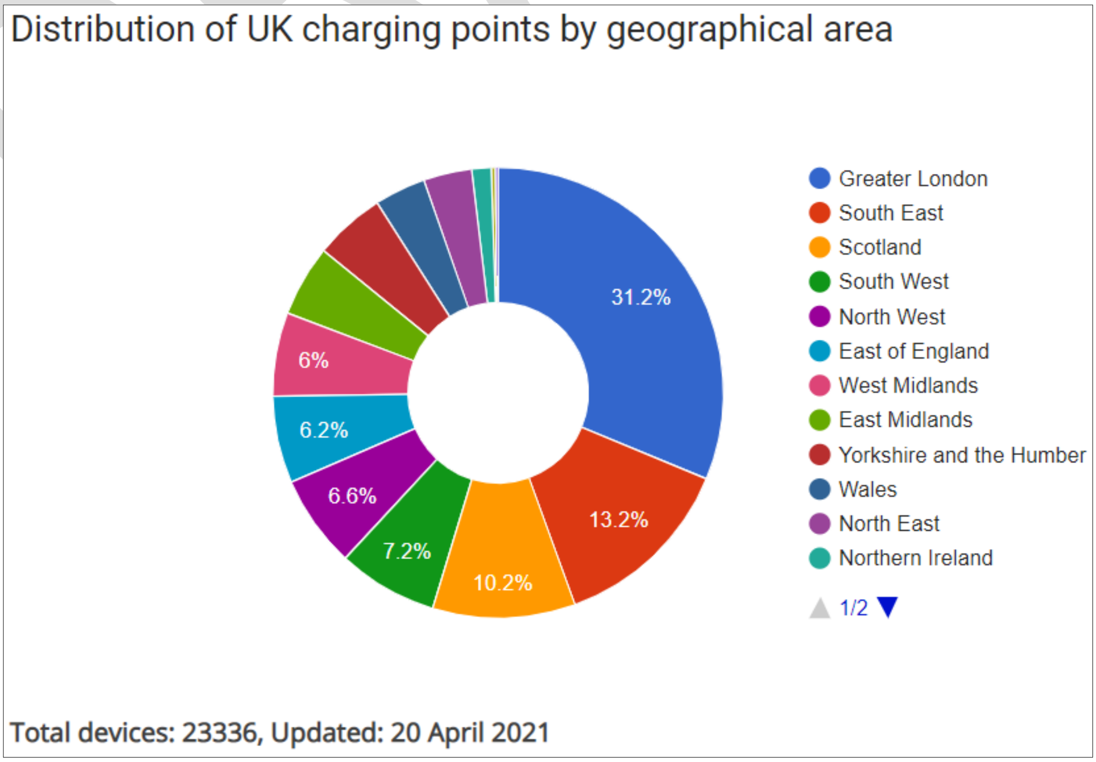

Figure 4-2 Total Connectors by Nation and Region (source: Zap-Map)

According to the National Charge Point Registry (NCR), the UK has 22,123 charging outlets provided for public use, while Zap-Map (Figure 4-3) reports 39,697 connectors from 23,036 devices in 14,728 locations.

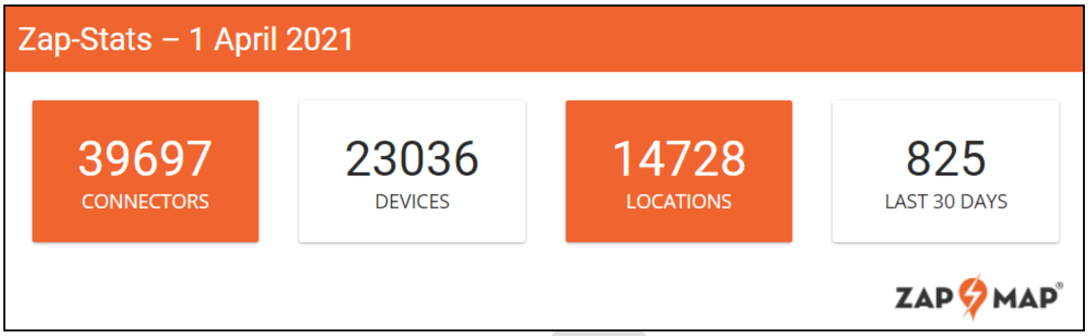

Figure 4-3 UK Publicly Accessible Charge Points Summary

In December 2020, the NCR included a total of 80 charging connectors available within the Cheshire East area, only 1.1% of the UK total. Since the NCR is **not** a live database, this figure does **not** report the current operational status of those charge points (i.e. in or out of service or even still in place). To access status information, it is necessary to refer to the appropriate Network Operators' website or in some cases to Zap-Map, as information provider. Therefore, a physical count of Zap-Map has been undertaken to sense check NCR figures. 23 rapid chargers were found within the Cheshire East area in Zap-Map. As each rapid charger has a minimum of 2 connectors (CCS and CHAdeMO), this tallies with the 45 number registered in NCR.

Table 4-5 CEC Publicly Accessible Charge Points in Cheshire East (Source: NCR)

Charger Type	Quantity of Outlets
Fast up to 22kW AC	19
Rapid 43kW AC	16
Rapid 50kW+ DC	45

Figure 4-4 shows the locations of the existing EV charging points in Cheshire East. This map has been created using NCR and Zap-Map data, where the only available information are their charging speed/wattage and their coordinates.

The figure also shows the boundaries of the three distribution network operators (DNOs) covering parts of Cheshire East:

- Western Power Distribution (WPD)
- Scottish Power Energy Networks (SPEN)
- Electricity North West Limited (ENWL)

It is important to identify the electricity network provider covering an area where EV charging infrastructure is proposed. This is because every DNO has different procedures that must be followed in proposing a potential location, and successful engagement with the DNO can reduce costs incurred in proposing locations where network capacity is too low to facilitate an additional charger. Relevant procedures and recent engagement with each of these DNOs are discussed in more detail in Chapters 6 and 7.

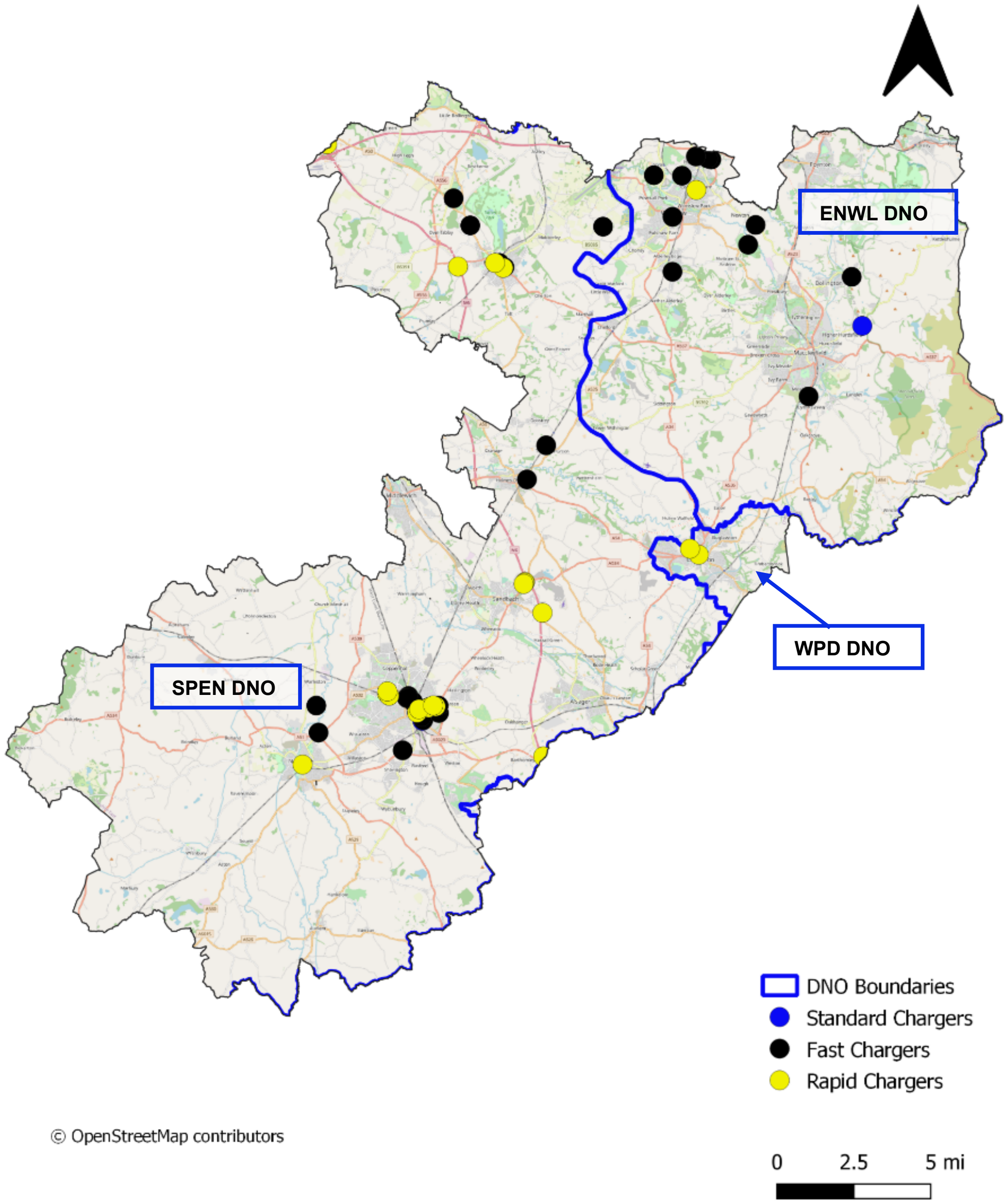

Figure 4-4. Existing Charging Infrastructure and DNO boundaries

The existing charging infrastructure in Cheshire East includes Sandbach motorway services, which are currently served by the Ecotricity network and feature two rapid chargers on each side of the motorway. A survey of rapid chargers in Cheshire East also revealed that the private sector is installing chargers including some KFC, Morrisons, Lidl, Sainsburys, Shell and BP locations, as well as other establishments such as hotels and a health club.

There is a notable lack of charging infrastructure in the east of the borough and the Macclesfield area in particular, with no 'rapid' chargers and few 'fast' chargers in operation at the time of writing.

Initial discussions with the respective District Network Operators for Macclesfield and Congleton have also identified these areas as having constrained capacity in the electricity network. This issue could limit the potential to provide EV charging in these areas and is a key area for future investigation to develop solutions to overcome these constraints.

In order to understand where the existing level of infrastructure provision in Cheshire East sits against other authorities, Table 4-6 shows a comparison of Cheshire East charge points against a number of similar sized authorities in terms of population. The existing PIV per outlet ratio in Cheshire (26) is above the UK average of 16. However, this figure is substantially lower than other comparative areas such as Dorset, Cheshire West and Chester, and East Riding of Yorkshire, which current ratios vary between 49 to 64.

Table 4-6 Cheshire East Area Charging Outlets Against Comparative Areas (Source: NCR)

District/Area	Population (mid-2019)	Total PIV registered Q3 2020	Number of Charge Points	Total Number of Outlets	Total vehicles per charge point	Total vehicles per outlet
Cheshire East UA	384,152	2,119	33	80	64	26
Cheshire West and Chester	343,071	1,291	9	23	143	56
East Riding of Yorkshire	341,173	897	5	12	179	64
Wakefield	348,312	799	19	48	42	17
Leicester	354,224	624	30	55	21	11
Coventry	371,521	694	145	237	5	3
Bournemouth, Christchurch, and Poole	395,331	1,294	42	93	31	14
Dorset	378,508	1,855	15	38	124	49
United Kingdom	66,796,807	355,872	12,334	22,123	29	16

The data presented in Table 4-6 above suggests that at present there is limited correlation between the numbers of charging outlets and Plug-In Vehicle (PIV) registrations.

4.3 Baseline conditions influencing future demand

A range of key factors can influence charging demand in different areas, including access to off-street parking spaces, demographics, and key traffic routes. As such, a review of these factors has been completed for the Cheshire East area in order to inform potential future locations of charging infrastructure.

4.3.1 Household Type

Not every household in Cheshire East has access to off-street parking, which can accommodate individual charging points. People without access to off-street parking might therefore be discouraged to shift to EVs because of this reason. This section of the report presents the local household access to off-street parking and identifies potential areas where higher demand for on-street charging demand may exist.

To carry out this analysis, Census (2011) household data has been gathered. This has included a review of household characteristics to identify types of dwellings likely to have access of driveways and garages. The following dwelling types were considered to have limited off-street parking availability:

- Whole house or bungalow: Terraced (including end-terrace)
- Flat, maisonette or apartment: Purpose-built block of flats or tenement
- Flat, maisonette or apartment: Part of a converted or shared house (including bed-sits)
- Flat, maisonette or apartment: In a commercial building
- Caravan or other mobile or temporary structure

The output of this analysis has been mapped, and Figure 4-5 shows the density of dwellings with limited off-street parking in the principle towns and key service centres in Cheshire East, along with the existing charging points.

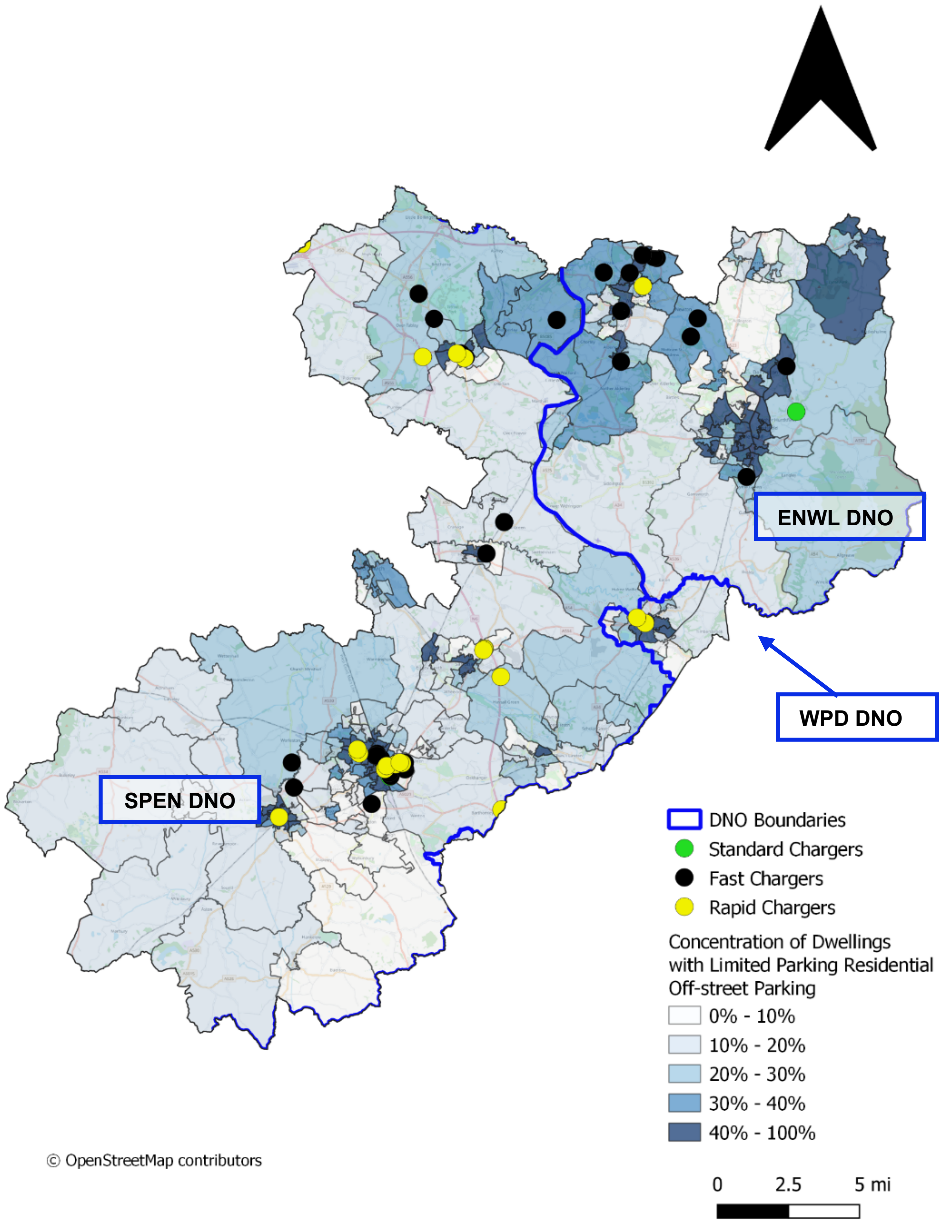

Figure 4-5 Existing Charging Points and Limited Off-Street Parking Availability

As expected, the majority of areas without off-street parking are located in the denser urban areas, examples include Macclesfield, Crewe, Nantwich, Knutsford and Wilmslow. The area to the north-east of Poynton is located around a countryside area and the Macclesfield canal, so may represent a high concentration of dwellings with limited off-street parking due to caravans and boat houses.

4.3.2 Demographic Analysis

There is an established link at present between income levels and the uptake of EVs in large part due to the higher cost of EVs versus Internal Combustion Engines and the limited second-hand market. Price parity for EVs is expected to be achieved by the mid-2020s due to the falling price of batteries and increasing supply of vehicles. For the purposes of understanding where stronger uptake of EVs may come forward, data regarding income levels has been analysed, however this strategy also considers how a balanced network can be provided across the borough.

Figure 4-6 shows the Index of Multiple Deprivation (IMD) across Cheshire East. The IMD is the official measure of relative deprivation for small areas in England and ranks every area from 1 (most deprived area) to 32,844 (least deprived area).

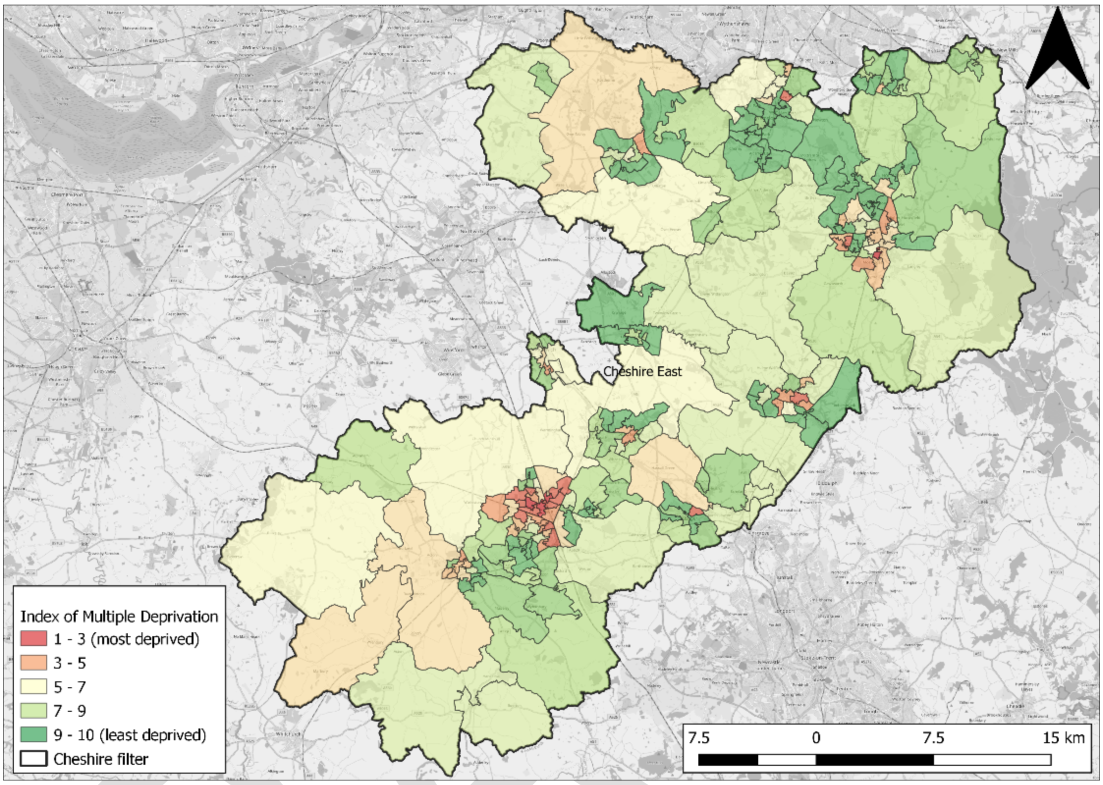

Figure 4-6 Index of Multiple Deprivation in Cheshire East

This figure suggests the most deprived areas of Cheshire East include Crewe, Congleton, and Macclesfield, while the least deprived areas are outside of the principal towns and in the North of Cheshire East including Wilmslow, Knutsford, and Holmes Chapel.

4.3.3 Commuter Journeys

To understand the possible demand for rapid charging, an analysis of commuter journeys has been undertaken to identify key routes across the borough and between adjacent areas. These routes are expected to experience a higher volume of traffic and there may be a requirement for EV top up charging.

Analysis of travel to work data contained in Cheshire East's Local Transport Plan has been pulled through into this strategy to understand the dominant movements to and from Cheshire East. The spatial nature of journeys in and out of Cheshire East is displayed in Figure 4-7 below.

From this analysis, it can be seen a high number of commuting trips to and from Cheshire West and Chester. Journey flows to and from the north, mainly Manchester and Stockport, are also high, with lower traffic demand to/from the south and east of Cheshire East.

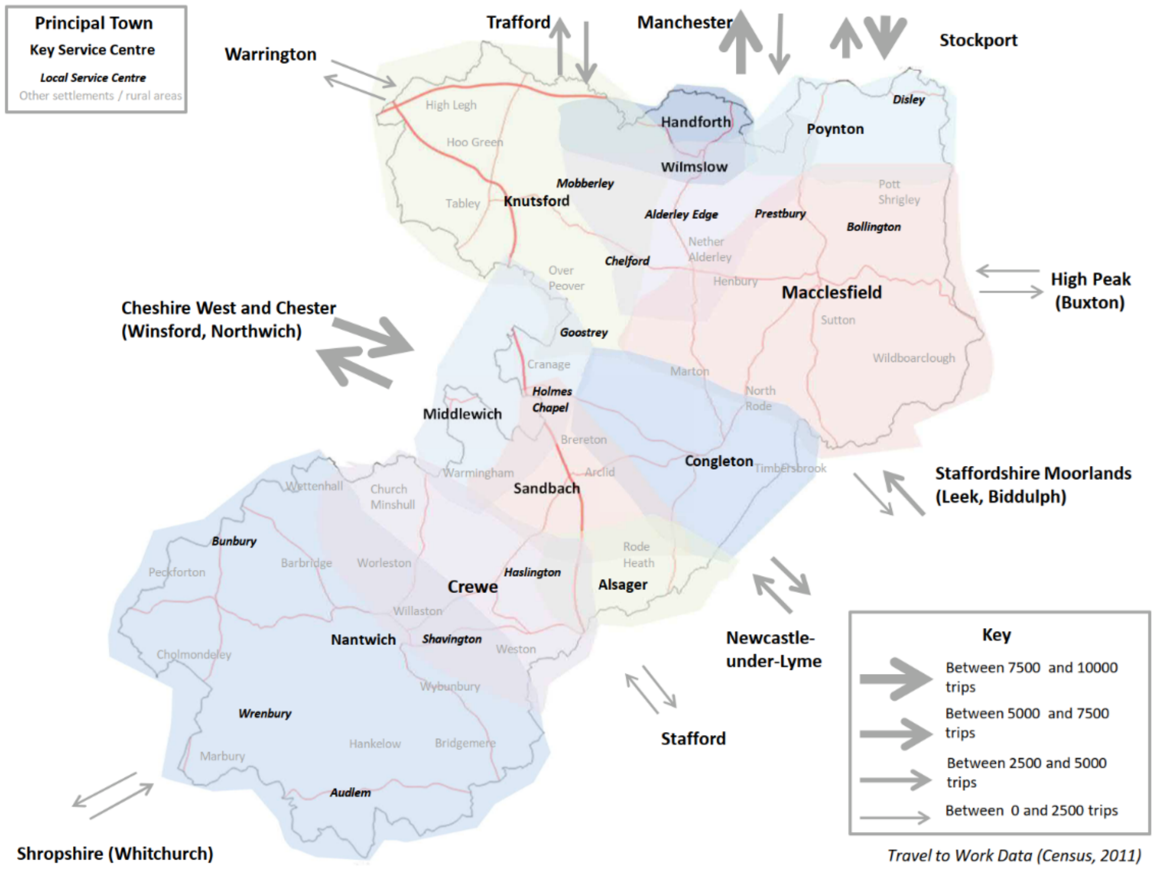

Figure 4-7 Travel to Work flows (Census, 2011)

The amount of charging points should also be influenced by the mode share and distance travelled. Table 4-7 and Table 4-8 summarise the information extracted from Travel to Work data within the Census 2011, which gives an idea of these two key factors within Cheshire East. This data alongside information regarding demographics has been fed into the classification tool presented in the next section 4.3.

Table 4-7 Commuter Mode of Transport (Census 2011)

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Mode	Principal Towns / Key Service Centres										
	Alsager	Congleton	Crewe	Handforth	Middlewich	Poynton	Knutsford	Macclesfield	Nantwich	Sandbach	Wilmslow
Work from Home	7%	9%	4%	7%	8%	9%	12%	7%	11%	6%	10%
Under-ground, metro, light rail, tram	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%
Train	2%	3%	2%	5%	2%	5%	2%	3%	2%	3%	5%
Bus, minibus, or coach	2%	1%	3%	2%	1%	1%	1%	2%	1%	2%	1%
Taxi	0%	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%
Motor-cycle, scooter or moped	1%	1%	1%	0%	0%	0%	0%	1%	1%	1%	0%
Driving /passenger in a car or van	76%	75%	71%	73%	79%	71%	72%	71%	73%	78%	72%
Bicycle	1%	1%	5%	2%	2%	4%	4%	2%	3%	2%	1%
On foot	6%	9%	12%	9%	7%	7%	9%	13%	9%	8%	9%
Other method of travel to work	1%	1%	0%	1%	1%	1%	1%	1%	1%	0%	1%

Table 4-8 Distance Travelled to Work (Census 2011)

Mode	Principal Towns / Key Service Centres										
	Alsager	Congleton	Crewe	Handforth	Middlewich	Poynton	Knutsford	Macclesfield	Sandbach	Wilmslow	Nantwich
Less than 2km	9%	18%	23%	16%	12%	11%	13%	23%	16%	14%	13%
2km – 5km	7%	9%	27%	17%	6%	10%	8%	16%	6%	11%	7%
5km – 10km	21%	6%	11%	17%	18%	22%	12%	11%	24%	16%	20%
10km – 20km	26%	28%	11%	20%	21%	23%	23%	14%	18%	22%	14%
20km – 30km	6%	8%	5%	4%	11%	5%	10%	9%	7%	6%	7%
30km – 40km	4%	5%	4%	2%	5%	2%	3%	2%	6%	2%	5%
40km – 60km	3%	2%	3%	2%	2%	2%	2%	1%	2%	2%	5%
Over 60km	4%	3%	3%	3%	3%	2%	3%	2%	4%	4%	4%
Work from home	12%	14%	8%	12%	14%	15%	20%	13%	11%	16%	17%
Other	7%	8%	6%	7%	7%	8%	7%	7%	7%	7%	7%
Average Distance (km)	18.2	17.6	14.8	16.8	21.1	16.4	19	15	18.2	19.4	20

4.4 Classification Tool

Jacobs has developed a Spatial Distribution Model to inform a classification tool which ranks the suitability of potential charging sites based on three usage cases for EV charging: residential, destination and on route.

The model is fundamentally based upon answering two basic questions:

- How many electric vehicles will there be?
- Where will those electric vehicles charge?

The answers to both questions are informed by a series of interconnected models, which can be independently altered to suit the needs of the specific question being answered.

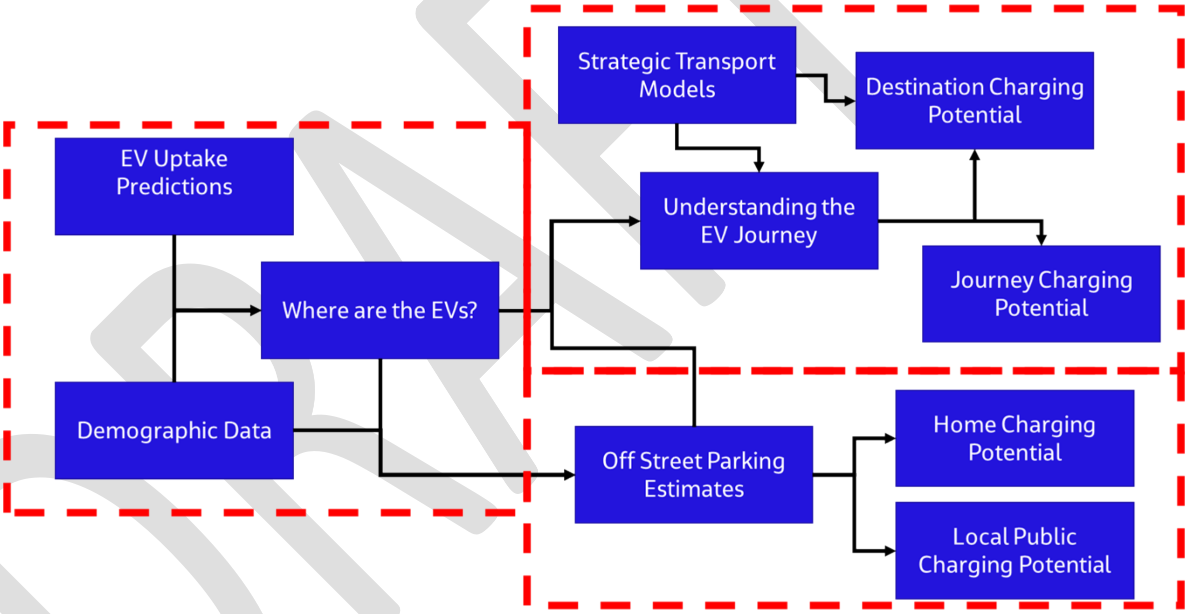

Figure 4-8 The Broad Structure of the EV Model

Figure 4-8 shows the broad structure of the EV classification model. The model is broken down into three separate components, each of which deals with a separate independent component of the overall model. As part of this model, data regarding travel patterns, demographics and housing stock type in Cheshire East has been used to assess the suitability of potential locations for hosting charge points. Appendix A gives further information on how the model has been developed and deployed for this study. Output from the model has informed the appraisal of potential sites as detailed in Chapter 6.

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5. Strategic Priorities

This chapter sets out the objectives of this strategy, measures that could contribute to meeting these objectives, and an assessment of what measures are most appropriate to be taken forward in the short, medium and long term.

5.1 Strategy Objectives

Through the stakeholder workshop the following objectives have been agreed for this strategy:

A stakeholder workshop was carried out where the following objectives were agreed for this strategy:

- To support the uptake of electric vehicles by individuals, businesses, and organisations within Cheshire East
- To contribute towards improved air quality and reduced carbon emissions from transport
- To guide the provision of infrastructure that is safe, easy to use and represents good value for money both on installation and throughout its life
- To help ensure infrastructure makes a positive contribution to the streetscape through sensitive placement and appearance, avoiding any negative impacts on other road users, particularly pedestrians
- To seek to overcome inequalities in infrastructure provision, enabling our communities to transition to electric vehicles in a timely way
- Supporting electric vehicles in the context of a wider transport system that encourages mileage reduction, active travel and public transport

These objectives have guided the development of this strategy and will continue to guide implementation of the key measures set out within it.

5.2 Summary of Measures

Table 5-1 below outlines EV infrastructure measures that could contribute to meeting the proposed objectives of this strategy. The rationale and future uncertainties for each proposed measure are also noted.

Table 5-1 Potential Measures

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
Increase number of charging points	Increase provision of rapid charging infrastructure for taxis in convenient locations.	Taxis contribute to air quality issues and carbon emissions, particularly near taxi ranks and key routes into town centres. Engagement with the Hackney carriage (HC) and Private Hire Vehicle (PHV) industry elsewhere in the UK shows that quick top-up charging using rapid chargers in convenient locations is important to enable taxi transition to EV.	If technology around wireless charging develops further into a commercial proposition for taxis, charging infrastructure could be incorporated within taxi ranks or feeder areas.
	Provide charging infrastructure for buses.	In line with the Government's Bus Back Better strategy there is a desire to strengthen local buses and accelerate the move away from diesel to zero-emission buses. The strategy for England reflects the government support to Net Zero bus services.	There is still some uncertainty regarding whether electric or hydrogen will become the dominant technology for buses. Additionally, there is also uncertainty regarding the sustainability of local bus networks in some areas of the country and the capacity to incorporate new technology.
	Provide charging points at car parks for key destinations (e.g. Town Centre, railway stations station, retail parks, leisure centres, libraries and at major employment sites).	Evidence shows that the public highly value the opportunity to top-up at publicly accessible charge points to complement the bulk of charging which is carried out at home. Without the public charging infrastructure in place, this could delay the uptake of EVs. Evidence demonstrates that some of the most popular publicly accessible locations for charging EV are key destinations where drivers can park for a significant period of time. A high proportion of current vehicles (and in the short term) are anticipated to be plug-in hybrids which have relatively short ranges and older BEVs have relatively small batteries. Therefore, top up charging at key destinations will support journeys to work and for other everyday purposes such as retail and leisure, at least in the short term.	There is uncertainty regarding the rate of EV uptake due to manufacturing capacities. In addition, price parity between EV and ICE is not expected until the mid-2020s which may continue to affect rates of transition. With increasing battery sizes and range the requirement for destination charging may reduce in the medium to long term.
	On-route charging points on the Major Road Network.	As noted above, the opportunity for top up charging is highly valued, particularly for when longer distance journeys are	With increasing battery sizes and quicker charging times via higher powered chargers the requirement

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
		required. Without the infrastructure in place, this could delay the uptake of EVs.	for charging at home may reduce with a move to a situation similar to Internal Combustion Engine refuelling. At present there is no firm evidence for this scenario however and the situation should be monitored as EV technology develops.
	Provide charging points to support residents with limited access to off-street parking provision and charging, focussed on community hub locations.	Homes in areas with limited off-street parking may not have the option to introduce a household charging point and therefore will require alternative public charging points. From the baseline analysis there are notable areas of flats and terrace housing clustered in the town centres which are likely to require on-street charging or alternative public charging car parks close to homes. Focussing on consolidated community hub locations would be more feasible than committing to installing charge points in front of all properties.	
	Introduce charging forecourts.	Significant sized charging forecourts are being trialled in a number of locations on a commercial basis. At present the business case for larger and more extensive hubs is uncertain due to questions regarding the uptake of EV in the short to medium term and how owners will charge their vehicles in the future.	
	Introduce charge points for the council’s own fleet and potentially the grey fleet.	This will support the uptake of EVs within the Council’s own fleet and any grey fleet.	Price parity is not anticipated to be achieved by the mid-2020s however lower operating costs may offset this higher vehicle cost.
	Introduce charge points for HGVs.	HGVs comprise a significant proportion of traffic and are contributing to air quality issues and carbon emissions. However, at present there is a lack of commercially available EV options for HGVs.	There is significant uncertainty regarding whether electric or hydrogen technology can serve HGVs in the future, what shape this technology would take and the timescales involved.
Engagement with the District Network Operator	Continuous engagement and joint working with Scottish Power through the	Scottish Power are currently conducting the “Charge” project that merges electricity and transport planning to create an over-arching map of where EV charge points will be required and where they can be best accommodated by the electric grid. The project will also determine where future upgrades to	As noted above, significant uncertainties regarding the supply and uptake of vehicles alongside the availability of V2G technology will affect the level of power required

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
	"Charge" project, and similar engagement with Electricity North West and Western Power Distribution. Investigation of potential for distributed renewable energy solutions.	electricity supply capacity are required to futureproof the network and feed into future business cases to secure investment as part of broad network development. If these locations can be identified this will avoid costly investment later which hinders the business case for charging infrastructure. The project is in progress with an end date of December 2022 and there is an opportunity for CEC to use the recommendations in this strategy and subsequent detailed planning to position the Council at the forefront of EV infrastructure provision in the region. Similarly, engagement with Electricity North West and Western Power Distribution will be crucial to overcome some of the key electricity power constraints within the Cheshire East area.	from the grid. Joint work with the DNOs should explore the impact of varying uptake scenarios to inform an assessment of likely upgrades to the network. There was a large degree of uncertainty regarding the ability to address key network constraints in areas such as Macclesfield and Congleton in a timely way to support EV uptake. Alongside engagement with DNOs opportunities for distributed renewable energy such as solar could be investigated.

5.3 RAG Assessment and Sequencing

Following on from the identification of the potential measures, a **R**ed-**A**mber-**G**reen assessment has been conducted for effectiveness against the strategy objectives, and for deliverability. This is reported in the table below alongside a recommendation for whether the measures are brought forward in the short, medium or long term.

Table 5-2 RAG Assessment of Potential Measures

Theme	Potential Measures	Effectiveness	Deliverability	RAG Rating Justification	Sequencing
Increase number of charging points	Increase provision of rapid charging infrastructure for taxis in convenient locations			A greater number of strategically located charging points for taxis could encourage EV uptake giving drivers confidence that reliable and accessible charging infrastructure is in place. This measure would benefit from being developed as part of a broader EV Taxi Strategy. Although charging infrastructure cannot currently be sited on taxi ranks engagement with the taxi trade can identify locations at which breaks are regularly taken where rapid charging infrastructure could quickly recharge batteries.	Short – medium term
	Provide charging infrastructure for buses			Further engagement is required with industry stakeholders to determine the deliverability of transitioning buses to EV. Detailed consideration would also be required as to whether there is scope to install charging infrastructure at bus depots.	Medium term
	Provide charging points at car parks for key destinations (e.g. Town Centre, railway stations station, retail parks, leisure centres, libraries			Providing charging infrastructure at key locations will give people the confidence to transition to EV. A mixture of slower and rapid charge points could be delivered at particular sites depending on the length of stay of users. OZEV grants are available for employers and these could be promoted through existing CEC communication channels with employers.	Short term

Theme	Potential Measures	Effectiveness	Deliverability	RAG Rating Justification	Sequencing
	and at major employment sites).				
	On-route charging points on the Major Road Network			This option is deliverable due to Council land ownership and partners (e.g. supermarkets and commercial companies) who are looking to increase charging infrastructure. This is also likely to be a need for fleet vehicles who need to charge whilst out on the job. Public surveys point to the availability of top up charging being key to the uptake of EVs however there is some uncertainty regarding how well these charge points would be utilised in practice.	Short term
	Provide on-street charging points to support residents with limited access to parking provision and home charging, with a focus on community hubs.			This measure would increase the visibility of charging infrastructure and may increase confidence amongst residents for investing in EVs. However, introducing on-street charging may be met with resistance from some residents, particularly if EVs have parking priority in spaces with charging infrastructure. For this reason, focussing on consolidated community hub locations is recommended. Concerns have been raised regarding cables trailing across pavements and solutions will be needed to ensure charging infrastructure does not negatively impact on accessibility for highway users. Detailed planning and engagement is required to identify feasible locations.	Short to medium term

Theme	Potential Measures	Effectiveness	Deliverability	RAG Rating Justification	Sequencing
	Provide off-street charging points to support residents with limited access to parking provision and home charging			As above, this measure would provide a charging solution for people who do not have off-street parking to charge their vehicle. This measure would be more deliverable, for instance using council-owned car parks, but there may be challenges with off-street parking being distant from residential units that may affect the attractiveness of this charging infrastructure.	Short term
	Encourage and where possible support the introduction of charging forecourts			Due to uncertainties regarding the uptake of EV in the short to medium term there is a question mark regarding the business case for large charging hubs. There is evidence that drivers prefer the use of hubs due to availability and convenience. In the short term it is recommended that smaller clusters of charging infrastructure are provided (linking to the use cases outlined above) to give users the confidence a charge point will be available for use. The Council could however engage with partners who may seek to develop larger facilities on a commercial basis.	Recommendation to engage with commercial partners to seek charging forecourts to be brought forward by the commercial sector
	Introduce charge points for the Council's own fleet and potentially the grey fleet			This could be considered as part of the Council's plan to shift its own fleet to EV with infrastructure provided at key sites.	Short term
	Introduce charge points for HGVs			Due to there being limited commercially available EV options for HGVs this measure is not recommended at this time, however the situation should be kept under review to understand future developments for electric or hydrogen technology.	Long term
Engagement with the District	Continuous engagement and joint working with			Although this strategy is identifying feasibility for the short-term provision of sites it is clear from initial discussions with the DNOs that strategic investment is	Continuous engagement recommended

Theme	Potential Measures	Effectiveness	Deliverability	RAG Rating Justification	Sequencing
Network Operator	Scottish Power through the "Charge" project, and similar engagement with Electricity North West and Western Power Distribution. Investigation of potential for distributed renewable energy solutions.			required in particular for Macclesfield and Congleton to address a general lack of electricity capacity in the network. Additionally, further network strengthening may be required more widely within the borough in the longer term to support the large scale uptake of EVs. Investigation of the potential for distributed renewable energy solutions could be conducted to address constrained power supply at key locations.	

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6. Prioritising Charging Locations

In Chapter 5 provision of EV charging infrastructure was confirmed as one of a number of potential measures that will be pursued as part of this strategy to encourage the uptake of EVs in Cheshire East. Chapter 4 set out Cheshire East's baseline EV context including where charging points exist as well as the demographic factors affecting likely future EV charging demand across the borough. This information has been taken into account in identifying the highest priority locations for installation of new EV charging infrastructure in Cheshire East, as set out in this chapter.

The review of potential sites carried out for this strategy began with council-owned car parks, as well as broader areas where on-street charging infrastructure will be considered. Some of the car parks considered are located so as to be attractive to people wishing to charge their EVs whilst visiting leisure and shopping areas, or for commuters wishing to charge while at work. Others are better located for residential use, or even for mid-journey topping up along key routes through the borough. And many of the recommended car park locations could serve more than one of these use cases.

These various types of uses were considered as part of the key criteria for the assessment of each potential site, along with the security of the location, energy grid capacity, and whether demand for the proposed charging point would be impacted by other existing or likely future commercial charging facilities. Before setting out the highest priority car park locations, this chapter begins with a discussion of the three main use cases for EV charging infrastructure: Destination, Residential, On-Route charging.

6.1 EV Charging Use Cases / Location Types

In considering where EV charging infrastructure should be located, it is necessary to consider the different reasons why drivers may find themselves seeking a charge in each location. The following sections explore the main types of uses in more detail, including issues to consider when addressing the demand.

6.1.1 'Destination' charging

'Destination' charging occurs in public locations where there is a high footfall of people typically spending two hours or more. This could include high streets, leisure and cultural facilities, tourist attractions, shops, and retail outlets. At these locations, at least a 'Fast' charger (7-22kW) would be needed, though in some cases a 'Rapid' charger (up to 50kW) may be more suitable. For destination charging, the preferred locations are off-street, prime town centre locations and points of interest.

A focus on destination charging in town centres would be a key recommendation for the foundations of a joined-up strategy across the area. If the town centre locations do not have charge points present, a strategic option would be to begin by installing one 'double-headed' charge point per location (able to charge two vehicles simultaneously, and to monitor subsequent demand. By taking a phased approach, the charging network can be grown according to demand, providing a visible asset to the community but also avoiding under-utilisation. There are many benefits of focusing on town centres, as charge points can support multiple use cases including workers, shoppers and visitors, some residential areas, as well as raising the profile of EVs.

For ease of installation and operation, car parks in council ownership are ideal. However, it is important that charge points be placed in visible locations – at the entrance of car parks where possible – and not tucked away where they are difficult to find. There is sometimes a trade-off required in terms of identifying the most affordable way to connect a charge point to the electricity grid, so the exact site of each charging point must be considered on a case-by-case basis.

Next steps

- Review proposed high-priority car park locations to assess parking regulations, opening times, space availability and accessibility
- Agree approach to parking fees, charging fees, enforcement and maintenance
- Undertake site surveys to identify exact locations and costs
- Engage further with the relevant DNO to confirm power capacity and secure a quote for connection to the grid
- Undertake procurement for proposed charge points, followed by installation
- Promote availability of charging points through resident communications as well as Zap-Map and other databases

6.1.2 ‘Residential’ charging

‘Residential’ charging focuses on provision for residents without access to off-street parking where charging at home is not possible. Residential charging is often located in areas where there is a high percentage of terraced housing and apartments / flats where there is no dedicated parking facility. This is more of an issue with many PHEVs that cannot charge rapidly using destination chargers during normal use of the vehicle. At residential charging locations, the charge point type is usually ‘Fast’ (7kW). The preferred location for this type of provision is either on-street parking or in appropriate local car parks (for overnight charging).

Residential charging community hubs could be considered for some areas where they are needed to enable those without access to a driveway or garage to charge near home. The focus should initially be on areas that performed well in terms of the ‘Residential Assessment’ within the modelling exercise (see Appendix B), where residents are expected to be more likely to purchase an electric car but where access to private off-street charging may be a barrier.

Next steps

- Investigate opportunities for OZEV residential charging grants to secure funding for chargers in specific residential locations (further information provided in Chapter 7)

- Carry out procurement, and a number of the same steps as for Destination charging locations
- Promote to developers the implications of new building regulations for developments (consultation outlined in further detail in Appendix C) to accelerate the private provision of residential chargers for new homes

6.1.3 'On-route' charging

As described in Chapter 4, the modelling exercise carried out as part of this strategy has considered where journeys are being taken to, from and through any part of Cheshire East. Also in consideration are factors such as the likelihood of the driver of each journey to choose an EV for their journey (based on a demographic analysis of their residential area), how far they are travelling, and where other charging opportunities exist. There may also be a requirement for top-up charging for fleet and grey fleet vehicles during daily operations. The result is a picture of where EV drivers are likely to find themselves in need of a top-up charge while driving within (or through) Cheshire East.

Motorway services are the ideal form of 'on-route' charging, and such facilities already exist within Cheshire East on the M6 near Sandbach. These facilities are usually installed by private sector operators without the need for local authority support or involvement. However, where gaps exist in the charging network such as along the A34, A51 and A6, and suitable council-owned car parks exist in convenient locations, 'Rapid' charge points (50kW or more) could be provided to satisfy this demand.

Next steps

- Consider highest priority car park locations suiting on-route charging demand, and procure and deliver charge points where suitable as per Destination charging as discussed earlier

6.1.4 'Commuter' charging

'Commuter' charging occurs in any public car park that links to an alternative form of transport such as a railway station, transport interchange or park-and-ride facility. Providing commuter charging in these types of location could have the benefit of removing cars from town centre locations and encouraging the majority of the journey to be taken by public transport, thus being consistent with multi-modal sustainable transport strategies.

Due to the likely length of stay, slower charging can be provided at these locations. There is little difference in cost between 'Slow' (3kW) and 'Fast' (7kW) charging, and the average EV battery size is increasing along with the time required to achieve a full charge. 'Fast' (7kW) charge points are therefore considered most suitable at locations where commuters are likely to wish to charge.

Council-owned car parks have been considered for their appeal to potential 'commuter' chargers as part of the modelling exercise carried out within this strategy. However, where a commuter car park is not council-owned, it may be possible to engage with the station owner regarding the provision of charging infrastructure there.

Next steps

- Consider highest priority car park locations suiting commuter charging demand, and procure and deliver charge points where suitable as per Destination and On-route charging as discussed earlier

6.2 Recommended Charging Locations

Providing on-street EV chargers is more expensive than off-street, and requires a longer lead-in time particularly due to the need to consult the public on a Traffic Regulation Order (TRO) to reserve the parking bay for the exclusive use of drivers wishing to recharge their EV. For this reason, the first opportunity to explore for installation of EV charging infrastructure within the borough is the council's many car parks located throughout the borough. The next section sets out the car parks that have been determined to be the most suitable locations for EV charging points.

On-street charging points also have a role to play, particularly where off-street provision is unfeasible. The best areas for implementation of on-street charging points are therefore considered immediately following the discussion of car park charging locations.

6.2.1 Car Park Charging Locations

As outlined above, the assessment completed has allowed for recommendations to be made as to which car park locations should be taken forward for further consideration. Table 6-1 below shows a total of 39 high-ranking specific car parks spread out across 17 areas within Cheshire East. Table 6-2 presents the same proposed car park locations by town, rather than by overall suitability to allow for a balance network to be provided.

The full assessment of car parks is set out in Appendix B, including scores for each of the key criteria:

- Likely demand resulting from nearby leisure and shopping destinations
- Likely demand resulting from nearby employment destinations
- Likely demand resulting from nearby residential areas (taking into account demographics as well as housing types and presence of off-street parking)
- Likely on-route demand resulting from journeys passing nearby
- Avoiding conflicts with existing or likely forthcoming commercially provided charge points
- Security of the location
- Capacity of the energy grid to power new charging points within the car park

Appendix B includes the assessment of 14 other potential car park locations that were considered as part of this analysis, but which were not determined to be among the most suitable car parks within each town. In addition, several other sites were considered but eliminated before the assessment began, due to the possibility of future re-development or practical issues such as limited size of the car park.

One specific car park site that was omitted from the analysis was the Royal Arcade multistorey car park in Crewe, which is in the process of being developed. This car park is almost certainly a very suitable location for a charging hub, and should be considered in more detail as part of the scheme's development for 'fast' chargers.

Table 6-1 Highest Ranking Car Park Locations

Overall rank	Car Park	Town
1	Spring Street	Wilmslow
=2	Exchange Street	Macclesfield
=2	Gas Road	Macclesfield
=2	Railway Station	Macclesfield
=2	Pickford Street	Macclesfield
=2	The Carrs	Wilmslow
=3	South Drive (additional charge points should monitoring data show high utilisation)	Wilmslow
=3	Broadway Meadow	Wilmslow
=3	Princess Street	Knutsford
=4	Fairground	Congleton
=4	Antrobus Street	Congleton
=4	Back Park Street	Congleton
=4	Civic Hall	Poynton
=4	Princess Street*	Congleton
=4	Booths Knutsford	Knutsford
=5	Springfields	Prestbury
=5	South Street	Alderley Edge
=5	Tatton Street	Knutsford
=5	Victoria Centre	Crewe
=6	Community Centre	Disley
=6	King Street	Knutsford
=6	Shirleys	Prestbury
=7	Delamere Street	Crewe

Overall rank	Car Park	Town
=7	London Road	Holmes Chapel
=7	School Road	Handforth
=7	Westfields	Sandbach
=7	Fairview	Alsager
=7	Wilmslow Road	Handforth
=8	Snow Hill	Nantwich
=8	Pool Bank	Bollington
=8	Station Road	Alsager
=8	Cheshire Street	Audlem
=8	Chapel Street	Sandbach
=8	Civic Way	Middlewich
=9	Civic Centre/Library (Rapid chargers to complement current Type 2 chargers)	Crewe
=9	Scotch Common	Sandbach
=9	Brookhouse Road	Sandbach
=10	Love Lane (additional charge points should monitoring data show high utilisation)	Nantwich
=10	Civic Hall	Nantwich

* Rapid chargers are currently being moved from the Princess Street car park in Congleton, so the reasoning behind this decision should be understood before any further charge points are considered at this location.

It can be seen from Table 6-1 that towns like Wilmslow, Macclesfield and Congleton appear more likely to experience greater demand for charging facilities than some of the other towns appearing lower down in the table, e.g. Nantwich, Sandbach and Crewe. However, there is likely to be some level of demand in every town, so it is intended that investment will be spread across the borough to some extent. Following a period of monitoring, the areas where demand is highest may require further investment to increase the number of chargers available. At that stage it will need to be determined if more chargers should be added to existing charging hubs in those towns, or whether new charging hubs should be created to broaden the coverage of the charging network in the town.

Table 6-2 lists the potential car park sites in alphabetical order by town, and includes an initial assessment of whether rapid or fast chargers should be considered for the site, or both. This assessment is based on the length of stay that would be likely at each location, with destination and on-route demand indicating a need for rapid chargers, and residential and employment / commuting locations being able to benefit from a number of less expensive and slower chargers to serve those likely to stay longer or overnight. In most cases, it appears worth providing both types of chargers.

Table 6-2 Highest Ranking Car Park Locations by Town

Town	Town Priority	Car Park	Rapid	Fast
Alderley Edge	1	South Street	✓	✓
Alsager	1	Fairview	✓	✓
	2	Station Road	✓	✓
Audlem	1	Cheshire Street	✓	
Bollington	1	Pool Bank	✓	✓
Congleton	=1	Fairground	✓	✓
	=1	Antrobus Street	✓	✓
	=1	Back Park Street	✓	✓
	4	Princess Street*	✓	✓
Crewe	1	Victoria Centre	✓	✓
	2	Delamere Street	✓	✓
	3	Civic Centre/Library**	✓	✓
Disley	1	Community Centre	✓	✓
Handforth	1	School Road	✓	✓
	2	Wilmslow Road	✓	✓
Holmes Chapel	1	London Road	✓	✓
Knutsford	1	Princess Street	✓	✓
	2	Booths Knutsford	✓	✓
	3	Tatton Street	✓	✓
	4	King Street	✓	✓
Macclesfield	=1	Exchange Street	✓	✓
	=1	Gas Road	✓	✓
	=1	Railway Station	✓	✓
	=1	Pickford Street	✓	✓
Middlewich	1	Civic Way	✓	
Nantwich	1	Snow Hill	✓	✓
	2	Love Lane***	✓	✓
	3	Civic Hall	✓	
Poynton	1	Civic Hall	✓	✓
Prestbury	1	Springfields	✓	✓
	2	Shirleys	✓	✓
Sandbach	1	Westfields	✓	✓
	2	Chapel Street	✓	✓
	=3	Scotch Common	✓	
	=3	Brookhouse Road	✓	
Wilmslow	1	Spring Street	✓	✓
	2	The Carrs	✓	✓
	3	South Drive***	✓	✓
	4	Broadway Meadow	✓	✓

* Rapid chargers are currently being moved from the Princess Street car park in Congleton, so the reasoning behind this decision should be understood before any further charge points are considered at this location.
** Rapid chargers could complement current Type 2 chargers at Crewe Civic Centre / Library car park.
*** Additional charge points could be considered should monitoring data show high utilisation of existing points at Nantwich Love Lane or Wilmslow South Drive car parks.

The assessment of grid capacity is indicative at this stage, with all Distribution Network Operators (DNOs) currently working to improve the strategic information they offer about grid capacity to assist in the process of shaping charging networks. Based on the information available to date, it appears that grid capacity throughout

Macclesfield and Congleton is constrained. If this is the case, it may be difficult to provide rapid chargers in the highest-priority car park locations (or indeed in any council-owned car parks or even in on-street locations) within these towns. Both towns are high priorities for charging point provision due to a lack of existing infrastructure at the moment, but collaborative working with the DNOs covering these towns (ENW for Macclesfield and WPD for Congleton) may lead to the identification of car parks that are suitable for rapid chargers, or otherwise the most suitable car parks for 22kW fast chargers.

Installing EV charging infrastructure is not just for facilitating the charging of vehicles – it also helps to provide assurance to potential EV buyers that they will be able to charge their EV should they make their purchase. Providing at least one charger in each key town or local area may not maximise use of the resulting charging network, but would be beneficial in unlocking the potential demand for EVs and helping potential buyers to overcome their hesitations. Depending on the supplier and the commercial model underlying the network, this decision may need to be made with the supplier during the procurement process (discussed further in the following chapter).

6.2.2 On-Street Charging Locations

In addition to the car park locations prioritised above, on-street charging provision is considered for residential areas where council-owned car parks are unlikely to be suitable, and where demand from residents is likely to be particularly high due to demographic factors as well as a lack of off-street parking.

The modelling exercise carried out as part of this strategy has highlighted that the highest priority areas for potential provision of on-street charging points include parts of Alderley Edge, Wilmslow and Macclesfield. The assessment focused on propensity of residents to purchase an EV, areas where a higher than average number of homes were of a type that would often not have access to their own off-street parking (where private chargers could be installed), and gaps in existing charging point provision (including consideration of the likelihood of the private sector providing charging infrastructure nearby in the future, as discussed later in this chapter).

Table 6-3 Highest priority residential areas for on-street charging

Rank	Town	Residential Area
1	Alderley Edge	East of Town Centre
2	Wilmslow	Town Centre
3	Macclesfield	Town Centre
=4	Alsager	North East of the Town Centre
=4	Nantwich	Town Centre
=4	Knutsford	North of Town Centre
=7	Holmes Chapel	North and East of Town Centre
=7	Handforth	Town Centre
9	Congleton	Town Centre
10	Sandbach	Town Centre
11	Crewe	Town Centre/East/South

Provision of on-street residential chargers is not likely to be a quick or affordable process, so finding the right delivery partner or partners is essential. The

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procurement process will specify the need for suitable hardware and ongoing management solutions.

6.3 Future EV Charging Provision

As part of future work to develop and implement EV charging infrastructure, other use types and users can be considered. Taxis, buses and workplaces are some examples of areas that the council may be able to influence and support. An indicative guide to charging for these use types is provided below. The section concludes with a high-level assessment of potential locations within the borough where commercial charging points may be likely to be provided.

6.3.1 Taxis

Some council-owned car park locations could serve taxis in the future, and in the future, it may be possible to provide on-street ultra-rapid charging at taxi ranks and stands. Charging provision for taxi drivers tends to require at least a 'rapid' solution due to the fact that taxi drivers require minimal downtime so as not to impact on their shift. In some towns and cities where electric taxi uptake has been small, a lack of dedicated charging for taxis has been at fault. Other cities, including London, have provided charging points for exclusive use by taxi drivers to help support uptake. Above all, charging put in place to support the taxi trade should be easily accessible.

Engagement with local taxi companies would be required before any infrastructure can be provided specifically for the taxi industry. At present, the OZEV grant for taxi infrastructure scheme is closed.

Next steps

- Engage with local taxi companies to understand EV transition strategies and highest priority locations
- Explore opportunities for securing funding through the next round of OZEV taxi funding when announced

6.3.2 Buses

Most bus operators running electric buses would only make the transition to electric if they could provide their own charging infrastructure within a depot or bus station for overnight charging. For this purpose, even slower chargers may be adequate. However, some bus services may require topping up once or twice during a typical day using rapid chargers in locations that are more convenient to the route being run.

Engagement with bus service providers would be required to understand the most appropriate places for charging facilities to be provided, as well as any future plans to roll-out EV fleets within Cheshire East.

Next steps

- Engage with local bus operators to understand their current and potential future charging needs including locations and charging constraints

6.3.3 Workplaces

Workplace charging is an ideal alternative for EV drivers who drive to work but do not have access to off-street parking at home. Workplace charge points could be used for both fleet vehicles as well as employees and visitors, and OZEV workplace grants are still available for any individual businesses wishing to install charge points. Charge points at workplaces can be 'Fast' (7kW) due to the long stays that are likely for employees.

The council has little control over workplace car parks other than its own. To be seen to be leading by example, it may be possible to promote the council's own achievements in making the transition to EVs.

Next steps

- Understand the implications for new development areas of changes in building regulations (see Appendix C), and communicate this to developers

- Integrate the findings of the council's fleet review into the charging strategy, which has identified further opportunities to convert vehicles to electric.

- Integrate the work on charging requirements for new Council fleet and grey fleet EVs and identify suitable locations at council offices, as well as charger types for specific uses

- Seek workplace grants to support new charge points, and promote the fund to other large employers to encourage them to access their own grants

6.3.4 Potential Commercial Charge Point Sites

Many private companies with car parking space are beginning to pursue the opportunity to either make money by offering charging infrastructure (such as motorway services or petrol stations), while others are seeing the potential to attract customers to their core business by offering free or discounted EV charging. Although this portion of the EV charging network is likely to happen largely on its own without council involvement, the council may be able to accelerate the process to help more people make the transition to an EV faster. In addition, knowing more about the plans these companies may have to roll-out charging infrastructure will help to avoid any duplication of infrastructure, or investment in chargers that are unlikely to be used.

The following land uses are those most likely to increase their charging point offer in the near future:

- Supermarkets

- Service / petrol stations

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- Privately-managed car parks
- Other large retail / shopping centres

An analysis of these land uses within the Cheshire East area has been undertaken to identify potential commercial sites where existing car parking space could well see additional charge points in the future. This was only a high-level analysis, and electricity network capacity has not been considered.

A list of the identified potential sites is presented in

Table 6-4 and mapped in Figure 6-1 below.

Table 6-4. List of potential Commercial Charge Point sites

Town	Commercial Site	Land Use
Crewe	Morrisons	Supermarket
	Marks and Spencer	Supermarket
	ASDA	Supermarket
	Wickes	Other big retail
	Tesco Extra	Supermarket
	B&Q	Other big retail
Macclesfield	Tesco Superstore	Supermarket
	Sainsburys	Supermarket
	The Grosvenor Shopping Centre	Other big retail
	ALDI	Supermarket
	B&Q	Other big retail
Alsager	Sainsburys Local	Supermarket
Congleton	Morrisons	Supermarket
	ALDI	Supermarket
	Brown Street Car Park	Private car park
	Tesco	Supermarket
	Shell	Petrol station
	Marks and Spencer	Supermarket
Handforth	Tesco	Supermarket
	Tesco Petrol Station	Petrol station
	John Lewis	Supermarket
	Lidl	Supermarket
	Trek Bicycle	Other big retail
	Best Western Pinewood Hotel	Other
Wilmslow	BP	Petrol station
	Shell	Petrol station
	Waitrose	Supermarket
	Sainsburys	Supermarket
Knutsford	Shell	Petrol station
	Station Garage	Other
	ALDI	Supermarket
	BP	Petrol station
	Boots	Other big retail
	Sainsburys Local	Supermarket
	SPAR Euro Garage Knutsford	Other big retail

Town	Commercial Site	Land Use
Middlewich	Tesco Superstore	Supermarket
	Morrisons	Supermarket
	LIDL	Supermarket
	Shell	Petrol station
Nantwich	Marks and Spencer	Supermarket
	Morrisons	Supermarket
	ALDI	Supermarket
	Wall Lane Car Park	Private car park
Poynton	ALDI	Supermarket
	Waitrose	Supermarket
Sandbach	B&M	Other big retail
	Waitrose	Supermarket
	ALDI	Supermarket
	Ashfield Way Car Park	Private car park
	McDonald’s	Other big retail

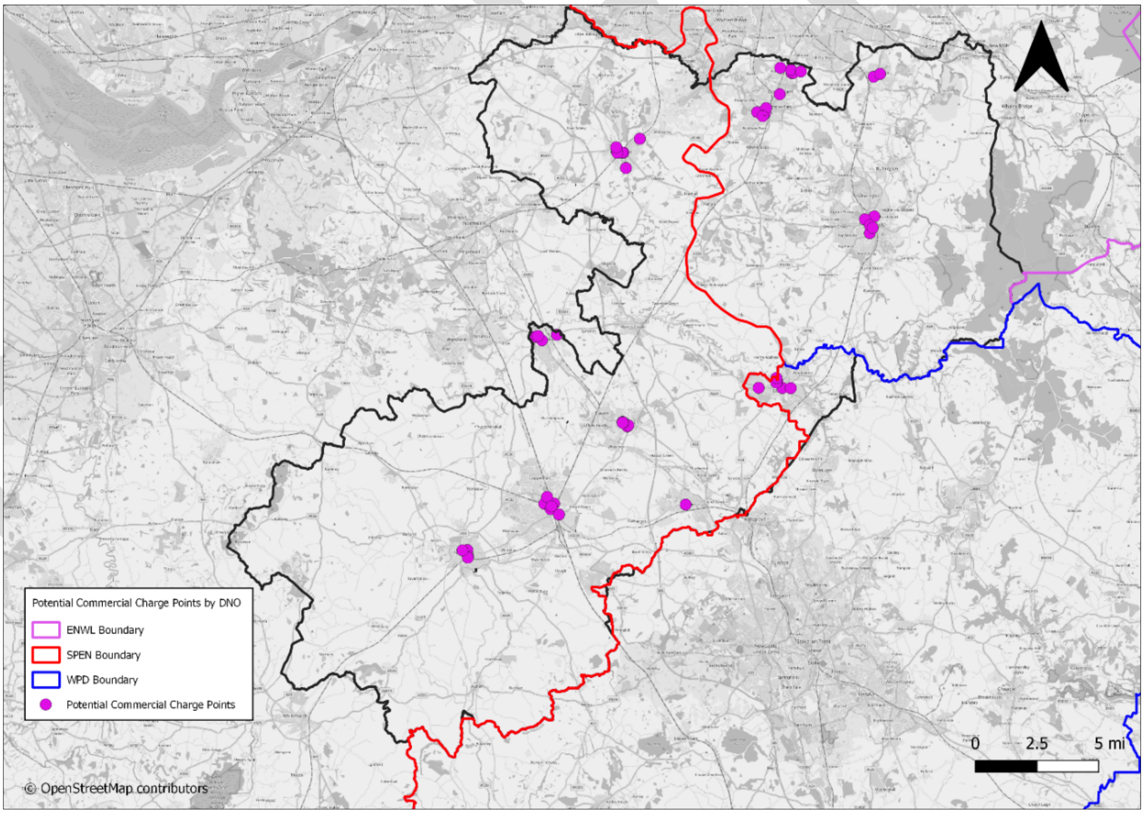

Figure 6-1 Potential Commercial Charge Points by Distribution Network Operator

This high-level analysis of potential commercial charge points was completed in parallel with the assessment of car park charging locations. Proposed car park locations that were in close proximity to any of these sites were marked down slightly to reflect the risk of a future commercial charge point undermining demand for a council-installed charge point. However, it may still be worth considering locations that are near these commercial sites, especially if after engagement it becomes clear that the owner has no plans to pursue EV charging infrastructure in the near future.

6.3.5 Council Fleet Charging

There is an opportunity for the Council to lead by example and work towards achieving net zero emissions by transitioning fleet vehicles to electric for cars and light vans (with an alternative hydrogen powertrain being considered for heavy goods vehicles).

The Council and its main service providers, have a number of charging points already available for both fleet and grey fleet (business use). These sites, and others across the borough are also currently being investigated to assess the practciality of increasing or adding charging points.

Location	Type	Current Provision
Environmental Hub, Middlewich (ANSA)	Depot	2 Fast Chargers
Brunswick Wharf (Ringway Jacobs)	Depot	2 Fast Chargers
RJ - Macclesfield Depot (Ringway Jacobs)	Depot	
West Park (ANSA)	Depot	
Wardle Depot (Ringway Jacobs)	Depot	2 Fast Chargers
Crewe Crematorium	Depot/Destination	
Macclesfield Cemetery	Depot/Destination	
Westfields, Sandbach	Office/Destination	2 Fast Chargers
Macclesfield Town Hall	Office/Destination	2 Fast Chargers
Delamere House, Crewe	Office/Destination	2 Fast Chargers

The following locations are also being assessed to provide a strategic network of charging points for the Council's fleet during the day and for those vehicles parked overnight in town centres. However, not all of these locations will be required.

Location	Type
Sandbach Leisure Centre	Destination/Worktime
Holmes Chapel Leisure Centre	Destination/Worktime
Congleton Leisure Centre	Destination/Worktime
Macclesfield Leisure Centre	Destination/Worktime
Poynton Leisure Centre	Destination/Worktime
Wilmslow Leisure Centre	Destination/Worktime
Nantwich Swimming Baths	Destination/Worktime
Shavington Leisure Centre	Destination/Worktime
Tatton Park	Destination/Worktime
Alsager Library	Destination/Worktime
Civic Way Car Park for Middlewich Library	Destination/Worktime
Fairground Car Park for Congleton Library	Destination/Worktime
Wilmslow Library	Destination/Worktime
Knutsford Library	Destination/Worktime
Nantwich Library	Destination/Worktime
Jordangate Multi Storey Car Park	Overnight/Worktime
Crewe Multistorey/Delamere Street	Overnight/Worktime

Although these charging points will primarily be to support the conversion of the councils fleet, including the grey fleet (business travel), a number of these sites overlap with those being considered for the provision on public charge points and we will coordinate between these two workstreams as part of the next phase of feasibility, design and procurement activities.

7. EV Charging Commercial Models

This chapter details potential options for how charging infrastructure can be purchased, installed, and maintained, including funding opportunities and other considerations at delivery stage.

The long-term financial business model for recharging services relies fundamentally on the demand generated by the number of EVs in the marketplace. A successful model needs to create value both to the charge point owner (to help them make a return on their investment), and to the driver (who wishes to use the service at a price they believe is reasonable). The challenge therefore lies in balancing supply and demand to achieve an acceptable return on public investment, as well as achieving local emission reduction objectives.

Much of the UK's charging infrastructure has historically been supported by capital grants from government and provided free-to-use to drivers to encourage the conversion to EV. However, public funding is becoming less readily available and private investors require an acceptable return on their investment, which is difficult to define in this evolving market. Since it is proving difficult to change from free-to-use to fee-based charging services in some areas of the UK, it is recommended new charging facilities have a fee applied from the outset. A fee encourages consumers to recognise the value of the service and provides revenue for ongoing maintenance and operation. However, if fees are considered to be too high, this limits demand for charging services and could slow-down EV uptake, ultimately limiting emissions reduction.

Appendix D details a range of considerations that will need to be assessed in developing the preferred commercial model, and in testing the market for preferred models amongst potential operators.

7.1 Summary of UK EV Commercial Models

There is a continuous spectrum of differing commercial models that could be followed in delivering or expanding an EV charging network.

Table 7-1 outlines the key features of three models, setting out how they work and the risk implications for a Local Authority.

It is important to note that although a particular commercial model might be preferred, it cannot be known if a specific model is possible in a specific area until market research and/or an actual procurement process have been carried out.

In reality, multiple commercial models could coexist in a single Local Authority area. For instance, existing charging points from an early pilot project might remain in operation under the direct management of a Local Authority (model 1 ‘In-House Management’ below), while new charging points might be ‘purchased’ or implemented in partnership with a newly procured private-sector charging network operator (model 2 ‘Partnership’ below). Meanwhile, using private land without the approval or even the awareness of the LA, multiple private-sector network operators could build up charging networks of their own (model 3 ‘Commercially-Led’ below).

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Table 7-1 Summary of EV charging commercial models – UK

Model	Features / *Risk*
1. **In-House Management –** LA selects locations, purchases charging points and keeps any revenue	• Purchase could include installation and ongoing maintenance • OZEV grant funding could be used for residential on-street charging points • Potential to ensure equity through providing in areas of market failure. • Appropriate for workplace and fleet installations where demand is assured. • Income for the authority. • *If under-utilised, financial risk falls on the LA* • *Interoperability with other provision needs to be factored in.*
2. **Partnership / Concession –** LA leases public highway or off-street parking bays to private suppliers / operators	• Annual permit price plus possible up-front charge • Operator selects own locations and LA consults / approves / makes traffic order • LA may receive a small share of revenue from each charge point annually • Likely to be more suitable for rapid / fast chargers near key destinations • Publicly-owned car parks / land could be considered under this model • *Financial risk divested to suppliers / operators, but interested operators may be limited in some areas*
3. **Commercially-Led** – Private-sector suppliers use private land with limited or no LA involvement	• Rapid / ultra-rapid charging points purchased and installed on private property (such as petrol station forecourts, private car parks, supermarkets, highway services, etc) • Requires sufficient capacity in the electricity network • *No financial risk to LA however this approach will likely lead to gaps in provision where locations are less commercially attractive*

In the early years of UK charger deployment, the Public ownership model was favoured for slow and fast chargers due to the availability of capital funding for councils from Office for Low (now Zero) Emission Vehicles (OLEV / OZEV). However, this model left councils with an ongoing operating cost burden without the funds to support it, causing poor reliability and availability with the associated customer dissatisfaction. Recognising this, private charging suppliers began offering to cover the operation and maintenance costs if the council or private organisation paid the capital and electricity costs. In this way the council can maintain asset ownership while passing on responsibility for operation and maintenance for a fixed period, usually with the option of extension, in the supplier's contract. This requires a Service Level Agreement (SLA) with the clear requirements for maintenance response and reporting, against which performance should be monitored.

Meanwhile, Public-Private-Partnership models (PPP) were used to establish national networks of rapid chargers, led by vehicle manufacturers with some funding from the European Union and the UK government. The PPP model is now favoured by many councils for all public charging provision. This is a form of model 2 in

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Table 7-1.

The tax-payer has ultimately funded much of the UK's existing slow and fast local charging infrastructure to date, through government grants and local government funding, but vehicle manufacturers and charging suppliers have also invested in charging infrastructure. A number of charge point manufacturers, such as Podpoint in the UK and Fastned in Holland, have launched Crowdfunding schemes with some success to fund their networks. In the case of some privately-owned recharging networks such as Ecotricity's Electric Highway, revenue from other assets was used to cover the network's operation initially whilst demand was low. However, over time users have increasingly begun paying a charge for the charging service received.

7.2 Funding

The UK Government's early grants to kick-start charging deployment have reduced in recent years, and Government is keen to encourage private investors into the market. There are a number of funding opportunities that CEC can consider, as outlined in the following sections.

7.2.1 EV Charging Infrastructure Investment Fund (CIIF)

This Public-Private fund launched in 2018 provides a £200M cornerstone investment by government to be matched by the private sector. The Fund is now managed on a commercial basis by a private sector fund manager, Zouk Capital. CIIF supports faster expansion of publicly accessible EV charge points along key road networks, in urban areas and at destinations. Its intention is to increase capital invested in the sector to increase EV adoption. The fund is planned to have a 10-year life, up to March 2030.

7.2.2 OZEV's On-street Residential Charging Grant

This grant offers LAs 75% funding towards the capital costs of procuring and installing charge points for residential areas, which must be available 24/7 and have dedicated parking bays covered by Traffic Regulation Orders (TROs). The council must provide 25% match funding and cover the ongoing operating and maintenance costs. This presents an opportunity for LAs wishing to provide charging facilities in areas where off-street parking is limited.

7.2.3 OZEV's Workplace Grant

This grant is a voucher-based scheme designed to provide eligible applicants with support towards the upfront costs of the purchase and installation of EV charge points. The contribution is limited to the 75% of purchase and installation costs, up to a maximum of £350 for each socket, up to a maximum of 40 across all sites for each applicant. Although not able to be directly accessed by a local authority, promotion of this grant scheme to employers within Cheshire East could help to complement the public charging network with workplace-based charge points, thus helping to spread the demand.

7.3 Procurement options

The procurement process is an opportunity to secure the most suitable chargers for each location, customer, and function. For instance, lamppost and bollard chargers may be adequate for many residents, while ultra-rapid chargers may be required on movement corridors and fast chargers will help customers in and around town centres. Below are some options for how to go about selecting a charging point provider or set of providers.

7.3.1 Work with an existing framework contract

Crown Commercial Services (CCS) and Eastern Shires Purchasing Organisation[13] (ESPO) both have framework contracts in place that allow any UK local authority to source charging points through them. These options are worth exploring, as the time and resource requirement of carrying out your own procurement may be avoidable if the offers available from providers through these frameworks are acceptable for Cheshire East and the relevant bidders are willing to extend their provision to an additional buyer / partner. This option provides the following benefits:

- Provides access to market leading suppliers with a verified track-record in the industry
- Offers optional elements and full turnkey solutions
- Ensures compliance with UK procurement legislation
- Has direct call-off options
- Is suitable for lease or purchase of single or high-volume quantities
- Is likely to save time and financial resource compared to carrying out in-house procurement

A hybrid approach would be to carry out a mini-competition between those suppliers named on one of these contracts, which may lead to further benefits being offered by bidders particularly keen to be appointed.

An additional option would be calling off Greater Manchester's EVCI framework that is available to associate members of the Association of Greater Manchester Authorities such as Cheshire East Council. As above this would have the benefit of avoiding the costs and timescales associated with procurement however this would need to be balanced off with the negatives of having less control over the contract.

7.3.2 Undertake in-house procurement

As part of conducting a procurement process use can be made of documentation used for other past procurements by neighbouring or other similar LAs, amending for the local circumstances where necessary. Purchase and install lamppost / bollard chargers and fast chargers for residential areas, business areas and town

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[13] https://www.espo.org/Frameworks/Fleet-Highways/636-Vehicle-Charging-Infrastructure

centres, perhaps match-funded by an OZEV grant, with operation by the charger operator and some level of shared revenue. Maintenance may remain the responsibility of Cheshire East Council. There would be a low or no commitment for the chargers to remain in the location selected. Ultra-rapid chargers would potentially in future be installed along key corridors under similar agreements. Planning consent would be potentially easier to achieve, but the council would have larger up-front costs and take greater commercial risk.

7.3.3 Seek exclusive operators for each type of charger

Firms offering different types of charger can be invited to tender for exclusive operating contracts for their chosen type of charger. Cheshire East Council could request firms to offer prices for either installation, or combined installation, operation and maintenance, of new charging points, or for contracts where the provider will fund, install, operate, and maintain new charging points. Firms could be invited to choose the locations where they would like to install charging points, which effectively pushes the risk of choosing a poor location onto the operator (e.g. failing to secure planning permission or failing to achieve sufficient demand for installed chargers). There would be lower commercial risk for the council, with revenue share potentially still available. The council would likely be asked to commit to allowing the operator to use the site for a number of years, with the parking space likely to be devoted to EV charging.

7.3.4 Seek exclusive operator/s for a full charging package

One firm, or multiple firms under a lead operator, could be sought to offer all desired types of chargers for Cheshire East. The details of this approach would be similar to the previous approach, the main difference being that bidders would likely consist of consortia rather than individual providers. Again, there would be lower commercial risk for the council, with revenue share potentially still available. The council would likely be asked to commit to allowing the operator to use the site for a number of years, with parking spaces in fast charger locations likely to be devoted to EV. Firms may be attracted to this idea as they would not be competing with other firms for charging revenue and grants, but there may not be any existing examples of this model within the UK.

7.3.5 Invite interest from all suppliers

Rather than excluding some suppliers through a procurement process, the council could invite interest from any supplier who wishes to operate a charging point in Cheshire East (with proposed locations needing to go through a planning procedure and review by legal teams and the relevant DNO). A revenue-sharing agreement could be negotiated, with lower risk for the council. The council might be asked to commit to allowing the operator to use the site for several years, with the parking space likely to be devoted to EV charging. This approach is likely to require more internal resource to manage requests for new locations when compared to working with an exclusive partner or partners.

7.3.6 Revenue and rent

Where exclusive charging point parking spaces are used, firms could be charged a form of rent for parking spaces used or operate on a peppercorn lease with a revenue share agreement arranged with the council (this latter agreement may be more encouraging to private firms).

7.3.7 Choosing locations or leaving this to the provider/s

It is possible for the LA to choose the locations where its charging points would be installed in some of the options listed here, whereas other procurement and management models require this choice to be left at least partially in the hands of the operator. If operators / suppliers choose where they would like to place chargers, subject to council approval and other guidelines to be stated in the procurement documentation, this pushes the risk onto the operator but probably reduces the revenue that can be generated for the council. Alternatively, councils can choose to select all specific locations and prescribe these to the providers. The risk of the latter approach is that some providers may not be willing to take the risk of council-selected sites not leading to enough revenue or may insist on only installing and charging for the maintenance of charging points.

A hybrid approach would be to package up a number of busier (more attractive) sites alongside a number of less desirable sites so that the more popular locations help to cross-subsidise the less popular ones. The risk here is that the provider is less enthusiastic about providing additional chargers to expand the network quickly.

7.3.8 Ultra-rapid charging

If the council owns land near trunk roads through Cheshire East such as the M6 or M56, ultra-rapid chargers could be provided as part of EV forecourts at locations along these routes where energy links and capacity are good. Encouraging private investment in ultra-rapid EV infrastructure, working with business and Highways England, could be a key objective of the strategy. A planning procedure and review by legal teams may be necessary, although the risk of objections may reduce given charger locations would be out of town or at existing service stations. A revenue-sharing agreement could be negotiated. However, it is more likely that the private sector will provide ultra-rapid chargers on privately-owned land unless the council-owned land is particularly conveniently located for specific destinations where charging demand is expected to be high.

7.4 Tender evaluation

Regardless of the selected procurement option, it is critical to give importance to the tender evaluation to ensure that the scoring mechanism for the selection process rewards providers whose products help to deliver the objectives of this strategy. For instance, flexible products that can be kept up to date and easily replaced when technology improves in the future would be encouraged, whereas hard-to-use products or those that are not accessible to people of all abilities would lose points and therefore be less likely to be selected. Higher-quality products are likely to save money and time in the long run, so are worth paying more for.

Scoping the procurement process in detail should include consultation with key partners, including the DNO. It will be important for tenderers to outline how they will seek to manage the demand for charging across the day and discourage charging during peak energy consumption periods. Related to this, tenderers can be asked to outline their approach to charging (in terms of both technology and pricing), and how this benefits potential customers.

Overall, it is important to provide enough detail in procurement documentation so that tenderers know what is sought or most desired, without being so prescriptive as to eliminate all tenderers from eligibility (or interest). Flexibility allows tenderers to propose their preferred approach, and if that approach delivers the objectives of this strategy and is acceptable to the council, then the resulting partnership is more likely to be successful for both parties. Appendix D includes a list of the minimum information that should be provided to the tenderers.

7.5 Contract type

The form of contract required will depend upon the council's desired level of involvement. The following options exist:

- Where minimal in-house experience exists, a "Design and Build" contract procurement exercise could be undertaken. Here the specification contains only high-level functional details of the sites to be installed to, plus the quantity and type of charge points required.
- Where in-house technical experience is available, the specification could be far more detailed with some or all of the layout and electrical design works performed in-house and provided to the bidders.
- Alternatively, a specialist project manager could be contracted to oversee these aspects of the project, particularly where both the client and contractors have limited EV experience.

If revenue can be generated through the charging network, the contract for any partnership will need to consider the details carefully. Some examples and issues are set out in Appendix D.

7.6 Preferred Commercial Model

After consideration of the potential models available the preferred approach is one that retains an element of control over the location of sites and their operation whilst working collaboratively with the private sector to leverage investment funding and access up-to-date technologies throughout the life of a contract or concession. Engagement is due to be conducted as part of the finalising this strategy with the commercial sector to identify a detailed commercial model for deployment of infrastructure.

8. Next Steps

This strategy sets out the key recommended measures to be pursued by Cheshire East Council in supporting the creation of an effective EV charging network across the borough. The strategy seeks to consider the private sector's likely role in creating parts of this network, focusing the council's attention and resources on those aspects of the network that are unlikely to be served adequately by the private sector without guidance and a contribution of resources from the council.

8.1 Key Measures for the Short, Medium and Long Term

Along with charging infrastructure provision, there are a number of other measures that the council can pursue to help support EV uptake across the borough. Table 8 1 below outlines the potential measures that have been identified, including the timeframe within which they will be considered and pursued.

Table 8-1 Proposed sequencing of key measures

<table>
<tr><th>Measure</th><th>Short term
(0 – 2 years)</th><th>Medium term
(2 -5 years)</th><th>Longer term
(5+ years)</th></tr>
<tr><td>Providing charging points in car parks at key destinations (e.g. Town Centre, train stations, retail parks, major employment sites).</td><td>✓</td><td colspan="2" rowspan="5">Continuous monitoring of charge point usage and commercial provision to determine when / if further phases of Council-led charge points are required</td></tr>
<tr><td>Providing on-street charging points to support residents with limited access to parking provision and home charging with a focus on off-street car parks and consolidated on-street community hubs.</td><td>✓</td></tr>
<tr><td>Providing on-route charging points to serve the Major Road Network</td><td>✓</td></tr>
<tr><td>Providing off-street charging points to support residents with limited access to parking provision and home charging</td><td>✓</td></tr>
<tr><td>Introduce charge points for the Council's own fleet and grey fleet</td><td>✓</td></tr>
</table>

Measure	Short term (0 – 2 years)	Medium term (2 -5 years)	Longer term (5+ years)
Continuous engagement and joint working with the District Network Operators (Scottish Power Electricity Networks, Electricity North West, Western Power Distribution) to bring forward cost effective charge points and strategic strengthening of the power network, particularly in Macclesfield and Congleton where capacity is constrained. There is also an opportunity to investigate how distributed renewable energy solutions such as solar power may contribute to addressing power constrictions.	✓	✓	✓
Engage with taxi industry and providing charging infrastructure for taxis in convenient locations.	✓ (focusing on rapid chargers)	✓ (focusing on rapid chargers)	✓ (potential for wireless inductive chargers)
Engage with bus operators and consider providing charging infrastructure for buses.		✓	✓
Encourage and where possible support the introduction of commercially provided charging forecourts.	✓	✓	✓
Introduce charge points for HGVs should appropriate technology come forward.			✓

Chargers purchased and installed should be easily accessible, reliable and well-maintained, whilst the equipment and operating specifications will require some level of future proofing to prepare for future industry change and expansion.

EVs can contribute to reducing local emissions, but they cannot assist in reducing congestion – this is a problem in urban centres and key highways throughout the area. It is therefore important that this strategy does not encourage additional private car ownership where public transport is the sustainable transport focus. Rather, this strategy is intended to encourage the switch to EV for existing private and business car and van owners.

The proposed charger types for each priority location has considered the likely dwell time of users – i.e. rapid chargers for shorter stay destinations and fast or even slow chargers for commuter and residential locations where stays are likely to be longer. Council-owned sites such as car parks and council offices in urban and residential areas are the initial focus of this strategy, taking advantage of quick wins that are within their control, whilst encouraging private stakeholders and partners to participate in a programme of charging roll-out in the future.

For residential areas, research shows that EV drivers prefer the convenience of charging at or close to home overnight, or at work during the day. The UK Government's recent consultation on charging requirements for new residential buildings with off-street parking should be taken into account in new planning applications, although the responsibility for provision will fall onto house builders. For residential areas without off-street parking, shared publicly-accessible recharging facilities will be required. However, it is likely that more centralised locations such as car parks, which can be installed more quickly and at lower cost, represent better value for money at this stage than attempting to install a substantial network of on-street charging points.

Charging hubs in off-street locations for residential use can also perform better than on-street chargers in terms of addressing potential streetscape concerns and footpath obstructions in residential streets. Residential on-street charging facilities risk social exclusion critiscism for reallocating already limited parking spaces to EV charging bays, and incur additional enforcement costs to maintain accessibility. Residential charging hubs can take a number of different forms: multiple slow or fast chargers located in existing parking areas which are unutilised overnight, e.g. public sector buildings or schools. The aim would be to allow commuting employees to charge at these hubs during the day, with residents of nearby homes able to access them at night. As we are still in the early adopter phase, it is important to open dialog with car dealerships to understand if sales are impacted by a lack of off-street parking.

It is recommended that tariffs are applied for use of charging infrastructure. However, the details of these tariffs will be subject to many factors. Establishing a tariff up-front avoids the need to add a charge later once EVs make up a majority of the overall UK vehicle fleet. Fees may change over time, starting lower to ensure they do not create a barrier to EV adoption.

8.2 Design of charging hubs

When designing charging hubs, the following issues will be considered:

- **Site survey −** A physical survey of proposed charging sites will be carried out to ensure the location is suitable.

- **Physical space –** Enough physical space must be allocated to the charging hub to allow the chargers and electrical cabinets to be installed and maintained whilst retaining safe pedestrian access.

- **Layout –** Location and orientation of charging bays must accommodate the quantity of charger outlets proposed. Locations for each charger and feeder cabinet must be assigned to ensure the number of chargers purchased will indeed fit in the space. Underground cable routes and distances must be taken into account. All locations should be recorded.

- **Obstructions –** Any underground services, trees or existing street furniture that may cause obstructions will be identified, along with any mitigating actions.

- **Lighting –** Establish whether sufficient lighting is available to allow use of the chargers without daylight, including consideration of personal security and perceived security, with additional lighting installed if required.

- **Health and safety –** Specialist advice will be secured regarding electricity and earthing systems to ensure all installations are safe as well as compliant with relevant standards.
- **GPRS signals –** For the purposes of monitoring, maintenance and payment, it is essential that an adequate mobile signal is present at each proposed location.

The first steps in implementing this strategy are recommended to be as follows:

- Engage with key stakeholders and carry out public consultation on this strategy
- Seek funding for new charging points via government grant applications
- Carry out market testing and procurement of a delivery partner or partners
- Agree proposed priority locations with delivery partner/s once appointed
- Oversee delivery of the first tranche of charging infrastructure and monitoring usage
- Investigating and pursuing the other key measures to increase EV uptake

8.3 Stakeholder Engagement

EV stakeholders are many and varied, each with their own interests and objectives affecting the EV charging market. The council is planning to engage with stakeholders as this strategy is finalised and implemented including:

- **Vehicle users** with personal and/or business needs (including taxi and bus operators)
- **Suppliers** of equipment and charging services
- **Landowners** – promote the EV charging opportunities available to landowners through Local Authority business forums, workshops, and events
- **Electricity suppliers** – through Local Authority centralised electricity procurement
- **DNO grid operators** – Investigate localised areas of power constraint and availability before surveying proposed charging locations
- **Neighbouring LAs and Town/Parish councils** – Seek to work alongside neighbours as well as parish councils to develop a consistent strategy that works for everyone's emissions reduction objectives. Each organisation will have its own priority locations, but users are likely to span the entire area, so consistent and interoperable charging methods, access and payment tools, fees and parking arrangements are preferable.
- **Local community** – Consult with the community through the development of the strategy, share information, raise awareness, and improve understanding of the need of an EV charging infrastructure strategy.

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9. References

Limited residential off-street parking

- Data on dwelling types was gathered from dataset on https://www.nomisweb.co.uk/: **KS401EW - Dwellings, household spaces and accommodation type**

- The following dwelling types were considered to have limited off-street parking availability (i.e. likely absence of driveways and garages):

  - Whole house or bungalow: Terraced (including end-terrace)
  - Flat, maisonette or apartment: Purpose-built block of flats or tenement
  - Flat, maisonette or apartment: Part of a converted or shared house (including bed-sits)
  - Flat, maisonette or apartment: In a commercial building
  - Caravan or other mobile or temporary structure

- The total of each dwelling type was calculated for each CEC LSOA and displayed as a % of the total number of dwellings

Car ownership data / income data

- EV ownership calculation – this can be used to calculate an estimate as a number or percentage on a postcode district level

- VEH0134 (see tables VEH0134b and VEH0134c) : Licensed ultra low emission vehicles by postcode district: United Kingdom (ODS, 936KB) – used for the total numbers of ULEVs, BEVs and PHEVs

- VEH0122: Licensed vehicles by postcode district and body type (ODS, 3.27MB) – used for total number of cars in the postcode

- The numbers for relevant postcodes were converted to LSOA before plugging them into GIS

Charging point locations

- National Charge Point Registry was used for charge point coordinates

- https://data.gov.uk/dataset/1ce239a6-d720-4305-ab52-17793fedfac3/national-charge-point-registry

Distance to charge points

- https://www.gov.uk/government/statistical-data-sets/journey-time-statistics-data-tables-jts

Appendix A: Development of EV Charging Model

This appendix details how potential demand for EV charging across Cheshire East was assessed.

EV Uptake

The usage potential for any charging site will depend on a number of different factors, but the most important driver will be the total number of electric vehicles. This is not a static number, either spatially or temporally, and so it is important to develop a model which can handle both the variation in location and by the year of interest.

To understand how the vehicle fleet will transition to EVs, it is necessary to create a model for how a new technology will diffuse into an already existing fleet. The diffusion of the new vehicle models will be governed by two important characteristics.

- The rate at which new vehicles are purchased. This determines the "churn" of vehicles within the fleet overall. If few new vehicles are being purchased (due to a recession, say) then there will be a substantial slowdown in the transition to EVs as the population of vehicles is not being replaced.

- The probability of new vehicle purchases being an EV. If the fleet is to transition to EVs then the probability of each new vehicle being an EV, should increase to 100%. This is the 2030/2035 target that has been introduced by the UK government.

To answer the first question, the data for income per MSOA and the ratio of new vehicle to existing vehicle registrations was used to generate a probability of new vehicle purchase. This variable alters with income due to the strong relationship between average income and new vehicle purchase rates.

To answer the second question, a choice model was used. A choice model is a technique for providing a systematic method of choosing between multiple options, each of which may have benefits associated with it.

The form of the logit choice model used in this work is a Binary Logit Choice Model, with changing variables over the two alternatives. This form of the model allows us to calculate the probability of choosing between two distinct options available to the purchaser. The general form of this model is shown below.

$$P(C_1) = \frac{\exp(\lambda U_1)}{\exp(\lambda U_1) + \exp(\lambda U_2)}$$

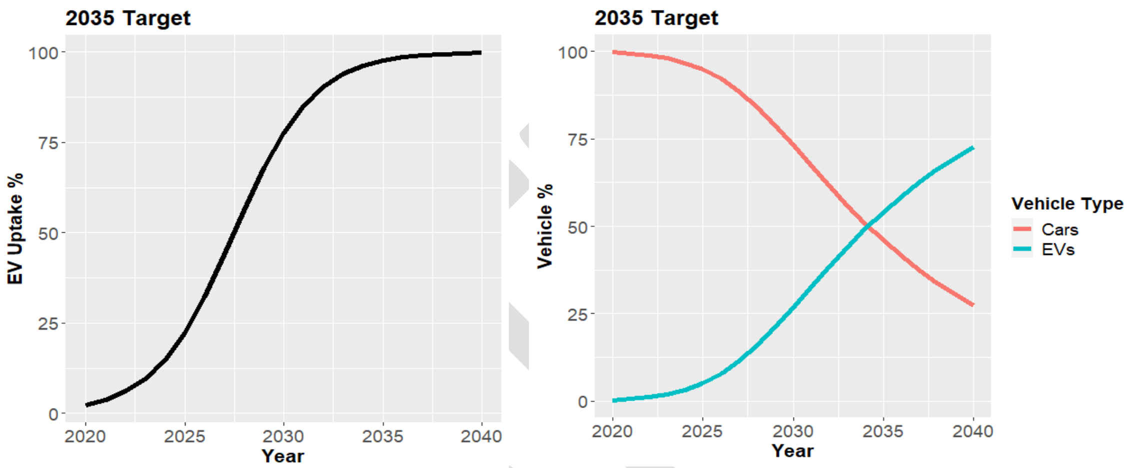
Here, C_1 represents Option 1, U_1 represents the Utility of that choice (defined below) and λ is a parameter used to determine the sensitivity to change for the utility values within the logit choice model.

The utility in this case is defined through a combination of income and EV price.

From this model it is possible to create a stock flow equation which governs the movement of vehicles into and out of the vehicle fleet.

$$Fleet_{2021} = Fleet_{2020} + New\,Vehicles_{2021} - Scrapped\,Vehicles_{2020}$$

Essentially, the fleet in 2021 is governed by the fleet in 2020 plus all new vehicles from 2021, minus those vehicles scrapped in 2020. The new vehicles will be composed of a mix of ICE and EV.



How the probability of EV uptake, plus the total fleet % varies with time

In the above graphs, we can see how the number of EVs in the fleet lags behind the 2035 goal. Even though 100% of all vehicles by 2035 will be EVs, the fleet still will only contain approximately 50% EVs.

Local Charging Potential

To understand how local charging may vary, it is necessary to include spatial variation in the model, the differing demographics across the area is used. For spatial variation in EV uptake, the two most important demographics are:

- The total number of vehicles within each OA as this determines the baseline probability of owning a vehicle. This ensures that inner city areas, with fewer vehicles in general, are not over-represented.

- The income levels of each area determine both the probability of purchasing a new vehicle, and also the probability of that vehicle being an EV due to the price differential.

The income for each area is fed into the overall EV uptake model to generate an individual EV uptake prediction for each area of interest. The total number of vehicles within each OA provides a hard cap on the number of EVs.

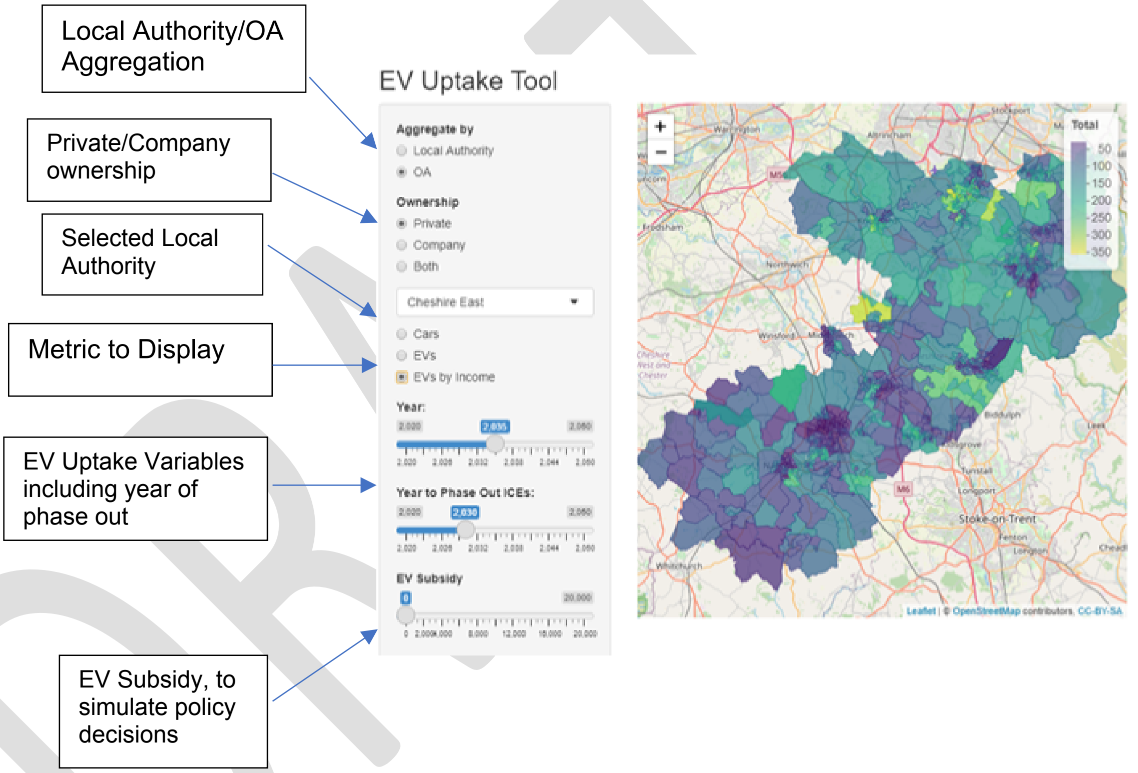
However, this simply provides the total number of EVs for each area, it does not contain any information on where we expect those electric vehicles to charge, for this we need to include information on the ability of the EVs to charge at home.

Almost all research has shown that, if given the choice, people will overwhelmingly prefer to charge their EVs at home. However, this is not possible if there is no off-street parking, and so it is also necessary to assess this capability within the model.

This has been achieved through using the house type from the census data to form a broad understanding of the dwelling type and the capacity for off street parking. For example, if most houses are detached, then we would expect more off-street parking.

This information is combined with EV uptake to form an overall assessment of public charging potential.

The model combines each of the previous elements into a single UI.



Elements of the Model

The interactive model is designed to display the data generated by the underlying model and to enable proof of concepts for each idea to be quickly tested.

For example, the above image shows the total number of EVs within Cheshire East, with the income distribution model, a 2035 phase out, no EV subsidy and for the year 2030.

Journey Charging Potential

Understanding the potential for charging within a journey, is a different and much more in-depth proposition than for localised charging. In addition to accurately assessing the general uptake and distribution of electric vehicles, it is also necessary to understand where those vehicles are going to be driving and the probability of those vehicles charging on the way.

This data will be used to generate information on each link within the Major Road Network (MRN) within the area of interest.

The basic process used to generate the traffic flow for each link is as follows:

1. Determine the shortest path between the origin-destination (OD), in terms of the road network. The shortest path has been determined by creating a graph network from the road network, and then using an A* Pathing algorithm to determine the shortest journey time between the OD pair.

2. For each OD pair, create a data point with the OD information and the full path information. This information will contain an identifier for the OD pairs which will allow us to alter the EV demographics of the OD pairs, without needing to rerun the shortest path algorithm.

3. For each network link, sum up the total number of vehicles that use this link, aggregated by the necessary factors that we believe are important in determining the propensity to charge.

From this data, it is then possible to map predicted number of vehicles, segregated by the factors that it is believe will determine the given probability of any vehicle to charge on the vehicle network.

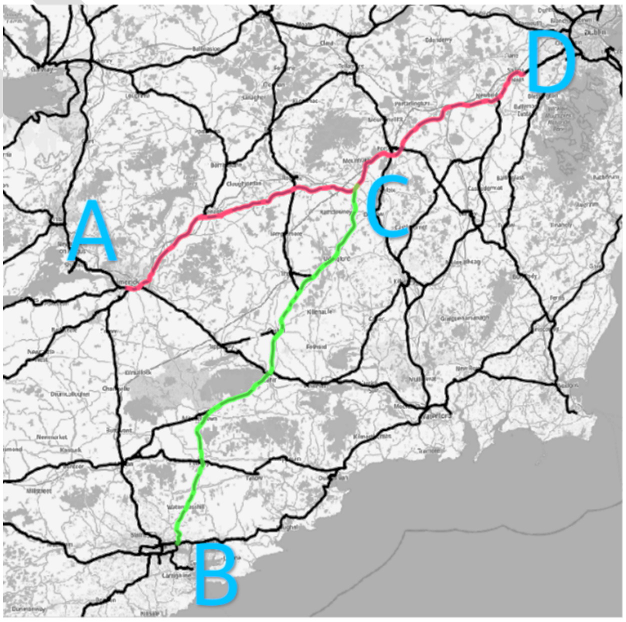
By aggregating routes derived from Origin-Destination pairs, we can derive a likely fleet population for every link on the road network

A:C Each link on this route is populated by a fleet determined by the vehicle population at A

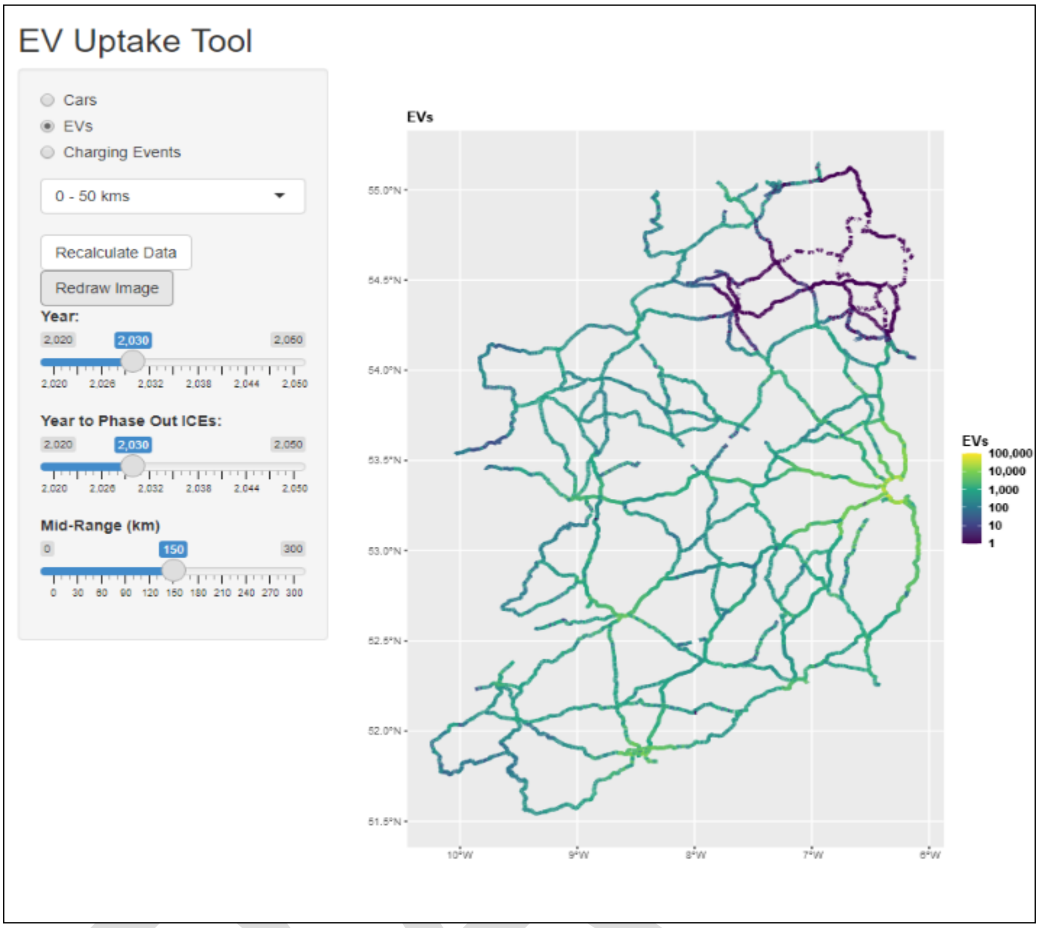
B:C Each link on this route is populated by a fleet determined by the vehicle population at B

C:D Each link on this route is populated by a fleet determined by the vehicle population at both A and B

This is replicated for each possible set of Origin-Destination pairs



A schematic of the process used to derive aggregate journey statistics



Example of Road Network Analysis

From this data, it is then possible to generate a complete picture of the number of Electric Vehicles which will be expected on any link with the network as a whole.

By connecting the network data, with the detailed origin EV uptake data, it is possible to construct a complete model of the movements of vehicles within the network.

An example of this complete network is shown above for the road network of Ireland. This particular model shows the results for all 0-50km journeys and as might be expected, the vehicle flow is more concentrated around the major population centres. If the 50-100 kms journeys were selected, then this would expand out into the connecting roads between those centres.

The data from this model feeds into understanding the potential for capturing journey charging events.

Assessing Model Outputs

It is possible to utilise the EV Uptake model to systematically create metrics which can be used to assess the suitability of different potential charge point locations.

Due to the ongoing uncertainty around all EV metrics, it was decided to assess the metrics on a purely ranking order. This would allow for a relatively easy comparison between different sites under potential different EV uptake scenarios, and also removes the necessity to decide what constitutes a “good” level of EV uptake. Each site is ranked from 0-6 with 0 representing the lowest ranked sites, and 6 the highest.

Whilst the generation of each individual metric is an objective process, the ranking and weighting of each metric is fundamentally subjective and relies upon a degree of knowledge as to the appropriate level of importance for each assessment. This is captured within the assessment longlist through the inclusion of a series of adjustable weights for each metric, allowing for a rapid iteration through the subjective assessment process whilst maintaining the objectivity of the previous metric derivations.

The data used within the assessment has been aggregated (or generated) at the LSOA level, as there is an abundance of data available at this level whilst also providing that data at the required spatial fidelity.

In addition to the directly derived model assessment outputs, we have also incorporated two manual assessments for security of location and the existence of other charge points within the area. These two assessments are more subjective than the quantitative model assessments.

Journey Assessment

Within the Journey Assessment we are assessing the potential for each site to capture charging events from vehicles which are in the middle of a journey. Essentially, this assessment is geared towards drivers who may be undertaking a longer journey who will need to stop and charge their vehicle en-route to their destination.

This will likely lead to a fundamentally different usage profile than would be expected for those using local public charging infrastructure. There would typically be a preference for rapid/ultra-rapid charge stations combined with a potentially greater willingness to pay a premium for the speed of charge.

A typical example of the sort of charge point which would service this need, would be the Braintree all electric forecourt operated by Gridserve.

The data used to generate this assessment comes from the Journey Profiling component of the model, with additional input on the likely EV uptake for the origin points generated by the EV Uptake component of the model. Due to the ranking nature of the assessment (rather than being based on an absolute value) the assessment is based on the number of EVs passing through any particular link within the assessment LSOA, rather than a direct calculate of the number of charge points.

Job Assessment

If a vehicle is going to take on a significant amount of energy, then it needs to either use a rapid charging system or remain in the same position and use a charge point with a lower capacity. In addition to when the vehicle is parked at home, the other major time when a vehicle will be stationary is when the vehicle is parked whilst the driver is at work. So, by assessing the total number of jobs within a particular area, it is possible to understand the potential level of charging demand.

However, when compared to journey charging, the typical charge point needed for employment based charging will be of a lower necessary capacity as the vehicle will remain connected to the charge point for longer.

The distribution across time for work-place charging will typically follow the arrival and departure patterns of workers, with an unmanaged charging profile peaking in the morning.

The data used to determine this is derived from the census data and as such is aggregated to the MSOA level. However, typical MSOAs will be approximately 1km across within a typical urban area and so can be used to assess charge point areas.

The metric used is the total number of jobs within each MSOA.

Retail/Leisure Assessment

In addition to work-place charging, a second possibility for longer term parking is from retail and leisure-based transport. This is parking induced by either shopping or leisure opportunities such as the cinema or sports events.

The typical dwell time for retail/leisure will be typically less than for employment based charging. Whilst the maximum dwell time could be comparable, the average and minimum time will be substantially less. There is therefore a greater opportunity for a mix of more standard, fast, and rapid chargers.

As well as the retail/leisure area being the fundamental destination, it may also be possible to use the charging area to develop a limited retail/leisure area.

The data used in this assessment was derived from the census data at the MSOA level, similarly to the Job Assessment. However, the breakdown of different employment types has been used to generate the data for Retail/Leisure compared to the general employment levels.

The metric used is the total number of Retail/Leisure jobs within each MSOA.

EV Uptake Assessment

The EV Uptake Assessment uses the raw EV numbers generated by the model, aggregated from the OA level to the LSOA level to understand how EV numbers increase across Cheshire East. Whilst it would be possible to use the OA numbers, there can be quite extensive OA variation across an LSOA.

Whilst there is an extensive amount of detail which goes into the generation of this data the fundamental metric is straightforward, it is simply the number of total EVs in each LSOA.

Whilst it would be possible to generate a more sophisticated model of EV uptake, incorporating such factors as total EVs per person, total EVs per standard vehicle etc., the level of charging necessary will be essentially entirely dependent on the raw EV total and so it is this simpler metric which is used.

The metric used is the total number of Electric Vehicles within each LSOA.

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EV Off-street Assessment

Although the total charge required within an area, will be determined by the total number of EVs, understanding the location type of chargers required, necessitates a greater degree of understanding of the metrics involved. If the EVs are concentrated within areas with extensive off-street parking then it may not be necessary to provide localised public charging, as that need will already be met privately.

Therefore, it is necessary to understand not just the total number of vehicles within each LSAO, but also the total number of dwellings without off-street parking as it is this number, when compared to the total number of EVs, which will determine the need for localised public charge points.

This information is already contained within the model, using the house type as a proxy to determine the probability if a particular house has on or off street parking.

The metric used is the number of Electric Vehicles per Off-Street parking space within each LSOA.

Security of location

The Security of Location is a metric designed to look at the general safety/security of each charge point, with particular consideration given to the perceived safety of the user rather detailed statistics about the actual level of potential risk within the area.

This metric does not consider the potential for accidents within the site.

The assessment was performed through a combination of Google Street View searches plus satellite imagery to identify possible issues which may lead to either a greater confidence in the site or be a cause for concern. For example, a site which is well lit and in full view of offices is likely to be of perceived greater security than a dark charge point which is hidden from view.

The metric is an individual assessment for each charging point, rather than at the LSOA level.

Charging Conflicts

The final assessment looks at the potential for conflicts with existing or planned future charge points. This is an important assessment as an area which is highly rated in other aspects, may not actually need a charge point if there is already sufficient provision within the local area.

For example, in Wilmslow the South Drive Short Stay car park scores incredibly highly across all the potential assessments and so would be an ideal place for a charge point. Unfortunately, there is already an existing rapid charge point within the car park itself.

This is an assessment criterion which will require careful weighting as the existence of current charge point does not necessarily preclude the installation of an additional charge point, particularly if the current charge point is well used.

Similarly, to security, the metric used is a manual assessment for each potential location rather than at the LSOA level.

Combining Model Assessments

After each location has been assessed, both through the model and through the manual assessment process, the scores are combined within an Excel Spreadsheet. This allows for the weighting to be directly applied to the scores and adjusted in-situ. A typical example of this is shown in the table below.

An example of the scoring system used within the assessment

Weighting							
1	1	1	1	1	1	1	
Journey Assessment	Job Assessment	Retail/ Leisure Assessment	EV_Assessmen t	EV_Offstreet_A ssessment	Security of location	Charging Conflicts	Score
1	4	4	5	5	5	0	24
1	4	4	5	5	4	3	26
1	4	4	5	5	4	3	26
1	4	4	5	5	2	3	24
1	4	4	5	5	4	2	25
3	4	4	1	0	3	5	20
3	2	4	0	1	2	1	13

The final score is then used to perform the initial assessment of the potential charge point sites.

Appendix B. EV Charging Point Long List – Car Parks and On-Street Areas

Overall Rank	Car Park	Town	Town Rank	Capacity (spaces)	Type of Settlement	DNO Supplier	Jobs Assessment	Retail/Leisure Assessment	Highest Destination Score	EV Off-street Assessment	Journey Assessment	EV Assessment	Security of location	DNO Capacity	Charging Conflicts	Score	Charger Type/s
1	Spring Street	Wilmslow	1	308	Key Service Centre	ENW	4	5	5	5	5	5	5	4	1	30	Rapid + Fast
=2	Exchange Street	Macclesfield	=1	107	Principal Town	ENW	5	5	5	5	4	3	5	2	5	29	Rapid + Fast
=2	Gas Road	Macclesfield	=1	45	Principal Town	ENW	5	5	5	5	4	3	5	2	5	29	Rapid + Fast
=2	Railway Station	Macclesfield	=1	57	Principal Town	ENW	5	5	5	5	4	3	5	2	5	29	Rapid + Fast
=2	Pickford Street	Macclesfield	=1	110	Principal Town	ENW	5	5	5	5	4	3	5	2	5	29	Rapid + Fast
=2	The Carrs	Wilmslow	2	60	Key Service Centre	ENW	4	5	5	5	5	5	2	4	3	29	Rapid + Fast
=7	Duke Street	Macclesfield	5	261	Principal Town	ENW	5	5	5	5	4	3	4	2	5	28	
=7	South Drive Short Stay	Wilmslow	3	330	Key Service Centre	ENW	4	5	5	5	5	5	5	3	0	28	Rapid + Fast
=7	Broadway Meadow	Wilmslow	4	100	Key Service Centre	ENW	4	5	5	5	5	5	4	3	1	28	Rapid + Fast
=7	Sunderland Street	Macclesfield	6	40	Principal Town	ENW	5	5	5	5	4	3	4	2	5	28	
=7	Waters Green	Macclesfield	7	42	Principal Town	ENW	5	5	5	5	4	3	4	2	5	28	
=7	Town Hall	Macclesfield	8	80	Principal Town	ENW	5	5	5	5	4	3	4	2	5	28	
=13	Leisure Centre	Wilmslow	5	100	Key Service Centre	ENW	4	5	5	5	5	5	2	4	1	27	
=13	Princess Street	Knutsford	1	54	Key Service Centre	SPEN	4	4	4	5	1	5	4	5	3	27	Rapid + Fast
=13	Fairground	Congleton	=1	97	Key Service Centre	WPD	5	5	5	4	5	3	4	5	1	27	Rapid + Fast
=13	Rex/Hoopers	Wilmslow	6	132	Key Service Centre	ENW	4	5	5	5	5	5	2	4	1	27	

Overall Rank	Car Park	Town	Town Rank	Capacity (spaces)	Type of Settlement	DNO Supplier	Jobs Assessment	Retail/Leisure Assessment	Highest Destination Score	EV Off-street Assessment	Journey Assessment	EV Assessment	Security of location	DNO Capacity	Charging Conflicts	Score	Charger Type/s
=13	Antrobus Street	Congleton	=1	84	Key Service Centre	WPD	5	5	5	4	5	3	3	5	2	27	Rapid + Fast
=13	Back Park Street	Congleton	=1	98	Key Service Centre	WPD	5	5	5	4	5	3	2	5	3	27	Rapid + Fast
=13	Victoria Centre	Crewe	1	482	Principal Town	SPEN	5	5	5	5	3	3	5	3	3	27	Rapid + Fast
=20	Civic Hall	Poynton	1	204	Key Service Centre	ENW	3	4	4	4	1	4	5	3	5	26	Rapid + Fast
=20	Christchurch	Macclesfield	9	82	Principal Town	ENW	5	5	5	5	4	3	2	2	5	26	
=20	South Street	Alderley Edge	1	47	Local Service Centre	ENW	1	3	3	5	2	5	4	2	5	26	Rapid + Fast
=20	Whalley Hayes	Macclesfield	10	258	Principal Town	ENW	5	5	5	5	4	3	3	1	5	26	
=24	Princess Street	Congleton	4	90	Key Service Centre	WPD	5	5	5	4	5	3	3	5	0	25	Rapid + Fast
=24	Booths Knutsford	Knutsford	2	261	Key Service Centre	SPEN	4	4	4	5	1	5	5	3	2	25	Rapid + Fast
=24	Springfields	Prestbury	1	61	Local Service Centre	ENW	1	2	2	4	4	5	4	1	5	25	Rapid + Fast
=24	Community Centre	Disley	1	40	Local Service Centre	ENW	0	2	2	5	2	5	4	2	5	25	Rapid + Fast
=24	Delamere Street	Crewe	2	99	Principal Town	SPEN	5	5	5	4	3	3	2	5	3	25	Rapid + Fast
=29	Commercial Road	Macclesfield	11	59	Principal Town	ENW	4	3	4	4	3	3	3	2	5	24	
=29	South Drive Long Stay	Wilmslow	7	45	Key Service Centre	ENW	4	5	5	5	5	5	1	3	0	24	
=29	Tatton Street	Knutsford	3	144	Key Service Centre	SPEN	4	4	4	5	1	5	4	2	3	24	Rapid + Fast
=29	Shirleys	Prestbury	2	61	Local Service Centre	ENW	1	2	2	4	4	5	3	1	5	24	Fast only

Overall Rank	Car Park	Town	Town Rank	Capacity (spaces)	Type of Settlement	DNO Supplier	Jobs Assessment	Retail/Leisure Assessment	Highest Destination Score	EV Off-street Assessment	Journey Assessment	EV Assessment	Security of location	DNO Capacity	Charging Conflicts	Score	Charger Type/s
=29	Westfields	Sandbach	1	95	Key Service Centre	SPEN	2	4	4	2	3	3	3	5	4	24	Rapid + Fast
=34	King Street	Knutsford	4	125	Key Service Centre	SPEN	4	4	4	5	1	5	4	1	3	23	Rapid + Fast
=34	London Road	Holmes Chapel	1	32	Local Service Centre	SPEN	2	2	2	3	2	3	3	5	5	23	Rapid + Fast
=34	Snow Hill	Nantwich	1	247	Key Service Centre	SPEN	5	5	5	3	0	4	4	4	3	23	Rapid + Fast
=34	Cheshire Street	Audlem	1	59	Local Service Centre	SPEN	0	2	2	0	4	3	3	5	5	22	Rapid only
=34	Chapel Street	Sandbach	2	100	Key Service Centre	SPEN	2	4	4	2	3	3	3	3	4	22	Rapid + Fast
=39	Fairview	Alsager	1	288	Key Service Centre	ENW	2	3	3	3	1	4	0	5	5	21	Rapid + Fast
=39	West Street	Congleton	5	216	Key Service Centre	WPD	5	5	5	2	5	3	2	3	1	21	
=39	Scotch Common	Sandbach	=3	140	Key Service Centre	SPEN	2	4	4	1	3	3	4	2	4	21	Rapid only
=39	Brookhouse Road	Sandbach	=3	147	Key Service Centre	SPEN	2	4	4	1	3	3	2	4	4	21	Rapid only
=43	Station Road	Alsager	2	60	Key Service Centre	ENW	2	3	3	4	0	5	2	1	5	20	Rapid + Fast
=43	Civic Way	Middlewich	1	84	Key Service Centre	SPEN	4	4	4	0	3	3	3	2	5	20	Rapid only
=43	Civic Centre/Library	Crewe	3	89	Principal Town	SPEN	5	5	5	4	3	3	0	5	0	20	Rapid + Fast
=46	School Road	Handforth	1	48	Key Service Centre	ENW	3	3	3	3	0	2	4	4	3	19	Rapid + Fast
=46	Pool Bank	Bollington	1	71	Local Service Centre	ENW	2	2	2	5	0	3	2	2	5	19	Rapid + Fast
=46	Love Lane	Nantwich	2	124	Key Service Centre	SPEN	5	5	5	2	0	4	3	5	0	19	Rapid + Fast
=46	Thomas Street	Congleton	6	46	Key Service Centre	WPD	2	3	3	0	3	3	3	5	2	19	

Overall Rank	Car Park	Town	Town Rank	Capacity (spaces)	Type of Settlement	DNO Supplier	Jobs Assessment	Retail/Leisure Assessment	Highest Destination Score	EV Off-street Assessment	Journey Assessment	EV Assessment	Security of location	DNO Capacity	Charging Conflicts	Score	Charger Type/s
=46	Wrexham Terrace	Crewe	4	102	Principal Town	SPEN	2	5	5	1	3	3	2	3	2	19	
=51	Wilmslow Road	Handforth	2	56	Key Service Centre	ENW	3	3	3	3	0	2	2	5	3	18	Rapid + Fast
=51	Civic Hall	Nantwich	3	151	Key Service Centre	SPEN	4	4	4	2	0	4	4	3	1	18	Rapid only
53	Chapel Street	Congleton	7	52	Key Service Centre	WPD	5	5	5	1	1	3	2	3	2	17	
On-street areas (scores for on-street areas only used off-street assessment, EV assessment and charging conflict criteria)																	
1	East of Town Centre	Alderley Edge	N/A	On Street	Local Service Area	ENW				5		5			5	15	Slow / Fast
2	Town Centre	Wilmslow	N/A	On Street	Key Service Area	ENW				5		5			4	14	Slow / Fast
3	Town Centre	Macclesfield	N/A	On Street	Key Service Area	ENW				5		3			5	13	Slow / Fast
=4	North East of the Town Centre	Alsager	N/A	On Street	Key Service Area	SPEN				3		4			5	12	Slow / Fast
=4	Town Centre	Nantwich	N/A	On Street	Key Service Area	SPEN				4		4			4	12	Slow / Fast
=4	North of Town Centre	Knutsford	N/A	On Street	Key Service Area	SPEN	Not assessed for residential chargers			4	N/A	5	For later assessment		3	12	Slow / Fast
=7	North and East of Town Centre	Holmes Chapel	N/A	On Street	Local Service Area	SPEN				3		3			4	10	Slow / Fast
=7	Town Centre	Handforth	N/A	On Street	Key Service Area	ENW				5		2			3	10	Slow / Fast
9	Town Centre	Congleton	N/A	On Street	Key Service Area	WPD				2		3			4	9	Slow / Fast
10	Town Centre	Sandbach	N/A	On Street	Key Service Area	SPEN				1		3			4	8	Slow / Fast
11	Town Centre/East/South	Crewe	N/A	On Street	Principal Town	SPEN				1		3			2	6	Slow / Fast

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Appendix C. Building Regulations Consultation

Over the summer of 2019, the UK government, under the provisions of the Automated and Electric Vehicles Act (AEVA), consulted on how to adopt the EU's EPBD into UK law. The EPBD sets out requirements for the minimum provision of charging infrastructure in new and existing residential and non-residential buildings. The outcome of this consultation is yet to be announced but will likely impact the requirements for provision of EV charging infrastructure within Cheshire East.

A summary of the consultation proposals is provided in **Error! Reference source not found.**. The proposals for non-residential buildings are intended to ensure that existing and new key destinations and workplaces are able to accommodate growing EV volumes. The proposals for residential buildings aim to increase the likelihood of homeowners purchasing ULEVs by updating the Building Regulations to require EV charging infrastructure in all new homes, where appropriate.

UK Government Consultation Proposals for EV Charging Provision in Residential and Non-Residential Building

UK Government's Consultation Options			
Requirement	**Residential New Buildings**	**Non- Residential New Buildings**	**Non- Residential - Existing Buildings**
Charge points	At least 1 Charge point (min 7kW) for all parking spaces	1x Charge point for each new or majorly renovated non-residential car park with >10 spaces	1 x Charge point installed for every non-residential car park with >20 spaces
Ducting	Ducting for all parking spaces	Ducting for one in 5 parking spaces for each new or majorly renovated non-residential car park with >10 spaces	No additional ducting
Timing	From date regulation comes into force	From date regulation comes into force	By 1st Jan 2025

Appendix D. Revenue Generation Options

Many PIV owners and drivers compare the fees levied for public charging services against their home electricity tariff to assess value for money. They also consider the comparative charging cost against ICE refuelling cost, since most PIV drivers have chosen the PIV to replace an ICE for the expected reduction in operating cost, as well as for environmental reasons. Therefore, PIV charging tariffs must be chosen carefully to reflect the relative convenience of the service on offer.

Public charging costs currently vary between network operators, and also by charge point type and membership/PAYG schemes. Some operators still provide free charging services, whilst others charge by duration (per hour), although most drivers favour pricing per unit of electricity received (kWh). Many operators now charge a fixed connection fee in addition to their per kWh tariff. Some operators offer membership schemes with monthly fees attracting low per kWh rates, although most also offer a pay as you go (PAYG) facility in line with current UK Government capital funding requirements. Some examples of current offerings by leading players in the UK EV Charging market are provided in Table 9-1 below.

Table 9-1 Examples of EV Charging Network Offerings October 2019

Network Operator	Charger Type	Fees / kWh	Other Fees
POLAR	Slow, fast, rapids	12p/kWh	Subscription = £7.85/month Most chargers free to use
Electric Highway	Rapids	39p/kWh	19p/kWh for Ecotricity home energy customers
Shell Recharge	Rapids	39p/kWh	30p/kWh through Shell Recharge App
Genie Point	Fast, rapids	30p/kWh	£1 or 50p connection fee for Rapid/Fast chargers. £10 overstay fee > 4 hours. Higher fees inside London.
Charge Your Car (CYC)	Slow, fast, rapids	Various from FREE	£1 connection fee. Recharging fees set by each charge point owner – flat fee OR per kWh, overstay etc.

Tariffs should reflect the perceived benefits of the charging service being provided (convenience, reliability, availability, and price) to ensure use, so great care must be taken to set fees which are acceptable to PIV drivers. These vary depending upon the perceived value of the charging service provided. Typically, lower fees are charged for slow and fast charging services, than for rapid services. In recognition of the higher value associated with the rapid use case, network operators tend to charger higher fees for rapid charging, the highest price currently being charged in the UK is 39p/kWh for rapid.

The results of a 2018 study of the North East Combined Authority's EV charging estate are useful in providing some examples of potential charging network revenue. Using the total electricity delivered in 2018, we calculated the revenue if users had been charged at a comparative level to UK home electricity prices i.e. charging fees =15p/kWh. This fee would have produced a revenue of £72,284 over the period.

Regular revenue from charging services could clearly assist the charging network owner in maintaining, growing, and upgrading the charging network to meet future demand and technical capabilities.

Further examples of potential revenues are provided for illustration purposes in Table 9-2, at a range of public charging tariffs. This revenue must be sufficient to cover the ongoing operating costs of power, land lease, maintenance, operation, customer service and any network development requirements to meet customer needs, which should grow as PIV uptake increases.

Table 9-2 Potential EV Charging Revenues (for illustration only)

Potential electricity revenues			**Electricity tariffs/kWh**				
2018 Use	**Average Energy (kWh)**	**Number of Charge Events**	**14p**	**25p**	**30p**	**35p**	**40p**
Fast chargers	7.66	29,774	£34,210	£57,017	£68,421	£79,824	£91,228
Slow chargers	7.77	4,402	£5,131	£8,551	£10, 261	£11, 971	£13,681
Rapid chargers	9.53	23,045	£32,943	£54,905	£65,886	£76,867	£87,848
Revenue			£72,284	£120,473	£144,567	£168,662	£192,756

One alternative commercial model is for the LA to require the network operator to pay all OPEX costs, taking responsibility for the costs of powering, operating, and maintaining the network and therefore setting an appropriate fee with the LA's agreement, and the network operator then makes a payment per transaction back to the LA. If a p/kWh payment from each charging transaction was required, this would result in the following example revenue based on 2018 use:

- @ 1 p/kWh - Revenue = £ 4,817
- @ 2 p/kWh - Revenue = £ 9,634

Alternative means of generating revenue could include charging for parking and other services whilst recharging a PIV. If parking charges are introduced at most fast and slow public locations this may provide a greater revenue than the pence per transaction model. The duration of fast and slow charging events often reflects the duration of parking rather than the energy delivery period, so this would provide recompense for the parking service being provided as well as the charging service. Combined fees can be levied by the network operator, recompensing the parking operator accordingly.

It is therefore recommended that appropriate fees are agreed with the procured network operator, varying by charger type and potentially by location.