Warrington electric vehicle strategy

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WARRINGTON
Borough Council

Warrington Electric Vehicle Strategy

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Non-technical summary

Introduction

This strategy is intended to provide an evidence base for the identification of strategic locations for electric vehicle (EV) chargepoint installation in Warrington. It also considers the best method of delivery for that EV infrastructure.

This strategy helps identify demand for EV charging infrastructure at a borough level. This follows on from the Council's declared Climate Emergency in 2019 and seeks to reduce greenhouse gas emissions to levels which are consistent with the allocated carbon budgets for the borough of Warrington, and to achieve net zero carbon emissions by 2050.

This non-technical summary provides a short, accessible summary of the strategy, avoiding the use of technical language as much as possible. For detailed information and a fuller understanding of the strategy please review the full document. A list of key acronyms and definitions is set out in Table 5 at the end of this non-technical summary.

Through engagement with stakeholders and review of relevant data, strategies, and policies the following objectives of the strategy were defined:

- Reduce carbon emissions in Warrington in line with WBC's declaration of a climate emergency.
- Improve air quality levels in line with the Air Quality Management Strategy.
- Align with the LTP4 ambition to reduce single occupancy journeys (particularly for shorter journeys) and move towards an integrated transport network.

These objectives were used to guide option development and appraisal based on the national and local evidence base.

Strategy and Policy

There are many policies and strategies at international, national, regional, sub-regional and local levels that are creating an increasingly supportive framework for the transition to EV in Warrington. Key examples of these polices are:

- International and National
  - COP26 and policy from the European Union that the UK has adopted such as the Directive for Alternative Fuels Infrastructure requires Governments to adopt national policy frameworks for infrastructure roll-out
  - UK Government's ultimate vision is that every new car and van sold in the UK will be either PHEV (Plug-In Hybrid) or BEV (Battery Electric Vehicle) by 2030
  - Taking charge: the electric vehicle infrastructure strategy (2022) – to support the rollout of chargepoints across the UK
  - Department for Transport (DfT) Decarbonising Transport: A Better, Greener Britain (2021) – Presents the path to net zero transport in the UK by 2050, the wider benefits it can deliver, and the principles that underpin the approach to delivering it
- Regional
  - TfN Strategic Transport Plan (2019) – Outlines the case for transformational transport investment across the North
  - TfN West and Wales Strategic Development Corridor (2017) - looking at improving connections for people and businesses
- Sub-regional
  - Cheshire & Warrington Energy and Clean Growth Strategy – sets out the energy challenges facing the sub-region
- Local
  - Warrington Air Quality Action Plan (2017-2022) – outlines the actions that WBC will deliver between 2017 and 2022 to reduce concentrations of nitrogen dioxide within the two designated Air Quality Management Areas (AQMAs).
  - Declared Climate Emergency (2019) – the Council declared a climate emergency in June 2019 and resolved that by 2030 it would be carbon neutral in its operation and activities

- Warrington Local Transport Plan 4 (2019) – the current Local Transport Plan for Warrington identifies EVs as an area to develop during the period of the plan as part of an integrated and sustainable transport network.
- Warrington Means Business Strategy (2017) – Warrington's economic growth and regeneration programme including outlining areas for economic growth and redevelopment which creates opportunities for introducing EV charging within new developments
- Green Energy Strategy (2020) – provides details of the Council's goals, plans and projects and how such work will be approached in future and the Council's targets met. The strategy highlights the importance of EVs in Warrington
- Warrington Climate Emergency Strategy July 2022 – aims to mobilise people and organisations in Warrington to all play their part to address the climate crisis. The strategy includes support for actions which help the uptake of EVs.
- Electric Vehicle Taxi Strategy (2022) – Sets out Warrington's strategy to increase awareness and uptake of EVs by Hackney Carriage and Private Hire Taxis

Evidence base and analysis

EVs are currently the only mature technology offering a workable alternative to ICE vehicles; however, uptake in the UK is still somewhat limited. Generally, uptake is led by relatively affluent, and environmentally conscious, buyers who are keen to:

- Adopt new technologies;
- Reduce their personal transport impacts; or
- Purchase an EV for tax reasons/ company policy.

Early research shows that EV consumers preferred 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.

National Picture and Challenges

There is still a low national population of BEVs (395,260 end of 2021), which represents 1.07% of the UK car population, and indicates that the UK is still at the 'early majority' stage (the group of people that generally adopt new ideas before the average but are not leaders in doing so). There was a clear increase in the number of BEV sales during 2021, but this only accounted for 190,727 out of approximately 1.65 million vehicles sold that year.

There are also challenges to the uptake of electric vehicles emerging at the global, and national level. There is a limit to the mitigation that Warrington Borough Council can put in place for this, set out in Table 1

Table 1. Potential Opportunities for Local Authorities to Address Challenges

Challenge	Potential for WBC influence	WBC Mitigation
Plug-In Vehicle (PIV) production	None	None
Battery production	None	None
Micro-chip availability	None	None
Chargepoint technology	Partial	Infrastructure strategy should consider future EV models and their battery systems to determine the type of chargepoint to install.
Vehicle charging costs	Mostly	The tariffs imposed on public infrastructure can play a part in how frequently a post will be used. There is a need to compare tariffs with the private sector in your area and neighbouring Local Authority tariffs.
Residential charging for households with no off-street parking	Largely	Develop a clear approach to on-street chargepoints in residential areas with no or limited off-street parking.

Types of Chargepoints

Slow, fast, rapid, and high-power chargers suit different locations and charging behaviours. Slow and fast chargers suit destination charging patterns, where the driver looks to recharge at a location that they will be leaving the car for a considerable amount of time. Rapid and high-power chargers' suit on-route charging, quick recharging at destinations, and support the taxi and delivery/ logistics (LGV only) trades due to their high-speed capabilities.

There are many specifications of chargepoint in the market, differentiated by power output, communication protocol, type, and number of charging locations (see Table 2). They can typically be installed mounted onto a wall or as free-standing units in the ground. PIV cars and light vans are supplied with a charging cable used to connect the vehicle to slow or fast chargepoints. Charging cables are typically supplied with a Type 2 plug to connect to slow and fast chargepoints in the UK. Charging cables are also available fitted with standard UK three-pin plugs, which are intended for infrequent use where Type 2 charging solutions are not available. 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.

Table 2. Chargepoint Types

Chargepoint Types	Power Output (kW)	Charging Duration (40kW battery)	Use Cases
Slow	<7	13 hours	Destinations
Fast	7 – 22	2 to 5 hours	Destinations
Rapid	43 – 50	30 minutes to 80%	On-route
High Power	100	TBC depending upon vehicle	On-route

The EV industry has seen substantial technological development in recent years, this is exemplified by the ongoing development of induction charging. Induction charging transfers electricity 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. Most of the major vehicle (car) manufacturers have stated that they are likely to offer wireless charging capability in the future, but none currently have definitive plans to do so.

Electric Vehicles in Warrington

1,491 plug-in cars and vans were registered in Warrington by December 2021 equating to 1.22% of all cars and vans registered in the area, which is below the UK national average of 1.9%. Lack of off-street parking spaces in residential areas presents a particular problem, limiting the ability of PIV drivers to recharge their vehicles at home and suggesting the need for more public charging facilities in areas with a high percentage of homes without off-street parking. Warrington's terraced/flats housing stock figure is lower than the national average, and when coupled with its below average Gross Disposable Household Income (GDHI) this suggests overall demand to be relatively low in the near term, however there are likely to be some early adopters and there will be a need to support these residents, as well as to help accelerate growth in the medium and long term.

The housing stock and relative affluence/ deprivation of Warrington will influence EV uptake within the Borough. It is likely that residents of flats and terraced properties have limited access to off-street parking and would therefore require on-street chargepoints or alternatives in suitable parking locations close to home.

Relative levels of deprivation can also have a bearing on EV uptake. Currently, the cost of an EV and the associated infrastructure is relatively high and therefore uptake in these areas of higher deprivation may not be strong in the near term whilst there is still a price premium on these vehicles. Conversely in more affluent areas uptake of EV is likely to be stronger.

Electric Bus

Most UK bus fleets use diesel powered ICE buses contributing to the poor air quality in urban areas, so the Bus Services Act 2017 encourages LAs and the bus industry to work together to achieve economic, environmental and social objectives for their communities.

Battery electric buses offer zero-emission, quiet operation, better acceleration, higher energy efficiency and lower cost of ownership compared to traditional ICE buses. For both fleet vehicles and buses the charging times must match the stationary opportunities that exist within the operating schedule, to minimise lost revenue. Maintaining the same number of buses, the same trip schedule, same number of drivers etc is paramount in ensuring that moving to electric does not negatively impact the existing operating model and business case.

Charging Infrastructure

A range of key factors can influence charging demand in different areas as outlined in the evidence base, including the number of origins and destinations, key traffic routes, areas of car parking provision and areas with high residential densities. Existing charging infrastructure is located in various destination areas such as the town centre (Times Square car park), Warrington Bank Quay station car park (for onward travel), and retail areas such as Asda and IKEA. There are however large sections of the Borough that do not have any publicly accessible chargepoints.

The main destination areas comprise of employment, retail and major transport hubs. These areas are predominantly located within the town centre and along the M62 corridor. To the north-east Birchwood Park is a major employment site and to the north-west is IKEA and Gemini Retail Park. In addition, employment sites with available parking provide an opportunity for charging during the day and perhaps overnight if close to residential areas so slow or fast chargers would be suitable.

The surrounding highway network of Warrington town centre includes key routes such as A56, A50, A49 and A57 as well as strategic connections via the M62, M6 and M56 motorways. The travel to work analysis shows there are significant commuter movements along these links and potential demand for rapid chargepoints at service stations and along key links.

WBC recently made a successful Zero Emission Bus Regional Area (ZEBRA) bid to replace all 120 of its diesel buses with brand new electric buses. Independent of ZEBRA funding a new bus depot is already planned to be built with funding and planning consent already in place. The successful ZEBRA bid will now see the new depot equipped with electric vehicle charging infrastructure and housing a new fleet of zero emission buses.

The potential locations for charging infrastructure are shown in Table 3 according to their suitability for the various use cases. A more detailed site assessment is considered below.

Table 3. Potential Charging Infrastructure Locations

Potential charging infrastructure locations	Use Cases				
	Areas with limited off-street parking / car clubs	Destination	Taxis	On-route	Buses
Locations in the vicinity of Warrington Bank Quay station					
On-street charging within town centre (locations to be confirmed)					
On-street charging within residential areas outside of the town centre (locations to be confirmed)					
Rapid charging along main arterial routes					
Off street town centre car parks					
Supermarkets with car parking provision					
Warrington Interchange					
New bus depot, Dallam Lane					

Warrington has recently been successful in a Low Emission Vehicle Infrastructure (LEVI) bid which has secured an award of £695,000 funding from Government for around 150 on street chargers and 4 rapid charging hubs across the borough. The delivery of this infrastructure will require a range of actions to be taken, including:

- procurement of commercial partner and delivery model;
- stakeholder and public engagement;
- site identification, surveys and audits;
- design, installation and monitoring.

Future Demand

The usage potential for any charging site depends on many different factors, but the most important is the total number of EVs. This is not a static number, either spatially or by time of day because demand can vary hour-by-hour depending on travel patterns.

Despite the switch for new vehicles to 100% ULEV by 2030 and the subsequent switch to 100% BEV by 2035, it will still be many years until most vehicles within Warrington will be EVs. However, the 50% cross-over point is predicted to occur at some point between 2030 and 2035. The greatest rate of change for EV uptake is forecast between 2025 and 2035. After this period, the general distribution is largely settled.

Generally, when considering EV uptake, most of the focus is on the purchase of new EVs. However, the final distribution of those vehicles (such as where they are parked at night, where they are parked during the day, who owns them etc.) will also be determined by the second-hand market. Data on second-hand purchases of EVs is difficult to obtain. As current levels of EV ownership are relatively low, the probability of those EVs being sold is even lower. However, in the future this could be a key market in deprived areas of Warrington due to affordability and sales of nearly-new vehicles.

Key points identified through EV forecasting for Warrington are:

- EV uptake will be greater in urban areas, and more specifically that the density of EV uptake will be much higher.
- Most EV uptake will take place between 2025 and 2035 because of Government policy.
- Areas of lower-density population areas show a much higher ratio of long-range trips for commuting.
- It is important that the correct type of charger is installed in the correct places.

Commercial Models

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 chargepoint 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). Key commercial models are:

- Model 1: Local Authority in-house management
- Model 2: Partnership/ concession of the local authority and a private operator
- Model 3: Commercially led, with no local authority involvement

Much of the UK's charging infrastructure has been supported historically by capital grants from Government. These grants provided free-to-use infrastructure 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.

Because 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.

It is possible for the local authorities to choose the locations where its chargepoints would be installed in some of the commercial models. 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, this pushes the risk onto the operator but. reduces the opportunity to meet policy aims in WBC such as delivering an equitable and balanced network. 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 UK Government's early grants to kick-start charging deployment have reduced in recent years to encourage private investors into the market. There are several funding opportunities that can be accessed by WBC or local businesses. WBC has already successfully secured funding through the ZEBRA grant, the On-street Residential Charging Scheme (ORCS) and the Local Electric Charging Infrastructure (LEVI) schemes.

Site Assessments

Site assessments were undertaken to review potential sites for future chargepoint installation by WBC. A longlist of sites considering off-street car parks and key destinations was reviewed. These were initially based on the draft version of this strategy, and was supplemented by additional locations to ensure a good geographic spread across the borough and a good variety of site types (e.g. commercial and leisure). The shortlisting process was therefore focused on determining where the greatest impact is likely to be achieved from chargepoint installation.

Once the longlist of sites had been developed, assessments were conducted using output from an EV Forecasting Model against likely demand for residential, on-route and destination EV charging. The longlist was scored to and filtered to a shortlist based on assessment scores and achieving a geographical balance. It is recommended that those sites not included on the shortlist are kept under review for delivery in the medium to long term in line with demand, or through ad hoc opportunities. The shortlist scoring criteria incorporated; Destination Charging Potential, On-Route Charging Potential, Residential Charging Potential, Feasibility of Power Connection, Commercial EV Charging Conflict, Security of Location, EV Uptake.

The shortlist review also included feasibility assessments including liaison with the Distribution Network Operators within the borough (Electricity North West and Scottish Power Energy Networks). The shortlisted sites are set out in the main report (section 9). They will, in the first instance, be used to inform the delivery process for the successful LEVI bid. This will require more detailed site by site assessments, thorough engagement and procurement processes to be taken forward before the final list of sites for implementation can be confirmed.

Future Programme of Work

The strategy has identified a wide range of areas where the council could take action to support the move to a greater use of electric vehicles, by the council itself, its residents and businesses and visitors. Table 4 sets out these potential areas of action and a recommended timescale for their implementation.

Table 4. Warrington EV Strategy Programme of Actions

Potential Option	Short term (0-2 Years)	(2-5 Years)	5+ Years
Roll out of the Electric Vehicle Taxi Strategy for the Borough including engagement with the Hackney Carriage (HC) and Private Hire (PH) trade umbrella organisations			
Update Parking Standards (currently 2015) to encourage EV uptake			
Implement EV bus scheme following successful ZEBRA funding bid			
Work with local businesses to encourage transition to an EV fleet			
Myth busting campaigns and practical support for the general public			
Increase provision of rapid charging infrastructure for taxis in convenient locations			
Provide charging infrastructure for buses			
Provide chargepoints at key destinations			
Support the use of and roll out of electric cargo bikes and review use of e-scooters			
Use renewal process for Council Fleet and operational vehicles as an opportunity (subject to funding) to transition to EV			
Encourage EV uptake through contract procurement			
Work with Development Control colleagues to increase EV uptake and EV car clubs at new developments			
Promote and continue to support the car club in Warrington giving flexible access to EVs			
Provide off-street or on-street chargepoints to support residents with limited access to EV charging at home			
Continuous engagement and monitoring of the "Charge" project with DNO			
Provide on-route chargepoints where gaps exist in commercial operators provision			
Investigate potential for EV conversion grant / “scrappage scheme”			
Supporting the transition of LGVs to EVs			
Support the transition of HGVs to EVs			
Introduce charging hubs/ forecourts			

Acronyms

Table 5. Key acronyms and definitions

Type	Acronym	Definition
Alternative Fuel Vehicles	AFV	Uses more than one form of on-board energy to achieve propulsion (usually a petrol or diesel engine plus electric motors and a battery). Some HEVs use the electric motor to make more efficient use of petroleum fuel, but the motor cannot power the vehicle alone.
DNO	Distribution Network Operator	The company that owns and operates the power lines and infrastructure that connect the National Grid network to the point of supply such as EV chargepoints
Electric Vehicle	EV	Driven by an electric motor, powered from a battery, which must be plugged into an electricity source to recharge. Full EVs do not have Internal Combustion Engines (ICEs) and therefore have zero tailpipe emissions. These pure EVs are sometimes referred to as Battery Electric Vehicles (BEVs).
Electric Vehicle Supply Equipment	EVSE	Term used to refer to all equipment used to deliver energy from the grid to a PIV
Fuel Cell Electric Vehicle	FCEV	Consultation/ lobbying is ongoing to ban these vehicles post 2030. This is an important point as mini-cab and private hire drivers use the Toyota Prius hybrid.
Hybrid Electric Vehicle	HEV	All PIVs require infrastructure to recharge their batteries, so understanding this category's needs is key when planning charging networks.
Internal Combustion Engine	ICE	Engine powering a vehicle with petrol or diesel.
Kilowatt	kW	A measure of how much electrical power an EV needs to operate. For EVs the greater the kW of the motor driving the car the more powerful it is. Chargepoints are rated in kW, the greater the number the more charge is delivered to a vehicle in the same space of time, i.e. faster charging.
Kilowatt-hour	kWh	A unit of electricity. 1 kWh = 1 unit of electricity. An EV battery will store these units of energy to discharge as energy for operation of the vehicle.
Open Chargepoint Protocol	OCPP	The Open Charge Point Protocol is an application protocol for communication between Electric vehicle charging stations and a charging station network
Plug-In Hybrid Electric Vehicle	PHEV	Combines a plug-in battery and an electric motor with an ICE, either of which can be used to drive the wheels. Therefore, total tailpipe emissions vary depending on how much of the journey uses the battery. They are required to plug-in to recharge their battery.
Plug-In Vehicle	PIV	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 as well as Fuel Cell Electric Vehicles (FCEV).
Ultra-Low Emission Vehicle	ULEV	This term is used in the UK to refer to any motor vehicle emitting extremely low levels of emissions, currently set at 75g CO2/ km driven or less. UK targets are set for ULEV uptake and statistics are reported quarterly at local authority level.[1]

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

Contents

Appendices

Tables

Figures

1. Introduction

This report is intended to provide an evidence base for the identification of strategic locations for electric vehicle (EV) chargepoint installation in Warrington. The following elements are considered in the report:

- Background information and the existing electric mobility environment.
- Strategic locations for installing EV charging infrastructure and how suitability for this installation may vary across different location types.
- The different delivery models that are available for the installation of chargepoints.

This strategy helps identify demand for EV charging infrastructure at a borough level. This follows on from the Council's declared Climate Emergency in 2019 and seeks to reduce greenhouse gas emissions to levels which are consistent with the allocated carbon budgets for the borough of Warrington, and to achieve net zero carbon emissions by 2050.

1.1 Document Structure

- Section 2: Strategy and Policy Review - A review of current national, regional, sub-regional and local policy and legislation in relation to electric vehicles and charging infrastructure.
- Section 3: Evidence Base and Analysis - A review of electric vehicle and charging technologies.
- Section 4: Charging Infrastructure Mapping - This section outlines potential charging locations which could be considered based upon outline analysis against different use cases, such as destinations, residential, taxis and on-route.
- Section 5: Geospatial Modelling - A review of data, spatial and temporal model results, and commuting and travel pattern analysis.
- Section 6: Potential Measures - This outlines the potential future measures which could be developed as part of the strategy which have been informed by the policy review and evidence base analysis. This also includes details regarding how future uncertainties could impact the development of the potential measures identified and how the strategy can be structured to be robust across these different scenarios.
- Section 7: Appraisal and Sequencing - This section displays the outputs of the Red Amber Green ratings assessments for impact and deliverability of the measures, alongside the recommended timescales for development and delivery of the measures.
- Section 8: EV Charging Commercial Models - This section details potential options for how charging infrastructure can be delivered and maintained, alongside analysis underpinning these options.
- Section 9: Site Assessment - Breaks down the criteria used for site assessment, the site scoring and outlines a high-level timeline of recommended measures and key actions to be taken in the short, medium and long-term, and key next steps.
- Section 10: Summary Programme of Work - This section outlines a high-level timeline of recommended measures and key strategic actions to be taken.

2. Strategy and Policy 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 section, setting out the policy and legislative foundation for this study.

2.1 Recent National and International EV Developments

During November 2020, the UK Government made announcements on new domestic (UK) policy with reference to 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.

From COP26 came the declaration on accelerating the transition to 100% zero emission cars and vans- this was signed by governments, businesses, and other organisations with an influence over the future of the automotive industry and road transport. Specifically, governments will work towards all sales of new cars and vans being zero emission by 2040 or earlier, or by no later than 2035 in leading markets[2]. The implications of the broad UK Government announcements in relation to EVs and specifically WBC are set out here in the following sections.

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[3]. It is now net-zero by 2050, and the 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 (~5%), 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 these goals as a minimum following its departure from the EU. Grams of CO2 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.

In 2020, the maximum CO2 emissions from new car and van sales was 95g and 147g CO2/km respectively. From 2021 these targets will be converted to worldwide harmonised light vehicle test procedure CO2 emissions targets following the change in the vehicle CO2 test procedure. The 2021 actual emissions will represent the new baseline. Manufacturers will then have to meet a 15% reduction for cars and vans by 2025, and a 37.5% reduction for cars and a 31% reduction for vans by 2030, both against this 2021 baseline.

The UK Government's ultimate vision is that every new car and van sold in the UK will be either PHEV (Plug-In Hybrid) or BEV (Battery Electric Vehicle) by 2030, and all new cars and vans will be fully zero emission at the tailpipe from 2035. For Heavy Goods Vehicles (HGVs) all new medium sized trucks up to and including 26 tonne will be zero emissions from 2035, with the heaviest, above 26 tonne by 2040. The UK's current objectives are set out in "Decarbonising Transport – A Better Greener Britain"[4].

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[5].

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, and 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

[2] COP26 declaration on accelerating the transition to 100% zero emission cars and vans - GOV.UK (www.gov.uk)

[3] https://www.legislation.gov.uk/ukpga/2008/27/contents

[4] Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

[5] UK New Car Registrations (SMMT): December 2020: The Future Is Clearly Electric! - Ezoomed

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. A fleet of fully zero emission road vehicles will remove the source of 91% of today's domestic transport GHG emissions[6]. Furthermore, 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 study is ensuring that enabling infrastructure is in place, including EV chargepoints.

The process of national EV developments is ongoing with a consultation ending recently on "Future of transport regulatory review: zero emission vehicles"[7]. This consultation aims to address transport regulation, particularly with regard to those areas that are potentially outdated and not designed with new technologies or business models in mind.

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 Warrington:

- 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: Transitioning to zero emission cars and vans: 2035 delivery plan - Delivery plan setting out significant milestones towards phase out dates for petrol and diesel cars and vans. Key milestones include:
  - By 2022 the Local Electric Vehicle infrastructure Fund will be launched.
  - 2022 – 2023: Further consultation on the CO2 regulatory regime expected, EV Home charge Scheme to focus on renters, leaseholders and those living in flats.
  - 2023 – 2024: 6 rapid chargepoints to be installed at every motorway service area.
  - 2024 – 2025: Potential date for introduction of a new road vehicle CO2 emissions regulatory regime.
  - 2025 – 2030: Favourable company car tax rates for zero emission cars until at least March 2025, Full progress review undertaken, Government car and van fleet to be 100% zero emission by 2027.
  - 2030 – 2035: At least 2,500 high powered chargepoints across the strategic road network, all new cars and vans to deliver significant zero emission capability from 2030 to 2035.
  - 2035: All new cars and vans to be 100% zero emission at the tailpipe.
- Policy paper: Taking charge: the electric vehicle infrastructure strategy, published (2022) - The following are key applicable extracts:
  - By 2030, there are forecast to be around 300,000 public chargepoints as a minimum in the UK, but there could potentially be more than double that number.
  - Everyone can find and access reliable public chargepoints wherever they live.
  - Effortless on and off-street charging for private and commercial drivers.
  - Fairly priced and inclusively designed public charging.
  - Market-led rollout for the majority of chargepoints, however the Government proposes to mandate Local Authorities develop local strategies and support provision of on-street charging infrastructure.
  - Infrastructure is seamlessly integrated into a smart energy system.
  - Continued innovation to meet drivers' needs.
- Policy paper: Government vision for the rapid chargepoint 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 chargepoints (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

[6] Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

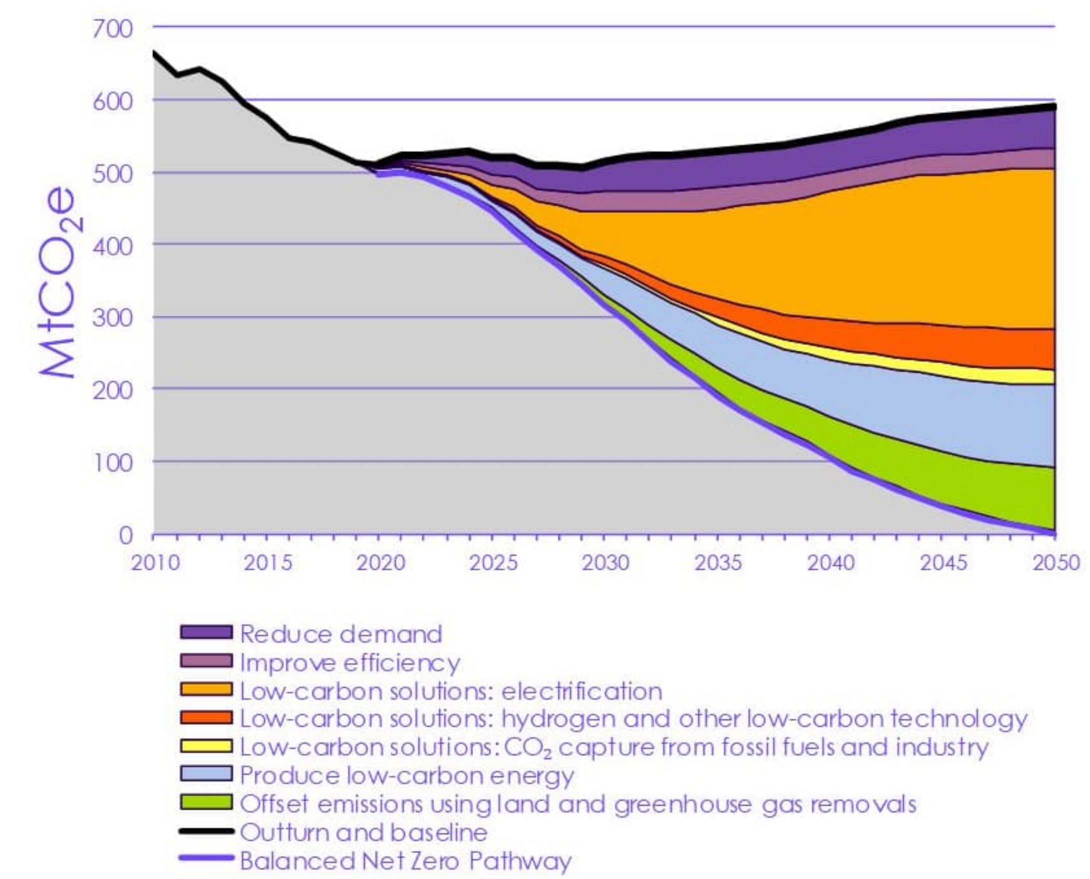
[7] Future of transport regulatory review: zero emission vehicles - GOV.UK (www.gov.uk)

this date. These high-powered chargepoints are able to charge up to 3 times faster than most of the chargepoints currently in place and can deliver around 120-145 miles of range in just 15 minutes for a typical electric vehicle.
- By 2030, it is expected that the network will be extensive and ready for more people to benefit from the switch to electric cars. There are plans for around 2,500 high powered chargepoints across England's motorways and major A roads.
- By 2035 it is expected there will be around 6,000 high powered chargepoints across England's motorways and major A roads.

- Department for Transport (DfT) Decarbonising Transport: A Better, Greener Britain (2021) – Presents the path to net zero transport in the UK by 2050, the wider benefits it can deliver, and the principles that underpin the approach to delivering it. In addition, this strategy outlines the commitments and actions needed to decarbonise transport.
  - All non-zero emission HGVs (>above 26t) are expected to be phased out by 2040, with lighter HGVs (from 3.5t up to and including 26t) being phased out by 2035.
  - The sale of new petrol and diesel cars and vans (under 3.5t) will be phased out by 2030, and all new cars and vans will be fully zero emission at the tailpipe from 2035.
  - Consultations are being undertaken to determine a phase out date for the sale of new non-zero emission buses, as well as plans to determine a phase out date for the sale of new-zero emission coaches.
- DfT Bus Back Better: National Bus Strategy for England (March 2021) – Details how the government will spend the £3bn in long-term funding (announced in February 2020) to level up buses across England, outside of London, including key actions to transition buses to zero emissions.
  - The document notes the UK has one of the most ambitious approaches in the world to achieving net zero by 2050, and reliable, frequent, and affordable electric buses will form a key pillar of public transport moving forward if this goal is to be realised.
- HM Government The Road to Zero (2018) – Revolves around a core mission of putting the UK at the forefront of design and manufacturing zero emission vehicles.
  - The strategy commits the UK to developing one of the best EV infrastructure networks in the world.
- HM Government The Building Regulation 2010 (2021) – gives practical guidance on common building situations about how to meet the requirements of the Building Regulations 2010 for England. From June 2022, Part S of the UK Building Regulations will be updated with the following requirements;
  - Every new home, including those created from a change of use, with associated parking must have an EV chargepoint.
  - Residential buildings undergoing a major renovation which will have more than 10 parking spaces must have at least one EV chargepoint per dwelling with associated parking, along with cable routes in all spaces without chargepoints.
  - All new non-residential buildings with more than 10 parking spaces must have a minimum of one chargepoint and cable routes for one in five (20%) of the total number of spaces.
  - All non-residential buildings undergoing a major renovation that will have more than 10 parking spaces must have a minimum of one chargepoint, along with cable routes for one in five spaces.
  - All new private EV chargers must have smart charging capability.
- 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 the 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 203[7]. 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 the 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 CO2e by 2035 and to approximately 1 Mt CO2e by 2050 (See illustration in Figure 2-1).

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



Source: BEIS (2020) *Provisional UK greenhouse gas emissions national statistics 2019*; CCC analysis.
Notes: 'Other low-carbon technology' includes use of bioenergy and waste treatment measures. 'Producing low-carbon energy' requires the use of carbon capture and storage (CCS) in electricity generation.

- 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 chargepoints.
- 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 chargepoints.
- Energy Saving Trust's 'Positioning chargepoints and adapting parking policies for electric vehicles' (2019) – Provides guidance on the installation of chargepoints 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 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 chargepoints 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 (NO2) in the UK (2017) – Sets out how the UK aims to reduce roadside nitrogen dioxide (NO2) 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.
- Manual for Streets 2 (2010) – Highlights the need to design footpaths to ensure accessibility and safety but does not address chargepoint 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). Although this has since been superseded in certain aspects, it provides important background context.

2.3 Regional

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

- Scottish Power Charge Project (2019-2022) – a project to merge transport and the electricity network to create an over-arching map of where EV chargepoints will be required and where they can best be accommodated by the electricity grid.
- Transport for the North (TfN) Draft Decarbonisation strategy (2021) – Sets out how TfN and partners across the North are committing to a regional near-zero carbon surface transport network by 2045. Supports TfN's key aims for improving localised air quality.
    - 55% reduction in emissions from 2018 to 2030, achieved mostly through mode-shift and demand reduction.
    - 95% reduction in emissions from 2018 to 2040, reflecting longer-term decarbonisation measures, such as a high proportion of zero-emissions vehicles in the vehicle fleet.
- TfN Strategic Transport Plan (2019) – Outlines the case for transformational transport investment across the North, to rebalance the UK economy and drive major improvements in strategic connectivity through the North.
    - To support move to electric vehicles, TfN calls for a rapid increase in the number of public chargepoints across all parts of the North, as part of improvements planned to the North's road network and through close engagement and collaboration with energy providers.
    - Current and future electric vehicle drivers must be able to easily locate and access electric vehicle charging infrastructure that is affordable, efficient, and reliable.
- TfN West and Wales Strategic Development Corridor (2017) – significant economic and population growth is forecast within this corridor which will increase demand on transport infrastructure. The work on this corridor is looking at improving connections for people and businesses and exploring the options for improving road and rail capacity.

2.4 Sub Regional Strategy / Policy

- 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 the 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.
- Cheshire and Warrington Strategic Economic Plan – Sets out the sub-region’s ambition to grow the economy’s GVA £50 billion per annum by 2040. This includes a focus on sustainable transport and connectivity.

2.5 Warrington

The following existing county or local strategies and policies help set the foundation for EV growth and promotion in Warrington:

- Warrington Draft Electric Vehicle Strategy (2021) – Sets out the strategy for Warrington Borough Council (WBC) to accelerate the transition to Electric Vehicles across the Borough.
- Warrington Air Quality Action Plan (2017-2022) – outlines the actions that WBC will deliver between 2017 and 2022 to reduce concentrations of nitrogen dioxide within the two designated Air Quality Management Areas (AQMAs).
- Declared Climate Emergency (2019) – the Council declared a climate emergency in June 2019 and resolved that by 2030 it would be carbon neutral in its operation and activities. The Council also approved their Green Energy Strategy in September 2019. Then in July 2022 the Warrington Climate Emergency Strategy was agreed which aims to mobilise people and organisations in Warrington to all play their part to address the climate crisis. The strategy includes support for actions which help the uptake of EVs. An increased uptake in EVs supports carbon targets through reducing the level of emissions generated by car travel.
- Warrington Last Mile Study (2020) – aims to provide high quality and fit for purpose transport infrastructure to make walking, cycling and public transport the obvious way to get to, from, and through Warrington town centre. This EV Strategy needs to provide complementary measures to the Last Mile Study to maximise the uptake of sustainable modes of travel and reduce car usage where possible.
- Warrington Local Transport Plan 4 (2019) – the current Local Transport Plan for Warrington identifies EVs as an area to develop during the period of the plan as part of an integrated and sustainable transport network.
- Warrington Central 6 Wards Masterplan (2020-2040) – a 25 year plan for the Central 6 area to give a strategic vision for change to create a place that enables all people to live as full a life as they are able and be part of the wider Warrington community. A transition to EVs would support the Masterplan through providing a mode of travel to access opportunities, such as through the use of car clubs.
- Warrington Means Business Strategy (2017) – Warrington’s economic growth and regeneration programme with the aim to achieve inclusive growth where local people can enjoy and participate in the benefits growth will bring. The Strategy outlines areas for economic growth and redevelopment which creates opportunities for introducing EV charging within new developments.
- Warrington Updated Proposed Submission Version Local Plan 2021-2038 (2021) – A strategy to guide decisions on planning applications and to identify areas where investment and growth should be prioritised. Within the strategy objective W4 commits to provide new infrastructure and services to support Warrington’s growth; address congestion; promote safer and more sustainable travel; and encourage active and healthy lifestyles. By providing a clear EV strategy Warrington can invest in EV charging infrastructure precisely where it is needed and in turn meet its Local Plan objectives.
- Standards for Parking in New Developments (2015) – Supplementary Planning Document (SPD) expands on the policies within Warrington’s Development Plan and relevant national guidance in relation to development proposals for Parking in New Development. The current standards require 5% of parking spaces of new developments to provide an electric chargepoint or passive provision for a chargepoint. These standards are currently under review.
- Green Energy Strategy (2020) – provides details of the Council’s goals, plans and projects and how such work will be approached in future and the Council’s targets met. The strategy highlights the importance of EVs in Warrington and that they will need to be fully integrated into the council’s fleet. The report highlights this work has started and that chargepoints have been made available for the councils use. The report also highlights the need to provide electric vehicle chargepoints (EVCPs) across Warrington. This is essential if people are to switch to EVs.
- Developing a local strategy for Warrington in the face of the global climate emergency (2021) – set out a review of the current climate situation, what it means for the borough, identifies key themes and possible

actions, and finally sets out local strengths, weaknesses, opportunities, and threats that the borough faces. Important highlights include upgrading WBC's vehicle fleet to EVs, growing the EVCP network and providing EVCPs in areas with limited off-street parking.

- Our Corporate Strategy (2020) – Sets out Warrington's recovery from the coronavirus pandemic, whilst also equipping the borough with the tools to enhance its reputation as a key player in the Northwest for all who live, work, visit and do business here. The strategy identifies sustainable transport as one of the key areas to promote the town as one that is clean, green, and vibrant. EVs provide a more sustainable alternative to petrol and diesel vehicles, but a balanced EVCP network is vital to their use. In turn, a good EVCP network is required to support the Corporate Strategy's success.
- Electric Vehicle Taxi Strategy (2022) – Sets out Warrington's strategy to increase awareness and uptake of EVs by Hackney Carriage and Private Hire Taxis; and accelerate the transition of the Borough's taxi fleet to EVs. EVCPs will pay an important role for EV taxi drivers who will use the charging time to take a break from the road.

2.6 Summary

This strategy and policy review has shown that there is support for WBC's transition to EVs at all spatial levels, and an increasingly supportive and proactive policy and legislative framework is emerging. Specific aspects of the policies and strategies have also informed later sections of this document covering the evidence base and option development.

3. Evidence Base and Analysis

3.1 Electric Vehicle Trends

The UK is facing a climate emergency and consequently is committed to reducing Greenhouse Gas (GHG) emissions by at least 80% of 1990 levels by 2050 through its Climate Change Act 2008[8]. However, in June 2019 the government passed new laws[9] tightening this target to net zero by 2050 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 are 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 gas emissions.

Diesel engines emit less CO2 and greenhouse gases than petrol engines. This happens because of the 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 emitting less CO2. Most estimations indicate that diesel engines emit about 10% less CO2 than the petrol engines of the same category. When looking at other sources of pollution, such as fine particles (like PM10, PM2.5, NO2 or NOx) petrol results in fewer emissions then diesel.

Currently, there is a shift away from diesel to petrol engines. This is because diesel is now categorised as 'dirty'. Both petrol and diesel have environmental impacts and removing 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.

Carbon dioxide (CO2) is the main component of GHG, which traps heat in the atmosphere causing global climate change. The transport sector currently generates the highest proportion of CO2 emissions in the UK, due to the increasing miles driven by Internal Combustion Engine (ICE) vehicles which burn carbon-based fuels and consequently emit CO2 from their exhausts. The transport sector has made the lowest contribution to UK GHG emissions reduction of only 3% from 1990 to 2018[10], making it a prime target for future regulation.

Nitrous Oxide (N2O) is also a contributor (as is methane) but CO2 is the largest contributor which is why legislation has focused on its impact. Nitrous oxide is released naturally from soils and water bodies as part of microbial processes. The two major man-made sources are from agriculture and manufacturing. 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. EV have the benefit of regenerative breaking but tyre wear will be similar which is why reducing vehicle numbers long term is the best option for clean air.

The UK Government's ultimate vision as set out in "The Road to Zero Strategy" published in July 2018[11] 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 18th November 2020 the government brought the ban on new ICE car sales forward to 2030 which also prohibits the sale of new non plug-in hybrid vehicles.

EVs are currently the only mature technology offering a workable alternative to ICE vehicles; however, uptake in the UK is at the early majority stage. Generally, uptake is led by relatively affluent, and environmentally conscious, buyers who are keen to:

- Adopt new technologies;
- Reduce their personal transport impacts; or
- Purchase an EV for tax reasons/ company policy.

Early research shows that EV consumers preferred 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.

[8] https://www.legislation.gov.uk/ukpga/2008/27/contents

[9] https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law

[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/790626/2018-provisional-emissions-statistics-report.pdf

[11] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to- zero.pdf

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. 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)[12]. Local councils can apply for on-street residential chargepoint funding and the local electric vehicle infrastructure pilot funding[13].

A caveat to prevailing thought is that early purchases were by 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 investing in 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 sold totalling 191,000 by the end of 2021 (SMMT) which is 0.52% of the UK car population, the normalising of driver behaviour is some way off.

Table 3-1 shows the growth for BEVs and PHEVs since 2013. This shows that there is still a low national population of BEVs (395,260 end of 2021 (SMMT)), which represents 1.07% of the UK car population, and indicates that the UK is still at the early majority stage. There was a clear increase in the number of BEV sales during 2021, but this only accounted for 190,727 out of approximately 1.65 million vehicles sold that year.

Table 3-1. The Society of Motor Manufacturers and Traders Figures

Year	BEV	PHEV	Total	Total vehicle registrations	% BEV	% PHEV	% Total	BEV Growth	PHEV Growth
2013	2,512	1,072	3,584	2,264,737	0.11%	0.05%	0.16%	-	-
2014	6,697	7,821	14,518	2,476,435	0.27%	0.32%	0.59%	4,185	6,749
2015	9,934	18,254	28,188	2,633,503	0.38%	0.69%	1.07%	3,237	10,433
2016	10,264	26,643	36,907	2,692,786	0.38%	0.99%	1.37%	330	8,389
2017	13,597	33,666	47,263	2,540,617	0.54%	1.33%	1.87%	3,333	7,023
2018	15,474	44,437	59,911	2,367,147	0.65%	1.88%	2.53%	1,877	10,771
2019	37,850	34,734	72,584	2,311,140	1.64%	1.50%	3.14%	22,376	-9,703
2020	108,205	66,877	175,082	1,631,064	6.63%	4.10%	10.73%	70,355	32,143
2021	190,727	114,554	305,281	1,647,181	11.58%	6.95%	18.53%	82,522	47,677
Total	395,260	348,058	743,318	20,564,610	1.92%	1.69%	3.61%	-	-

In future, there will have to be a mix of infrastructure provision. However, the ratios of charger types and 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 are an alternative to ICE vehicles which reduce emissions, particularly in congested urban areas where stopping and starting, idling and over-revving of ICE 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. Despite the increased electricity

[12] http://www.legislation.gov.uk/ukpga/2018/18/contents/enacted

[13] On-Street Residential Chargepoint Scheme guidance for local authorities - GOV.UK (www.gov.uk)

requirement, EV 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. EV also produce less noise pollution and encourage a smoother driving style than ICE which increases driving efficiency by reducing the power required per km driven and causing lower particulate emissions from brake and tyre wear.

3.3 EV Terminology

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 Internal Combustion Engine (ICE) vehicles.

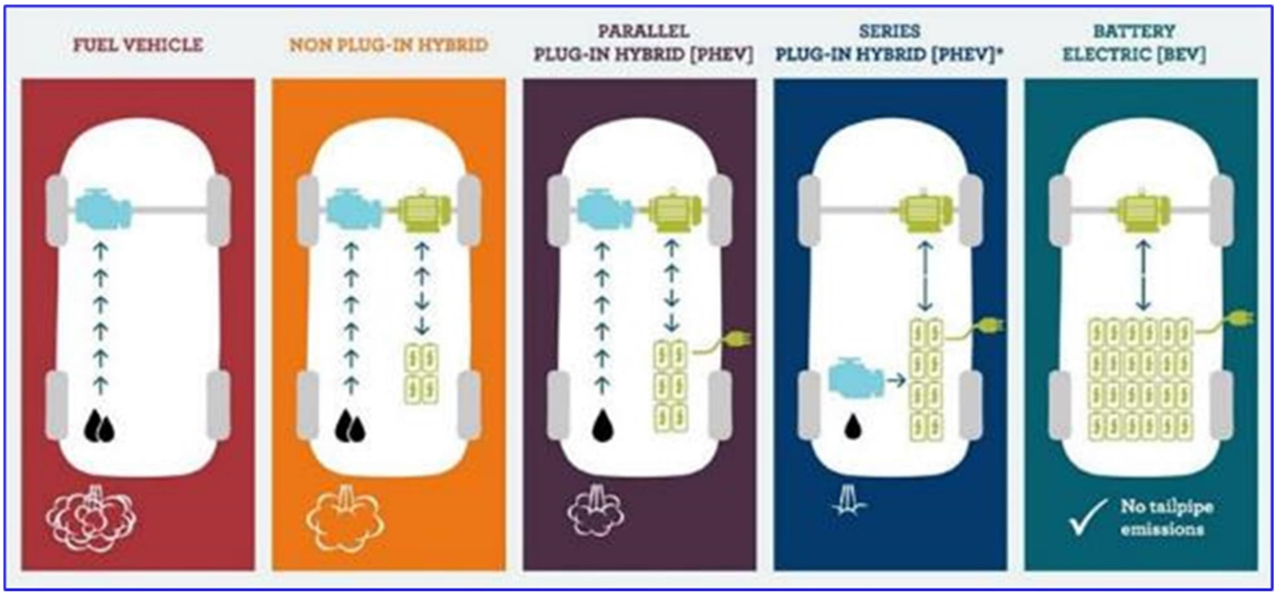
Ultra-Low Emission Vehicles (ULEVs) are currently associated with reducing road transport emissions. However, there are many acronyms used to refer to vehicles that can emit lower emissions than pure ICE vehicles. Table 3-2 provides a brief explanation of different low emission vehicle types and Figure 3-1 illustrates some of these vehicle types.

Table 3-2. Definitions of different low emission vehicle types

Type	Acronym	Description
Ultra-Low Emission Vehicle	ULEV	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.[14]
Electric Vehicle	EV	Driven by an electric motor, powered from a battery, which must be plugged into an electricity source to recharge. Full EVs do not have ICEs and therefore have zero tailpipe emissions. These pure EVs are sometimes referred to as Battery Electric Vehicles (BEVs).
Plug-In Hybrid Electric Vehicle	PHEV	Combines a plug-in battery and an electric motor with an ICE, either of which can be used to drive the wheels. Therefore, total tailpipe emissions vary depending on how much of the journey uses the battery. They are required to plug-in to recharge their battery.
Plug-In Vehicle	PIV	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 as well as Fuel Cell Electric Vehicles (FCEV).
Hybrid Electric Vehicle	HEV	All PIVs require infrastructure to recharge their batteries, so understanding this category's needs is key when planning charging networks.
Alternative Fuel Vehicles	AFV	Uses more than one form of on-board energy to achieve propulsion (usually a petrol or diesel engine plus electric motors and a battery). Some HEVs use the electric motor to make more efficient use of petroleum fuel, but the motor cannot power the vehicle alone.
Fuel Cell Electric Vehicle	FCEV	Consultation/ lobbying is ongoing to ban these vehicles post 2030. This is an important point as mini-cab and private hire drivers use the Toyota Prius hybrid.

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

Figure 3-1. Vehicle Types[15]



3.4 EV Technology Roadmaps

The UK Automotive Council has developed long-term technology roadmaps[16] 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.

3.4.1.1 Cars

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

Caution should be taken when manufacturers make a model launch as it is the manufacturing capacity which is the control factor for supply. Fuel Cell Electric Vehicles (Hydrogen) take up has been minimal and no EU based car companies have declared any intent to produce these cars.

The quoted range on a full battery varies by model, and with driving style and weather conditions. Table 3-3 provides some examples of ranges for currently popular EVs.

[15] NZ Electric Car Guide - Leading The Charge
[16] https://www.automotivecouncil.co.uk/technology-group-2/automotive-technology-roadmaps/

Table 3-3. Current EV car examples

EV Model	Price	Battery Capacity	Range
Vauxhall Corsa-E	£25,805	50 kWh	209 miles
Nissan Leaf	£26,995	39/ 59 kWh	140 / 239 miles
Renault Zoe R110 ZE40	£26,795	52 kWh	195 miles
Vauxhall Mokka-E	£29,365	50 kWh	209 miles
BMW i3 120 Ah	£31,305	37.9 kWh	145 miles
Kia E-Niro ('2')	£32,445	64 kWh	230 miles
Hyundai Kona	£32,550	64 kWh	245 miles
Kia Soul EV	£34,995	64 kWh	280 miles
Volkswagen ID.3 (Tour)	£38,815	77 kWh	280 miles
Kia EV6	£40,945	77.4 kWh	328 miles
Volkswagen ID.4	£41,430	77 kWh	320 miles
Hyundai Ioniq 5	£43,000	73 kWh	298 miles
Nissan Ariya	£43,140	63 kWh	223 miles
Volvo C40 Recharge	£44,800	78 kWh	273 miles
Tesla Model 3	£44,990	57 kWh	235 miles
Ford Mustang Mach-E	£47,580	91 kWh	379 miles
Tesla Model Y (Long Range)	£54,990	75 kWh	331 miles
Audi e-Tron	£61,310	95 kWh	252 miles

Another way of accessing EVs is through car clubs. Co Wheels operates in Warrington with EVs available for hire from as little as 30 minutes to days at a time.[17]

3.4.1.2 Vans

Light vans (up to 3.5 tonnes) can also make use of EV and hybrid technologies, providing an important opportunity to reduce urban emissions from local delivery, servicing and wider business vehicles. New light van sales have an average fleet-wide emissions target of 147g CO_2/km from 2020 and must achieve a further 15% reduction by 2025 reaching 31% by 2030 under EU regulations. Relatively few EV van models are currently available in the UK. More models are appearing however, as with cars it is the supply which is the constraint.

Table 3-4 provides examples from the current market range and includes the load capacity to provide an indication of each vans size.

[17] https://www.co-wheels.org.uk/warrington

Table 3-4. Current EV van examples

EV Model	Price	Battery Capacity	Range	Load Capacity (m3)
Peugeot Partner/Citroen Berlingo	£ 23,030	50 kWh	171 miles	3.3-3.7
Peugeot e-Expert/Citroen e-Dispatch/ Vauxhall Combo-e/ Vauxhall Vivaro-e	£ 25,000	50/ 75 kWh	143/ 211 miles	>6.6
Peugeot e-Boxer/Citroen e-Relay	£ 49,395	37/ 70 kWh	73/ 169 miles	8
Fiat E-Ducato	£ 59,699	47/ 79 kWh	142/ 224 miles	10-17
Ford E-Transit	£ 42,695	68 kWh	196 miles	15.1
LEVC van (PHEV)	£ 46,500	31 kWh	61 miles	5
Maxus EV80	£ 24,614	56 kWh	120 miles	10.2
Maxus e Deliver 3	£ 22,800	35/ 52.5 kWh	150/ 213 miles	6.3
Maxus e Deliver 9	£63,000	51.5/ 72/ 88 kWh	112/ 146/ 185 miles	9.7 - 11
Mercedes e Sprinter	£ 51, 950	35 kWh	71 miles	10.5
Mercedes e Vito	£ 39,895	35 kWh	93 miles	6.6
Nissan eNV200	£ 20,005	40 kWh	124 miles	4.2
Renault Kangoo ZE	£ 24,480	33 kWh	143 miles	4.6
Renault Master	£ 57,040	33 kWh	124 miles	13
Renault Zoe E-Tech Electric Van	£28,740	52 kWh	245 miles	1
Toyota Proace Electric	£41,195	75 kWh	205 miles	5.3
VW ABT e-Transporter	£ 42,060	37.3 kWh	82 miles	6.7

3.4.1.3 ECargo Bikes

An alternative to vans for ‘last mile’ deliveries is eCargo bikes. They are specially designed bikes for carrying cargo that have an electric motor to assist the rider while they pedal. ECargo bikes must conform with the Electrically Assisted Pedal Cycle regulations[18]. To meet these regulations, the electric motor must have a maximum power output of 250W. The electric motor stops assistance if the rider stops pedalling, applies the brakes, or reaches 15.5mph, although the rider can continue pedalling beyond this speed.

Key advantages of e-cargo bikes were identified in a report undertaken by the Cross River Partnership and are[19]:

- Speed and reliability;
- Flexibility of service;
- Low running costs;
- Low Capital cost;
- Employee health benefit;
- Public Relations benefit because of positive public perception; and
- Reduced noise.

Examples of eCargo bikes and their use cases are presented in Table 3-5, collated by the Energy Savings Trust for the eCargo Bike Grant Fund that was available from April 2019 until January 2022[20].

[18] UK Government, Electric bikes: licensing, tax and insurance, https://www.gov.uk/electric-bike-rules

[19] Cross River partnership on behalf of the Central London SubRegional Transport Partnership, Cycle Logistics Study, https://crossriverpartnership.org/wp-content/uploads/2019/03/20190520_Element-Energy_Cycling-logistics-study_FINAL-REPORT-1.pdf

[20] Energy Saving Trust, Finding the right ecargo bike for you , https://energysavingtrust.org.uk/wp-content/uploads/2021/09/EST0023-001-eCargo-factsheet-4pp-WEB.pdf

Table 3-5. E-cargo bike examples

Form	Typical Maximum payload	Price range	Example use case
Two-wheel	100kg	£3,000 - £6,000	Food deliveries, transporting packages and internal mail.
Three-wheel	250kg	£4,000 - £10,000	Transporting waste disposal equipment, park maintenance, transporting loose loads
Four-wheel	250kg	£8,000 - £12,000	First mile deliveries, consolidation and distribution hub usage offering covering for rider and loads and able to carry larger loads
Trailer	300kg	£2,000 - £5,000	Transporting construction equipment, expanding ecargo bike capacity. Can be attached to eCargo bikes or push bikes.

3.4.1.4 Heavy Duty Commercial Vehicles

Heavy duty commercial vehicles remain a challenge for EV technology primarily due to their weight, payload and range requirements. However, vehicle manufacturers are developing EV HGVs and starting to introduce the m to the market. One example of this is the Volvo fleet of Heavy-duty electric trucks. These offer the same benefits of smaller EVs although with the added benefit that the quieter operational volume of the vehicle is less intrusive.[21].

Several companies are also investing in alternative technology solutions to reduce emissions from heavy freight, such as:

- Creating all-electric powertrains;
- Adding self-driving features; and
- Adding new fleet logistics systems to standard rigs to improve efficiencies and emissions.

As a local example, CNG Fuels have opened one of Europe's largest biomethane compressed natural gas (Bio-CNG) refuelling stations in Warrington for HGVs.

3.4.1.5 Buses

A variety of low emission technologies are already used on buses, including hybrid, plug-in hybrid, electric, hydrogen fuel cell and biomethane models, enabling operators to choose appropriate technology solutions to meet their operational needs. The UK Government has provided funding towards the deployment of low emission buses through the DfT's Low Emission Bus schemes and Clean Bus Technology fund, and most recently advertised the opportunity to become the UK's first all- electric bus town[22]. Warrington has since secured funding to become one of the first all-electric bus towns[23].

There are two main types of electric bus: those which take power continuously from a source outside of the bus (e.g. overhead wires) whilst travelling; and those which use energy stored on-board usually in batteries. Hybrid electric buses use a combination of ICE and electric propulsion systems to reduce emissions. Future technology developments are targeting the use of fuel cells as the primary propulsion method as well as to extend range.

During the period of writing this report no indicators have been published or observed which give a clear direction to the vehicle manufacturer's technology direction. Some UK cities e.g. Manchester are trialling BEV buses and others e.g. Aberdeen are trialling FCEV buses. The consequences for infrastructure for FCEV are substantial.

A more detailed review of electric buses is provided in Section 3.9.

3.4.2 Warrington's Successful Zero Emission Bus Regional Area (ZEBRA) Bid

WBC recently made a successful bid to replace all 120 of Warrington's Own Buses diesel vehicles with brand new electric buses. Linking to ZEBRA funding, a new bus depot is already planned to be built with

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[21] Electric trucks | Volvo Trucks

[22] https://www.gov.uk/government/news/britains-first-all-electric-bus-town-to-pave-the-way-for-green-communities-of-the-future

[23] Zero Emission Bus Regional Areas (ZEBRA) scheme - GOV.UK (www.gov.uk)

funding and planning consent already in place. The successful ZEBRA bid will now see the new depot equipped with electric vehicle charging infrastructure and housing a new fleet of zero emission buses. Figure 3-2 summarises the ZEBRA bid below.

Figure 3-2. Warrington ZEBRA bid proposal

Warrington provides a unique opportunity to completely transform bus travel in one area. Our ZEBRA proposals include:

- Conversion of an operator's entire fleet
- Use of a new bus depot - being funded and delivered separately – that will open in time for delivery of the new zero emission fleet
- Close and established partnership working between a local authority and a municipal operator
- A renewable power source, with electricity from the council's own solar farm

3.5 Electric Vehicle Availability

In May 2022 there were 137 BEV car models available on the UK market according to Electric Vehicle Database[24]: A further 25 models are announced for sale by the end of 2022, with an additional 6 models announced beyond then. Many PHEV previously available in the UK are no longer available for sale and no new PHEV show in the pipeline, highlighting the manufacturers' continuing shift from PHEV to BEV focus in line with tightening EU new car sales emissions targets. The UK's recent announcement to include PHEV in the ban on non-EV sales which has been pulled forward to 2030 should continue to reinforce this focus.

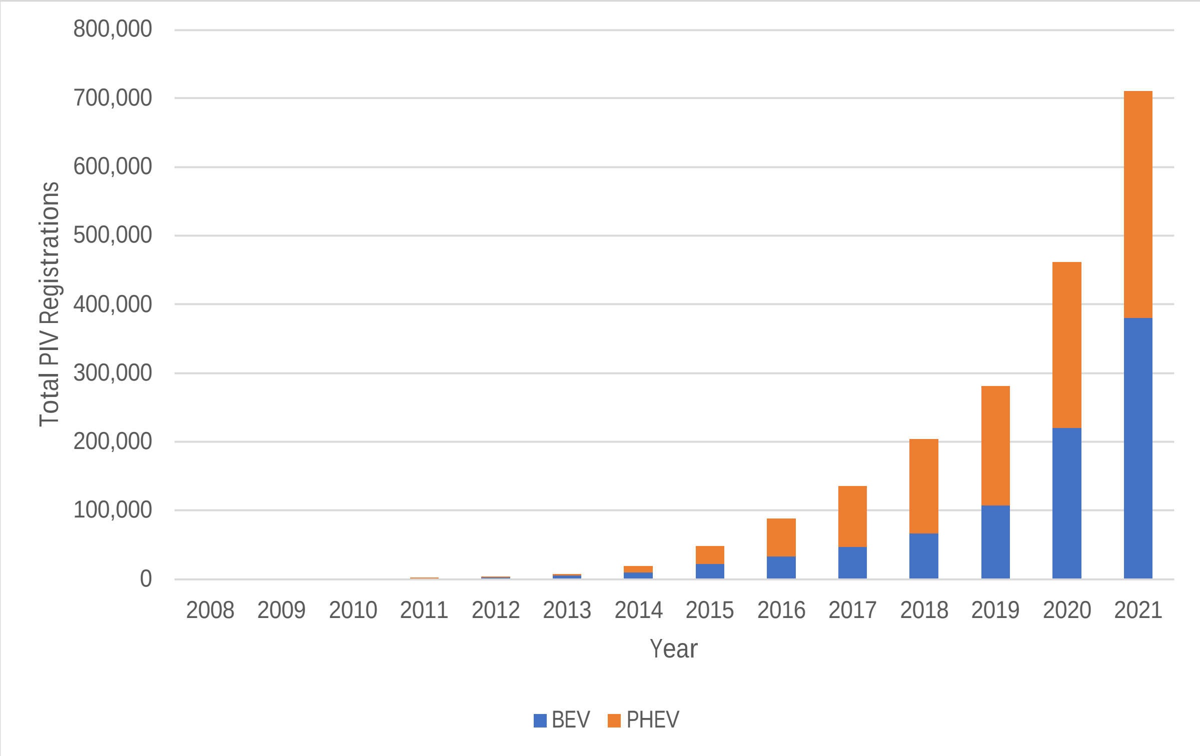
In addition to the future BEV focus, the majority (54%) of PIV sales in the UK by the end of 2021 were BEV according to the European Alternative Fuels Observatory (EAFO)[25], as shown in Figure 3-3. The UK's PHEV experience is similar to most European countries however, some such as Norway have the opposite situation due to their more favourable BEV incentive schemes.

In 2018 changes to new vehicle incentives were made in favour of BEV, changes were made to ban non-EV new car sales from 2030. As mentioned above there has since been an associated lack of new PHEV models coming to market and as a result the BEV-PHEV modal split has swung in favour of BEVs. Notwithstanding this the PHEV fleet will continue to need charging facilities going forward.

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

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

Figure 3-3. Total PIV registrations in UK, split by BEV and PHEV



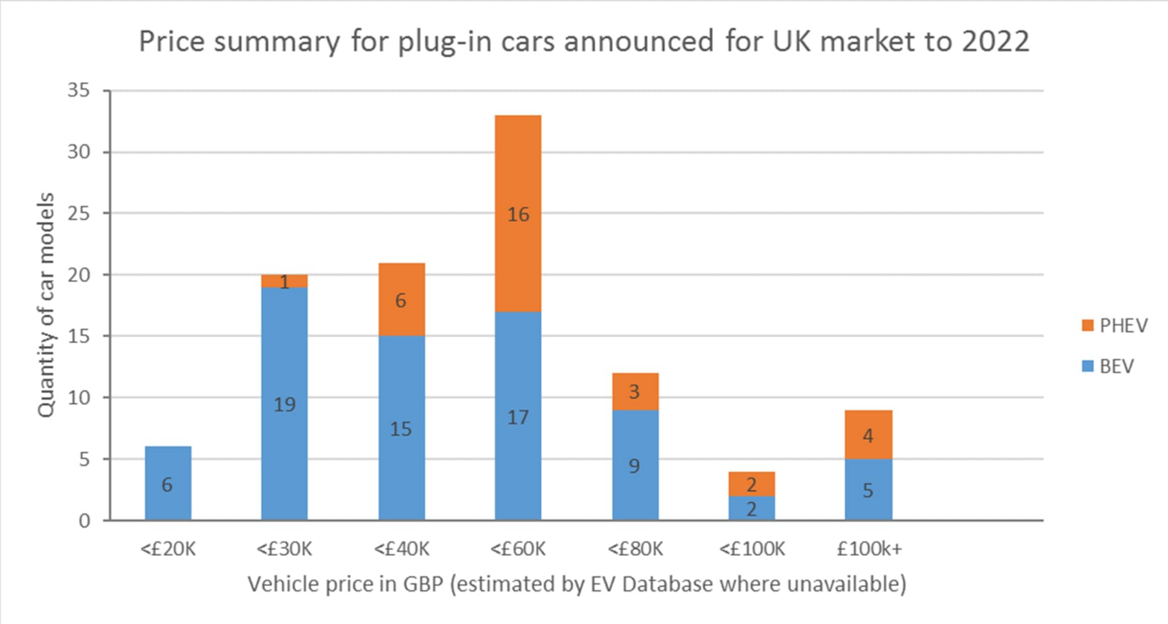
PIV model prices generally remain high as summarised in Figure 3-4, although estimates provided by the EV Database[26] suggest a concentration of new BEV models coming by 2022 priced at under £40K with battery capacities up to 66 kW. The second-hand EV market is still small, making up 3.1% of the total used car market in 2021[27] and most independent second-hand dealerships leave this limited market to 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 seek to dispel these myths but continuing regional awareness raising activities are required to get the correct messages out to consumers. Therefore, it is imperative that WBC continue to raise awareness of the benefits of EVs and disperse myths where appropriate. A good example of EV myth busting from the National Grid is linked in the footnotes below[28].

[26] Compare electric vehicles - EV Database UK (ev-database.uk)

[27] Record year for second-hand EV sales as used car market grows | RAC Drive

[28] 6 myths about electric vehicles busted | National Grid Group

Figure 3-4. PIV model prices announced for UK



3.5.1 Battery Capacity

Analysis of the BEV vehicles on the market shows how battery capacity is growing (see Table 3-6). However, there will be lower capacity batteries within the fleet from models sold in previous years that consequently have lower mileage ranges. Whilst this will affect the average range of current BEVs, it will become less of a concern as the existing fleet grows because more recent models have longer ranges.

Table 3-6. Distribution of vehicles along the battery range

Battery Range	Number of Vehicles	Typical Range
Up to 40 kWh	13	Up to 160 miles
40 to 50 kWh	24	160 - 200 miles
50 to 70 kWh	29	200 - 280 miles
70 to 90 kWh	59	280 - 365 miles
90 to 100 kWh	7	365 - 400 miles
100 kWh +	5	400 - 500 miles

3.5.2 Battery Charging Capabilities

Prior to 2016, most EVs charged at 3 kW AC (alternating current), called slow charging, which was adequate to fully recharge most batteries (typically up to 24 kWh) overnight. Rapid charging DC (direct current) technology has developed much faster than AC technology, giving consumers a faster method to recharge. However, only some plug-in models prior to 2016 are capable of rapid charging; while all new UK plug-in models to 2021 are capable of being rapidly charged.

Most vehicle manufacturers now use the Combined Charging System (CCS) or CHAdeMO[29] DC socket/ plug for rapid charging. The latest development in charging technology introduces charging at powers between 100 kW and 350 kW DC, referred to as 'high-power charging'. However, there are few PIVs currently available in the UK that are capable of charging at this rate. 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 150 kW+ for public use is now beginning in the UK. Most are designed to also deliver 50 kW DC charges to rapid chargeable vehicles to combat the current lack of high-power charging demand. 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 currently available rapid chargeable PIVs, approximately

[29] This is an abbreviation of 'CHArge de MOve'.

50% require the CHAdeMO connector. Therefore, new rapid chargers installed over the next five years will require both DC CCS and CHAdeMO connectors. Past this period, all manufacturers, with the exception of Tesla, have committed to transitioning to CCS.

The improvement in battery capacity, together with reduced charging times, means that consumers are unlikely to charge their EV daily (more potential to be once a week). Therefore, demand for public charging may reduce in the medium term.

3.5.3 PIV Supply Constraints

The lack of production capacity is a global issue, originating in vehicle production plants and battery production facilities across the world. This has been compounded by a chip shortage, which has also limited the global supply of all vehicle types. 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 supply constraints are associated with global manufacturing (both in terms of cost and production capacity) rather than public charging infrastructure provision within WBC. These constraints are outside of the Council's control and in some cases the UK Government. However, it is important that:

- Sufficient infrastructure is in place for current EV owners; and
- Current manufacturing issues are monitored closely by the Council so that infrastructure can be rolled out at the right time to facilitate demand and uptake in EVs.

The current uptake of EVs is getting stronger year on year. Historically, the UK Government has responded by offering purchase incentives for ULEVs since 2011. However, these have been reduced in recent years and now funding has ceased all together and has been repurposed to improved EV charging. The availability and cost (though less so than a few years ago) of Lithium-ion (Li-ion) batteries are limiting factors in PIV supply. Li-ion technology is the preferred choice for this decade due to the capital cost and reliability.

Alternative volume-ready technologies are not forecast to reach the PIV market until between 2028 and 2030. Many new battery manufacturing plants will need to supply the PIV volumes required to meet European targets, requiring significant investment and long-range planning. Therefore, there is still a substantial risk that PIV supply will stand in the way of achieving transport emission reduction targets in the UK.

On 06 July 2021, Stellantis announced that they would invest £100 million in Vauxhall Ellesmere Port plant, which includes new equipment to assemble battery packs (the cells will be sourced from ACC in Europe). The plant will build four electric van models and their passenger car equivalents under Stellantis's Vauxhall, Opel, Peugeot and Citroën brands.

3.6 Global, European and National Challenges

3.6.1 PIV Production

UK car production has dropped over the latter 6 months of 2021. December 2021 saw a drop in UK car production of 12.7 percent compared to December 2020. This fall in output has been mainly attributed to the lack of availability of semiconductors which is expected to continue throughout 2022 and possibly into early 2023. Other contributing factors are a shortage of staff due to COVID cases and the need for self-isolation.

This shortage in the availability of new vehicles makes it more difficult to predict the year-on-year growth of the EV market although the percentage of electric vehicles continues to rise in the UK - 26% of all new cars built in 2021.

Provided that disruption to vehicle production remains at a relatively short period of time, then it will have a limited effect on the model outputs. If the time period becomes longer (approaching one year) this will slow the number of Low Carbon Vehicles in the marketplace.

3.6.2 Battery Production

EV battery capacities have continued to increase gradually as new vehicles enter the market. Initially average battery capacity was in the region of 20kWh whereas in 2021 it was approximately 60kWh. The number of vehicles that can be manufactured depends heavily on the availability of batteries. As battery capacities increase so does the need for increased manufacturing capacity globally to meet both the demands of the car manufacturers and to ensure Government Net-Zero targets can be achieved.

Envision AESC in Sunderland has the capacity to produce batteries for 100,000 EV's per year with plans to expand further. Britishvolt plans to produce enough cells for 300,000 EVs with full capacity targeted for 2027. These numbers are dependant of the capacity of battery required by the various models of EV to be manufactured.

As battery manufacturing capacity increases inevitably the cost should reduce, consequently reducing the vehicle cost making the purchase of EV's accessible to more of the population.

Benchmark Minerals Lithium-ion Battery Gigafactory Assessment (September 2018) reported Europe's battery cell capacity to be at 120GWh by 2030 – enough cells for 2.2m EVs. Overall, Benchmark is now forecasting Europe to have a capacity of 789.2GWh by 2030, little over 14% of the global total of 5,454GWh. By the end of 2022, Europe is set to have 7 active lithium ion battery producers of which the top five by capacity (and Gigafactory location) are:

- LG Chem (Poland): 32GWh
- Samsung SDI (Hungary): 20GWh
- Northvolt (Sweden): 16GWh
- SK Innovation (Hungary): 7.5GWh
- Envision AESC (UK): 1.9GWh

Overall, Benchmark is forecasting Europe to have a capacity of 789.2GWh by 2030, little over 14% of the global total of 5,454GWh. It is important at this point to make clear that the capacity of the plants is in GWh and not number of batteries. Table 3-10 shows the impact of creeping battery capacity size has on vehicle supply. In simple terms the larger the battery the less vehicles produced.

Table 3-7. Impact of battery capacity on vehicle volumes

GWh	kWh	Number of vehicles (millions)
789.2	50	15.7
789.2	60	13.1
789.2	70	11.2
789.2	80	9.8

A further challenge is that not all batteries produced will either go into vehicles. Some batteries will go into static storage and larger vehicles. The current level is not known. Also, the balance of trade in terms of EV imported into Europe and exports is unknown.

Achieving a target of all new vehicles being EVs by 2030 could only be achieved if batteries get no larger than 50kWh, all produced batteries go into cars and vans, every proposed battery plant gets built, and no material supply problems occur. If PHEV, with smaller batteries, make up a larger proportion of the new car market this would help, however the market is quickly moving to full BEV.

If by the end of 2022 the expected battery production capacity of 77.4 GWh is achieved, with an average of 50kWh batteries will produce 1.5m vehicles. The UK is 14% of sales so assume 14% of EV produced goes to the UK, which is 210,000 per year.

The Society of Motor Manufacturers and Traders indicates that approximately 300,000 EVs were sold in the UK in 2021 (Table 3-1). This equates to approximately 900 new vehicles per local authority area per year. Although EV sales have increased year on year this section highlights the challenges to the continuing growth of EV production. If EV sales per local authority area plateau at around 900 per year this would mean only 7,200 new EVs per area by 2030. This is insufficient to replace the existing vehicle fleet in Warrington, which as of 2021 Q4 is 122,300 car and vans.

This demonstrates the challenge with achieving EV registration targets and why providing public charging infrastructure is only part of the picture.

3.6.3 Chip availability

A shortage of microchips around the globe is influencing almost every industry. The automotive sector is no exception, and car production has reduced across the world due to the lack of microchips.

Microchip factories take up to six months to re-start production of specific types of chip, leaving carmakers facing severe delays in their supply chain. Ford itself has said it expects the production of 1 million of its own cars to be hit by the shortage.

An acute lack of computer chips has left dealers struggling to supply many new conventional models let alone electric vehicles.

These are critical components in modern cars, being used in areas such as engine management and emissions control, emergency braking, airbags, entertainment systems and navigation. A modern car can use between 1,500 and 3,000 semiconductors. The motor industry also faced intense competition for the chips that were available from other sectors, particularly the consumer electronics industry.

3.6.4 Chargepoint Technology

Chargepoint technology continues to impact the behaviours of EV drivers regarding their charging habits. Rapid and Ultra-rapid chargepoints are becoming the predominant chargepoint type particularly situated at service stations and EV charging hubs around the UK. These chargepoints are designed to deliver a substantial amount of energy in a relatively short time, allowing drivers to travel large distances without any major time disruption to their journey. The quicker a driver can charge their battery the more use can be made of the post which can ultimately result in less chargepoints being required to support the rise in EV take up.

A vehicle with an 800-volt battery can still use the current, ‘conventional’ charging infrastructure. However, to enable faster charging than current conventional battery systems, this type of system requires a specific type of chargepoint. If more new vehicles are seen to be incorporating this system in future then greater capacity batteries will have the ability to charge in shorter time periods. Depending on the uptake, the chargepoints required would enable the possibility to replenish a battery over a shorter time at the chargepoint that would lead to the possibility of delivering more energy in a given 24 hour period. i.e. having the ability in supporting more EV’s compared to current chargepoints in a 24 hour period.

3.6.5 Vehicle Charging Costs

As the frequency to re-charge an EV battery decreases, due to increases in battery capacity, then the cost to replenish the battery can play a significant role in the use of a chargepoint. Being able to travel further between charging enables some drivers the possibility to charge at home, often overnight, and gain the benefit of lower electricity tariffs compared to the public network chargepoint tariffs.

The cost of energy will directly affect the amount of energy delivered at public chargepoints. Cheaper energy at home and the added convenience, combined with higher capacity batteries giving a driver the ability to travel further distances between charging sessions enables some motorists to have access to an alternative option to charging on the public infrastructure.

3.6.6 Residential charging for households with no off-street parking

The UK Government offers funding to support the provision of chargepoints for residents who do not have their own off-street parking through the On-Street Residential Chargepoint Scheme (ORCS)[30]. However, the process of installing an on-street chargepoint for residents involves several challenges that need to be considered.

- Existing street furniture and utilities – Narrow footways, underground utilities and streetscape ‘clutter’ can limit the opportunities to safely install chargepoints.
- Power requirements – Although less of an issue with slower chargers running on existing infrastructure, rapid and ultra-rapid chargers can often require extensive works to reinforce the local electricity grid, costing time and money.
- Setting of precedence – There is an apparent expectation (evident in media reporting) that households with no off-street parking should be able to charge outside their home via dedicated household provision. However, this has cost implications both during install and for highway maintenance and would have impacts on accessibility and street scene. The extent to which each household will have

[30] https://www.gov.uk/government/publications/grants-for-local-authorities-to-provide-residential-on-street-chargepoints/grants-to-provide-residential-on-street-chargepoints-for-plug-in-electric-vehicles-guidance-for-local-authorities

dedicated provision must therefore be addressed while EV uptake is relatively low, to establish the acceptable level of provision for the future.

- Conservation areas – Locations of this nature often have mandatory design guides when implementing new infrastructure or manipulating current infrastructure. These guides are in place to retain local sense of place, being sensitive to the existing built environment.

Other challenges that must specifically be addressed by WBC when considering on-street charging for those without off-street parking are:

Table 3-8. Specific considerations for WBC relating to on-street residential charging

Consideration	Commentary
Liability	This commentary on liability should not be considered legal advice or guidance but provides an appreciation of liability from a legal perspective. ▪ Negligence law is likely to be the over-riding guide to liability for EV charging infrastructure, coming back to who the duty of care sits with. ▪ The owner of any infrastructure will be liable unless this is contractually passed on to another entity. Where a homeowner is the owner of the hardware they would be responsible for it. However, if ownership of the property changed it is unlikely that liability could be passed on to the next homeowner. ▪ In cases where hardware is owned by one party but used by another there would be a responsibility on the user to do so safely. ▪ Where hardware is installed on the highway under a Section 50 licence, public liability insurance is required. ▪ Related to liability for the installation, operation and use of EV charging hardware is the impact that it may have on other users of the transport network. Where the hardware renders the footway unusable this could give rise to claims against the highway authority.
Planning	It is likely that planning permission will be required in most instances where a householder requests that an option be installed or facilitated to enable charging directly from their home. This is because it is likely that planning regulations will be triggered, which can be found on the planning portal[31]. In particular it is likely that part of the charging infrastructure will be installed within two metres of the highway.
Road Safety	There are a broad range of road safety risks associated with EV charging for residential properties with no off-street parking. Key considerations include: ▪ Trailing cables and other hardware causing trip hazards; ▪ Operation of the chargepoint and associated cabling by users within the carriageway ▪ Disabled access and usability of the chargepoints
Maintenance	Common and key points relating to maintenance are: ▪ Statutory services are generally a minimum of 300mm to 400mm deep in the footway. Most options would require a power supply to be installed beneath the footway and would require hardware to be installed into the footway. This would particularly be the case for rising bollards that are likely to need a deeper installation than other options. ▪ Vandalism is a risk for all options, with some hardware being more vulnerable to it than others. If private property (i.e. belonging to a home owner) were vandalised effective repair or making safe may take longer or be difficult to enforce compared with hardware that is council owned or commercially operated and that may be subject to responsibilities covered by legislation such as Section 50 of the New Roads and Street Works Act 1991. ▪ For some hardware, e.g. channel options, WBC as highway authority would likely be liable for the maintenance burden even though they would typically only be available for use by a single household.

There are several solutions for chargepoints to serve households with no off-street parking. These range from channels so that residents can lay a cable from their house while charging, to fixed chargepoints, with other proprietary options that require the householder to own specific hardware to use the chargepoints on their street. Each has its own advantages and disadvantages both for the user and highway authority. Some

[31] https://www.planningportal.co.uk/info/200130/common_projects/16/electrics/2 (accessed 20/07/22)

solutions require Traffic Regulation Orders to support them, Traffic Regulation Orders cannot be used to 'reserve' a space for a specific household.

A channel system is often promoted as one of the simplest solutions. This can leave the highway authority (WBC) with a long-term maintenance burden and this and other options that require cables to be laid across a footway are considered by some highway authorities to be an obstruction under the Highways Act 1980 and so are not allowed in these areas. Following queries from residents WBC has adopted this stance because it would constitute a hazard to other users[32].

Some local authorities are adopting a 'hub' solution, whereby residents can park and charge at a nearby location, perhaps in a nearby car park or gable end where parking pressures may be lessened. This can reduce the investment needed and reduce the risk of an excess of chargepoints being installed on street. However, this could pose challenges for those with limited mobility who are less able to walk between a hub and their home.

3.6.7 Opportunities for WBC Mitigation to remove barriers to EV uptake

The challenges set out in this sub-section may, to different extents, be addressed by WBC. This is set out in Table 3-9.

Table 3-9. Potential opportunities for Warrington Borough Council to address challenges

Challenge	Potential for WBC influence	WBC Mitigation
PIV production	None	None
Battery production	None	None
Micro-chip availability	None	None
Chargepoint technology	Partial	Infrastructure strategy should consider future EV models and their battery systems to determine the type of chargepoint to install.
Vehicle charging costs	Mostly	The tariffs imposed on public infrastructure can play a part in how frequently a post will be used. There is a need to compare tariffs with the private sector in your area and neighbouring Local Authority tariffs.
Residential charging for households with no off-street parking	Largely	Develop a clear approach to on-street chargepoints in residential areas with no or limited off-street parking, which considers the challenges and opportunities of departments across WBC and its stakeholders.

3.7 Electric Vehicle Charging Technology

Although electric vehicle chargepoints 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. A case study for Milton Keynes is provided in Appendix A.

3.7.1 The Need for Charging Infrastructure

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 their batteries to be recharged. Where this occurs, the duration of the charge and time of day will vary to meet users' requirements. Consumer preferences and habits also have a role to play in recharging behaviour. However, their preferences for charging have not yet been established, which makes it challenging to plan the provision of a charging network.

Slow, fast, rapid and high-power chargers suit different locations and charging behaviours. Slow and fast chargers suit destination charging patterns, where the driver looks to recharge at a location that they will be

[32] https://www.warrington.gov.uk/electric-vehicles (accessed 21/07/22)

leaving the car for a considerable amount of time. Rapid and high-power chargers' suit on-route charging, quick recharging at destinations, and support the taxi and delivery/ logistics (LGV only) trades due to their high-speed capabilities.

The role of this strategy is to identify sites within WBC that should be prioritised for EV charging infrastructure based on outputs from a demand-led geospatial model. This approach will reduce the risk of redundant infrastructure. The strategy will also advise on the speed of the charger that should be implemented at each location.

3.7.2 Chargepoints

There are many specifications of chargepoint in the market, differentiated by power output, communication protocol, type, and number of charging locations (see Table 3-10). They can typically be installed mounted onto a wall or as free-standing units in the ground. Most ground mounted chargepoints can be installed with retention sockets to make future maintenance, repairs, or replacements easier.

Table 3-10. Chargepoint Types

Chargepoint Types (Modes)[33]	Power Output (kW)	Current/ Supply Type	Socket/ Plugs	Charging Duration (40kW battery)	Use Cases
Slow (Modes 1 and 2)	<7	AC	Type 2 Socket	13 hours	Destinations
Fast (Mode 3)	7 – 22	AC	Type 2 Socket	2 to 5 hours	Destinations
Rapid (Mode 4)	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 (Mode 4)	100	DC	Tesla 120kW	TBC depending upon vehicle	On-route
		DC	CSS 150kW+		

3.7.3 Charging Rate

The most significant advances in BEV are the emergence of 800 V electrical systems which achieve much faster charging and reduced weight, allowing them to travel further between charges. Such systems enable greatly reduced charging times, as long as they are using fast chargers capable of working at up to 270 kW.

Charging operators are now preparing for higher powered charging. The pictures along the top row of Figure 3-5 shows normal 50 kWh rapid chargers at a motorway station, of which there are normally two, being replaced by 12 x 350 kWh. These new chargers allow approximately 100 miles of range to be added in less than five minutes. The pictures along the bottom row of Figure 3-5 shows a similar progression by Shell from a single 50 kWh charger to a forecourt of 10 x 175 kWh chargers.

[33] Modes relate to the International Electrotechnical Commission (IEC) 61851 standard. More information on each mode is provided at: https://www.allaboutcircuits.com/technical-articles/four-ev-charging-modes-iec61851-standard/

Figure 3-5. Examples of Charging Forecourts

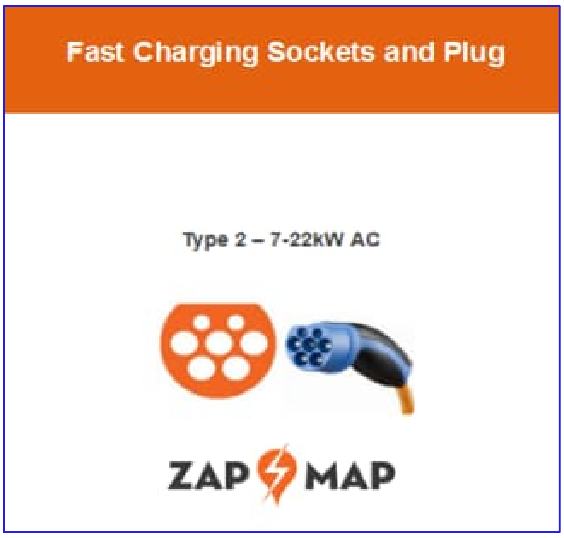
3.7.4 Charging Connectors

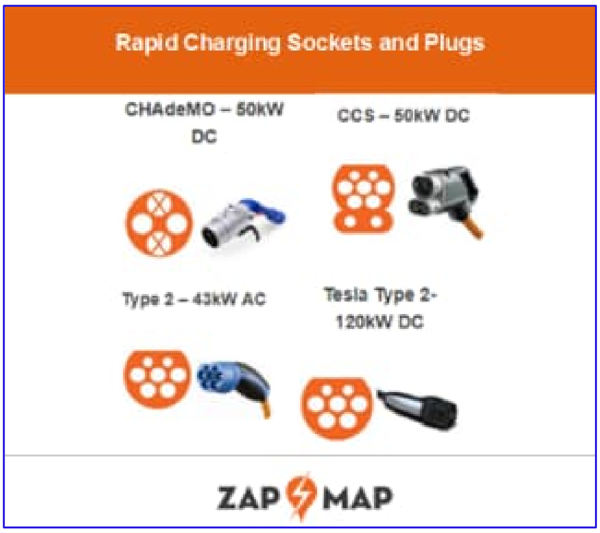
PIV cars and light vans are supplied with a charging cable used to connect the vehicle to slow or fast chargepoints. This cable has a plug specific to the vehicle on one end, and a suitable plug on the other end to connect to slow/ fast chargepoints in the UK. Some vehicles have separate charging sockets for slow/ fast and rapid charging solutions, whilst some manufacturers have standardised around one vehicle-side socket for all charging solutions.

Charging cables are typically supplied with a Type 2 plug to connect to slow and fast chargepoints in the UK (see image on the left in Figure 3-6). Charging cables are also available fitted with standard UK three-pin plugs, which are intended for infrequent use where Type 2 charging solutions are not available.

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. Most vehicle manufacturers use the CHAdeMO or CCS DC socket/plug for rapid and high-power charging (see image on the right in Figure 3-6).

Figure 3-6. Type 2 socket and plugs for slow/ fast and rapid charging in the UK (Source: Zap-Map)





3.7.5 Charging Protocols

The charging protocol governs how the vehicle communicates with the recharging equipment. It could also potentially communicate with a wider network of equipment and services such as payment systems, energy, communications, and other services. The use of the Open Chargepoint 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 for all PIV drivers;
- Flexible to needs of various stakeholders; and
- Cost less to run as new developments are shared easily and quickly.

3.7.6 Upgrading Existing Charging Infrastructure

In some instances, it may not be possible upgrade existing charging infrastructure to be OCPP compliant. In these cases, depending on age, utilisation and cost of ongoing maintenance, older stock will eventually need to be replaced with new OCPP compatible infrastructure. Ensuring all stock is OCPP compliant would improve functionality, reduce maintenance costs and improve the customer experience. More importantly, it would allow an easier transfer of assets to any new chargepoint operators operating platform should there be a need to change suppliers in future.

Existing charging infrastructure should be reviewed and any non-OCPP compatible infrastructure identified. Where possible, this should include the cost to upgrade or noted for future replacement. In the long-term, WBC can choose to pay for the upgrades or enter into a contractual agreement with a supplier who will pay for any necessary upgrades. These options depend on:

- The expectation for the network;
- Available investment funding; and
- The available timeline including disposal of assets, physical upgrade where possible, or replacement of stock.

3.7.7 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. 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. This may reduce the need for expensive electricity network reinforcement.

There are a number of rural settlements within WBC. Smart charging could potentially make sites that require the Designated Network Operator (DNO) network to be upgraded viable if peak demand can be managed.

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; as well as financial penalties from the energy supplier. Alternatively, smart charging allows the monitoring and management of the charging session. The session can be managed remotely and control when, for how long, and how rapidly, the PIV recharges. The benefits of smart charging are summarised in Appendix A.

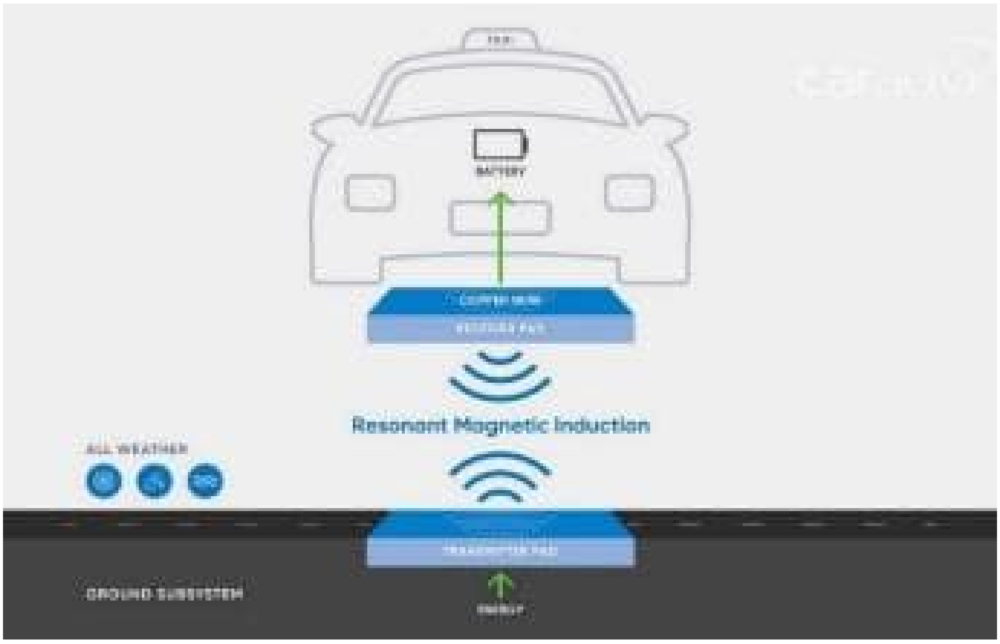
There are currently three levels of smart charging available:

- Basic load balancing distributes the available power capacity equally between all chargepoints to prevent overloading and high energy costs at peak times.
- A new system by Kempower[34], which diverts spare charging power from vehicles that no longer need it, to vehicles that do, via the reallocation of its power modules. This technology can divert spare charging power through the use of multiple dispensers (all normally capable of providing up to 125 kW to an EV), which are connected to a central power bank.
- 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. This ensures that the entire fleet is charged in time for individual departure at the lowest cost.

3.7.8 Emerging Induction Charging Technology

The EV industry has seen substantial technological development in recent years this is exemplified by the ongoing development of induction charging. Induction charging transfers electricity 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. The vehicle must be positioned so that the coils are aligned so that charging can begin (see Figure 3-7).

Figure 3-7. Induction Charging Indicative System



[34] https://fullycharged.show/blog/dynamic-load-sharing-a-rapid-charging-gamechanger/

Wireless EV charging delivers the same power, efficiency levels and charge speeds as conventional plug-in charging methods. Charging can be completed through water, snow, ice, concrete, granite, etc, without any concerns associated with cable connections. Leading wireless EV charging technologies operate at a similar efficiency to plug-in methods (approximately 90%).

Concerns have been raised about damage to health caused by exposure to electromagnetic fields. However, tests have been carried out by suppliers to ensure the wireless EV charging infrastructure is safe. Most of the top vehicle (car) manufacturers have stated that they are likely to offer wireless charging capability in the future, but none currently have definitive plans to do so. Availability of relevant infrastructure, and acceptability to locating the infrastructure within existing infrastructure such as the carriageway and at car parks, will play a major role in determining its possible introduction.

3.8 PIV Adoption

This strategy focuses on Plug-in Vehicle (PIV) adoption rather than ULEV adoption because the volume of PIVs registered (including both BEV and PHEV) drives the demand for recharging services. Published ULEV adoption figures include some hybrid vehicles which do not plug-in. It is also important to understand the local areas' circumstances when devising a charging strategy such as vehicle ownership, propensity to buy PIV, housing stock and therefore the ability to recharge at home.

3.8.1 PIV uptake in Warrington

The latest published DfT vehicle statistics[35] were used to investigate total vehicle registrations and the uptake of PIV to Q4 December 2021. This historical PIV registration data was then used to forecast possible increases in PIV adoption in the area to 2030. A caveat is that some vehicles will be registered outside of Warrington due to lease arrangements however due to the cross reference of the domestic chargepoint grant scheme most private owners are correctly allocated.

Table 3-11 shows that 1,491 plug-in cars and vans were registered in Warrington by December 2021 equating to 1.22% of all cars and vans registered in the area, which is below the UK national average of 1.9%. Warrington is home to 0.33% of all cars and vans in the UK, but currently has only 0.2% of all PIV registered in the UK. It should be noted that these figures do not include PIVs operating in Warrington that are registered outside the Borough, due to either in-commuting or lease vehicles being registered by the leasing company at their base location.

Table 3-11. Plug-In Vehicles registered

Area	Population Density	Total cars & vans registered Q4 2021 end	Total PIV at Q4 2021 end	% PIV (ranked)
Wokingham	939	108,200	2,118	1.96
Aberdeen City	1,225	103,000	1,287	1.25
Warrington	1,160	122,300	1,491	1.22
Thurrock	1,055	94,500	1,054	1.12
Rochdale	1,391	102,800	890	0.87
Newport	805	82,100	704	0.86
Stockton-on-Tees	962	101,000	808	0.80
North East Lincolnshire	833	81,000	603	0.74

Gross Disposable Household Income[36] (GDHI) and percentage of dwellings without off-street parking data[37] is also useful for interpreting PIV adoption, and to assess the need for public charging facilities. Table 3-12 presents the population, income and vehicle density figures for Warrington. Lack of off-street parking spaces in residential areas presents a particular problem, limiting the ability of PIV drivers to recharge their vehicles at home and suggesting the need for more public charging facilities in areas with a high percentage of homes without off-street parking. Warrington's terraced/flats housing stock figure is lower than the national average, and when coupled with its below average GDHI this suggests overall demand to be relatively low in the near term, however there are likely to be some early adopters and there will be a need to support these

[35] https://www.gov.uk/government/collections/vehicles-statistics

[36] https://www.ons.gov.uk/economy/regionalaccounts/grossdisposablehouseholdincome

[37] Dwelling data from https://www.nomisweb.co.uk/census/2011/data_finder

residents. Most cities and large towns in the UK have suburbs of terraced and apartment housing which will require recharging solutions in the medium to longer term. Warrington's vehicle ownership density figure is slightly higher than the national average, possibly due to its excellent road connections to the nearby cities of Manchester and Liverpool encouraging much commuter traffic.

Table 3-12. Warrington demographics related to PIV charging need

Area	Estimated Population Mid-2020	2020 people per sq. km	Vehicles/head of population	% Terraced homes & flats 2011 census	£ GDHI 2019
Warrington	209,397	1,873	0.63	35.29%	20,946
UK	67,100,000	276	0.59	46.90%	21,433

The EV taxi fleet is analysed in the WBC Electric Vehicle Taxi Strategy.

3.8.2 Vehicle forecasts and targets

Using the historical baseline data for PIV registrations up to September 2019, a forecast was made for adoption to 2030 assuming all conditions remain the same. This can be considered as the do-nothing scenario for PIV adoption in the Warrington area.

The forecast provided also includes a compound 20% uplift to 2030 (blue line) for comparison purposes. Table 3-13 shows the calculated forecast figures for 2020, 2025 and 2030 in each scenario.

Table 3-13. PIV forecast figures for Warrington area

PIV	Baseline	Do Nothing Scenario			20% Increase Scenario		
LA area	Q3 2019	Q4 2020 Forecast	Q4 2025 Forecast	Q4 2030 Forecast	Q4 2020 Plus 20%	Q4 2025 Plus 20%	Q4 2030 Plus 20%
Warrington	486	606	1,474	2,719	620	1,646	4,367

The UK has a technology neutral strategy to make every new car and van sold in the UK zero emission, recently this target was brought forward from 2040 to 2030 for PIVs. Vehicle targets are only set for ULEVs, only some of which are PIV as explained earlier. To achieve this, 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 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[38]

No systematic ULEV targets have yet been set for UK regions or individual LAs to enable comparison of their performance against the UK goals. Therefore, this strategy has calculated proportionate targets for Warrington by 2025 and 2030 using its 0.33% contribution to the current UK fleet as a basis. Warrington PIV registrations currently make-up 97% of its ULEV figure, so this percentage has then been applied to calculate PIV targets for the area shown in Table 3-14.

Table 3-14. PIV targets based on 0.33% of UK fleet CCC targets

PIV	Baseline	Warrington Proportionate CCC Targets @ 0.33%		
LA area	Q3 2019	Q4 2020 Target	Q4 2025 Target	Q4 2030 Target
Warrington	**486**	**2,177**	**14,725**	**43,534**

This exercise demonstrates that the calculated PIV targets are above the current PIV projections in both the do-nothing and 20% increase scenarios. Any further action should be to make Warrington EV ready by sequencing investment in a timely way ahead of forecasted demand.

3.8.3 Comparative areas

Table 3-15 compares Warrington's PIV situation with other areas with a similar population density and total car & van figures (within 20%). This demonstrates the wide variation in PIV uptake across the UK. Warrington currently sits roughly in the middle of similar LA areas in terms of PIV adoption.

[38] UK New Car Registrations (SMMT): December 2020: The Future Is Clearly Electric! - Ezoomed

This comparison shows that because Stockton and Rochdale both benefitted from early OLEV Plugged In Places programme funding to install chargepoints operated free of charge to EV drivers from 2010 onwards, but their PIV adoption rates are very low even 10 years on. Therefore, there are clearly more drivers of PIV demand besides the provision of EV charging infrastructure.

Table 3-15. PIV adoption in areas with similar population density and total car/van figures

Area	Population Density	Total cars & vans registered Q4 2021 end	Total PIV at Q4 2021 end	% PIV (ranked)
Wokingham	939	108,200	2,118	1.96
Aberdeen City	1,225	103,000	1,287	1.25
Warrington	**1,160**	**122,300**	**1,491**	**1.22**
Thurrock	1,055	94,500	1,054	1.12
Rochdale	1,391	102,800	890	0.87
Newport	805	82,100	704	0.86
Stockton-on-Tees	962	101,000	808	0.80
North East Lincolnshire	833	81,000	603	0.74

Investigating high PIV adoption in areas with similar population density to Warrington is shown in Table 3-16. The following paragraphs explain why these areas have higher PIV adoption rates than Warrington and the policies that Warrington can look to adopt to increase its PIV adoption rate. It is noted that given there is a net inflow of commuters into Warrington the % PIV may be higher in terms of vehicles operating on the highway network however, at present there is no available evidence to demonstrate this.

Table 3-16. Highest Ranking PIV uptake areas with similar population density

Area	Population Density	Total cars & light goods vehicles Q4 2021 end	Total PIV at Q4 2021 end	% PIV (ranked)
Swindon UA	965	288,500	28,000	9.70
Milton Keynes UA	870	350,800	30,552	8.71
Leeds	1,430	451,300	28,291	6.27
Solihull	1,205	217,000	11,336	5.22
Warrington	**1,160**	**122,300**	**1,491**	**1.22**

Swindon is home to automotive manufacturing plants and multiple vehicle lease companies which sometimes cause a spike in vehicle registration data which does not necessarily reflect where vehicles are kept and used. Swindon has not been part of government funded charging infrastructure programmes however the council owns its own power company Public Power Solutions Ltd (PPS) to deliver innovative power and waste solutions to benefit the local population. PPs are working on a charging strategy for the area and are investigating solar carports for charging facilities[39]. The council has also introduced new development planning requirements calling for charging facilities to be installed in every new home built with a parking space, in 10% of all new retail parking spaces, and 20% at new employment developments[40].

Milton Keynes was originally part of the Plugged in Places programme from 2010 installing chargepoints for public use across the city. In 2016 Milton Keynes was announced as one of four ‘Go Ultra Low’ cities receiving a further £9 million investment for a range of initiatives to make the city EV-ready. This included the introduction of a world-first consumer-facing EV Experience Centre, EV filling stations, charging technology innovation and further development of the charging network, and is matched with an incentivised permit parking offer for ULEV vehicles coming into the city. MK council has offered capital grants for public and workplace chargers and alternative residential charging solutions to cater for those with no access to off-street parking.

[39] https://www.local.gov.uk/electric-vehicle-charging-and-solar-carports-swindon

[40] https://www.swindon.gov.uk/news/article/249/swindon_is_charging_ahead_with_plans_for_an_electric_vehicle_future

West Yorkshire Combined Authority developed an EV charging feasibility study considering potential locations in 2017 including Leeds which has since gone on to introduce some ground-breaking schemes to encourage EV adoption. Leeds offers free parking for all EV in council operated carparks, offer grants and interest free loans to taxi, PHV, freight and bus operators for cleaner vehicles and operates an EV trial scheme covering electric PHV, vans and bikes. The Council is in the process of converting their entire vehicle fleet to EV including the charging infrastructure needed to support the transition at depots and key destinations.

The rate of take up in in the West Midlands in one of the highest in the UK, and Solihull has the second highest level of PIV registrations after Birmingham growing far faster than the UK average. TfWM are currently rolling-out regional charging infrastructure opportunities to deliver a consistent service across the region. Birmingham has been awarded OLEV Taxi funding to install 197 EV chargepoints in approximately 80 locations for the exclusive use of electric and hybrid Taxis and Private Hire Vehicles from 2020[41].

3.9 Electric Buses

This section provides an overview of electric bus policy, technology, applications and charging requirements. Electric bus technology includes full electric, plug-in hybrid, trolleybus IMC (in motion charging) and fuel cell models. According to Bloomberg New Energy Finance, at the end of 2017 there were 3 million city buses in operation worldwide only 13% of which were electric. By 2019 98% of the global electric bus fleet was reported to be deployed in China, with only approximately 4,000 electric buses operating in Europe. However, demand for electric buses in Europe is likely to rise in the coming years with increasing urban emission reduction targets.

3.9.1 Bus Policy

Buses are England's most used form of public transport, accounting for roughly 50% of all public transport trips.[42] Bus services can provide a reliable and innovative mobility service reducing congestion, increasing productivity and connecting communities, however bus patronage in many places of the UK has seen a decline in passenger numbers, with the Coronavirus pandemic resulting in further sharp downturns in use. Bus operators and transport authorities therefore are increasingly looking at measures to rebuild the bus networks and encourage passengers to return.

The majority of UK bus fleets use diesel powered ICE buses contributing to the poor air quality in urban areas, so the Bus Services Act 2017 encourages LAs and the bus industry to work together to achieve economic, environmental and social objectives for their communities. The government’s aim is to create a growing market for low emission buses in the UK, speeding up the eventual transition to an entirely ultra-low emission bus fleet.

A Low Emission Bus (LEB) is defined as producing 15% less GHG than a conventional Euro V diesel bus and meet Euro VI engine regulations[43]. An Ultra-low emission bus (ULEB) is defined as saving at least 30% well-to-wheel GHG emissions compared to a Euro VI diesel bus of equivalent passenger capacity and has a Euro VI certified engine or equivalent emissions capability[44].

Government incentives through the Green Bus Fund have helped deploy 1,200 low carbon buses since 2009, the Low Emission Bus Scheme facilitated a further 326, and the ultra-low emission scheme will enable another 263 ULEBs from 2019. The latest ULEB funding awards cover LAs from Brighton to Cardiff to North East England and include both electric and hydrogen buses and infrastructure[45].

In February 2020 the government announced £5bn funding to 2025 to improve bus and cycling services in England[46] and local areas were encouraged to apply to become Britain’s first all-electric bus town[47] receiving up to £50m as part of a £170m fund intended to make journeys easier, greener and more reliable. The press release stated that 200 electric buses could offset 3,700 diesel cars and also encouraged the development of improvements including bus-lanes and priority traffic lights to increase bus flow and speed-up trips.

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[41] https://www.birmingham.gov.uk/info/20013/roads_travel_and_parking/566/electric_vehicles

[42] annual-bus-statistics-2018-19 (publishing.service.gov.uk)

[43] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/694955/uleb-scheme-participant-guidance.pdf

[44] https://www.lowcvp.org.uk/Hubs/leb/ultra-low-emission-bus.htm#ULEB

[45] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/774207/ultra-low-emission-bus-scheme-winning-bidders.csv/preview

[46] https://www.bbc.co.uk/news/uk-politics-51453457

[47] https://www.gov.uk/government/publications/apply-for-the-all-electric-bus-town-scheme

3.9.2 Electric bus case studies

At the end of 2018, the largest fleet of electric buses in Europe was operated by Connexxion around Schipol airport in The Netherlands. VDL Bus & Coach supplied 100 electric buses for the Amstelland Meerlanden concession creating the largest electric bus fleet with a single operator in Europe. These articulated e-buses collectively cover up to 30,000 km per day and are fitted with the latest generation of batteries quick charging in 20 minutes or less at chargepoints along the route, allowing a 24-hour service. VDL have also supplied 55 electric buses to Rotterdam public transport operator RET who will use a combination of overnight depot charging with on-route rapid charging.

In 2019 London announced that it had the largest electric fleet in Europe[48] with more than 200 electric buses and 12 Low Emission Bus Zones resulting in a 90% drop in bus-related NOx emissions in these areas. In addition, 2 routes became Europe's first exclusively electric double-decker routes and a further 78 electric double-deckers were on order for delivery in 2020.

To support this transition in 2018 the Chinese bus company BYD and Scottish bus company ADL with partner SSE transformed the historic Shepherd's Bush bus depot in West London into an advanced smart electric bus operating centre, with the aim of becoming RATP Dev's first zero emission bus garage in London. SSE already operates large scale electric bus charging infrastructure at five facilities in London including the landmark fully electric depot in Waterloo. BYD's smart charging management system enabled the simultaneous overnight charging of all Shepherd Bush's electric buses with minimal manual supervision. London's long-term plan is that by 2037 all 9,200 buses across London will be zero emission[49].

In 2019 Nottingham launched the UK's first all-electric Park & Ride services from two sites using 13 electric BYD single decker buses. This complements the city's fleet of 45 electric Optare Solo buses and Versa minibuses which have delivered over one million electric miles and saved over 1000 tonnes of CO_2 emissions since 2012. Nottingham City Council own the electric bus fleet and contract CT4N to operate it, known as the Linkbus network. Purchase of the vehicles for these fleets was innovatively part-funded by the council's Workplace Parking Levy, which also supports the Linkbus network provided by the Council[50]. Nottingham also uses 53 Bio-Gas double-decker buses and has secured ULEB funding to expand their gas refuelling station to enable a further 67 to be deployed. Following a successful zero emission bus regional areas bid 78 new electric single deck buses will head to Nottingham. The city will receive £15 million toward the cost of the buses and electric charging infrastructure[51]

York has one of the largest electric double-deck fleets outside of London, adding 21 new buses manufactured by Optare in 2019, to the 12 existing single-deck buses operated by First York from two Park & Ride sites (a cornerstone of York's transport strategy) since 2014. The new double-deckers have a range of 150 miles requiring overnight charging only. Most recently in March 2022 York Council were awarded over £8.4 million to buy 44 additional fully electric buses, these will complement the 33 electric buses currently running on the York Park and Ride[52].

The Harrogate Bus Company, a subsidiary of Transdev, began using the UK's first opportunity-charged electric buses in 2018 (Volvo 7900e). The buses recharge in approximately 6 minutes using ABB's TOSA (Trolleybus Optimisation Système Alimentation) solution using pantograph attachments installed on masts at Harrogate's bus station to deliver power, but the long-term plan is to provide these charging systems at bus stops around the town.

Glasgow was the first UK airport to introduce a fleet of electric buses to its car park operation. Three all-electric Enviro200EV buses built by BYD and Alexander Dennis Limited (ADL) replaced the diesel fleet used to shuttle passengers between the terminal and long-stay car park.

3.9.3 Electric bus charging

Battery electric buses offer zero-emission, quiet operation, better acceleration, higher energy efficiency and lower cost of ownership compared to traditional ICE buses. For both fleet vehicles and buses the charging times must match the stationary opportunities that exist within the operating schedule, to minimise lost revenue. Maintaining the same number of buses, the same trip schedule, same number of drivers etc is paramount in ensuring that moving to electric does not negatively impact the existing operating model and business case.

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48 https://www.london.gov.uk/press-releases/mayoral/london-has-europes-largest-electric-bus-fleet

49 https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/cleaner-buses

50 https://www.nottinghamcity.gov.uk/wpl

51 Multi-Million Pound Investment in 78 New Electric Buses for Nottingham City Transport - Nottingham City Transport (nctx.co.uk)

52 Fleet of 44 electric buses coming to York after city wins £8.4 million in funding | YorkMix

Appropriate charging solutions for buses depend upon routes, pay-load, hours of operation, energy landscape (availability of power) and dwell-times at stops and depots. DC plug-in charging solutions may be appropriate at depots where buses are parked overnight or between shifts. However, costs for new high-power grid connections may be prohibitive meaning smart-charging tools may be required to manage peak power loading, energy costs and provide more flexibility for operators. Pantographs and underbody collectors may be integrated into bus-stops to provide quick top-up charges, reducing the initial vehicle investment by enabling smaller batteries to be used but increasing the required infrastructure cost.

ABB provides multiple charging solutions for buses[53], these are shown in Figure 3-8. Depot charging at powers ranging from 24 – 150 kW using the DC CCS connector with smart charging, sequential charging and remote-control capabilities enable large fleets to optimise charging activities. ABB also offer top-down and bottom-up pantograph solutions for on-route charging. ABB's innovative TOSA[54] (Trolleybus Optimisation Système Alimentation) solution offers a flash-charging technology with onboard traction equipment to suit high-frequency urban bus routes. Batteries mounted on bus roofs of buses are flash-charged in 20 seconds at 600 kW at selected stops while passengers are embarking and disembarking, with a further 5 minutes at the terminus at the end of the line providing a full recharge before the next journey begins. ABB also provides the onboard drivetrain solution including the Energy Transfer System (ETS) that connects the e-bus to the infrastructure, and a suite of network management tools to assist in selecting optimal stops for flash-charging deployment.

Figure 3-8. ABB charging solutions for electric buses

Siemens portfolio includes a range of equipment suiting different charging requirements of operators and bus manufacturers[55]. These solutions are displayed in Figure 3-9. Solutions include off-board top-down pantograph charging from 150 - 600 kW power, 60 – 120 kW on-board bottom-up pantograph chargers for en-route opportunity charging and DC plug-in solutions from 30 - 150 kW suitable for depot use.

Figure 3-9. Siemens eBus charging solutions

Multiple manufacturers now offer e-bus charging equipment in Europe, either independently or in a package with e-buses e.g. Circontrol, Nidec, Proterra, Cummins.

[53] https://new.abb.com/ev-charging/

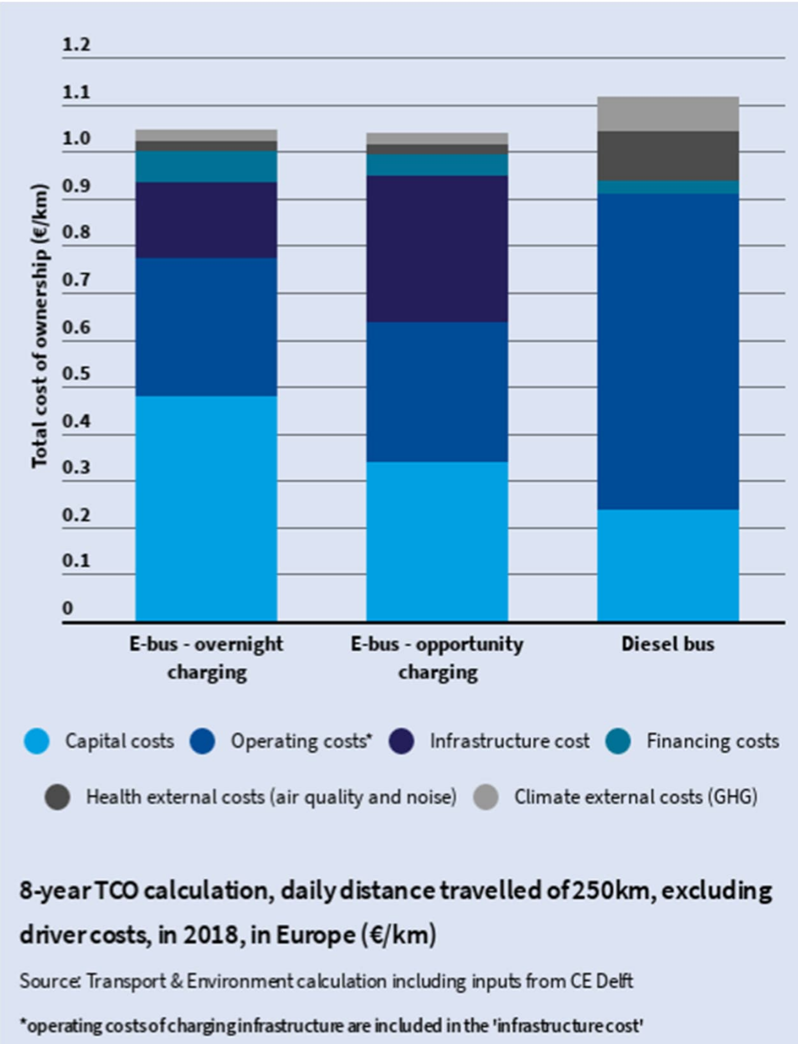
[54] https://new.abb.com/substations/railway-and-urban-transport-electrification/tosa-electrical-bus-charging-infrastructure

[55] https://new.siemens.com/global/en/markets/transportation-logistics/electromobility/ebus-charging.html

Where capacity in the local power network is limited innovative approaches are being used to overcome this challenge. Stagecoach is using Tesla Powerpacks to reduce the cost of charging a large fleet of ADL and BYD electric buses in Guildford, making it a “battery-supported bus depot”. Energy company Zenobe installed 78 stationery batteries and several charging stations at Stagecoach’s depot when the cost of electric supply upgrade proved cost prohibitive to Stagecoach’s electrification plans. The Tesla energy storage units charge from the grid at off-peak prices and then charge the electric buses overnight.

Figure 3-10 shows that an electric bus with overnight charging has potential for lower combined capital and operation costs than a diesel bus, due to significantly lower operating costs for e-buses in this example. It is expected that overnight charging buses will be increasingly common as battery prices decrease and gradually become more attractive than opportunity charging buses where infrastructure cost is much higher.

Figure 3-10. Cost comparison between electric bus and diesel bus in 2020 with 200km travelled per day



3.9.4 Availability of Electric Buses

Table 3-17[56] provides a sample of electric bus models on and coming on to the market, with different battery capacity, power and charging requirements to suit the complex range of bus operating models. Electric range does not appear in this summary, but due to the fixed and repeatable nature of bus routes the power required can be calculated. The technology challenge for bus operators is do they charge slowly over night,

[56] https://www.mobilityhouse.com/int_en/solutions/solutions-for-electric-bus-fleets

charge high power at a convenient point, opportunity charge or continuously draw power such as the old trolley buses.

Table 3-17. Sample of Electric Bus models and Charging connectors (from Mobility House website – 5th Feb 2020)

Manufacturer	Models	Capacity	Power	Charging mode
Solaris	Urbino 12e | 18 e	240 kWh | 75 – 240 kWh	160 kW | 240 kW	CCS & Pantograph
BYD	Enviro 200 EV	240 kWh	160 kW | 240 kW	CCS & Pantograph
Sileo	S12 / S18	225 kWh | 380 kWh	240 kW | 480 kW	CHAdeMO
Irizar	i2e	90 – 120 kWh	180 kW	CCS
VDL	SLF120 | SLFA180	63 - 240 kWh | 63 – 180 kWh	153 kW | 255 kW	CCS & Pantograph
Volvo	7900 Electric	4x 19 kWh	200 kW	CCS & Pantograph
SOR	NB 12 Electric	225 kWh	160 kW	Pantograph
Caetano	e.City Gold	85 kWh – 250 kWh	180 kW	CCS
Proterra	Catalyst 35/40 Foot	94-440 | 94-660 kWh	2 x 190 kW	CCS & Pantograph
Ebusco	Electric City Bus 2.1	311 kWh	110 – 220 kW	CCS
Ursus	City Smile 12E	226 kWh	105 kW	CCS
Daimler	Citaro E-Cell	243 kWh	180 kW (CCS)	CCS & Pantograph

Note: There is an arrangement where ADL are assembling BYD buses in Scotland.

3.10 Household Type and Levels of Deprivation

Mapping of these two aspects can identify the need for charging infrastructure measures to specific localities as outlined below.

3.10.1 Census 2011 Household Composition

A review of baseline data has been undertaken to establish an understanding of the demographics across Warrington and the potential areas where a higher demand for charging may exist.

Figure 3-11 shows the density of flats across Warrington using Census 2011 data. Figure 3-11 shows that there is a concentration of flats within Warrington town centre. Flats also form part of the household structure on the residential areas on the edge of the town centre. It is likely that residents within flats have limited access to off-street parking and would therefore require on-street chargepoints or alternative public charging services in suitable parking locations close to home.

Figure 3-11. Density of households living in flats across Warrington

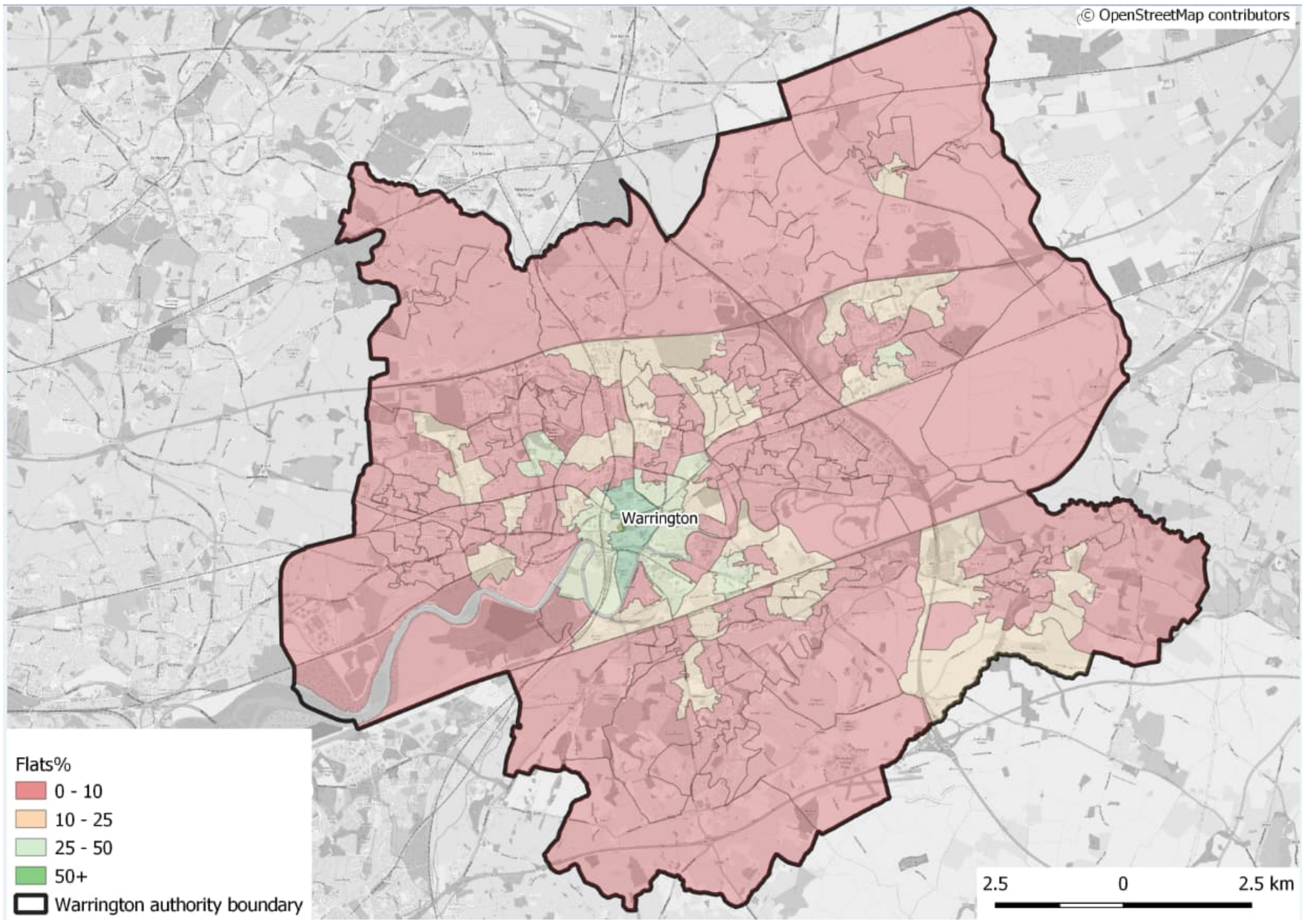
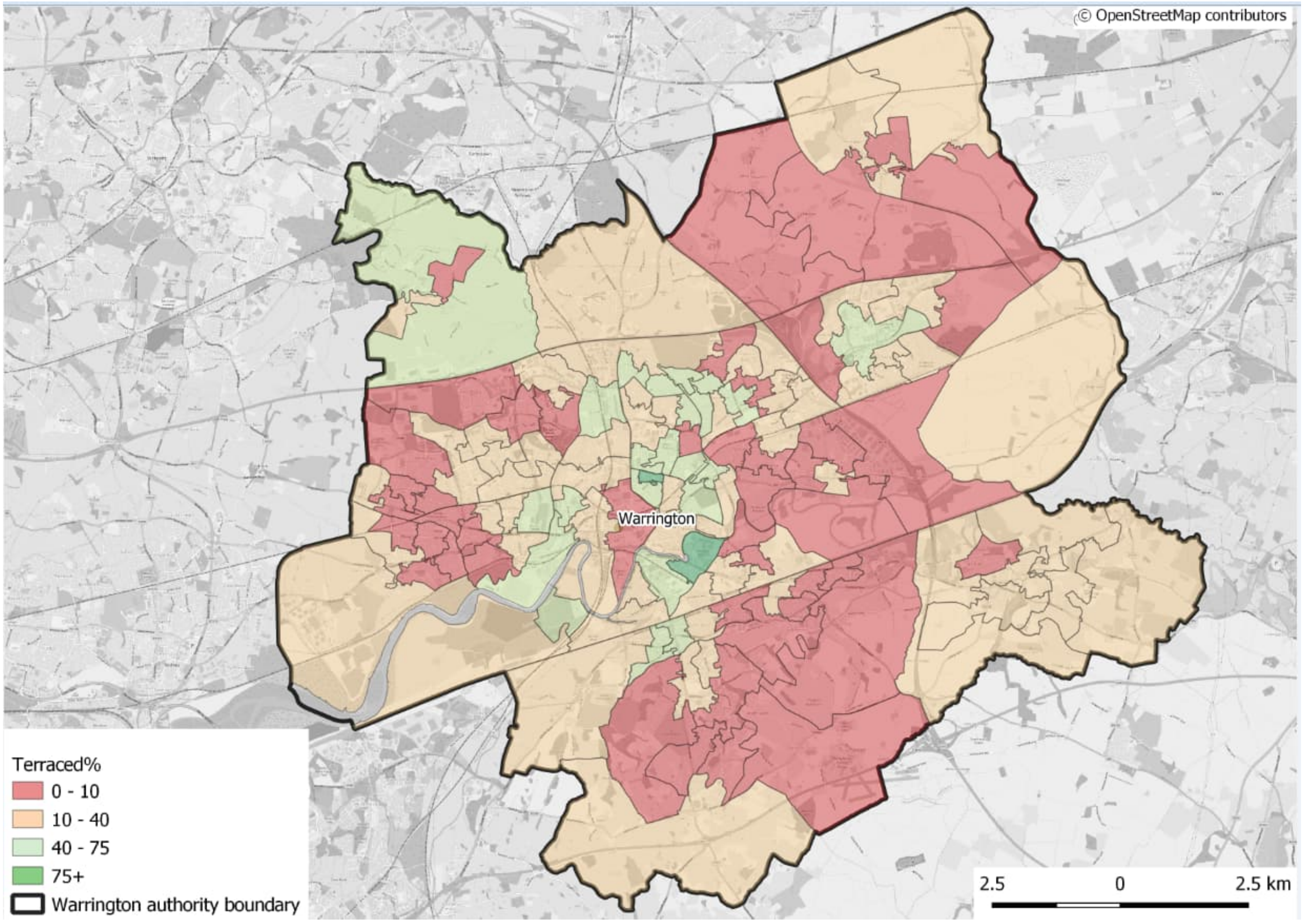


Figure 3-12 shows that there is a concentration of terraced properties in central Warrington, the west of Warrington, and to the north-east of Warrington. Terraced properties also form part of the household structure on the residential areas to the south and east of the Warrington borough. The remaining areas of Warrington have a relatively low density of terraced properties. It is likely that residents of terraced properties have limited access to off-street parking and would therefore require on-street chargepoints or alternatives in suitable parking locations close to home.

The terraced street and high rise accommodation provide a challenge for local authorities if the prevailing thought is to provide an alternative to off street parking for all individuals in this position. Traffic Regulation Orders are required for charging locations on the public highway so only EV can park in these spots which can be challenging in terms of public acceptability on streets that have limited parking. There is also a need to ensure other users of the public highway are not negatively impacted. Cables trailing across footpaths cause hazards for pedestrians and should be avoided. Additionally, chargepoints/columns should not be installed on footways where this narrows the pavement and causes an obstruction. Relatively compact products are available that provide charging post connections at the kerbside to avoid trailing cables and wherever possible larger infrastructure should be hosted on the carriageway (with suitable protection provided) to avoid impacting on pedestrian accessibility. Another option is to install replacements for petrol stations where cars can charge on rapid chargers relatively quickly.

Figure 3-12. Density of households living in terraced properties across Warrington



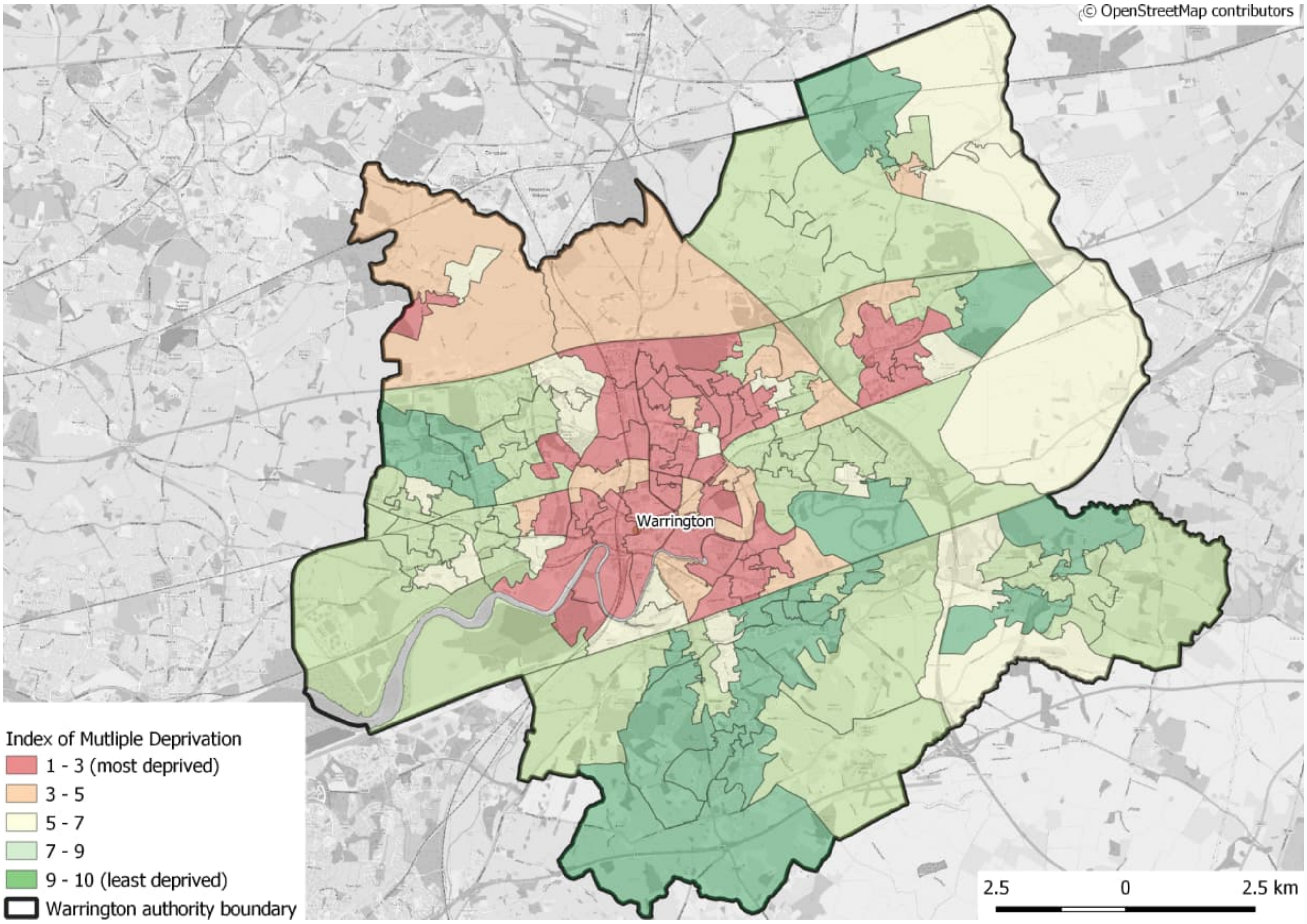
3.11 Income Levels Distribution

Figure 3-13 shows the Index of Multiple Deprivation (IMD) across Warrington. 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 3-13 shows the most deprived area in Warrington is in the town centre and the surrounding residential areas. Areas of Birchwood (to the east) and Burtonwood and Winwick (north of M62) also have relatively high deprivation levels. The south and south-east of Warrington have low deprivation levels. Currently, the cost of an EV and the associated infrastructure is relatively high and therefore uptake in these areas of higher deprivation may not be strong in the near term whilst there is still a price premium on these vehicles.

Conversely in more affluent areas to the south and east of Warrington uptake of EV is likely to be stronger. Detailed mapping of propensity to purchase an EV is currently being conducted as part of the Charge project by Scottish Power to identify priority areas at which electricity capacity will need to be strengthened. Once this data is available it is recommended this information is factored into more detailed consideration of charging infrastructure locations.

Figure 3-13. Index of Multiple Deprivation in Warrington



3.11.1 Cross referencing

A comparison between deprivation levels and areas of limited off-street parking can guide the direction of the strategy. Areas with limited off-street parking and high levels of deprivation include the town centre and immediate surrounding area, and Burtonwood, to the north-west of the Borough. The areas with lower levels of deprivation and limited off-street parking include areas slightly south of the town centre such as Lower Walton and Stockton Heath.

Strategy recommendations can be framed differently for these respective areas with more emphasis placed in the short term on enabling flexible and more cost-effective access to EV through car clubs in areas with higher levels of deprivation and limited off-street parking. Conversely in areas with lower levels of deprivation and constrained levels of off-street parking more emphasis can be placed on the provision of charging infrastructure in the short term.

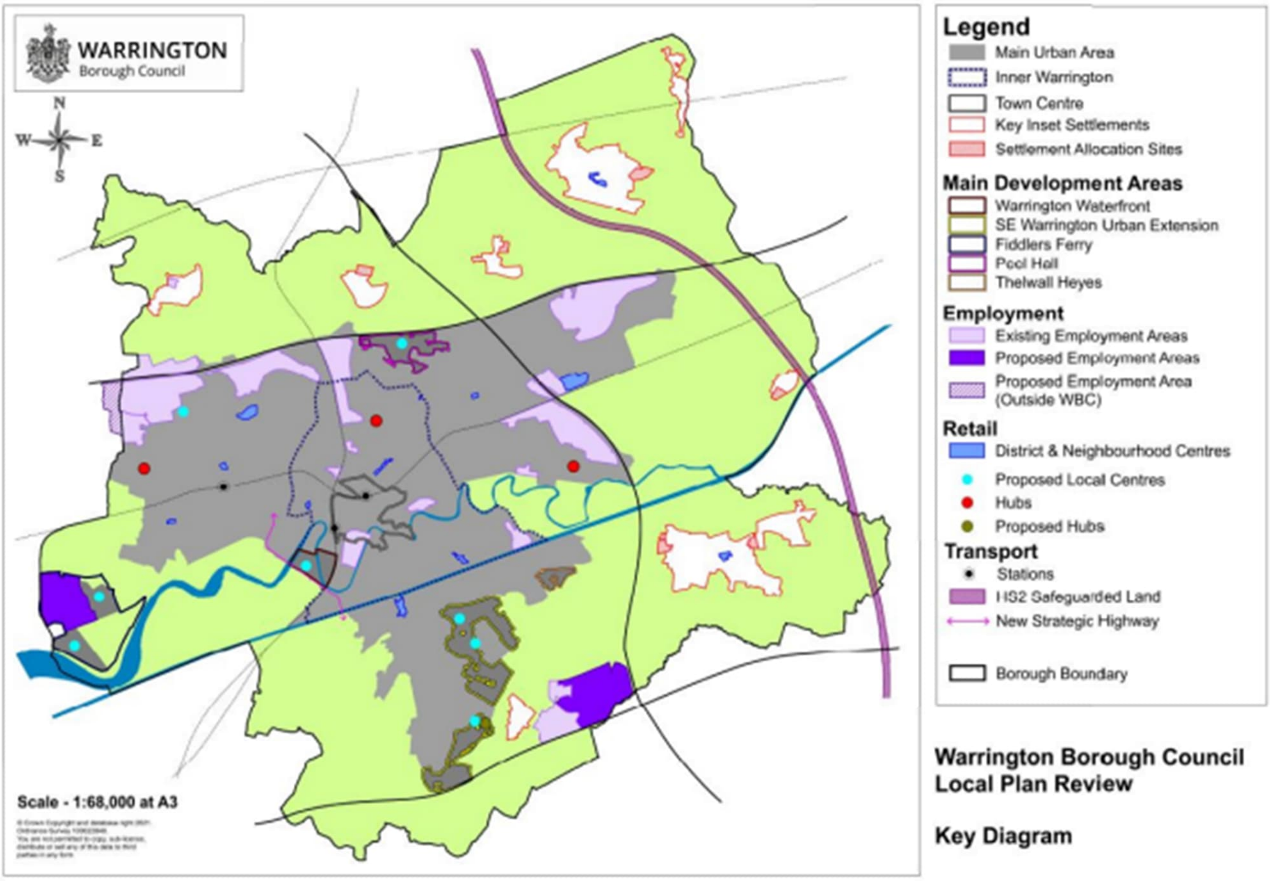
3.12 Planned Development

Through identifying areas of planned or potential development, these areas can be future proofed with EV charging infrastructure to contribute to the presence of supporting EV infrastructure across the Borough.

3.12.1 Local Plan Sites

Figure 3-14 shows the draft Local Plan (LP) sites that are likely to generate demand for charging infrastructure. This shows that the LP developments are primarily focused in the centre of Warrington, with economic growth areas to the north and garden suburbs / suburban areas to the south. This highlights areas of major opportunity for future proofing with charging infrastructure for both residential areas, and employment / retail developments.

Figure 3-14. Draft Local Plan 2021 sites



3.13 Stakeholder Engagement

The draft strategy was submitted to the Energy Saving Trust for its review. Comments received and responses to that consultation are provided in Appendix B. The responses shown in the appendix are reflected throughout this final EV Strategy.

Following completion of the draft EV strategy public consultation was undertaken. It also considered responses from a limited number of businesses. The key outcomes from this consultation were:

- Public Consultation
  - Current EV owners in Warrington typically charge their vehicles at home (75%).
  - Over 50% of respondents anticipated switching to EVs in the next five years.
  - Current barriers to adoption include cost, range anxiety and availability of public chargers.
  - Nearly 90% of respondents thought that there should be more publicly available chargers in Warrington. Strongest support for these is at destination locations such as supermarkets but with a significant number of people (65%) also supporting EV charging forecourts. A smaller percentage although still approximately 50% support on street chargers both in the town centre and in residential areas, suggesting there is less support for on street charging for those without off-street parking than there is for destination charging. This may be because those with off street parking do not value on street residential charging.
- Business Consultation
  - Although a small sample, all business respondents anticipate switching to EVs in the next five years, with charging expected to take place at a central depot or at the home of the staff member responsible for the vehicle.
  - Existing infrastructure was seen as the main barrier to earlier uptake of EVs

3.14 EV Strategy Objectives

Through engagement with stakeholders and review of relevant data, strategies and policies the following objectives of the strategy have been defined:

- Reduce carbon emissions in Warrington in line with WBC's declaration of a climate emergency.
- Improve air quality levels in line with the Air Quality Management Strategy.
- Align with the LTP4 ambition to reduce single occupancy journeys (particularly for shorter journeys) and move towards an integrated transport network.

The above objectives have been used to guide option development and appraisal that is outlined in following sections of this strategy.

4. Charging Infrastructure Mapping

A range of key factors can influence charging demand in different areas as outlined in the evidence base, including the number of origins and destinations, key traffic routes, areas of car parking provision and areas with high residential densities. As such, a review of these factors has been completed in Warrington to inform potential future locations of charging infrastructure. Existing charging sites, car parks and key destinations are mapped in Appendix C.

4.1 Existing charging infrastructure

Existing charging infrastructure is located in various destination areas such as the town centre (Times Square car park), Warrington Bank Quay station car park (for onward travel), and retail areas such as Asda and IKEA. There are however large sections of the Borough that do not have any publicly accessible chargepoints.

Different chargepoints provide different levels of power which affects the charging time which is required to achieve a full charge. Slow units are chargepoints between 3kW and 6kW, fast chargers offer a speed between 7kW and 22kW. Rapid chargers typically charge at 50 kW and ultra-rapid chargepoints charge at 100kW+ power. Table 4-1 below outlines the existing chargepoints serving Warrington and their speed classification. There is currently a lack of rapid charger provision in Warrington with a key gap in the town centre. The only location at present is Burtonwood Motorway Services that is only accessible from Junction 8 of the M62. This will act as a barrier for the uptake of EV in Warrington for a range of use cases, most notably taxis.

Table 4-1 details the chargepoints which are publicly available (also see Figure D-2 in Appendix D). There are other chargepoints at many EV dealerships within Warrington and in some workplaces however these have restricted access.

The limited number of chargepoints across all key use cases acts as a barrier to EV uptake according to surveys.

Table 4-1. Existing chargepoints

Existing chargepoint location	Charging speed
Skymaster, Warrington	Rapid
Park Royal Hotel	Rapid
Miller & Carter Warrington	Rapid
Lymm Services M6 (North)	Rapid
Burtonwood Services	Rapid & Fast
IKEA Warrington	Rapid & Fast
102-104 Dalton Avenue	Fast
Bentleys Toyota	Fast
Times Square Multi Story Car Park	Fast
Warrington Motors Vauxhall	Fast
Warrington Bank Quay Railway Station	Fast
Marks & Spencer - Gemini Trade Park	Fast
Apollo Retail Park	Fast
Emerson Management Services Ltd	Fast
Tesco Extra - Warrington	Fast
White Street	Fast
Gladstone Street	Fast
Manchester Road	Fast
Bewsey Street	Fast
Pentagon Motor Group	Fast
Halliwell Jones BMW Warrington	Fast
Asda	Fast & Slow
Warrington West Railway Station	Fast
Premier Inn Warrington	Slow
Birchwood Shopping Centre	Slow
Spencer House	Slow

Source: zapmap.co.uk & National Chargepoint Registry

4.2 Destinations

The main destination areas comprise of employment, retail and major transport hubs. These areas are predominantly located within the town centre and along the M62 corridor. To the north-east Birchwood Park is a major employment site and to the north-west is IKEA and Gemini Retail Park. In addition, employment sites with available parking provide an opportunity for charging during the day and perhaps overnight if close to residential areas so slow or fast chargers would be suitable.

The town centre has a number of destinations such as Bank Quay and Central rail stations, retail areas, Warrington hospital and areas of employment. A number of these areas have existing car parks where charging infrastructure could be introduced however this would require working alongside private landowners to improve their understanding of the benefits of providing charging infrastructure. Charging infrastructure located on private land may be restricted to customers, staff and visitors to the particular site if public access agreements are not agreed. Charging sites have now been identified and scored with this analysis is set out in Section 9.

4.3 Taxis

Taxis undertake a significant number of journeys and therefore travel significantly more miles per day than a typical driver. As such, a transition to EV within the taxi industry would heavily contribute towards increasing EV miles and reducing urban emissions. The high number of miles also means that taxi drivers may require top up charging and experience from elsewhere in the UK indicates the availability of convenient rapid charging facilities is key to the transition of taxis to EV. The current mileage range for LEVC TX taxi is 64 miles on pure EV[57] suggesting that some taxi drivers will require daily top up charging. An LEVC TX also has a range extender which can be used as the battery charge decreases extending the range to 301 miles.

Key taxi ranks have been identified in the town centre and at Warrington Bank Quay station as part of the stakeholder engagement workshop with WBC officers. Whilst the charging infrastructure could not be implemented directly onto the taxi rank (at least until wireless charging becomes a feasible proposition), convenient off-street rapid charger locations should be considered close to taxi stops and main routes. Ideally charging infrastructure for taxis should be bookable and ringfenced only for use by taxis as quick recharging will be crucial in ensuring minimal downtime for drivers. An audit of off-street opportunities is required in the town centre and surrounding Bank Quay station, covering council, network rail and private car park operators.

4.4 On-route

The surrounding highway network of Warrington town centre includes the A56 to the south, A50 to the east, A49 connecting the north to the town centre, and the A57 to the west. Also, there is the M62 east towards Manchester, the M62 west towards Liverpool, the M6 north and south towards Lancashire and Cheshire East respectively, and the M56 south towards Cheshire West. The travel to work commuter movement analysis shows there are a number of movements from Warrington towards these areas, and therefore potential demand for rapid chargepoints at service stations and along key links.

Potential on-route locations for further investigation could include A57 W (Great Sankey), A49 N Orford, A49 (S) Stockton Heath, A50 S (West).

4.5 Buses

As noted earlier in this report, WBC recently made a successful bid to replace all 120 of its diesel buses with brand new electric buses. Independent of ZEBRA funding a new bus depot is already planned to be built with funding and planning consent already in place. The successful ZEBRA bid will now see the new depot equipped with electric vehicle charging infrastructure and housing a new fleet of zero emission buses.

4.6 Summary

In summary, the potential locations for charging infrastructure are shown below according to their suitability for the various use cases. A more detailed site assessment is set out in section 9.

Table 4-2. Potential charging infrastructure locations

Potential charging infrastructure locations	Use Cases				
	Areas with limited off-street parking / car clubs	Destination	Taxis	On-route	Buses
Locations in the vicinity of Warrington Bank Quay station					
On-street charging within town centre (detailed audit and feasibility required alongside stakeholder engagement)					
On-street charging within residential areas to the south, north and north west of the town centre (detailed audit and feasibility required alongside stakeholder engagement)					
Rapid charging along main arterial routes including A57 W (Great Sankey), A49 N Orford, A49 (S) Stockton Heath, A50 S (West)					
Off street town centre car parks					
Supermarkets with car parking provision					

57 TX https://www.levc.com/tx-electric-taxi/)

Potential charging infrastructure locations	Use Cases				
	Areas with limited off-street parking / car clubs	Destination	Taxis	On-route	Buses
Warrington Interchange					
New bus depot, Dallam Lane					

4.7 Recommended Process for Delivery

Alongside site consideration, it is important to outline the recommended process for delivery of chargepoints. Stages of work are broadly sequential however some elements could be delivered in parallel:

- Determine WBC's preferred commercial model;
- Stakeholder/ partner engagement to understand sites that are being brought forward by commercial providers, further opportunities for sites, conducting informal market sounding, understanding key areas of electricity capacity constraint and assessing stakeholder acceptability;
- Developing a long list of sites that gives WBC a scalable pipeline of infrastructure provision – it is recommended a minimum provision of charging infrastructure is implemented across all use cases to give early adopters the confidence to transition to EV with further infrastructure brought forward to keep pace with demand as evidenced by monitoring of usage. It is also recommended that key actions are taken to strengthen and future proof the energy network including collaborative working with Scottish Power Energy Networks;
- Conducting audits, assessment and option appraisal to determine the suitability and deliverability of sites for the various use cases;
- Following determination of WBC's preferred commercial model, scoping and delivering a suitable procurement exercise;
- Detailed site design, construction and operation/ monitoring.

5. Geospatial Modelling – Future Demand

5.1 Model Overview

The usage potential for any charging site depends on many different factors, but the most important is the total number of EVs. This is not a static number, either spatially or temporally. Therefore, it was important to develop a model that can handle both the variation in location and the year of interest.

To understand how the public fleet will transition to EVs, the model includes a function to assess how new vehicle technology will diffuse into an existing fleet. The diffusion of the new vehicle models was governed by two important characteristics outlined in Table 5-1.

Table 5-1. Characteristics to model diffusion of new vehicle models

Characteristic	Description
Rate that new vehicles are purchased	This determines the "churn" of vehicles within the overall fleet. If few new vehicles are being purchased (e.g. due to a recession), there will be a substantial reduction in the transition to EVs as the population of vehicles is not being replaced.
Probability of new vehicle purchases being an EV	If the fleet is to transition to EVs, the probability of each new vehicle being an EV should increase to 100%. This aligns with the 2030 target that has been set by the UK Government.

Income data for each Middle Super Output Area (MSOA) and the ratio of new vehicle to existing vehicle registrations was used to generate a probability of new vehicle purchases. This variable alters with income due to the strong relationship between average income and new vehicle purchase rates.

To calculate the probability of new vehicle purchases being an EV, 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 choice model used was a Binary Logit Choice Model, with changing variables over two alternatives. This allowed the probability of choosing between two distinct options available to the purchaser to be calculated. The general form of this model is:

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

C1 represents Option 1, U1 represents the Utility of that choice (defined below) and l 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.

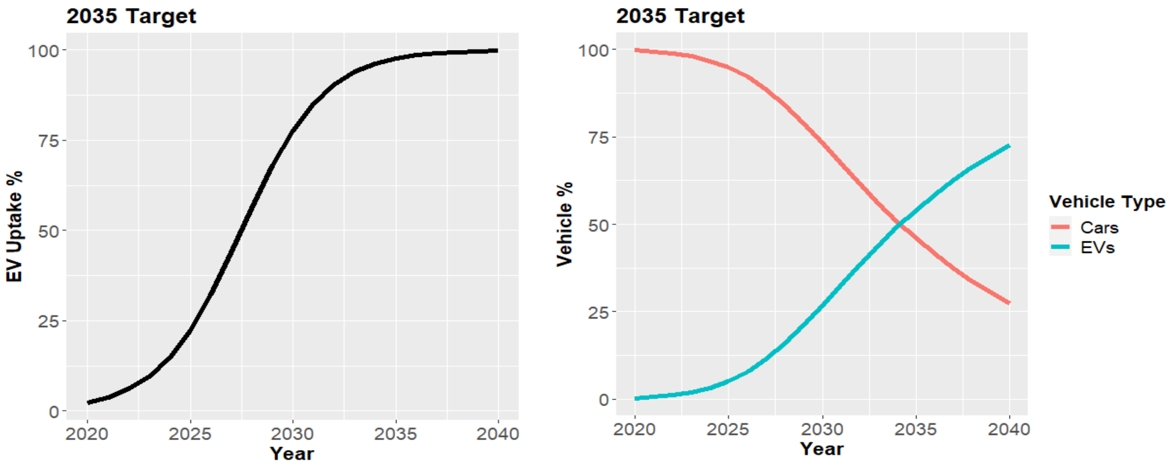
From this model, a stock flow equation was created to govern the movement of vehicles into and out of the public fleet.

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

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 comprise a mix of ICE and EV.

Figure 5-1 shows the number of EVs in the fleet lags behind a potential 2035 goal for full decarbonisation of the new vehicle fleet. Even though 100% of all vehicles sold are EVs by 2035, the fleet still only contains approximately 50%.

Figure 5-1. EV uptake targets



5.2 Data Review of Information Used in the Model

The model was constructed, where possible, through the combination of publicly available data sets shown in Table 5-2.

Table 5-2. Model data inputs

Data	Description	Use
Current EV Sales	The current EV sales by Local Authority.	Used to determine both the current state of the EV market and used to verify the uptake model.
Current Car Totals	The current car totals by Output Area.	Used to disaggregate the EV Uptake into smaller zones
Housing Distribution	Total numbers of houses, including housing type by Output Area.	Used to determine the percentage of homes with off-street parking.
Income Distribution	Median income by MSOA.	Used to determine both EV Uptake percentage and the probability of purchasing a new vehicle.
Employment Distribution	Employment type by LSOA.	This is used to determine the destination charging potential using different employment types to categorise the zones.
Journey to Work OD Matrices	Survey data from MSOA to MSOA.	Used to determine journey charging potential.
OpenStreetMap Road Network	Open-source Road network.	Used to construct a graph network of the UK which, with the JTW matrices, is used to model long distance movements.

5.3 Forecast Uptake in Warrington

Figure 5-2 shows the uptake of EVs and decline of ICE vehicles in Warrington from 2020 to 2040. It can be clearly seen that despite the switch for new vehicles to 100% ULEV by 2030 and the subsequent switch to 100% BEV by 2035, it will still be many years until most vehicles within Warrington will be EVs. However, the 50% cross-over point is predicted to occur at some point between 2030 and 2035.

Figure 5-2. EV and ICE Numbers

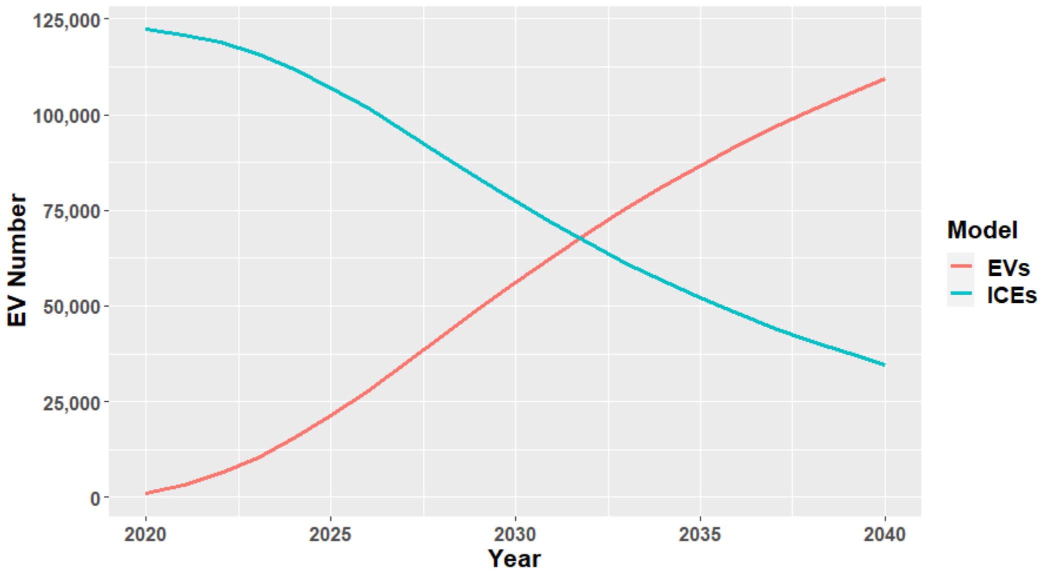
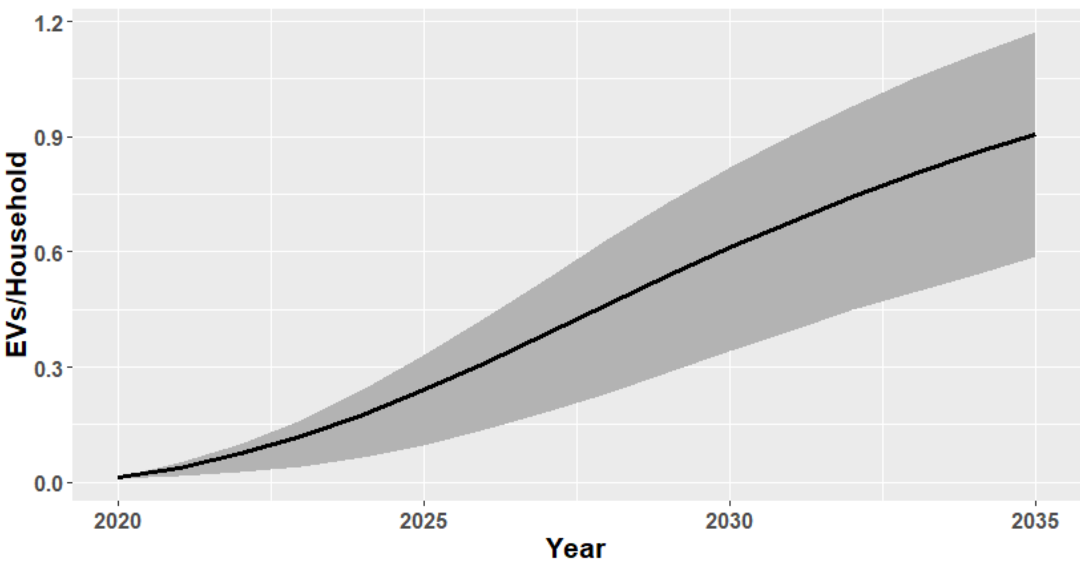


Figure 5-3 illustrates the distribution of EVs per household across Warrington, the EV distribution within Warrington will not be equal. In Figure 5-3 the black line represents the median line of EVs per household. The wider buffer represents the threshold for the bottom 25% and top 75% of EV ownership, for each OA within Warrington. By 2035, the bottom 25% of areas will be approximately 50% less likely to own an EV than the top 25%.

Figure 5-3. EV Distribution per Household



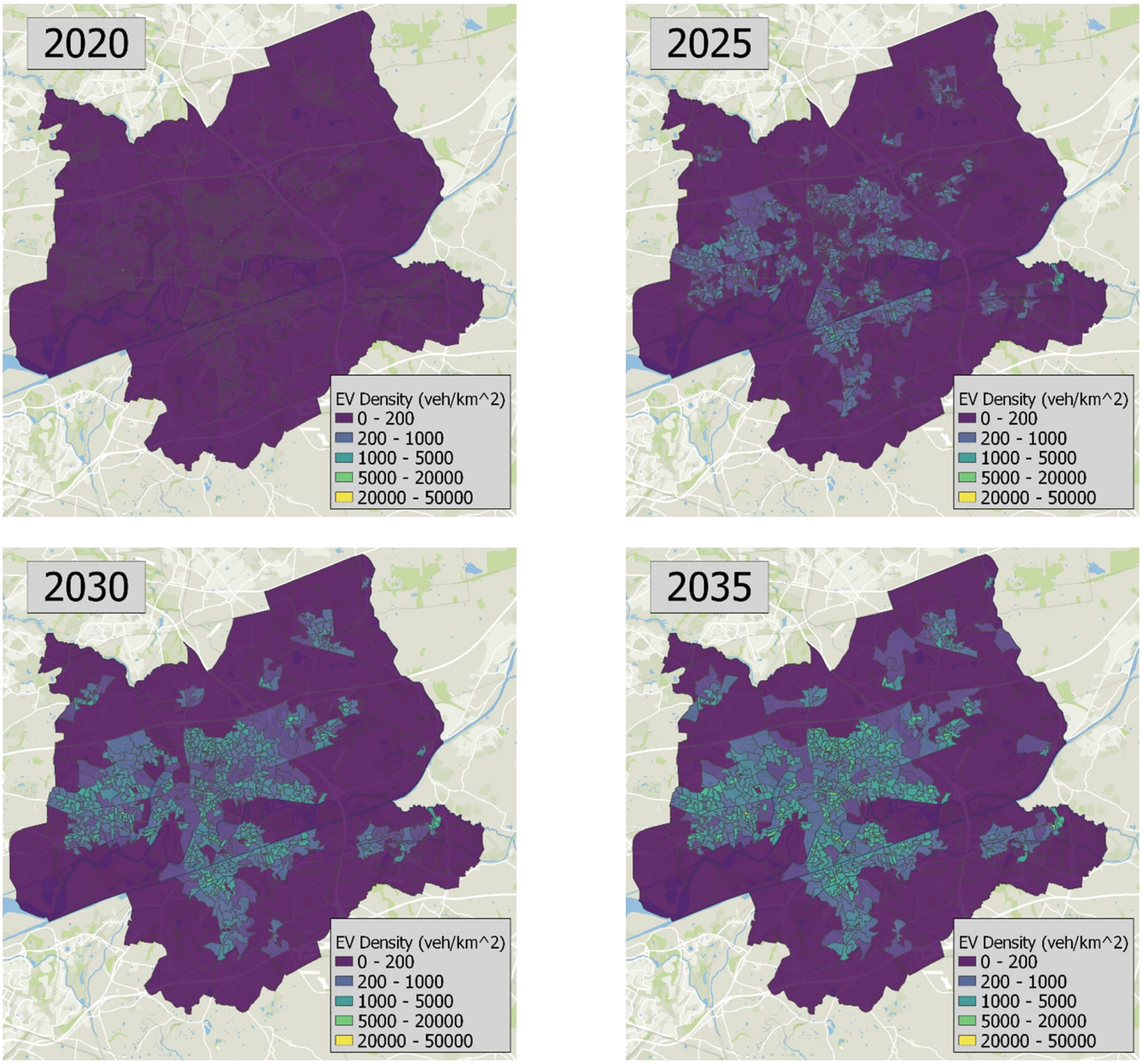
5.4 Spatial Model Results

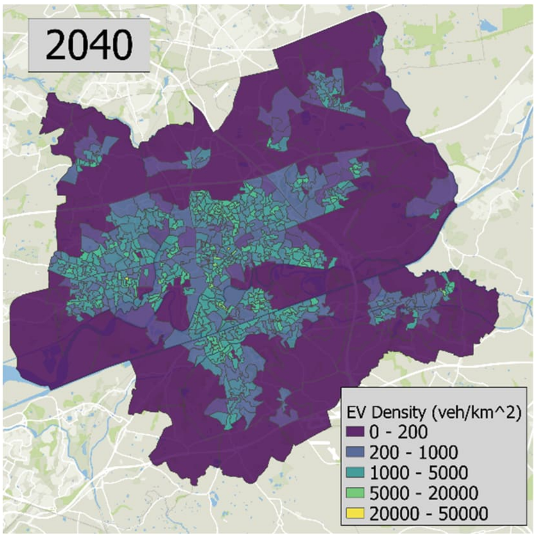
Figure 5-4 shows how the spatial distribution of EV density will alter. The figure illustrates that the greatest rate of change for EV uptake occurs between 2025 and 2035. After this period, the general distribution is largely settled.

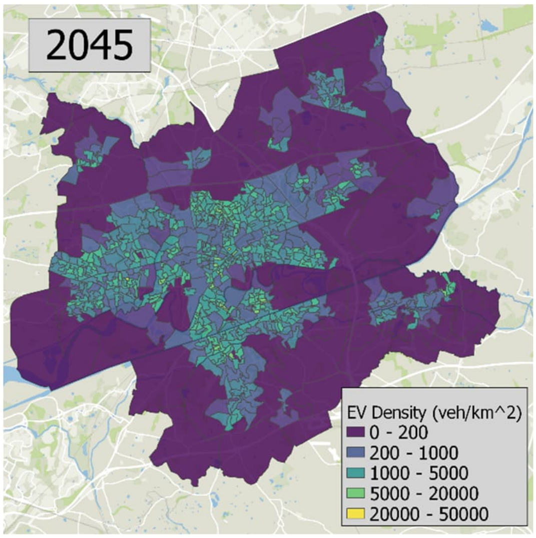
This can be confirmed by comparing these results with those shown in Figure 5-2, where the total numbers are increasing rapidly over this 10-year period.

Beyond 2040, the total number of EVs within any specific area, is more likely to be driven by the underlying factors which drive general car numbers, rather than any EV specific factors. This is because EVs will have become so ubiquitous by 2040, that they may, perhaps, no longer be referred to as EVs but simply "vehicles".

Figure 5-4. Spatial Distribution of EVs







5.5 Commuting and Travel Pattern Results

It is not only the static demographics that will determine the potential requirements for charging infrastructure, but also the movement of vehicles. Charging infrastructure is intended to serve transport, which is a fundamentally dynamic system. To determine charging demand more accurately, and so the subsequent need for infrastructure, it is necessary to analyse movements within Warrington.

As part of the preliminary analysis within this strategy, Journey to Work Census data has been used. This is a freely available dataset detailing both the place of origin and the place of work for all people within the UK.

Although the data provides high level statistics on movements between different Census areas for commuting, it is not as complete as mobile phone data, which can include:

- Time of Travel: This may be to within a very precise time frame but is typically aggregated up to AM Peak, Inter Peak, PM Peak and Off Peak.
- Trip Purpose: The purposes for the trips are split between work and non-work trips, and between home-based and non-home based.
- Trip Mode: The most common modes captured are active, motorised and rail.
- Trip Direction: The direction in this case refers to “From Home” and “To Home” and is used to determine the overall flow direction in commute-based trips.

In addition to the use of Journey to Work Census data, the NTEM (National Trip End Model) data set has also been used to derive a ratio for the number of weekday and weekend trips. The NTEM data set is widely used in strategic transport planning as it provides a breakdown of trip purposes by MSOA for different time periods and modes of transport.

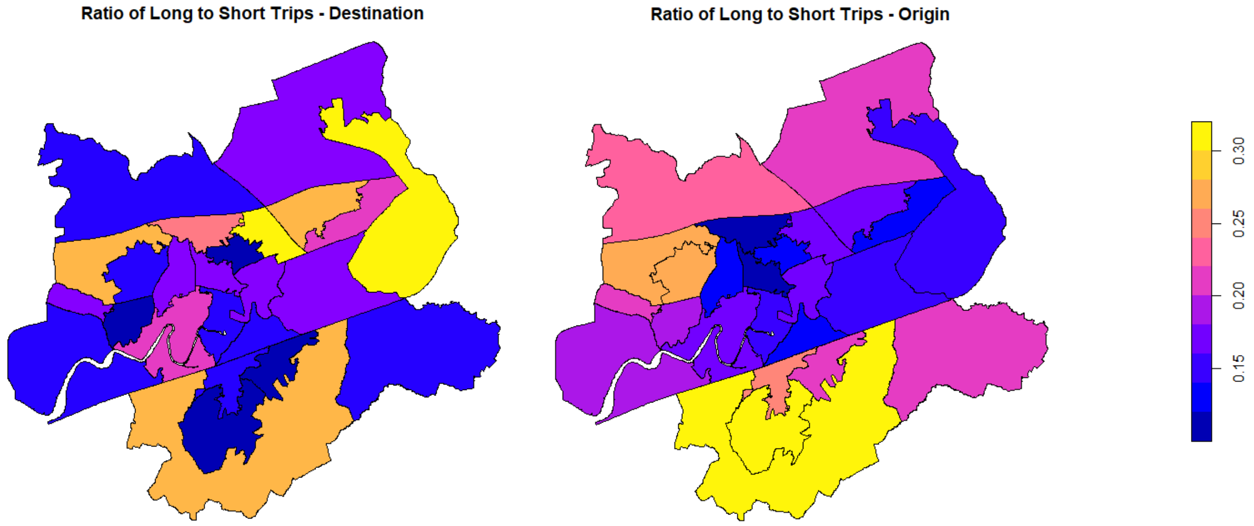
5.5.1 Ratio of Long to Short Trips – Destination

Figure 5-5 shows the ratio of long to short journeys within Warrington, collated by where journeys begin (origin) and end (destination). Within the map, the areas with a higher ratio (those in yellow/ orange) have a greater proportion of long-range trips.

There are multiple areas within Warrington that show a much higher ratio of long to short journeys across both maps. For the origin point of trips, the more rural areas show comparatively longer trips. Where longer journeys are forecast, this suggests that these areas would require more frequent charging.

However, for destinations, the picture is more mixed indicating the distribution of trips across Warrington is variable but with little clear structure.

Figure 5-5. Ratio of Long to Short Trips

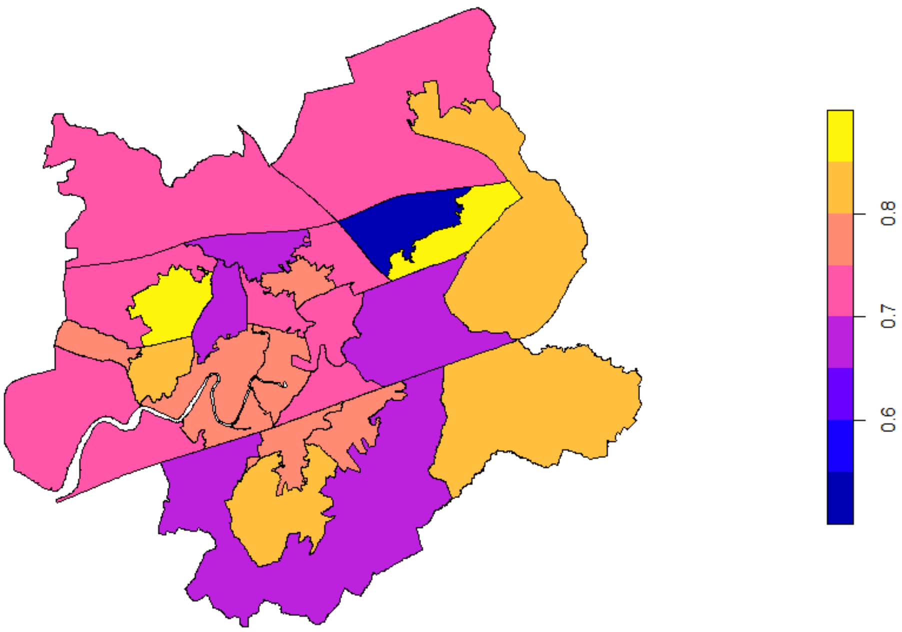


The ratio of weekend to weekday journeys is presented in Figure 5-6. The areas with a higher ratio are those where the trips during the weekend are greater than those during the week. Weekend trips are likely to be generated by leisure and other non-work-related activities, which could serve as an indicator for charging during non-weekday time periods.

There is generally limited structural variation across Warrington with the majority of MSOAs showing similar level of ratio for Weekend to Weekday trips. However, a dramatic difference can be seen in Birchwood and the area to the direct south. This is likely caused by the industrial park within Birchwood driving Weekday trips, and the nature parks driving weekend trips.

This graph shows that when considering installing charging infrastructure it is necessary to cater for the two different types of users.

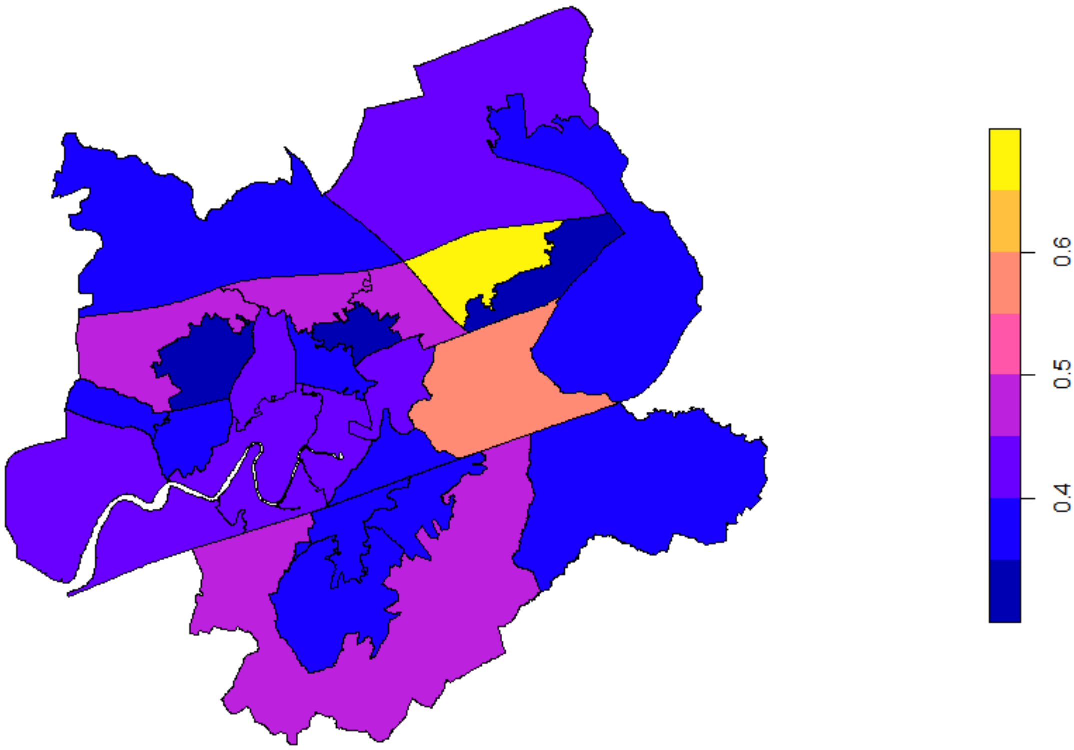
Figure 5-6. Ratio of Weekend to Weekday Trips



The final metric shown in Figure 5-7 is the ratio of work to non-work trips. If weekend trips are driven by nonwork trips, then this should present a reverse trend to Figure 5-7.

Again, taking Birchwood and the area directly to the south as an example, the graphs demonstrates that this is the case. There is a much higher ratio of work trips within Birchwood.

Figure 5-7. Ratio of Work to Non-Work Trips



5.6 Second Hand EV Uptake

Generally, when considering EV uptake, the majority of the focus is on the purchase of new EVs. This is, in many ways, natural as the influx of EVs into the overall vehicle marketplace will determine the overall success of the transition to electromobility. However, the final distribution of those vehicles (such as where they are parked at night, where they are parked during the day, who owns them etc.) will also be determined by the second-hand market.

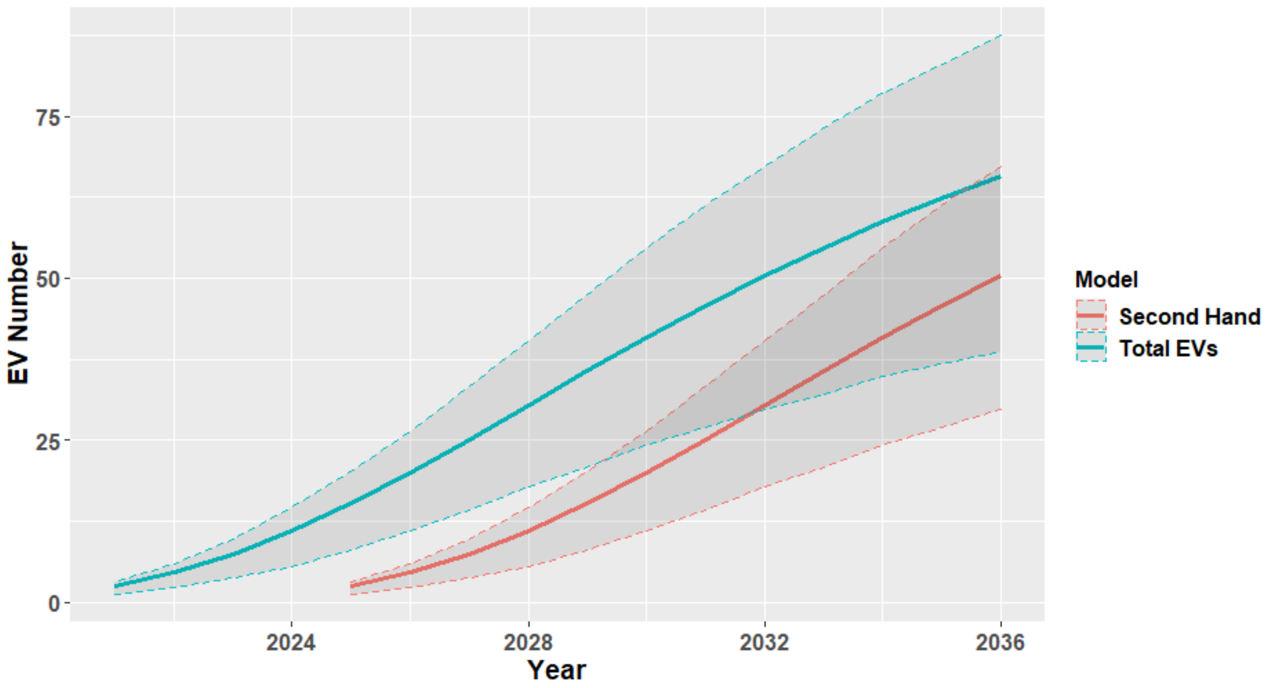
Data on second-hand purchases of EVs is difficult to obtain. As current levels of EV ownership are relatively low, the probability of those EVs being sold is even lower. However, in the future this could be a key market in Warrington due to affordability and strong sales of nearly-new vehicles.

The RAC report “Car Ownership in Great Britain”[58] shows the average length of time that a new vehicle is owned for. Based on the assumption that a new vehicle, once sold on, is then distributed across the local area purely weighted by the overall level of vehicle ownership, then it is possible to produce an EV population distribution.

Figure 5-8 shows the average number of EVs across the different census regions within Warrington. The solid line represents the average number of vehicles per Census Output Area.

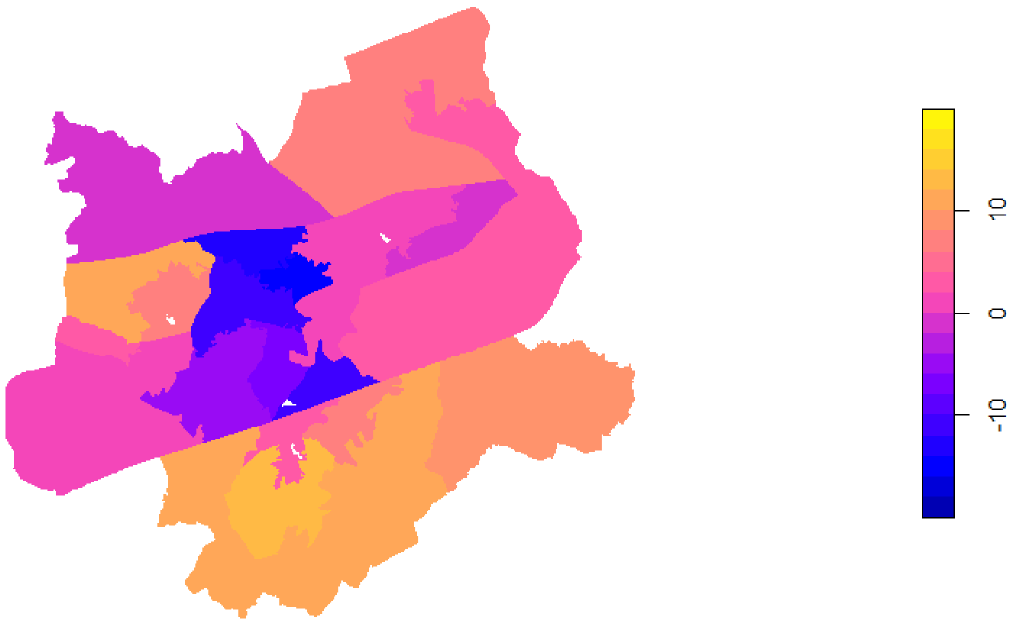
[58] https://www.racfoundation.org/wp-content/uploads/2017/11/car-ownership-in-great-britain-leibling-171008-report.pdf

Figure 5-8. EV Uptake Rates for New and Second-hand Vehicles



The impact on the spatial distribution of EVs is shown in Figure 5-9. The graph illustrates that the effect of incorporating second-hand EVs is to move the overall distribution away from the urban centre towards the less densely populated areas on the outskirts.

Figure 5-9. EV Change when Second-hand EVs are Incorporated



5.7 Modelling Summary

The following key points were identified within this analysis:

- The model shows that EV uptake will be greater in urban areas, and more specifically that the density of EV uptake will be much higher.
- The EV forecasting tool suggests that the majority of EV uptake will take place between 2025 and 2035 because of Government policy. Uptake prior to 2025 will continue to increase, but it is anticipated to

accelerate from 2025 onwards; whereas uptake post 2035 will be governed by the rate of purchase of new vehicles.

- For the ratio of long-range to short-range trips, when looked at as a function of destination, there is limited structural information. However, for the origin point of trips, certain more low-density population areas show a much higher ratio of long-range trips for commuting.
- When the ratios of work to non-work journeys or weekend-weekday journeys are examined, there is considerable variation in the more urban areas across relatively short distances. This can be clearly seen in Birchwood where the differing vehicle usage for and industrial park and a country park can be clearly seen. A relatively limited spatial variation can lead to a much greater variation in the potential use case for the charging infrastructure. Therefore, it is important that the correct type of charger is installed in the correct places.
- The incorporation of second hand EVs will lead to a general movement of vehicles away from urban areas and towards the less densely populated areas.

6. Potential Measures

Using the evidence base and stakeholder engagement set out in the preceding sections, the potential measures that could contribute to meeting the objectives of the EV strategy are outlined in Table 6-1alongside future uncertainties. Section 7 of the strategy considers whether these measures should be taken forward for further planning and notes whether measures should be delivered in the short, medium or long term.

Table 6-1. Potential Measures

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
Transitioning Taxis to EVs	Implement the Warrington Electric Vehicle Taxi Strategy	WBC has developed a strategy with the following aims: ▪ Increase awareness and uptake of electric vehicles (EVs) by Hackney Carriage (HC) and Private Hire Taxis (PHV); and ▪ Identify appropriate measures WBC and partners can take to support the accelerated transition of HC and PHV taxis to EVs.	The EV Taxi Strategy requires investment from the taxi trade alongside the measures that WBC can implement. The significant investment required by the trade and recent impacts of the coronavirus may mean that third parties take a cautious approach to investment.
Transitioning local buses to EV	Implement EV bus scheme following successful ZEBRA funding bid	The evidence base shows there are a range of EV bus models available alongside a variety of other low emission technologies such as hydrogen fuel cell and biomethane models, enabling operators to choose appropriate technology solutions to meet their operational needs. Electric buses have been introduced successfully in other areas of the UK such as Manchester and Nottingham. There is a particular opportunity in Warrington given that 80% of the bus fleet is under the management of council owned arms-length bus company, thereby providing greater potential to influence this transition. A successful bid has been approved to fund the full electrification of the bus fleet including the smaller operators in Warrington.	The Coronavirus situation has now improved requiring no social distancing measures, however travel demand and revenues from local buses has still not reach pre-covid levels. As of the 13/06/2022 DfT data indicates that public transport patronage is around 80% compared to prior levels[59].
Transitioning HGV and LGV to EV	Supporting the transition of HGV to EV	HGVs comprise a significant proportion of traffic in Warrington and therefore are contributing to air quality issues and carbon emissions. HGVs and LGV contribute 20% of NOx in Warrington, yet account for only 9% of distance travelled. However, at present there is a lack of commercially available EV options for HGVs.	EV technology for HGVs is still developing and the extent and timescales in which these vehicles will be available is uncertain. However, other ULEV technologies are being brought forward for this vehicle class, and significant work is being undertaken to investigate the potential for hydrogen as a fuel source, including within the Liverpool City Region.
	Supporting the transition of LGVs to EV including the provision of grants and/or loans (in addition to the existing OLEV fund)	LGVs comprise a significant proportion of traffic in Warrington and a move to EV would increase the number of EV miles undertaken since LGVs typically complete a greater daily mileage than the average vehicle. HGVs and LGV contribute 20% of NOx in Warrington, yet account for only 9% of distance travelled. There are a number of options available for smaller LGVs however this is more limited for larger LGVs. The majority of electric vans on sale in the UK have a range of around 80-120 miles in everyday use, which may be sufficient for many local deliveries in Warrington. There is an ongoing piece of work being undertaken by Highways England and	The availability of Li-ion batteries (or lack of) will affect the supply of these vehicles in the future in a similar manner to cars, giving uncertainty to the project uptake.

[59] Transport use during the coronavirus (COVID-19) pandemic - GOV.UK (www.gov.uk)

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
		Leeds City Council supporting the uptake of EV LGVs in Leeds and the surrounding Strategic Road Network.	
Increase number of chargepoints	Increase provision of rapid charging infrastructure for taxis in convenient locations.	As noted, taxis contribute to air quality issues and carbon emissions, particularly near taxi ranks and key routes into the town centre. Whilst high-level potential convenient charging locations have been identified in this strategy, further engagement with the taxi industry should be undertaken to inform more detailed planning as part of the EV Taxi Strategy. Engagement with the HC and 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.	As noted, WBC are investigating options for transitioning bus fleets to EV which will require bus charging infrastructure at depots and potentially top-up charging at some bus-stops too. WBC are currently planning for a new depot for Warrington's Own Buses with planning permission secured. Engagement with Scottish Power will be crucial to jointly scope out electricity requirements and supporting capacity enhancements (or alternative solutions such as battery storage should the cost of capacity enhancements be prohibitive).	As noted above impacts from the Coronavirus pandemic on travel demand are anticipated, however this also represents an opportunity to build back towards a better transport network with EV buses a key element of this.
	Provide chargepoints at key destinations	Evidence shows that the public highly value the opportunity to top-up at publicly accessible chargepoints 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	As noted in the evidence base there is significant uncertainty regarding the rate of EV uptake due to manufacturing capacities and the affect of the Government's 2030 ban. In addition, price parity between EV and ICE is not expected until the mid-2020s which may continue to affect rates of transition. With this in mind it is recommended a minimum provision of charging infrastructure is implemented across all use cases to give early adopters the confidence to transition to EV with further infrastructure brought forward to keep pace with demand as evidenced by monitoring of usage. With increasing battery sizes and range the requirement for destination charging may reduce in the medium to long term. As noted previously, provision of more chargepoints does not always directly correlate to an increase in EV uptake. Therefore chargepoint usage should be monitored.

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
	On-route chargepoints on the Major Road Network.	As noted above, the opportunity for top up charging is highly valued, particularly for when longer distance journeys are required. Without the infrastructure in place, this could delay the uptake of EVs. Warrington is situated on key strategic longer distance traffic routes including the M6, M62, M56 and a number of regional routes providing access to North Wales, Merseyside, Cheshire, and Greater Manchester. Charging infrastructure is already provided at motorway service stations and Highways England is investigating opportunities to improve provision on the Strategic Road Network.	With increasing battery sizes and quicker charging times via higher powered chargers the requirement for charging at home may reduce with a move to a situation similar to ICE refuelling. At present there is no firm evidence for this scenario however and the situation should be monitored as EV technology develops. There is a broad range of solutions to on-street charging for households with no off-street parking. They each have advantages and disadvantages and WBC may not find some solutions acceptable. It is therefore necessary to develop a borough wide approach to address the need for charging by residents with no off-street parking.
	Provide chargepoints to support residents with limited access to off-street parking provision and charging and consider home charging options for residents with no off-street parking.	Homes in areas with limited off-street parking may not have the option to introduce a household chargepoint and therefore will require alternative public chargepoints. From the evidence base there are notable areas of flats and terrace housing clustered in the town centre and the fringe to the north and the west which are likely to require on-street charging or alternative public charging car parks close to homes. WBC will be a ‘follower not a leader’ in this regard to take best advantage of learning from other settings in the UK.	
	Introduce charging hubs/ forecourts.	Charging hubs / forecourts are being trialled in a number of locations. Hubs can range in size from clusters of fast chargepoints to extensive sites with ultra-rapid charging and complementary facilities / retail opportunities. Smaller charging hubs can be a solution to the challenge of charging EVs for residents who do not have off street parking. However, 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.	

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
Promotion / education	Myth busting campaigns and practical support for the general public.	Previous public surveys indicate there are a number of perceived issues including the range of EV, cost, driving style, battery life, and the number of chargepoints that are available. Although some issues are real and this strategy seeks to address the myths, some aspects can be dispelled through promotional campaigns and engagement such as 'experience event'. Evidence shows that once people actually drive an EV this addresses most common concerns. The provision of locally tailored information including the locations of chargepoints would be helpful to overcome a range of myths.	Promotional campaigns in the short term would secure best value from existing and forthcoming charging infrastructure, however the supply of vehicles in the short term is limited so impact of these measures may also be constrained.
	Work with local businesses to encourage transition to an EV fleet / grey fleet.	Due to the number of fleet vehicles held by businesses and organisations (or grey fleet consisting of personal vehicles used for business purposes) there is an opportunity to achieve significant benefits by transitioning these to EV. Some businesses and organisations could achieve cost savings by switching to EV in addition to environmental benefits and the free service provided by the Energy Saving Trust can be promoted through existing business connections such as the Travel Choices work currently conducted by Warrington, economic development support services and the chamber of commerce.	
	Establishment of financial support (grant or loan scheme) to support businesses with the transition of fleet vehicles to EV.	Although there is already OLEV grants in place additional support could be provided in the form of grants or loans to purchase EV, particularly for organisations for who usage is not intensive enough to offset the higher purchase price against reduced operation costs.	
	Use renewal process for Council Fleet and operational vehicles as an opportunity (subject to funding) to transition to EV	Introducing EVs amongst WBC fleet and operations vehicles could be viewed as the Council "leading the way" in future vehicles whilst also increasing visibility of EV across the Borough. There is scope to integrate this measure with the provision of an EV car club in the town centre, with WBC using the vehicles within business hours and then the general public using them outside business hours, increasing the financial sustainability of the measure. Data provided by WBC shows that the existing opportunities to lease company cars is proving popular with significant numbers of BEVs on order to take advantage of beneficial tax rates.	The Coronavirus pandemic is changing if, how and when people travel and this may impact on the services and transport solutions that are required in the future.

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
Engagement with the District Network Operator	Continuous engagement and joint working with Scottish Power through the "Charge" project.	Scottish Power are currently conducting the "Charge" project that merges electricity and transport planning to create an over-arching map of where EV chargepoints will be required and where they can be best accommodated by the electric grid. The project will also determine where future upgrades to 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 WBC 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.	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 from the grid. Joint work with Scottish Power should explore the impact of varying uptake scenarios to inform an assessment of likely upgrades to the network.
Local policy changes	Update Parking Standards (currently 2015) to encourage EV uptake.	Parking Standards contain requirements which new developments need to meet, including the number of EV parking spaces or chargepoints. The policy review shows that since the current Parking Standards were developed significant developments have occurred in EV planning and technology and therefore an update is required to reflect the changes in the vision and commitment of the Council.	Vehicle and charging technology is rapidly evolving and periodic updates will be necessary to ensure the standards reflect current best practice.
	Encourage EV uptake through contract procurement	This measure is somewhat in place in many areas of the UK since procurement contracts often get a score for environmental sustainability. Discussions in the stakeholder workshop suggested there was some scope for broadening and strengthening requirements since many WBC contracts include vehicle operations and are approaching their procurement renewal period.	The impact of the Coronavirus situation on budgets and income for local authorities may impact on the deliverability of this option should enhanced vehicle standards increase the costs of procured services.
Integrated transport solutions	Encourage uptake of the car club for EV use and support its further roll out to give flexible access to EV.	Development of an EV Car Club has enabled the public to have flexible access to an EV which increases experience and propensity to use or buy EV, overcomes issues surrounding household parking/charging, and the cost of purchasing an EV. The Car Club was launched in partnership with Co Wheels in April 2022. Extension of the EV fleet available through this scheme and promotion of it will increase its profile, and is subsequently likely to increase demand and uptake of EV use through the Car Club and, in the medium term, may support increased EV ownership in Warrington through positive user experiences.	Mobility models are rapidly evolving and forthcoming innovations expected through workstreams such as Future Mobility Zones should be capitalised upon to ensure the customer offer is as persuasive as possible.
	Support the use of and roll out of electric cargo	Electric cargo bikes can be a key measure to address issues regarding last mile transport for freight. They allow heavier goods to be transported faster and more efficiently and are also accessible	

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
	bikes and review use of e-scooters.	for individuals who may not be physically able to ride a push bike. E-scooters are also an emerging option for relatively short journeys – they are currently not legal in the UK however the government is consulting on making these legal in certain contexts such as when ridden on the carriageway or on cycle tracks. These solutions could be promoted through existing Travel Choices streams of work already being conducted.	

7. Appraisal and Sequencing

7.1 RAG Assessment

Following on from the identification of the potential measures in section 6, a Red Amber Green assessment has been conducted for impact against the strategy objectives and deliverability. For measures relating to Taxis refer to the Warrington Electric Vehicle Taxi Strategy.

Table 7-1. Potential measures of RAG rating and deliverability

Theme	Potential Measure	Effectiveness	Deliverability	RAG Rating Justification
Transitioning local buses to EV	Implement EV bus scheme following successful ZEBRA funding bid			Since the draft EV strategy WBC has been successful in bidding for ZEBRA funding to replace all 120 of its diesel buses with brand new electric buses. Independent of ZEBRA funding a new bus depot is already planned to be built with funding and planning consent already in place. The successful ZEBRA bid will now see the new depot equipped with electric vehicle charging infrastructure and housing a new fleet of zero emission buses.
Transitioning HGV and LGVs to EVs	Supporting the transition of HGVs to EV			Although transitioning HGVs to EV would likely produce large benefits in terms of reducing carbon emissions and improving air quality, the evidence base review indicates there are no commercially available EV options for HGVs at present, therefore this option is not presently deliverable. Currently there appears to be greater potential for Hydrogen as a fuel source for HGVs and it is recommended separate work is conducted into this with sub-regional and regional partners including Liverpool City Region who are looking to use hydrogen through a Liverpool-Manchester hydrogen cluster including hydrogen production and hydrogen storage.
	Supporting the transition of LGVs to EV including the provision of grants and/or loans (in addition to the existing OLEV fund)			The short to medium term impact from this measure could be high due to the significant proportions of LGVs using corridors on which air quality is a concern. Although there are some LGV EV models commercially available the distance range is limited and there is relatively limited choice and availability vehicles. Given these constraints it is recommended that WBC monitor the success of other similar projects such as the Leeds / Highways England trial and technological developments and consider this measure in greater depth in the medium term.
Increase number of chargepoints	Increase provision of rapid charging infrastructure for taxis in convenient locations.			A greater number of strategically located chargepoints for taxis could encourage EV uptake giving drivers confidence that reliable and accessible charging infrastructure is in place. This measure would need to be taken forward as part of developing a broader EV Taxi Strategy as noted above. 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.
	Provide charging infrastructure for buses.			Since the draft EV strategy WBC has been successful in bidding for ZEBRA funding. The successful ZEBRA bid will now see the new bus depot equipped with electric vehicle charging infrastructure and housing a new fleet of zero emission buses.
	Provide chargepoints at key destinations			Providing charging infrastructure at key locations will give people the confidence to transition to EV. Slower speed (up to 7Kw) chargers are typically low cost and can be provided at key destinations, with OLEV grants available for employers. This measure could partly be delivered through existing WBC communication channels with key employers. In addition, key destination locations within the Council's control and those of key partners (e.g. rail station car parks) could be considered for charging infrastructure.
	On-route chargepoints 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.

Theme	Potential Measure	Effectiveness	Deliverability	RAG Rating Justification
	Provide on-street chargepoints to support residents with limited access to parking provision and home charging.			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 the EVs have parking priority in spaces with charging infrastructure.
	Provide off-street chargepoints 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 however there may be challenges with off street parking being disconnected from residential units that may affect the attractiveness of this charging infrastructure.
	Introduce charging hubs / 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 chargepoint will be available for use.
Promotion / education	Myth busting campaigns and practical support for the public.			This measure is deliverable and may increase the usage of existing charging infrastructure such as in the Times Square car park within Warrington Town Centre, and increase the numbers of people contemplating purchasing an EV. There is however a limit on the short term potential of this measure due to the current high purchase price and limited supply of new and used vehicles constraining uptake.
	Work with local businesses to encourage transition to an EV fleet / grey fleet.			This option is highly deliverable and can have a significant impact particularly if businesses with larger fleets transition to EVs. The Energy Saving Trust currently offer government funded support for fleet reviews to help develop a business case for individual businesses which can be promoted. A range of companies can also provide engagement and experience activities as research shows that once people drive an EV many myths can be dispelled.
	Establishment of financial support (grant or loan scheme) to support businesses with the transition of fleet vehicles to EV.			A grant scheme for new vehicles from OLEV is already in place and beneficial Benefit in Kind (BiK) tax rates provide an additional incentive for company cars. On this basis it is recommended WBC promote already existing offers to businesses.
	Use renewal process for Council Fleet and operational vehicles as an opportunity (subject to funding) to transition to EV			Given that the Council fleet accounts for a limited percentage of total vehicles across the borough, the overall impact of this measure on EV uptake may be limited. Further, some of the Council fleet consists of HGVs (e.g. household rubbish collection) and the technology isn't currently available to support the transition of these vehicles to EV. However, the Council have an important role to play in leading by example and this measure would increase EV awareness in the community whilst directly supporting other policy aims regarding reducing carbon emissions and improving air quality. It is recommended that an early action is working with the Energy Saving Trust to develop a business case to understand likely costs and benefits. A combined business model for a

Theme	Potential Measure	Effectiveness	Deliverability	RAG Rating Justification
				car club as noted above could make a transition for pool cars to EV more financially deliverable and could provide additional benefits through public use.
Engagement with the District Network Operator	Continuous engagement and joint working with Scottish Power through the "Charge" project.			The "Charge" project will identify areas with insufficient electricity supply to support charging infrastructure. WBC should continue to engage with Scottish Power to identify areas where there is insufficient electricity capacity to support charging infrastructure, and jointly develop a business case to seek funds to strengthen capacity where required. Although this measure would have limited short term impact, in the medium to long term this work will be crucial in delivering a large-scale transition to EV at little cost to WBC.
Local policy changes	Update Parking Standards (currently 2015) to further encourage EV uptake.			This could be delivered by the Council and this change would align with wider Council policy. With the significant scale of development planned in Warrington this measure could play a crucial role in future proofing new developments to enable transition to EV. Updates to the policy could include increasing the percentage of parking spaces that would be EV charging, and strengthening residential requirements to include EV chargepoints or passive provision.
	Encourage EV uptake through contract procurement			This measure is somewhat in place in many areas across the UK since procurement contracts often get a score for environmental sustainability. This could be introduced with more vigour however the impact of the Coronavirus situation on budgets and income for local authorities may impact on the deliverability of this option should enhanced vehicle standards increase the costs of procured services.
Integrated transport solutions	Encourage uptake of the car club for EV use and support its further roll out to give flexible access to EV.			The EV car club has been successfully established in Warrington using the pool car scheme. If high use of the vehicles can be achieved, then this will help provide a sustainable business model and lead to a relatively high number of petrol/diesel miles being avoided. Further development of the offer will help to achieve this.
	Support the use of and roll out of electric cargo bikes and review use of e-scooters.			Previous government funding schemes have been available for e-bikes through the Energy Saving Trust and there is potential that future funding opportunities may arise. E-bikes are readily available and therefore considered deliverable. These solutions have the potential to significantly reduce first / last mile freight movement, particularly in and around the town centre, and could be considered as part of the Town Centre Travel Plan.

7.2 Sequencing of Measures

The measures have been sequenced based upon the RAG assessments of effectiveness and deliverability. Highly effective measures that can be introduced quickly are recommended in the short term and more challenging measures that require scheme development or do not give benefits in the short term are classified as medium or long term.

Table 7-2. Timescales of potential measures

Potential Measure	Rationale
Short Term (0-2 Years)	
Development and roll out of an EV (or ULEV) taxi strategy for the Borough including engagement with the Hackney Carriage (HC) and Private Hire (PH) trade umbrella organisations.	Funding has been secured from Defra to fund the development of an EV taxi strategy. Key to realising benefits from this measure will be early and detailed engagement with the taxi trade to co-develop a deliverable programme of measures.
Increase provision of rapid charging infrastructure for taxis in convenient locations.	A key early measure as part of the EV taxi strategy will be planning for and delivering rapid charging infrastructure for taxis to complement other measures brought forward.
Implement EV bus scheme following successful ZEBRA funding bid	Since the draft EV strategy WBC has been successful in bidding for ZEBRA funding to replace all 120 of its diesel buses with brand new electric buses. Independent of ZEBRA funding a new bus depot is already planned to be built with funding and planning consent already in place. The successful ZEBRA bid will now see the new depot equipped with electric vehicle charging infrastructure and housing a new fleet of zero emission buses.
Provide charging infrastructure for buses.	Alongside development of the business case, planning for the provision of charging infrastructure at bus depots and for top up charging where necessary should be prioritised. In particular, early engagement with Scottish Power to scope out electricity supply capacity at the new depot will be crucial.
Provide chargepoints at key destinations	Although there is uncertainty regarding the rate of EV uptake given the constraints noted earlier in this strategy, a minimum provision across each use case will be required to give people considering the transition to EV the confidence to purchase / lease an EV. Later sections of this strategy give further details on the recommended approach and key potential locations.
On-route chargepoints on the Major Road Network.	
Provide on-street or off-street chargepoints to support residents with limited access to parking provision and home charging.	
Myth busting campaigns and practical support for the general public.	To gain maximum value from early investments in charging infrastructure (including the bank of chargepoints already provided in the Times Square car park), a proportionate roll out of this measure is recommended, bearing in mind that supply of vehicles will be constrained in the short to medium term.
Work with local businesses to encourage transition to an EV fleet / grey fleet.	This option is highly deliverable through existing WBC engagement channels with businesses.
Use renewal process for Council Fleet and operational vehicles as an opportunity (subject to funding) to transition to EV	WBC have direct control of fleet vehicles and initial scoping of the business case to be provided through government funded support from the Energy Saving Trust.
Continuous engagement and joint working with Scottish Power through the "Charge" project.	As noted above early and continued joint working with Scottish Power will be crucial in future proofing the electricity network and efficiently identifying early sites for deployment of charging infrastructure.
Update Parking Standards (currently 2015) to further encourage EV uptake.	The quantum of development coming forward presents an early opportunity to futureproof new development sites.
Encourage EV uptake through contract procurement	As contracts begin to reach their end point, the Council can amend the scoring criteria for tenders to give a greater focus to

Potential Measure	Rationale
	environmental and sustainability considerations including specific requirements for EV where appropriate.
Support the development of a car club in Warrington giving flexible access to EVs.	This measure aligns well with other transport aims in the LTP4 and there appears to be significant potential to provide flexible access to EV for Council pool cars and residents living in or near the town centre without access to a car or who are limited in terms of purchasing an EV by the lack of off-street parking.
Support the use of and roll out of electric cargo bikes and review use of e-scooters.	E-cargo bikes is a deliverable measure and funding has periodically been made available by Government. There could be scope for the Travel Choices team and other communication channels engaging local businesses to promote these solutions. However, in the case of e-scooters, UK trials are ongoing and further evaluation is required.
Medium Term (2-5 Years)	
Amend existing licensing laws to support the increase uptake of EV taxis	Initial feasibility of these measures could be included within development of the EV taxi strategy however significant planning and assessment will be required before these measures can be rolled out. These measures would also be most effective once rapid charging infrastructure has been provided in the short term to support top up charging during shift patterns.
Encourage uptake by providing loans or a scrappage scheme (in addition to the existing OLEV fund).	
Supporting the transition of LGVs to EVs.	Given there are limited commercially available models and relatively low distance ranges it is recommended this measure is kept under review, with outcomes from the initial trial in Leeds evaluated prior to proceeding.
Medium to Long Term (5+ Years)	
Supporting the transition of HGVs to EVs.	The technology for HGV charging is still under development and as such, this measure isn't deliverable in the current situation
Introduce charging hubs / forecourts.	Although clusters of charging infrastructure should be provided in the short term for each use case, due to significant uncertainty regarding the uptake of EV and how drivers will want to charge their vehicles, the development of larger charging hubs should be considered when there is more clarity on these issues. Given the high cost, a cautious approach is recommended regarding investing in this measure and understanding whether these solutions can be provided by the private sector.

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8. EV Charging Commercial Models

This section 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 chargepoint 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 been supported historically by capital grants from Government. These grants provided free-to-use infrastructure 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.

8.1 Summary of UK Electric Vehicle Commercial Models

There is a continuous spectrum of differing commercial models that could be followed in delivering or expanding an EV charging network. Table 8-1 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 has been carried out.

In reality, multiple commercial models could co-exist in a single Local Authority area. For instance, existing chargepoints 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 chargepoints 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 Local Authority, multiple private-sector network operators could build up charging networks of their own (model 3 'Commercially-Led' below).

Table 8-1. Summary of EV Charging Commercial Models – UK

Model		Description	Features/ Risk
1	In-House Management	A Local Authority selects locations, purchases chargepoints and keeps any revenue.	Purchase could include installation and ongoing maintenance. Office for Zero Emission Vehicles (OZEV) grant funding could be used for residential on-street chargepoints. Potential to ensure equity through providing in areas of market failure. Appropriate for workplace and fleet installations where demand is assured. Income for the Local Authority. *If under-utilised, financial risk for the operation and maintenance falls on the Local Authority. Inter-operability with other provision needs to be factored in.*
2	Partnership/ Concession	A Local Authority 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 Local Authority consults/ approves/ makes traffic order. Local Authority may receive a small share of revenue from each chargepoint 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 Local Authority involvement.	Rapid/ ultra-rapid chargepoints 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 Local Authority. 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 OLEV (now 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. This allowed the Council to 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 (PPP) models were used to establish national networks of rapid chargers. This was 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 Table 8-1.

The tax-payer has funded much of the UK's existing slow and fast local charging infrastructure, through Government grants and local Government funding. However, vehicle manufacturers and charging suppliers have also invested in charging infrastructure. A number of chargepoint 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 service received.

8.2 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;
- Fast chargers will help customers in and around town centres; and
- Ultra-rapid chargers may be required on movement corridors.

This section sets out options for selecting a chargepoint provider or set of providers.

8.2.1 Work within a Framework Contract

One possibility is to utilise a framework contract to allow local authorities to source chargepoints. These options are worth exploring, as the time and resource requirement of in-house procurement may be avoidable if the offers available from providers through these frameworks are acceptable to WBC. It would also require the relevant bidders to be willing to extend their provision to an additional buyer/ partner.

A hybrid approach would comprise 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.

8.2.1.1 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.

8.2.1.2 Disbenefits

- Less ability to tailor specifications and requirements.
- May not secure better preferential rates than full market testing.

8.2.2 Undertake In-House Procurement

As part of conducting a procurement process, documentation from other past procurements by neighbouring or other similar local authorities could be used and amended for local circumstances where necessary. This would involve conducting market sounding and then a full open market procurement exercise. Rather than excluding some suppliers through a procurement process, interest may be invited from any supplier who wishes to operate a chargepoint in WBC.

A revenue-sharing agreement could be negotiated, with lower risk for both authorities. The authorities 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. Where exclusive chargepoint parking spaces are used, firms could be charged a form of rent for parking spaces used, or operate on a peppercorn lease with an arranged revenue share agreement (this latter agreement may be more encouraging to private firms).

8.2.2.1 Benefits

- Enables tailoring of specifications and requirements to local situation and client preferences.
- By conducting market sounding, the procurement strategy could be tailored to take full advantage of the appetite expressed by commercial operators to invest funds and the likely conditions attached.
- Enables setting up a call off framework and avoiding the need to conduct further procurement exercises for a defined period of time. This means funding secured from the UK Government in the future could be deployed quickly and efficiently.

8.2.2.2 Disbenefits

- Timescales for this approach can be lengthy.
- Significant requirement for officer resource to conduct procurement process.
- Detailed technical knowledge required to develop specifications for infrastructure (although this can be sourced on a short-term basis from consultancy if not held internally).

8.2.3 Seek Exclusive Operators for Each Charger Type

Firms offering different types of charger can be invited to tender for exclusive operating contracts for their chosen type of charger. WBC could request firms to offer prices for:

- Installation (or combined installation, operation and maintenance) of new chargepoints; or
- Contracts where the provider will fund, install, operate, and maintain new chargepoints.

8.2.3.1 Benefits

- Firms could be invited to choose the locations where they would like to install chargepoints, 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).
- Ability to procure specialist providers for each type of charging infrastructure.

8.2.3.2 Disbenefits

- By compartmentalising revenue generation opportunities, this would likely decrease the attractiveness of the opportunity to the market. This would be particularly relevant for areas where low levels of infrastructure are required in the short term.

8.3 Choosing Locations or Leaving This to Provider(s)

It is possible for the local authorities to choose the locations where its chargepoints would be installed in some of the commercial models. 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 approval and other guidelines to be stated in the procurement documentation, this pushes the risk onto the operator. However, it reduces the opportunity to meet policy aims in WBC such as delivering an equitable and balanced network. Alternatively, local authorities 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 local authority-selected sites providing enough revenue. Alternatively, they may insist on only installing and charging for the maintenance of chargepoints.

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.

8.4 Integration of Modelling Results with Commercial Models

8.4.1 Commercial Modelling Introduction

Integrating the modelling results with potential commercial models introduces a wide range of uncertainties. In addition to the underlying potential variation in EV uptake, the commercial viability of any model will be determined by the:

- Broadly unknowable behavioural change for future EV users; and
- Price of electricity and installation/ maintenance costs.

Whilst it is possible to determine the broad range within which such parameters may fall, there is an inherent uncertainty.

However, as an indicative exercise three separate commercial models for the installation of 10 chargepoints across WBC was considered. The chargepoints are not in specified locations; but are drawn from the population charging potential at evenly spaced percentile intervals (i.e., the least commercially viable chargepoint to be considered would be in position 90 out of 100 chargepoints, the next at position 80 and so on).

It is unlikely that the chargepoints would be so evenly distributed across the charge potential, but in some ways, this simulates the need for local authorities to provide charging infrastructure based on equality of access rather than a purely commercial assessment.

The base level of usage for a single chargepoint in 2021 has been derived from the usage stats provided for 2021. The average charge recorded per day, for a single site, was 4.1 kWh. This is the value that will be scaled using the predicted EV uptake values.

4.1 kWh of charge per day, sold over the course of a year at a price of £0.15/ kWh and over the cost of purchasing the electricity, would create a revenue of £225 per year. Whilst this is substantially under the cost of installing a chargepoint (typically at around £5,000 including scoping etc.), it is the expected growth in EVs which may make this a potentially viable revenue stream.

The total number of chargepoints to be installed at each site is determined through assuming that the total charging demand will scale with the expected growth in EVs, and each chargepoint will be able to serve a total demand determined by:

$$Total\ Energy = \ Charge\ Point\ Power \times 24 \times Max\ Utilisation$$

The Chargepoint Power is determined by the power rating of the chargepoint (e.g. 7 kWh). 24 is the number of hours in the day and the Max Utilisation is a ratio specifying the actual number of hours which the chargepoint could realistically be expected to charge. For example, a chargepoint with a Max Utilisation of 50%, would be expected to be in use for no more than 12 hours in a day.

8.4.2 Commercial Models

Three distinct commercial models have been chosen for this preliminary examination:

- Model 1: WBC installs all ten chargepoints across the ten sites. It is responsible for the maintenance, operating and installation costs but retains all revenue.
- Model 2: Private Companies install at the five best chargepoints whilst WBC installs the other five. Each operator is responsible for their own costs, but the Private Companies pay a commission of 10% on all profits generated from the chargepoints.
- Model 3: Private Companies install all ten chargepoints but pay a relatively modest fixed rent.

There are many other models which could be proposed. However, these three models are considered to represent a reasonable balance between Public and Private installation. The basic structure of each model is that a series of chargepoints are installed with the total number determined by the charging demand at each site. For this basic model, the costs are assumed to be linear with little to no efficiencies of scale in the delivery of chargepoints.

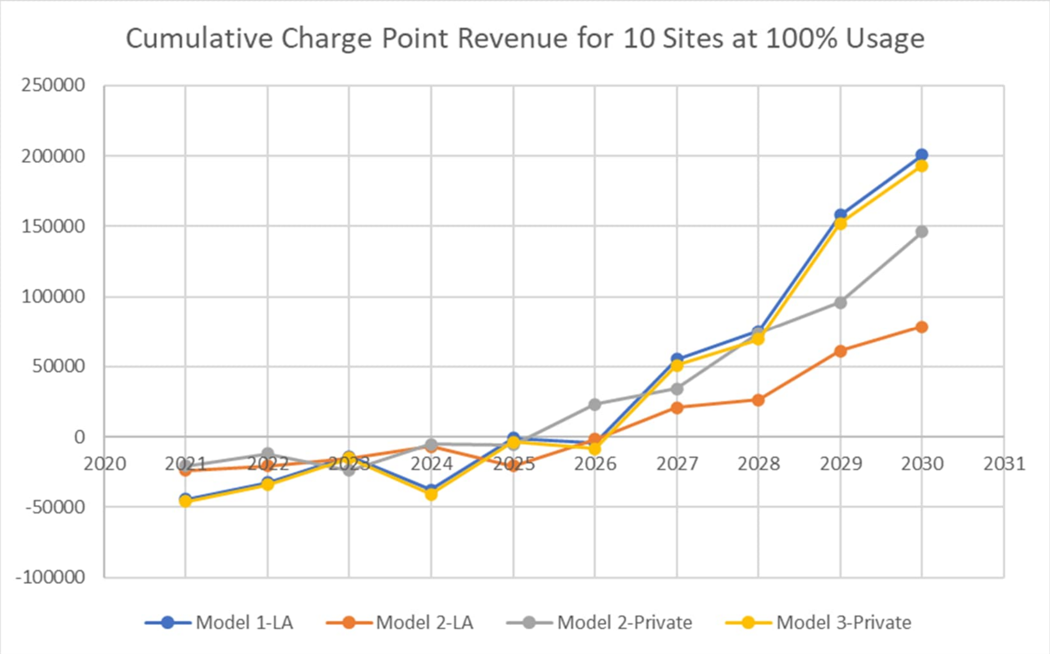
The cost of each chargepoint, and the subsequent revenue, is borne by the installing party. The exception is Model 2 where a commission is paid to WBC from the private installers. The price per kWh (£0.15) is assumed to be constant throughout each model.

Figure 8-1 illustrates the fundamental risks involved in funding extensive EV infrastructure. Under the standard charging demand no models break even before 2025. After this point, both Model 1 and Model 3 begin to generate increasing revenue fuelled by the increasing uptake of EVs.

However, both Model 1 and Model 3 show a large initial outlay. Whilst it is expected that this will eventually be recouped, there is the risk external events may lead to a substantially reduced charging demand.

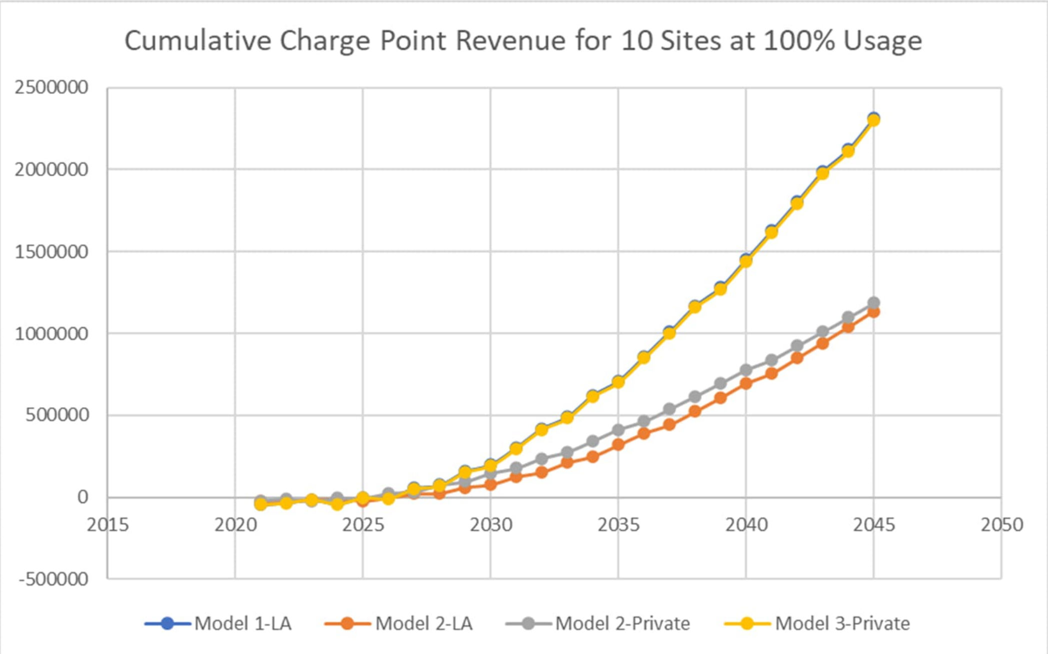
Model 2, a blended model between private and public installation, shows a much flatter revenue curve. Both private and public spend far less in the first five years, but also generate less income as the EV demand increases.

Figure 8-1. Cumulative revenue at standard EV charging demand (2021 – 2030)



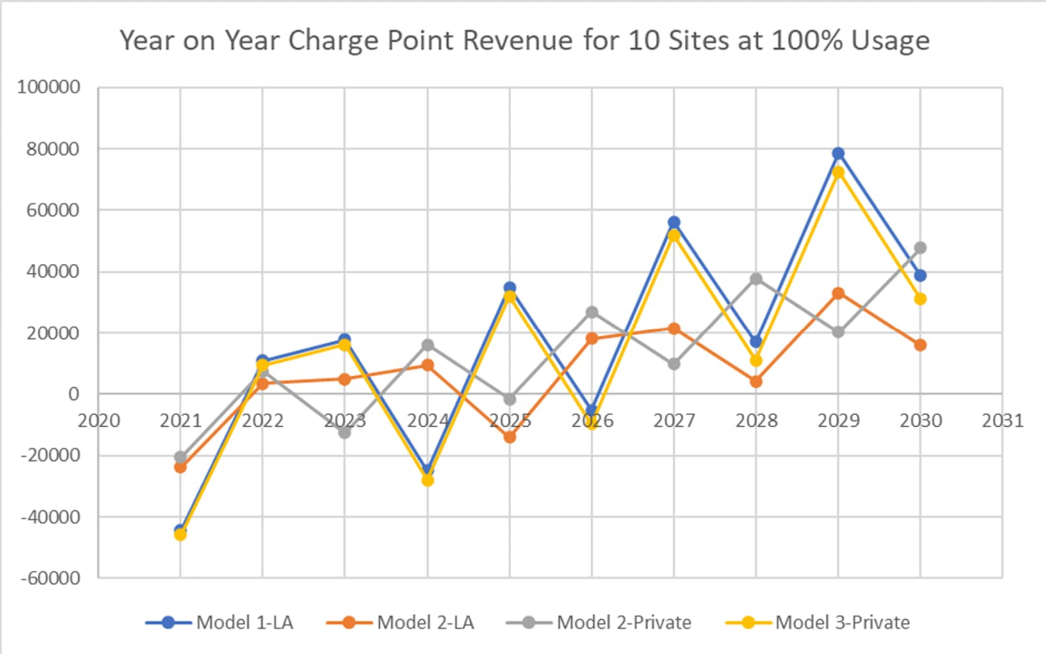
In Figure 8-2, the future outlook has been expanded through to 2045. At this point, the cumulative net revenue generated across the 10 different sites has increased much more steeply, leading to each site generating a healthy profit. However, it is important to note that this is based on multiple assumptions, specifically that each site may continually install chargepoints to keep up with demand.

Figure 8-2. Cumulative revenue between 2021 and 2045 (100% usage)



In contrast, the annual revenue between 2021 and 2031 in Figure 8-3 shows major fluctuations in revenue (and hence the reduction in total cumulative revenue). This is caused by the purchase and installation of chargepoints.

Figure 8-3. Annual Revenue



The figures in this section have all shown potential futures for revenue. However, these results are based on a series of assumptions and different values for each parameter could lead to higher/ lower revenues reported in this section.

8.5 Review of Viable Funding Models

The UK Government's early grants to kick-start charging deployment have reduced in recent years to encourage private investors into the market. There are several funding opportunities that can be considered, as outlined in the following sections.

8.5.1 Electric Vehicle Charging Infrastructure Investment Fund (CIIF)

This Public-Private fund launched in 2018 and provides a £200 million 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 chargepoints along key road networks, in urban areas and at destinations. Its intention is to increase the capital invested in the sector to increase EV adoption. The fund is planned to have a 10-year life, up to March 2030.

8.5.2 OZEV's On-Street Residential Charging Scheme

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

8.5.3 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 chargepoints. The contribution is limited to 75% of the purchase and installation costs, up to a maximum of £350 for each socket. It also restricts each application to a maximum of 40 sockets across all sites for each applicant.

Although this grant cannot be directly accessed by a local authority, promotion of this grant scheme to employers within the region could help to complement the public charging network with workplace-based chargepoints. This could help to increase charging provision and EV uptake.

8.5.4 OZEV's Local Electric Vehicle Infrastructure (LEVI)

LEVI funding will support the rollout of EV charging infrastructure. To test the design of the new scheme the DfT have launched a £10 million pilot competition, which is anticipated to fund between 3 and 8 projects. Local authorities in England are eligible to apply.

Applicants must be planning an EV charging infrastructure project that:

- supports the transition to EV use in a local area, with a particular focus on provision for those without off-street parking
- will provide an improvement in accessible EV charging provision that would not otherwise be met by current or planned EV charging infrastructure
- shows innovation – this could be either technical or commercial innovation

Applicants must be able to demonstrate:

- how the project will be delivered successfully
- the value for money offered by the project, including how the project minimises taxpayer funding and maximises private sector investment

8.6 Summary

The available commercial models for chargepoint installation and operation are based on a series of key decisions:

- Who will install the infrastructure?
- Who will manage/maintain the infrastructure?
- Who will collect revenues?
- Who is responsible for site selection?

Each of these questions is not necessarily answered with a single discrete entity. However, it is possible to construct a commercial model with some level of public/ private ownership/ responsibility across all four aspects. The exact nature of the relationship between public/ private involvement for each aspect varies according to the:

- Level of risk which each party is willing to take; and
- General ability of each party to provide the necessary service.

Preliminary commercial modelling suggests that chargepoints will not be able to recoup their costs before 2025 at the earliest, under optimistic EV uptake scenarios. Therefore, the choice of any commercial model will need to balance the short-term loss involved in installing the infrastructure, against the longer-term potential benefits of revenue collection from increasing EV numbers.

Balancing this risk does not involve a definite answer, but rather understanding exactly what the charging infrastructure policy of WBC is intending to achieve. If it is a network of chargepoints, to provide access to all in a timely way, then the commercial viability may be of less concern. However, provision should be made for future operating costs to ensure infrastructure is maintained. This could lead to a blended public-private model where the private firms install at commercially viable sites, with a concession model subsidising the less viable sites. The benefit of this is that the initial outlay of costs would be reduced, allowing WBC to focus on sites with less financial viability.

However, if the aim is to create a self-funding network of chargepoints in the shortest possible time, then it would make more sense for either WBC or a private operator to install the minimum number of chargepoints, focusing on the most financially viable sites.

9. Site Assessment

In line with the strategy measures set out in Section 7, these site assessments were completed using data from a demand-led evidence base and model. The assessments primarily focus on the short to medium term, where trends in EV uptake and technological developments are more certain.

9.1 Development of Longlist

To develop a longlist of sites, off-street car parks and key destinations were reviewed. These were initially based on the draft version of this strategy, and was supplemented by additional locations to ensure a good geographic spread across the borough and a good variety of site types (e.g. commercial and leisure).

Once the longlist of sites had been developed, assessments were conducted using output from an EV Forecasting Model against likely demand for residential, on-route and destination EV charging, as set out in Table 9-1.

Table 9-1. Assessment Criteria for Longlist

Sifting Criteria	Description
EV Uptake of Wider Area	Projected EV uptake of the LSOA and travel catchment. This variable is scored from 1-3, 3 being the highest projected level of EV uptake in the wider area and 1 being the lowest.
Destination Charging Potential	Based on an assessment of future usage based on proximity to key facilities such as retail employment, and tourism/leisure locations. This variable is scored from 1-3, 3 being the highest projected level of destination charging potential and 1 being the lowest.
On-Route Charging Potential	Whether the site is located in close proximity to routes used by high volumes of traffic making longer journeys. This variable is scored from 1-3, 3 being the highest projected level of on-route charging potential and 1 being the lowest.
Residential Charging Potential	The expected charging demand that would be expected from residential parking for people who do not have off-street provision. This variable is scored from 1-3, 3 being the highest projected level of residential charging potential and 1 being the lowest.

The longlist sites scoring is included in Appendix D. However, it is recommended the remaining sites on the longlist are kept under review in the future for delivery in the medium to long term in line with demand, or through ad hoc opportunities. The locations of the longlist sites is included in Appendix D.

9.2 Shortlist Assessment & Recommendations

From the longlist, 21 sites were selected for the shortlist based on assessment scores and achieving a geographical balance. This shortlisting focused on determining where the greatest impact is likely to be achieved from chargepoint installation

The assessment methodology for sites on the shortlist is detailed in Table 9-2. The shortlist of sites is then presented in Table 9-3. The sites are ranked by their total score, which is a combination of the residential demand, on-route demand, destination demand, EV's in wider area, security, and commercial conflicts scores.

The purpose of these assessments is to identify a list of suitable sites or broad locations for further investigation and potential inclusion in funding bids or other opportunities for delivery. It is recommended that further technical feasibility work is conducted alongside engagement with residents and stakeholders, including the DNO prior to any further development work being undertaken.

In some cases some EV charging availability already exists in locations listed or alternative nearby sites may be identified through more detailed consideration

Table 9-2. Assessment Criteria for 21 sites on the shortlist

Sifting Criteria	Description
Destination Charging Potential	Model outputs were used to scope sites 1 – 5 based on an assessment of future usage based on proximity to key facilities such as retail, employment and tourism/leisure locations.
On-Route Charging Potential	Whether the site is located in close proximity to routes used by high volumes of traffic making longer distance journeys.
Residential Charging Potential	The expected charging demand that would be expected from residential parking rather than on-route or destination parking. Model outputs scored sites 1-5 based on the number of EVs predicted to not have access to private off-street parking i.e. those that would require some form of public charging infrastructure.
Feasibility of Power Connection	Sites were scored using a red-amber-green (RAG) approach, red being the costliest (above £30k), amber being medium (between £10k and £30k) and green being the least costly likely to be less than £10k). Power feasibility assessments were carried out by Jacobs electrical engineers using data supplied by the DNO to assess potential costs for connecting to the electricity network.
Commercial EV Charging Conflict	Proximity to existing chargepoints (e.g., nearby Shell and BP garages, supermarkets). Sites were scored 1-5 on their potential for conflict with current and future commercial chargepoint investment. Sites located in close proximity to current chargepoints, or close to companies with future plans for chargepoint investment such as Shell and BP scored lower.
Security of Location	Sites were scored 1-5 for security based on factors such as lighting, fencing, security barriers, CCTV, and proximity to surrounding developments. Sites scoring 5 were most secure, whilst sites scoring 1 were least secure and lacked the listed security measures.
EV Uptake (within 1km)	Model output for the projected EV uptake within 100m grids. Daily travel catchment calculations scored each site out of 5, 5 being high projected output and 1 being low.

Infrastructure feasibility assessments were carried out in liaison with the DNOs, Energy North West (ENWL) and Scottish Power Energy Networks (SPEN), with their operating boundaries shown in Figure 9-1. The feasibility assessments used a combination of the:

- ENWL Network Asset Viewer https://enwl-login.acceleratedinsightplatform.com/login;
- Western Power Networks costing tool that includes unit cost assumptions that are applicable across other geographic areas, to support cost estimates for the sites in the ENWL area; and https://www.westernpower.co.uk/connections-landing/get-a-guide-price/interactive-costing-tool
- SPEN Connectmore Interactive Map and Connection Cost Estimator tools https://www.spenergynetworks.co.uk/pages/charge.aspx.
- The assessment considered whether each site would have a sufficient energy supply to facilitate the proposed chargepoints. For each site, a requirement of 100 kWh power was assessed to:
- Reflect the need for rapid chargers as identified in the evidence base;
- Best practice of installing a cluster of chargers for resilience; and/ or the need for significant banks of slow/ fast chargers.

Where it was identified that there is not currently capacity or 100 kWh, 50 kWh was considered. Further technical feasibility work will be required prior to any sites being implemented. This includes updating cost estimates to include any necessary civils and other costs as well as finalising connection costs to the power network. The sites consist of existing car parks or locations that could accommodate car parking.

The shortlist sites are set out in Table 9-3 and a corresponding map of these sites is provided in Figure 9-1. Within the shortlist, the top performing sites are Winwick Street Car Park (or immediate vicinity), Asda town centre car park, Time Square multi-storey car park and the Tesco Extra car park. Excluding Tesco Extra, all these sites are located within Warrington town centre.

In contrast, those sites that scored lower down on the shortlist included Padgate Railway station, Penketh Swimming Pool and community centre car park and Walton Hall and Gardens car park. These sites are all situated outside of the centre.

Although Table 9-3 provides a ranking it should be used as a framework to inform decision making, with site choice being influenced by changes in provision and evolving demand.

Table 9-3. Shortlist Sites

Car Park	Easting	Northing	Spaces	Residential Demand	On-Route Demand	Destination Demand	EVs in Wider Area	Security	Commercial Conflicts	Total Score	Power Assessment Cost	Ranking
Time Square Multi-Storey	360797	388019	100+	5	5	5	3	5	5	28	Low	1
Winwick Street Car Park (or immediate vicinity)	360621	388513	20-50	5	5	5	4	3	5	27	Low	2
Warrington Town Hall Car Park	360283	388171	20-50	4	5	5	2	4	5	25	Low	3
Broomfields Leisure Centre	361921	385257	20-50	1	5	3	5	3	5	22	Low	4
Co-Op Latchford	361518	387556	20-50	4	2	4	3	2	5	20	Medium	5
Cobden Street Car Park	360861	389020	20-50	2	4	5	3	2	3	19	Medium	6
Birchwood Station	365165	390819	20-50	5	3	4	1	4	2	19	Low	6
Co-Op Sankey	357002	388565	20-50	3	1	2	5	3	5	19	Medium	6
Co-Op Fearnhead	362931	390667	100+	2	1	2	5	4	5	19	Medium	6
Grammar School Road Car Park	362645	387078	50-100	3	3	2	4	3	3	18	Low	10
Warrington Hospital	359457	388904	100+	4	1	4	3	3	2	17	Medium	11
Warrington Sport for All Centre	362407	387223	20-50	3	3	2	4	3	2	17	Low	11
Marsh Street Car Park	361877	389092	20-50	3	2	4	3	2	3	17	High	11
M6 J21 Manchester Road	366065	389234	NA	1	5	2	1	3	5	17	Low	11
Orford Park, Winwick Road	360810	389955	100+	3	2	3	2	2	3	15	Medium	15
Hood Manor Shopping Centre	358321	388526	20-50	1	1	2	5	1	5	15	Medium	15

Car Park	Easting	Northing	Spaces	Residential Demand	On-Route Demand	Destination Demand	EVs in Wider Area	Security	Commercial Conflicts	Total Score	Power Assessment Cost	Ranking
Pepper Street Car Park	368373	387252	50-100	2	2	1	1	4	5	15	Low	15
Jackson Avenue Car Park	365524	395171	100+	1	3	1	1	4	5	15	Medium	15
Walton Hall and Gardens	360063	385219	100+	2	3	3	1	1	5	15	Medium	20
Padgate Rail Station	363055	390047	20-50	1	1	2	4	1	5	14	Medium	19
Penketh Swimming Pool and Community Centre	356399	387930	0-20	1	1	1	4	1	5	13	Low	20

Figure 9-1. Shortlist Sites Map

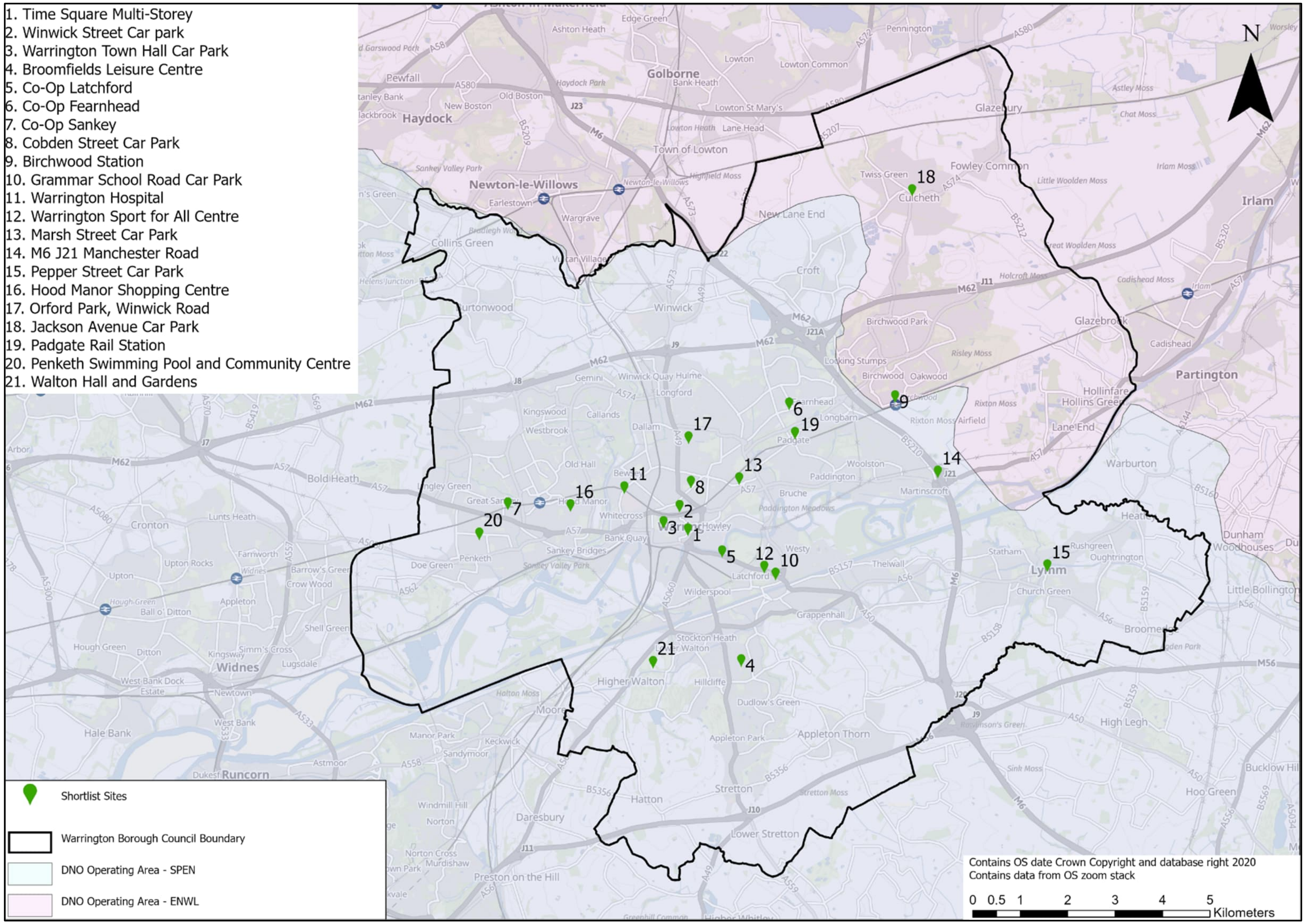


Table 9-4. Recommended Delivery Plan

Settlement	Current and Recommended Infrastructure	Timescales (Short 2022-2024; Medium 2024-2026; Long 2026+)
Town Centre	**Current situation:** At present there are 56x slow 7kW chargepoints in the Time Square Multi-Storey car park, 1x slow 7kW charging post at the Warrington Bank Quay Railway Station and 2x slow 7kW chargepoints at the Ibis Court. There are also 3x slow 7kW chargepoints on White Street, 4x slow 7kW chargepoints on Bewsey Street and 3x slow 7kW chargepoints on Gladstone Street.	Short
	Recommendation: 2x rapid 50kW chargepoints are recommended at the Winwick Street Car Park (or immediate vicinity) to accommodate short stay vehicles in the town centre. This location is also suitable for EV taxis to charge as it is near the railway station and bus station.	
Winwick	**Current situation:** At present there are few chargepoints in Winwick, there are 2x slow 3kW chargepoints at the Premier Inn near Winwick Quay.	NA
	Recommendation: No chargepoints are immediately recommended here as there is near by provision of slow chargepoints as mentioned above and rapid charging is available less than a 10-minute drive away by the IKEA. This recommendation should be kept under review as local demand evolves.	
Birchwood	**Current situation:** Current there are 2x slow 7kW chargepoints at Spenser House and 2x slow 7kW chargepoints at Birchwood Vets. There are also 4x slow 7kW chargepoints at 102-104 Dalton Avenue and 3x slow 7kW chargepoints at Emerson Management Services Ltd.	NA
	Recommendation: There is a strong commercial case for EV charging both in the business park and retail area and therefore it is recommended that this development is left to the private sector. These developments should be kept under review.	
Croft and Culcheth	**Current situation:** At present there are no chargepoints in this settlement or close by.	Short
	Recommendation: 2x slow 7kW chargepoints are recommended at the Jackson Avenue Car Park to cater for the expected EV uptake as shown in Figure 5-4.	
Lymm	**Current situation:** At present there are no chargepoints in this settlement. However, there are 3x rapid 50kW chargepoints nearby at the Lymm M6 north services.	Short
	Recommendation: 2x slow 7kW chargepoints are recommended at the Pepper Street Car Park to accommodate the expected EV uptake and offer an alternative the existing rapid charging.	
Stockton Heath	**Current situation:** At present there are no chargepoints in this settlement or close by.	Short
	Recommendation: 2x rapid 50kW and 2x slow 7kW chargepoints are recommended at the Broomfield Leisure Centre to serve users of the leisure centre and EVs in the wider area. On-street charging should also be considered for this area to accommodate limited off-street parking. Off- street charging facilities are being implemented at the Forge car park in Stockton Heath district centre.	
Sankey Bridges	**Current situation:** At present there are no chargepoints in this settlement or close by.	Short-medium

	Recommendation: 2x slow 7kW are recommended at the nearby Hood Manor Shopping Centre to support EVs in the wider area and residential demand. Security upgrades should be considered.	
Great Sankey	**Current situation:** At present there are 7x slow 3kW chargepoints in the Warrington West Railway Station Car Park.	Short
	Recommendation: 2x slow 7kW chargepoints are recommended at the Co-op Sankey car park to accommodate the expected EV uptake in the wider area. On-street charging should also be considered for this area to accommodate limited off-street parking.	
Burtonwood	**Current situation:** At present there are no chargepoints in this settlement, however there is a mix of rapid and slow chargepoints available less than a 5-minute drive away at the Burtonwood services.	Short
	Recommendation: At present the current chargepoint mix is deemed sufficient. However, this recommendation should be kept under review as local demand evolves.	
Railway Stations	**Current situation:** There are several railway stations in Warrington this includes: Sankey for Penketh, Warrington West, Warrington Central, Warrington Bank Quay, Padgate and Birchwood. Slow charging is currently available at Warrington Quay and Warrington West.	Short-medium
	Recommendation: Consider the need for increasing provision at all railway stations across the borough.	

10. Summary Programme of Work

Table 10-1 outlines the potential measures that have been identified, in the order that they are recommended for implementation.

Table 10-1. Warrington EV Strategy Sequencing Programme

Potential Option	Short term (0-2 Years)	(2-5 Years)	5+ Years
Roll out of the Electric Vehicle Taxi Strategy for the Borough including engagement with the Hackney Carriage (HC) and Private Hire (PH) trade umbrella organisations			
Update Parking Standards (currently 2015) to encourage EV uptake			
Implement EV bus scheme following successful ZEBRA funding bid			
Work with local businesses to encourage transition to an EV fleet			
Myth busting campaigns and practical support for the general public			
Increase provision of rapid charging infrastructure for taxis in convenient locations			
Provide charging infrastructure for buses			
Provide chargepoints at key destinations			
Support the use of and roll out of electric cargo bikes and review use of e-scooters			
Use renewal process for Council Fleet and operational vehicles as an opportunity (subject to funding) to transition to EV			
Encourage EV uptake through contract procurement			
Work with Development Control colleagues to increase EV uptake and EV car clubs at new developments			
Promote and continue to support the car club in Warrington giving flexible access to EVs			
Provide off-street or on-street chargepoints to support residents with limited access to EV charging at home			
Continuous engagement and monitoring of the "Charge" project with DNO			
Provide on-route chargepoints where gaps exist in commercial operators provision			
Investigate potential for EV conversion grant / “scrappage scheme”			
Supporting the transition of LGVs to EVs			
Support the transition of HGVs to EVs			
Introduce charging hubs/ forecourts			

10.1 Targets and Monitoring

Most strategies set out proposed criteria by which they will be judged, and how success will be measured. In this case, because too many variables remain regarding EV uptake and the factors that influence this, it would be unwise to set a figure for how many new chargepoints are envisaged to be installed or figures for EV uptake as a result of this strategy, and in what timeframe. Instead, WBC will review the ratio of EVs to chargepoints within the borough and forthcoming requests from members of the public to consider the need for future chargepoints. WBC will also consider usage statistics at the chargepoints it commissions to assess future need.

Appendix A. Additional Technology Analysis

A1. Case Study: Milton Keynes On-Street Charging Infrastructure

MK Promise was an innovative approach to deploy publicly available on-street charging infrastructure designed for drivers with no access to off-street parking for EV's. Local residents were invited to apply for a chargepoint to be installed near to them. A resident could request that a charger be installed within approximately five minutes' walk from their home.

Once applications were made, a survey was conducted for the area to understand if there was suitable parking and whether power could be supplied. On many residential estates, parking demand was high. The regulatory process for ringfencing on-street sites for EVs was difficult to navigate. Out of 39 enquiries in total, six have been installed and one still pending. Of the six that were installed, the quickest installation time was 237 working days and the longest was 629 working days (the average time was 408 working days). This was a result of obtaining a Traffic Regulation Order (TRO). Due to delays, new DNO applications had to be made as original quotes had expired (only last for 90 days). These installations proved to be extremely difficult to deliver and focus transitioned to installing chargepoints at workplaces and hubs.

Milton Keynes secured £1.1 million of funding from OZEV in 2021 for 250 on-street chargepoints. However, at the time of writing, this investment programme is still being rolled out and has not been evaluated.

A2. Smart Charging

Smart charging uses the OCPP charging protocol 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 chargepoint 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.

Appendix B. Response to Consultation

Energy Saving Trust Comments and Response

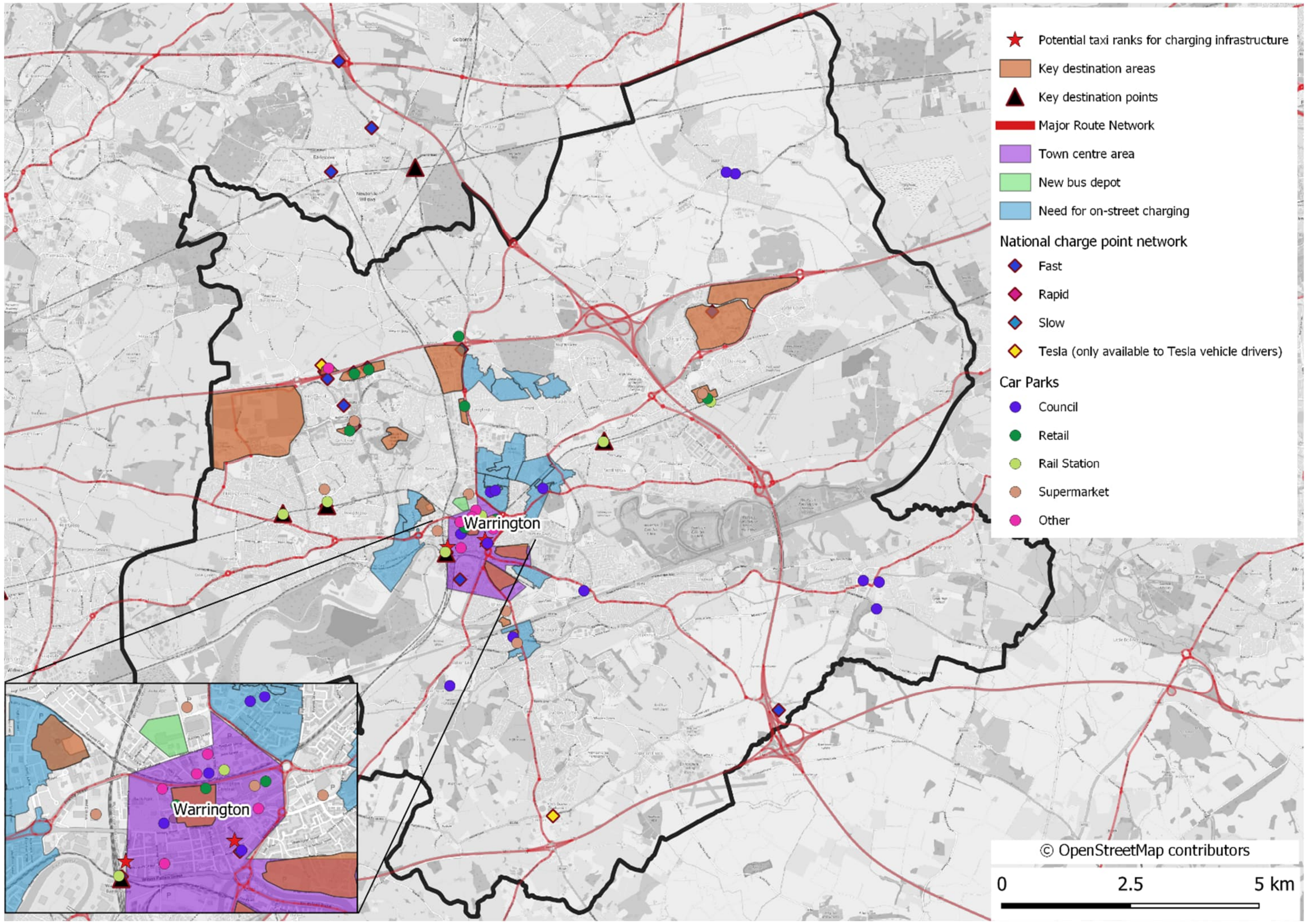
EST review	EST Things to consider	EST Case studies	WBC Response
What is the purpose of this strategy? What level of detail is required? Has the national and regional policy context been outlined?	It would be useful to consider the intended audience for the final document. This document is probably too long and technical for the public to find accessible. Perhaps consider writing a more accessible summary of the strategy that could go on your web site. You may also want to include who has been/will be involved in drafting the strategy, e.g. which internal teams. Need to update the document to ensure the most up to date policies are referenced e.g. the Transport Decarbonisation Plan		Replace Executive Summary with a Non-Technical Summary. Confirm teams that were involved in stakeholder engagement for draft of strategy. Policies updated.
Are the aims, objectives or targets clear? Are timelines and actions identified?	How will priorities be taken forward following the strategy being published? Will a working group decide how any measures will be delivered?		WBC is currently organising a cohesive approach to the climate emergency, into which implementation of the EV Strategy will fall and be addressed.
Has equity been considered in the strategy?	Equity of chargepoint provision for residents is going to be an important consideration, particularly in light of the Government's 2030 new petrol and diesel vehicle ban. Priority should be given to considering which areas are at risk or being left behind when chargers are installed.	The West Sussex County Council strategy aims to ensure that there is a mix of commercially viable and more community centred locations: https://www.westsussex.gov.uk/roads-and-travel/travel-and-public-transport/travelwise-sustainable-transport/electric-vehicles/	This is considered through the spatial modelling, site assessment, and strategic priorities An EqIA is being prepared
Are there any references to national or local EV uptake statistics as a baseline? Is there any forecasting of local future demand?	Update to the latest statistics available from DfT and consider how you might able to use other more current forecasting data e.g. the model being created by TfN.	ICCT research: https://theicct.org/publications/charging-gap-UK-2020	Research updated
Does the authority have any existing charging infrastructure? How is this being used?	It would be useful to include data on the current usage of the network. It can be useful to review the current network's performance to understand demand and to pinpoint any locations that require additional resources or conversely any locations that aren't performing well.		Data now available and analysed
How will different types of charging serve different user groups? (i.e. residential, destination, en route, hubs)	Developing a network that is suitable for all potential users is critical and will help with engaging with key stakeholders, particularly during any consultation process or when planning for new locations. One of the strategy's aims should be to ensure that the right type of		Modelling accounts for different use types of chargers and incorporates different locations. Different charger types proposed at different locations, reflected in WBCs ongoing installations.

EST review	EST Things to consider	EST Case studies	WBC Response
	chargers is available at the right location.		
How will locations be chosen? Are there any site criteria?	A method of prioritising locations could be useful. The council could consider an online map that would allow residents or taxi drivers to pinpoint potential locations for chargepoints.	Transport for Greater Manchester have set up an online map where you can suggest where you would like to see a chargepoint https://electrictravel.tfgm.com/chargers-everywhere/	Modelling has informed how locations may be chosen in the near future based on travel demand and EV uptake.
Are grid connection costs mentioned as a variable cost and project risk? Will the chargepoints be supplied with renewable energy? Is smart charging, load management, battery storage, onsite generation being considered?	Consider specifying any future chargepoint operators use renewable electricity. Consider how you will work with SPEN and ENW (where relevant) in the future. Future proofing is key and ensuring there is provision for upgrading equipment and software should be clearly outlined as part of the strategy. Innovative solutions such as vehicle to grid may be an opportunity to access additional funding streams. The council could consider this as part of a longer-term strategy or a procurement exercise.		WBC will consider specifying renewable energy where practicable but notes that this must not be at the expense of equitable chargepoint availability and costs. Both SPEN and ENW were consulted as part of the shortlist assessment, which actively changed the sites under consideration.
What ownership models are being considered? Are grant funding opportunities identified?	Further discussions are required to decide on the council's long term approach to working with a chargepoint operator and the best ownership model for the council. EST will continue to support the council where it can in making these decisions. It may be useful to include a more detailed discussion of the various operating models and routes to procurement available When updating the strategy it would be worth adding a reference to the forthcoming LEVI fund.	EST EV infrastructure procurement guide: https://energysavingtrust.org.uk/wp-content/uploads/2020/10/EST0038-01-Procuring-Electric-Vehicle-Charging-Guide-03.pdf	WBC's legal team has confirmed that it has a preference for site-by-site procurement to ensure that procurement rules are observed. This will also ensure that the roll-out of chargepoints does not try to replace the ongoing private sector provision and rollout.
How will the authority seek to ensure a reliable network?	Consider monitoring feedback on any infrastructure installed that is identified on platforms such as Zap Map or otherwise via social media.	There is a good example from City of York council where this has been done and it was useful to identify Maintenance requirements and deal with any complaints or concerns.	Publicly available sites that WBC is engaged in implementing are privately operated. Therefore it is the role of the private operator to undertake monitoring of this nature.
How will the authority promote the growing EV network? What information will be on the council's website?	Consider identifying which methods of promotion/comms might work best with different user groups to maximise the impact. Engagement is key to promoting uptake. For both residents and businesses, it is important to ensure there is a range of information available to help build confidence and dispel some of the myths and concerns around EV and issues such as range and battery reliability amongst other things.		Link to publicly available information e.g. zapmap plus list of council owned sites on website, are likely to work best because they will be presented alongside the offering across the whole of the borough (including private sector provision) and will be kept up to date with helpful information on current use and condition.

EST review	EST Things to consider	EST Case studies	WBC Response
	The recently introduced green number plate scheme could be an opportunity to incentivise further as this will make EV's more easily identifiable for parking officers for example.		
How will progress against targets be monitored, i.e. metrics?	We would suggest including a target for the number of chargepoints installed, even if it is over a short timescale e.g. in the next 2 years x number of chargepoints will be installed. Consider separately developing a short-term delivery plan for the installation of chargepoints.		WBC does not consider that a target to install a specific number of chargepoints within a defined period is helpful because it is output rather than outcome based. Instead WBC will review the ratio of EVs to chargepoints within the borough and forthcoming requests from members of the public to consider the need for future chargepoints. WBC will also consider usage statistics at the chargepoints it commissions to assess need.
Will chargepoint use be monitored to inform future plans?	This would be useful to include particularly to allow the council to make future decisions on installations.		Data is now becoming available and will be reviewed on a regular basis to help inform future site procurement.

Appendix C. Warrington Charging Demand Analysis

Figure B-1. Warrington charging demand analysis



Appendix D. Longlist

D1. Longlist sites

Table D-1. Longlist Sites

Car Park	Easting	Northing	Spaces	Residential Demand	On-Route Demand	Destination Demand	EVs in Wider Area	Total Score	Ranking in Group	Shortlisted (Yes/ No)	Rationale
ASDA town centre	360920	388516	100+	5	5	5	4	19	1	No	Large commercial site, provision likely in time
Winwick Street Car Park (or immediate vicinity)	360621	388513	20-50	5	5	5	4	19	1	Yes	Central location serving town centre and onward bus and rail travel
Morrisons Greenall's Avenue	361205	386503	100+	4	4	5	5	18	3	No	Large commercial site, provision likely in time
Tesco Extra	360414	389055	100+	5	5	5	3	18	3	No	Large commercial site, provision likely in time
Time Square Multi-Storey	360797	388019	100+	5	5	5	3	18	3	Yes	Central location with some existing charging infrastructure
ALDI Liverpool Road	360985	387869	50-100	4	5	5	2	16	6	No	Large commercial site, provision likely in time
Riverside Retail Park	360283	388171	100+	4	4	4	4	16	6	No	Large commercial site, provision likely in time
Warrington Town Hall Car Park	360037	388170	20-50	4	5	5	2	16	6	Yes	Central location serving town centre.

Car Park	Easting	Northing	Spaces	Residential Demand	On-Route Demand	Destination Demand	EVs in Wider Area	Total Score	Ranking in Group	Shortlisted (Yes/ No)	Rationale
Birchwood Park	365324	392082	100+	4	4	5	2	15	9	No	Initially included but DNO indicates already provision and nature of car park means delivery will be very difficult
Broomfields Leisure Centre	357672	388806	20-50	1	5	3	5	14	10	Yes	Local leisure use and only site in the area
Sainsburys Great Sankey	360861	389020	100+	5	1	3	5	14	10	No	Large commercial site, provision likely in time
Cobden Street Car Park	360955	389070	20-50	2	4	5	3	14	10	Yes	More central in community than Cobden
Sharp Street Car Park	357590	389104	20-50	2	4	5	3	14	10	No	No grid capacity when using Connect more tool
Warrington West Train Station Car park	361921	385257	100+	3	3	3	5	14	10	No	Large number of commercial chargepoints
Birchwood Shopping Centre	365165	390819	100+	5	3	4	1	13	15	No	Large commercial site, provision likely in time
Sainsburys town centre	361518	387556	100+	2	4	4	3	13	15	No	Large commercial site, provision likely in time
Co-op Latchford	361337	388387	20-50	4	2	4	3	13	15	Yes	No nearby chargers

Car Park	Easting	Northing	Spaces	Residential Demand	On-Route Demand	Destination Demand	EVs in Wider Area	Total Score	Ranking in Group	Shortlisted (Yes/ No)	Rationale
Birchwood Station	364993	390781	20-50	5	3	4	1	13	15	Yes	Long stay parking at rail head
Warrington Hospital	362645	387078	100+	4	1	4	3	12	19	Yes	Large site serving staff, patients and visitors
Junction Nine Retail Park	361877	389092	100+	3	3	4	2	12	19	No	Large commercial site, provision likely in time
Warrington Sport for All Centre	360285	390693	20-50	3	3	2	4	12	19	Yes	Local leisure use
Marsh Street Car Park	362407	387223	20-50	3	2	4	3	12	19	Yes	No nearby chargers
Grammar School Road Car Park	359457	388904	50-100	3	3	2	4	12	19	Yes	Local residential and local centre use
Co-op Sankey	357002	388565	20-50	3	1	2	5	11	24	Yes	Local destination hub
Co-op Fearnhead	360810	389955	100+	2	1	2	5	10	25	Yes	Local destination hub
Orford Park, Winwick Road	362931	390667	100+	3	2	3	2	10	25	Yes	Local destination
Hood Manor Shopping Centre	366065	389234	20-50	1	1	2	5	9	27	Yes	Local residential and local centre use
M6 J21 Manchester Road	358321	388526	NA	1	5	2	1	9	27	Yes	Existing proposal
Walton Hall and Gardens	356399	387930	100+	2	3	3	1	9	27	Yes	Tourist destination charging potential
Padgate Rail Station	355475	389917	20-50	1	1	2	4	8	28	Yes	Rail head

Car Park	Easting	Northing	Spaces	Residential Demand	On-Route Demand	Destination Demand	EVs in Wider Area	Total Score	Ranking in Group	Shortlisted (Yes/ No)	Rationale
Lingley Mere Business park	363055	390047	100+	3	1	3	1	8	28	No	Large commercial site, provision likely in time
Penketh Swimming Pool and Community Centre	368176	387282	0-20	1	1	1	4	7	31	Yes	Area not represented
Henry Street Car Park	360063	385219	20-50	2	2	1	2	7	31	No	Looks like power will be a struggle
Pepper Street Car Park	365524	395171	50-100	2	2	1	1	6	34	Yes	Best Lymm option for power
Common Lane Car Park	365412	395340	20-50	1	3	1	1	6	34	No	Lower scoring site in Culcheth
Davies Way Car Park	368102	387301	50-100	1	2	1	2	6	34	No	Power looks a challenge
Jackson Avenue Car Park	368373	387252	100+	1	3	1	1	6	34	Yes	Higher scoring site in Culcheth

D2. Longlist Sites Map

Figure D-2. Longlist Sites Map