Essex Vehicle Charge Point Strategy – Phase 1

Technical Evidence Base

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Safer, greener, healthier

Document Control Sheet

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Limitation Statement

The UK Government is phasing out the sale of new petrol and diesel cars. Following the completion of this Technical Evidence Base in early 2023, a previous commitment to accelerate the transition towards all new vehicles being zero emission vehicles, by phasing out the sale of new petrol and diesel cars by 2030 and plug-in hybrid vehicles by 2035, was amended to 2035. However, due to the UK Government subsequently confirming a Zero Emission Mandate, which ensures 80% of new cars sold by 2030 will be Zero Emission Vehicles (ZEV), this change in policy is considered to have minimal impacts on EV uptake projections. The UK Climate Change Committee noted 'delaying the fossil car phase-out date to 2035 is expected to have only a small direct impact on future emissions, due to the now-confirmed ZEV Mandate'.

Modelling of EV uptake undertaken in this Technical Evidence Base was conducted prior the UK Government's delay to the phase out of new petrol and diesel cars. This included a number of scenarios, which modelled low, medium and high uptake rates, due to significant political and industry uncertainties. These scenario-based assessments are reflective of inherent uncertainties and, given the marginal impact of the recent change in policy, are considered appropriate to underpin development of the Phase 1 Essex EV Charge Point Strategy. As and when the strategy is refreshed in the coming years, any modelling will be revisited and updated to reflect the most up to date information available at that time.

1 Introduction

1.1 Document purpose

This document sets out a supporting Technical Evidence Base as an appendix to the Essex County Council's (ECC) emerging Phase 1 Electric Vehicle Infrastructure Strategy. It provides information on wider policy commitments, guidance and technologies and also provides early analysis of longer-term trends around electric vehicle (EV) uptake, infrastructure requirements and details on how measures have been prioritised into the strategy.

The separate overarching Phase 1 strategy document sets the vision, objectives and priorities that the Council will focus on in the next 2-3 years. There is a clear focus on how to decarbonise transport as equitably as possible and support the uptake of sustainable transport while providing for EV uptake where necessary. At this stage the focus will be on zero emission battery powered EV cars and light goods vehicles (LGVs) / vans in the county with an acknowledgement that the Council will need to work with others to consider how to transition freight, taxis and public transport to zero emission fuels in future phases of the strategy. The strategy and technical evidence base will need to be reviewed and refreshed regularly to reflect this and ensure it meets the rapidly evolving EV landscape and technologies.

1.2 Background

ECC (the Council) have committed to reducing greenhouse gas emissions to net zero by 2050[1] in response to global action to limit climate change. Zero-emission EVs will play an important role in achieving this as part of a wider sustainable and integrated transport network. Domestic transport is the largest contributor (23%) of greenhouse gas emissions and to poor air quality of any sector across the UK economy. Over half of these emissions come from passenger cars and a third from heavy and light goods vehicles.

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[1] Net Zero: Making Essex Carbon Neutral report (ECAC, 2021)

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People in Essex will need access to a reliable, convenient, accessible and fairly-priced network of EV charge points to encourage and support a switch to EVs. However, a switch to EVs alone will not be enough and EVs also come with their own environmental and societal challenges. The delivery of publicly accessible EV charge points therefore needs to be within the framework of the Council's plan for levelling up the county[2],reducing the need to travel, shifting journeys to sustainable options and transitioning residual vehicle use to EVs.

1.3 The Need for an EV Strategy

The Council are at the early stages of planning for EVs and an initial strategy is needed to set out what the charging network should look like for all people across the county and how it should be delivered by both the public and private sectors for a safer, greener and healthier Essex. The emerging transport vision for the county will be promoted through a new Local Transport Plan (LTP) 4, due to be completed in 2024, which includes four strategic themes:

- Decarbonisation
- Supporting People: Health, Wellbeing & Independence
- Creating Sustainable Places and Communities

[2] Everyone's Essex: our plan for levelling up the county 2021 to 2025 (ECC, 2021)

- Connecting People, Places and Businesses

This strategy will align with all four themes and will directly help deliver the decarbonisation theme through our preferred approach of:

- **Reducing** the need to travel
- **Shifting** trips to the most sustainable form of travel
- **Decarbonising** residual car travel

The EV market is rapidly evolving, and the Phase 1 strategy intentionally focuses on what can be done in the next 2-3 years (up to 2025) to start enabling publicly accessible EV charge points in locations where:

- Alternative and more sustainable modes of travel are limited and car travel is necessary
- There is little opportunity for private off-street charging
- There is integration with sustainable travel
- They are commercially unattractive to the private sector

The strategy will be refreshed by 2025 and, looking at longer-term private car use and EV uptake, will start to explore the supply of renewable energy to EV charge points and how the Council can enable the conversion of public transport, taxis and freight vehicles to cleaner fuels. Separate strategies will also need to be developed to provide for alternative clean and zero emission fuels, such as hydrogen.

1.4 Document Structure

This document includes the following chapters:

Chapter 2 - Setting the Vision for Essex gives an overview of the challenges, draft vision and proposed objectives of the overarching strategy
Chapter 3 - Policy and Strategy Review looks at the current national, regional and local policy framework
Chapter 4 - Wider Context and Implications for Essex considers different EV and charging infrastructure technologies and how they relate to the county
Chapter 5 - Essex EV Baseline reviews the current levels of EV uptake, infrastructure and socio-demographic information for the county
Chapter 6 - Stakeholder Engagement summaries the outcomes of early engagement with officers from the wider Council, district partners and discussions with commercial charge point operators

Chapter 7 – Forecasting Analysis provides longer term horizon scanning of potential EV uptake and infrastructure requirements in the county
Chapter 8 - Developing an Action Plan provides an assessment of a long list of interventions and develops a prioritised action plan for the overarching strategy
Chapter 9 - Commercial & Operating Models assesses the different options available to the Council
Chapter 10 - Strategy Recommendations and Next Steps sets out what the overarching strategy should focus on in the short term and what the next steps might look like

2 Setting the Vision for Essex

This chapter sets out the draft Vision for delivering EV charging infrastructure in Essex and how this can be delivered as part of a wider vision for the future of the county transport network.

2.1 The Challenge

The strategy will need to start addressing the following specific challenges of delivering charging infrastructure in Essex that, is accessible, reliable, easy-to-use, safe, and fairly priced, within the wider context of carbon reduction:

- **Net Zero** – encouraging the necessary shift to electric vehicles to help reach the UK Government's and Essex's commitment to achieve net zero carbon by 2050
- **Sustainable travel** – supporting the transition to alternative fuels amidst the need to reduce the overall need to travel and encouraging active travel and public transport use
- **Social justice** – tackling the social and economic inequalities of provision of EV charge points, costs, and improving accessibility for all residents
- **Economic growth** – supporting new industry to bring investment and job opportunities for Essex as part of our wider levelling up agenda
- **Barriers to EV uptake** – addressing physical barriers, such as power supply, and potential practical issues reported by the wider public[3] around the cost of EVs, range anxiety, and limited numbers/quality of charge points (charge anxiety)

2.2 The Vision

The vision is to deliver:

"The right charger in the right place"

This means by 2030, residents, businesses, and visitors to Essex will be able to use electric vehicles and be assured there is an accessible, reliable, easy-to-use, safe, and fairly priced charging network. This will support communities with the socio-economic inequalities of using and charging an EV and help tackle the

[3] Common Misconceptions About Electric Vehicles (Office for Zero Emission Vehicles, 2022)

environmental priorities of reducing and decarbonising vehicle emissions across the county.

The vision sets out the principles of the longer-term ambitions for the charging network in Essex, up to and beyond 2030, for this initial Phase 1 Essex EV charging infrastructure strategy to work towards and start addressing over the next 2-3 years. It is acknowledged at this early stage, that the EV landscape is rapidly evolving, and the strategy will need to be adapted and refreshed through continued engagement with the public, businesses, industry and our public sector partners.

2.3 Strategy Objectives

The draft vision prioritises a publicly accessible network that supports the transition to electric vehicles, amidst the decarbonisation of the transport system and tackling the potential inequalities of accessing and using electric vehicles in the county. There are six strategy objectives, which build on each other, and start delivering this vision to help decarbonise travel in Essex for residents, businesses and visitors. The Phase 1 strategy sets out the Council’s role and how they will deliver these objectives in the next 2-3 years.

The six strategy objectives and our key priorities to deliver the draft vision include:

Objective 1: Social Equality	To deliver an **equitable** electric vehicle charging network that promotes social justice through inclusive design, fair pricing and is accessible to all residents
Objective 2: Healthy Environment	To deliver a **healthy environment** for all by helping decarbonise the transport system, reducing emissions from transport and improving air quality

Objective 3: Resilient and Safe Network	To guide and promote a **resilient** and **safe** network with infrastructure that is reliable, accessible, safe, compatible, easy to use and represents good value for money at installation and during its life
Objective 4: Integrated Network	To develop an **integrated** EV offer that complements the promotion of increased sustainable travel choices and future mobility solutions
Objective 5: Connected Network Meeting Essential Demand	**Better connecting** individuals and organisations throughout Essex to support the uptake of electric vehicles where it is needed most
Objective 6: Creating Better Places	**Create better places** using infrastructure that is sensitively placed in the right locations, designed to complement our public spaces and minimises the impact on all members of society

3 Policy and Strategy Review

There is a comprehensive policy and strategy framework at national, regional and local levels that is increasingly supportive of an accelerated transition to EV uptake. The key policies relevant to the Phase1 Essex EV Infrastructure Strategy are outlined in this section with further information of wider policy included in Appendix A.

3.1 Key National Strategy and Policy

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

- *End of sales of new petrol and diesel cars by 2030[4] (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: Taking charge: the electric vehicle infrastructure strategy, published (2022)* provides an overarching strategy for local authorities to adapt and follow, highlighting:
    - By 2030, there are forecast to be around 300,000 public charge points as a minimum in the UK, but there could potentially be more than double that number.
    - Everyone can find and access reliable public charge points 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 charge points.
    - Infrastructure is seamlessly integrated into a smart energy system.
    - Continued innovation to meet user needs.

3.2 Regional Policy

- *Transport East Decarbonisation Evidence Base and Strategic Recommendations Report (2020)* – Details the body's short-, medium- and

[4] Please refer to Section 1.2 and updated Government Guidance relating to changes made to this policy in September 2023

long-term goals in identifying and investing in locations for electric vehicle charging infrastructure.

- *Transport East – A 30-Year Transport Strategy for the East (2021)* – Sets out the region's transport vision, including the rollout of a comprehensive electric vehicle charging network, the setup of an EV infrastructure task force, and increased EV vehicle use at airports.
- *Transport East Investment and Delivery Plan (2020)* - Outlines the contribution of investment in boosting the East of England's economic role. This includes expanding the EV charge point network across the region.

3.3 Local Policy

- *Essex County Council's Everyone's Essex: our plan for levelling up the county 2021 to 2025 (2021)* – Sets out 20 commitments that ECC believe will make Essex a stronger county. This includes delivering high quality infrastructure, green growth and achieving net zero – all objectives that this EV Infrastructure will help deliver.
- *Essex County Council's Net Zero: Making Essex Carbon Neutral Strategy (2021)* – Describes the steps Essex is tacking to achieve carbon neutrality by 2050. This includes reducing travel and increasing sustainable travel choices. Where road journeys are essential the strategy highlights EVs as the preferred choice. This EV charging infrastructure Strategy will support the sensible use of EVs, hence help deliver the Net Zero Strategy.
- *Essex County Council's Local Transport Plan (LTP) (2011) -* The LTP is Essex current plan for transport in county. The strategy highlights the need to reduce carbon and the associated impact on the environment. The uptake of EVs is identified as part of this solution. This EV infrastructure Strategy will facilitate the uptake of EVs and therefore help deliver the LTP objectives.
- *Essex County Council's Local Transport Plan 4 Draft Outline (LTP) (2022)* –
  The new LTP, due Spring 2024, will focus on 4 key themes:
  1) decarbonisation
  2) supporting people health, wellbeing and independence
  3) creating sustainable places and communities
  4) connecting people, places and businesses
  The EV infrastructure strategy aligns with the emerging LTP4 themes, particularly decarbonisation, and aims to reduce travel, promote sustainable travel options and promote zero emission vehicles where private car trips are necessary. The strategy will identify the right mix of EV charging infrastructure to support communities and business throughout Essex.

3.4 Summary

There is an increasingly supportive policy and legislative framework and an EV strategy is a key policy requirement to support the case for central funding opportunities. The transition to EVs is likely to be influenced by factors outside the control of the Council and their partners, and in some cases the UK Government. Overcoming challenges around the global supply of batteries and vehicles, and the issue of EVs being comparatively more expensive than ICEs, will require a cross sector effort by both the Council and private sector organisations. The Council, through their emerging strategy, can take actions to ensure the local environment is fit for the EV future alongside wider cross sector working.

Specific aspects of the policies and strategies listed in this chapter have also informed the evidence base and option development of this study.

4 Wider Context and Implications for Essex

4.1 Background

This chapter gives an overview of the various EV and charging technologies available, as well as current trends in the development of this technology.

Throughout this chapter, the term ‘EV’ is used for simplicity even though in most cases only plug-in EVs are referred to. In general, EVs that use an electric drivetrain to power the wheels produce lower tailpipe emissions, less noise and encourage a smoother driving style than Internal Combustion Engine (ICE) only vehicles. EVs are particularly attractive in urban areas where stopping and starting, idling and over-revving of ICE vehicles in queues produces high concentrations of emissions.

The emerging technology and policy trends discussed in this chapter are summarised in the timeline below.

Present day upto 2030

Sale of ICE and PHEV vehicles ends

Substantial second-hand EV market emerges

Lithium-ion battery efficiency improvements

Growing demand for EV charge points especially on-street

2030 - 2040

Solid state batteries and wireless charging become more commercially viable

2040-2050

Majority of vehicles now rely on electric drivetrain technology and depend on the EV charge point network

Figure 4-1. Emerging technologies timeline

4.2 Electric Vehicle Trends

4.2.1 Background

The UK is facing a climate emergency and consequently is committed to reducing greenhouse gas emissions to net zero from 1990 levels by 2050 through its updated Climate Change Act 2008. Currently there is a major industry / purchasing shift from diesel to petrol engines as diesel is now categorised as more polluting. Both have environmental impacts and removing both options, in combination with encouraging uptake of other sustainable options such as active travel and public transport, will improve both air quality and carbon emissions.

4.2.2 EV compared to Petrol / Diesel Vehicles

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

CO_2 is the primary greenhouse gas emitted through human activities, which traps heat in the atmosphere causing global climate change. The transport sector currently generates the highest proportion of CO_2 emissions in the UK accounting for 27% of greenhouse gas emissions, due to the increasing miles driven by ICE vehicles that burn carbon-based fuels and consequently emit CO_2 from their exhausts. The transport sector has made the lowest contribution to UK greenhouse gas emission reduction, only achieving a 4.6% reduction from 1990 to 2019, making it a prime target for future regulation. The UK Government has recently published a Green Paper on a New Road Vehicle CO_2 Emissions Regulatory Framework for the United Kingdom.

In addition to CO_2, ICE vehicles produce methane (CH_4) and nitrous oxide (N_2O). While the emission levels of these gases are small in comparison to CO_2, the impact of these emissions are important because they have a higher global warming potential than CO_2. 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 (PM2.5) also originate from brakes and tyres. EVs have the benefit of regenerative braking to increase engine efficiency and reduce particulate emissions from braking compared to ICEs, but tyre wear will be similar to or slightly higher due to increased vehicle weight. Therefore, reducing total vehicle use is the best long-term option for clean air.

4.2.3 EV Uptake

EVs are an alternative to ICE vehicles allowing electricity stored on board to power the wheels rather than carbon-based fuels, so they generate zero exhaust emissions whilst driving. EVs can refer to a number of different vehicle types, which are:

- Battery Electric Vehicle (BEV) has no ICE and must be plugged in to charge.
- Plug in Hybrid Electric Vehicle (PHEV) is both a BEV and an ICE with the battery being charged by a plug.
- Hybrid Electric Vehicle (HEV) does not plug in and uses the ICE to generate electricity to drive the vehicle
- Fuel Cell Electric Vehicle (FCEV) uses on board hydrogen to generate power for the wheels. A hydrogen fuel car is an electric vehicle

These descriptions will be expanded upon later, but the term EV will only refer to battery unless hydrogen is included, which will be referred to as FCEV.

EV uptake in the UK is still at the early adopter stage led by relatively affluent, environmentally conscious buyers who are keen to adopt new technologies and reduce their personal transport impacts or 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 restricted in some residential areas where on-street parking is the only option. 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. 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. A specific challenge is that while the industry acknowledges the need for more chargers, it is difficult to specify what ‘more’ actually consists of. The rapidly emerging high-power charging hubs, such as the Gridserve forecourt near Braintree, provides an offer to drivers, which was not available before, and early evidence is showing that they are influencing behaviour.

The government reflects this need for charging provision in its “Road to Zero Strategy” and can now legislate to require its provision using the “Automated and Electric Vehicles Act” (AEV Act). A caveat to prevailing thought is that early purchases were generally to people with an identified charging provision. New buyers of EV are experiencing much greater range than the early adopters upon which most research was based. Ranges have gone from less than 100 miles to 200+ miles and therefore actual charging behaviour such as charging a smaller battery every night may change to charging a larger battery every few days. A new situation has arisen where large-scale private finance is going into rapid charge hubs to maintain the current behaviour of going to a fixed point to ‘fill up’.

Table 4-1: Annual BEV and PHEV Sales - SMMT Figures

Year	BEV	PHEV	Total	Total Registered	% 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%	1.86%	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%		

The table shows the growth of BEV and PHEV sales since 2013. With such a low national population of BEVs (395,260 end of 2021 (SMMT)), which is >2% of cars on the road, the normalising of EV driver behaviour has some way to go. There was a clear increase in 2021 of BEV but this was only 82,522 out of 1.6 million vehicles sold.

What is known, however, is that there will have to be a mix of infrastructure provision, though the ratios of the type of chargers and charger numbers are yet to be established. Currently there is provision for a national network but no detailed government strategy to achieve one.

EV uptake will help Essex to decarbonise, however, reducing the overall need to travel and the number of vehicle journeys through modal shift remains the best option for reducing the carbon impact of private transport.

4.3 Electric Vehicle Technologies

EVs use onboard electricity to provide power to the wheels and by doing so are much more efficient. In the UK, despite the increased electricity requirement, EVs have a lower operating carbon footprint than ICE vehicles and given the UK's progress towards and remaining plans for greener electricity generation, these benefits will increase further in the future. EVs also produce less noise pollution and encourage a smoother driving style than ICEs, which increases driving efficiency by reducing the power required per kilometre driven and causing lower particulate emissions from brake and tyre wear.

4.3.1 Electric Vehicle Terminology

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

Only those electric vehicles that plug into an electricity supply to recharge the battery are relevant to the EV recharging infrastructure discussed in this 'EV Infrastructure Strategy'. The specific vehicles that require EV charging points are Plug-In Vehicles, or PIVs, incorporating BEVs and PHEVs. For simplicity, this document refers to EVs rather than PIVs, though charging infrastructure is only required for PIVs rather than for all EVs.

Figure 4-2 below shows different types of electric vehicles, with only PHEVs and BEVs being of relevance in terms of EV charging infrastructure.

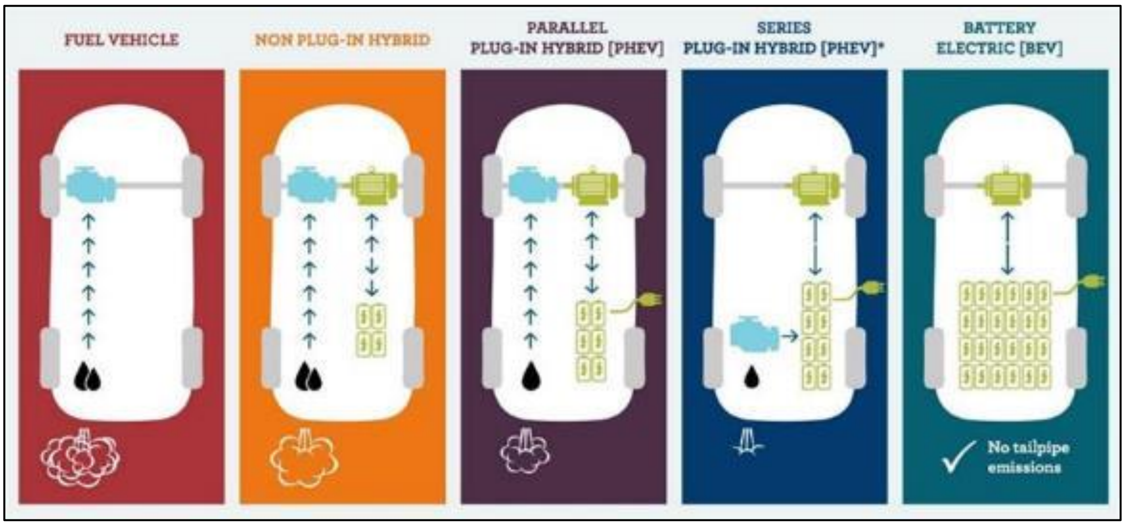


Figure 4-2: Types of Electric Vehicle

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

- **Electric Vehicles (EVs)** – EVs are vehicles driven by an electric motor, powered from a battery, which must be plugged into an electricity source to recharge. Full EVs have no combustion engine, and therefore zero tailpipe emissions, producing 0 grams CO_2/km when driven – these pure EVs are sometimes referred to as BEVs.
- **Plug-In Vehicles (PIVs)** – A collective term used to cover all vehicles that can be plugged into an external electrical outlet to recharge their battery. PIVs form a subset of ULEVs, which includes both BEVs and PHEVs as well as FCEV. All PIVs require recharging infrastructure to recharge their batteries, so understanding this category's needs is key when planning charging networks. The batteries are much smaller than in a BEV. Statistics for total licensed PIVs by local authority are published quarterly. However, UK targets do not focus on PIVs but rather on ULEVs, a more relative term that can be redefined as emission standards improve.
- **Plug-in Hybrid Electric Vehicles (PHEVs)** – Plug-in hybrids combine a plug-in battery and an electric motor with an ICE, either of which can be used to drive the wheels. The means of propulsion therefore dictates the amount of tailpipe emissions produced. All PHEVs plug-in to recharge their battery. In hybrids with parallel drivetrains, the electric motor and internal combustion engine can provide mechanical power simultaneously or separately.

- **Hybrid Electric Vehicles (HEVs)** – Hybrids use more than one form of on-board energy to achieve propulsion, usually a petrol or diesel engine plus electric motors and a battery. Some hybrid vehicles use the electric motor to make more efficient use of petroleum fuel, but the motor cannot power the vehicle alone. The controversial 'self- charging hybrid' falls into this category. This is an important point as a favourite of mini-cab and private hire drivers is the Toyota Prius hybrid. Hybrids that use a series drivetrain only receive mechanical power from the electric motor, which is run via a battery charged by a fuel-powered generator. The Nissan e-POWER is an example of this.

In addition to the terminology listed above, for clarity several additional EV-related terms are defined below:

- **Ultra-Low Emission Vehicles (ULEVs)** – This term is used in the UK to refer to any motor vehicle emitting extremely low levels of emissions, currently set at 75g CO_2/km driven or less. UK targets are set for ULEV uptake and statistics are reported quarterly at local authority level.
- **Alternative Fuel Vehicles (AFVs)** – These are vehicles that run on substances other than solely conventional petroleum gas or diesel. Alternative fuels include electric, solar, biodiesel, ethanol, propane, compressed air, hydrogen, liquid natural gas and liquid petroleum. All types of EVs are AFVs. Because this term focuses on the way a vehicle is propelled rather than its emission levels, there is no guarantee that an AFV is necessarily less polluting than a conventional ICE.
- **Fuel Cell Electric Vehicles (FCEVs)** – While FCEVs are not considered within this study, they have form part of the EV technology landscape. These are vehicles that use a fuel cell, instead in combination with a battery, to power an electric motor. The fuel cells generate electricity to power the motor, generally using oxygen from the air along with compressed hydrogen. Hydrogen must be stored and transported from the production site to the refuelling station, making it a costly infrastructure solution. If FCEV do come into wider usage in the future, they will require a separate new dedicated infrastructure network to be developed. Over the last 10 years, only 263 FCEVs have been registered.

4.3.2 EV Technology Roadmaps by Vehicle Type

The UK Automotive Council has developed long-term technology roadmaps 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 drive towards reducing emissions. Ignoring early teething issues, in terms of specific vehicle types being brought to market, it is likely that charging infrastructure will be required for the majority of vehicles in the overall fleet for the next several decades. The roadmap nuances across the different vehicle types are described in more detail in **Appendix B.**

The UK remains technologically neutral encouraging research and development to reduce urban air pollution and greenhouse gas emissions regardless of transport type. However, long-term roadmaps forecast EV technology as a focus area until at least 2050. This is a strong indicator that the EV presence in Essex is likely to expand.

4.4 Electric Vehicle Availability

Since only vehicles that plug-in to charge the battery are relevant to recharging infrastructure, in this section we provide a summary of current plug-in car availability in the UK. There are currently just under 200 plug-in car models available on the UK market (as of November 2022):

The question of PHEV longevity is focused on the additional cost, average price (£10,000 more than the average BEV) and the complexity of manufacture. The recent dominance of PHEVs in the UK market is like most European countries – however, other countries such as Norway and the Netherlands have seen the opposite due to their more favourable BEV incentive schemes. The table below shows that BEV in 2019 caught up with PHEV and in 2020 and 2021 significantly outsold PHEV.

Table 4-2: BEV and PHEV Sales Over Time (SMMT)

Year	BEV	PHEV
2013	2,512	1,072
2014	6,697	7,821
2015	9,934	18,254
2016	10,264	26,643
2017	13,597	33,666
2018	15,474	44,437
2019	37,850	34,734
2020	108,205	66,877
2021	190,727	114,554
Total	**395,260**	**348,058**

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

4.4.1 Battery Capacity

Analysis of the BEV vehicles on the market shows how battery capacity is growing. As a datum the first Nissan Leaf was 24kWh then it moved to 30kWh. It is now available as 40kWh or 62kWh. There will however be a legacy of lower capacity batteries within the fleet from earlier models sold in previous years.

The average battery capacity for currently available BEV's is 70kWh, resulting in an approximate vehicle range of 235 miles.

4.4.2 Battery Charging Capabilities and Constraints

EV charging technology is evolving rapidly. Prior to 2016, most EVs charged at 3kW AC (called slow charging), which was adequate to fully recharge most batteries (typically up to 24 kWh) overnight. With the development of vehicles with 7kW on-board chargers came fast 7kW AC charging, and with the introduction of higher capacity batteries, the 22kW AC fast charging technology has since come to market. A detailed overview of the current battery charging capabilities and the PIV supply constraints can be found in **Appendix C.**

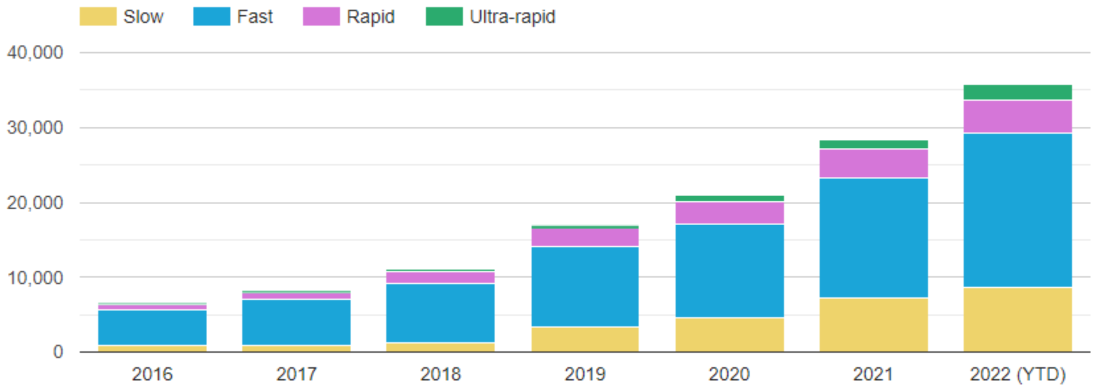
BEVs are becoming the dominant private vehicle of choice, the second-hand market remains small but growing, and battery capacity is expected to continue incrementally increasing. More BEVs will be seen across Essex as the vehicles become more affordable and myths are dispersed.

4.5 Electric Vehicle Charging Technology

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

4.5.1 Existing Charging Infrastructure in the UK

Figure 4-3 shows the breakdown of charge point devices by slow (3-5kW), fast (7-22kW), rapid (25-99kW) and ultra-rapid (100kW+) power rating for the past six years. The graph shows the past few years have experienced a notable increase in the number of public EV charge points in the UK. Between the end of 2016 and 2021, the charge point network grew four-fold from 6,500 to more than 28,000 devices and between 2020 and the end of 2021, close to 7,500 charge points were added to the UK network, a growth of 36%. Another trend is the growth in slow chargers, as local authorities install on-street charging options on residential roads and off-street charging options in car parks in locations with a high concentration of properties with limited residential off-street parking. Both implementations aim to enable EV purchase for people without off-street parking.



Source: Zap-Map database. Updated: 31st October 2022

Figure 4-3. The number of public charging points by speed (2016 to date)

4.5.2 The Need for Recharging Infrastructure

Connecting the vehicle to an external electricity supply, most commonly the electrical grid (the electricity transmission network) or an electrical storage facility is a necessity. Electric Vehicle Supply Equipment (EVSE) is the collective term used to refer to all equipment used to deliver energy from the grid to a PIV. EVSE includes plugs, sockets, conductors, power outlets and devices that allow communication between the recharging apparatus and the vehicle.

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

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 charge point to be installed near to them. The 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 (1) if there was a suitable parking spot and, (2) that power could be supplied. However, these installations proved to be extremely difficult to deliver and focus transitioned to installing charge points at workplaces and hubs. On many residential estates, parking demand was found to be high. The regulatory process for ringfencing on-street sites for EVs was difficult to navigate. Out of 39 enquiries, a total of 6 have been installed and one still pending. Of the 6 that were installed, the quickest time was 237 working days and the longest being 629 working days, the average time was 408 working days. Due to delays new District Network Operator applications had to be made as original quotes had expired as these only last for 90 days.

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

There are two clear types of market operators − the first group believes that every house should have a domestic or on-street charger, while the second group believes that rapid charge hubs in central locations are the way forward. The answer is that both are correct up to a point. What no one yet knows is the likely split between home, workplace, destination, and in-transit charging that UK EV users will seek over the next decade or more. However, it is anticipated that public on-street charging will become the most popular form of charging by 2030 as more middle- and lower-income households without off-street charging options purchase EVs.

4.5.3 Charge Points

The most well-known element of EVSE is the charge point – also called a charging post, charging point or charging station. There are many specifications of charge point in the marketplace, differentiated by power output, communication protocol, type and number of charging outlets. They can typically be installed mounted onto a wall or as free-standing units installed in the ground. Most ground mounted charge points can be installed with retention sockets to ease swap out for future maintenance, repair or replacement. Table 4-3 provides a summary of the different types of charge point currently available in the marketplace.

Table 4-3: Charging Point Types

<table>
<tr><th>Charge Point Types</th><th>Power Output (kW)</th><th>Current/ Supply Type</th><th>Socket/ Plugs</th><th>Charging Duration (40kW battery)</th><th>Use Cases</th></tr>
<tr><td>Slow</td><td><7</td><td>AC</td><td>Type 2 Socket</td><td>13 hours</td><td>Destinations</td></tr>
<tr><td>Fast</td><td>7 – 22</td><td>AC</td><td>Type 2 Socket</td><td>2 to 5 hours</td><td>Destinations</td></tr>
<tr><td rowspan="3">Rapid</td><td rowspan="3">43 -50</td><td>AC</td><td>AC – Type 2</td><td rowspan="3">30 minutes to 80%</td><td rowspan="3">On-route</td></tr>
<tr><td>DC</td><td>DC – CHAdeMO</td></tr>
<tr><td>DC</td><td>DC – CCS Captive cables with plugs attached</td></tr>
<tr><td rowspan="2">High Power</td><td rowspan="2">100</td><td>DC</td><td>Tesla 120kW</td><td rowspan="2">TBC depending upon vehicle</td><td rowspan="2">On-route</td></tr>
<tr><td>DC</td><td>CCS 150kW+</td></tr>
</table>

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

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

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

4.5.4 Further Charging Considerations

Further technical details on the current charging landscape in terms of charging types, estimates of miles per kWh, charging connectors and charging protocols are outlined in **Appendix D.**

There are also a number of future charging technological advances to be aware of, notably smart charging and vehicle to all charging, more details on these are also provided in **Appendix D.**

EV charging across Essex will be a blend of home off-street / on-street charging, on route charging, and destination charging. On-street charging is likely to be the largest growth area in the next few years. Rapid and ultra-rapid chargers installed today are likely to be just as utilised through 2040 as the EV second hand market expands.

4.6 Emerging Wireless / Induction Charging Technology

The EV industry has seen substantial technological development in recent years. Another advancement includes induction, or wireless, EV charging. Induction charging is fairly simple − electricity is transferred through an air gap from one magnetic coil in a transmitter pad to a second magnetic coil fitted to a receiver pad on the vehicle. However, international standards are required for this technology to go mainstream and it is likely to take time to develop this infrastructure widely to market. Further information on induction charging and current trials underway at the time of writing using this technology is detailed in **Appendix E.**

Wireless charging is continuing to develop, however, it is unlikely to become mainstream in Essex within the next 10 years.

4.7 Summary

This section summarises the current and future technology trends relating to EV availability and charging infrastructure, including:

EV Trends

- A kickstart to EV uptake is needed due to the increasing GHG emissions and new legislation - there must be the infrastructure in place to facilitate this.
- Plug-in Hybrid (PHEV) and Battery (BEV) Electric Vehicles are the only EVs dependent on charging infrastructure - all of which are being encouraged by central government.
- For successful uptake, EVs must become more widely available and affordable - key manufacturers such as Nissan, Renault and Citroen offer EV vans and have recently been joined by new models from LDV and Mercedes, with Ford, Volkswagen and LEVC announcing models coming soon to the UK - there are nearing 200 plug-in car models available in the UK.

EV Availability

- Rapid evolution of charging technology - prior to 2016, most EVs charge at 3kW, however in 2021 we are seeing the rollout of 150kW+ public chargers, with 300+ kW chargers becoming increasingly common in EV forecourts.
- The lack of EV production capacity is a global issue, originating in vehicle production plants and battery production facilities across the world. At present, the UK government does not hold an incentive-base allure for the limited supply, however the recent announcement of Britishvolt building a battery facility in the UK, plus the approval of formal planning permission for Envision AESC in Sunderland, will help address the shortage. The Faraday Institute has forecast a need for at least 7 Gigafactories to be built in the UK to meet demands and reduce the potential cost of importing to meet future needs.

EV Charging Technology

- 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 they will be leaving the car at for a considerable amount of time. Rapid and high-power chargers however, suit on-route charging due to their high-speed capabilities, perfect for journey stop-offs.
- Practicing smart charging is key in enabling a sustainable recharging market: energy cost reduction, increasing flexibility, demand response, and integrating barriers and renewable energy sources are some of the features of smart charging.

- Vehicle to Everything (V2X) is emerging as a potential key tool within managing energy needs and consumption across networks and individually. The technology works and is proven though commercial use cases and business models are still evolving.

Wireless/Induction Charging

- Various national companies and national governments across the world are trialling methods of wireless charging, attempting to iron out the questions raised on the topic such as retrofitting costs, whether infrastructure should be built if supply is not sufficient and vice versa, and the international standards needed for wireless charging to go global.

5 Essex EV Baseline

This section describes the existing level of charging infrastructure in Essex (correct at end of 2022) and presents a review of the key factors that can influence EV uptake and charging behaviours such as limited off-street parking, household type, and income levels across the county.

5.1 Existing Charging Infrastructure

5.1.1 Existing Charging Infrastructure in Essex

The National Charge point Registry (NCR) is the official UK database of information on public charge points. It was established by the UK Government in 2011 to provide a public database of all publicly-funded charge points across the UK, in support of the Government's objective to promote the use and sales of ULEVs. Privately funded chargers available for public use are also encouraged to be registered on this database, but this is not compulsory. Another useful source of information on charging infrastructure is Zap Map, a mapping application that builds on NCR data.

Figure 5-1 shows the locations of existing EV charging points in Essex. This map has been created using data from ZapMap and the NCR and shows the overall charging infrastructure of over 300 charge points across Essex, with 49 'ultra-rapid' chargers, 46 'rapid' chargers, 57 'fast' chargers and 149 'slow' chargers in operation in 2022.

Table 5-1 breaks these down by each district. There is a notable lack of infrastructure in Brentwood, Castle Point and Maldon. There are large clusters of slow chargers in many of the urban areas of Essex such as Chelmsford, Colchester, Harlow, Basildon, Braintree and also Clacton-on-Sea. The ultra-rapid chargers are located predominantly in forecourts and focused mainly on major roads in Essex such as the A12 to the northeast of Chelmsford and north of Colchester and also off the M11 from London to the southwest of Epping.

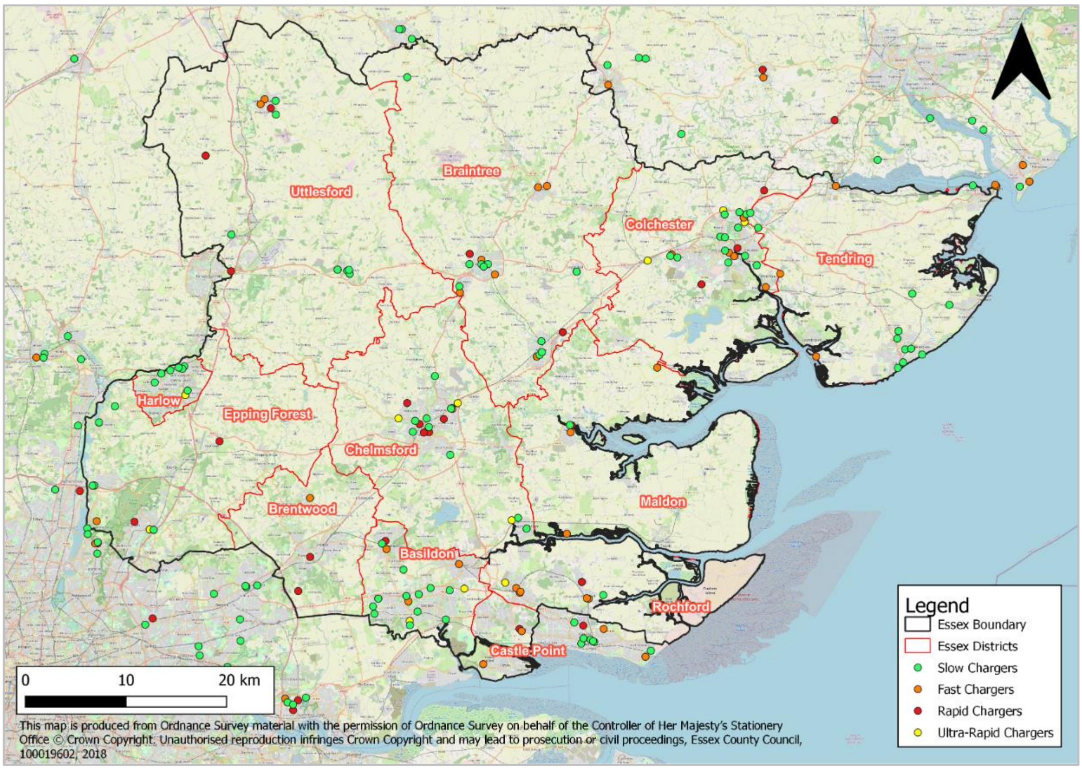


Figure 5-1: The Existing Charging Infrastructure in Essex (National Charge Point Registry) (ZapMap)

Table 5-1: Existing Charging Infrastructure by District (National Charge Point Registry) (ZapMap)

Chargers by District	No. Slow Chargers	No. Fast Chargers	No. Rapid Chargers	No. Ultra-Rapid Chargers	Total
Basildon	33	1	4	3	41
Braintree	25	16	4	23	68
Brentwood	1	1	2	0	4
Castle Point	0	0	2	0	2
Chelmsford	17	6	5	13	41
Colchester	25	11	10	4	50
Epping Forest	3	0	6	1	10
Harlow	9	0	0	2	11
Maldon	0	0	3	0	3
Rochford	2	8	1	3	14
Tendring	16	8	7	0	31
Uttlesford	18	6	2	0	26
Total	**149**	**57**	**46**	**49**	**301**

5.2 Baseline conditions influencing future demand

A range of key factors can influence demand in different areas across the UK and in Essex, including access to off-street parking spaces, demographics, geographic area, and commuter journey patterns. A review of these factors has been completed for Essex in order to inform potential locations of charging infrastructure.

5.2.1 Household type

On average, 30%[5] of UK households do not have access to private, off-street parking at home. This is higher in Essex with 36% of households without access to off-street parking which can accommodate individual charging points. People without access to off-street parking might therefore be discouraged to shift to EVs as they may not have access to draw power from their own electricity supply at home or they may not have access to a charge point near their home. This section of the report presents the local household access to off-street parking and identifies potential areas where higher demand for on-street charging demand may exist.

To carry out the analysis, Census (2011) household data from nomisweb[6] has been gathered. This has included a review of household characteristics to identify types of dwelling likely to have access to driveways and garages. The following dwelling types were considered to have limited off-street parking availability:

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

The output of this analysis has been mapped, and Figure 5-2 shows the density of dwellings with limited off-street parking in the main towns and key service centres in Essex, along with the existing charge points. This information was used to inform the forecast of EV uptake in the modelling in Section 7.

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5 Taking charge: the electric vehicle infrastructure strategy (DfT, 2022)
6 https://www.nomisweb.co.uk/

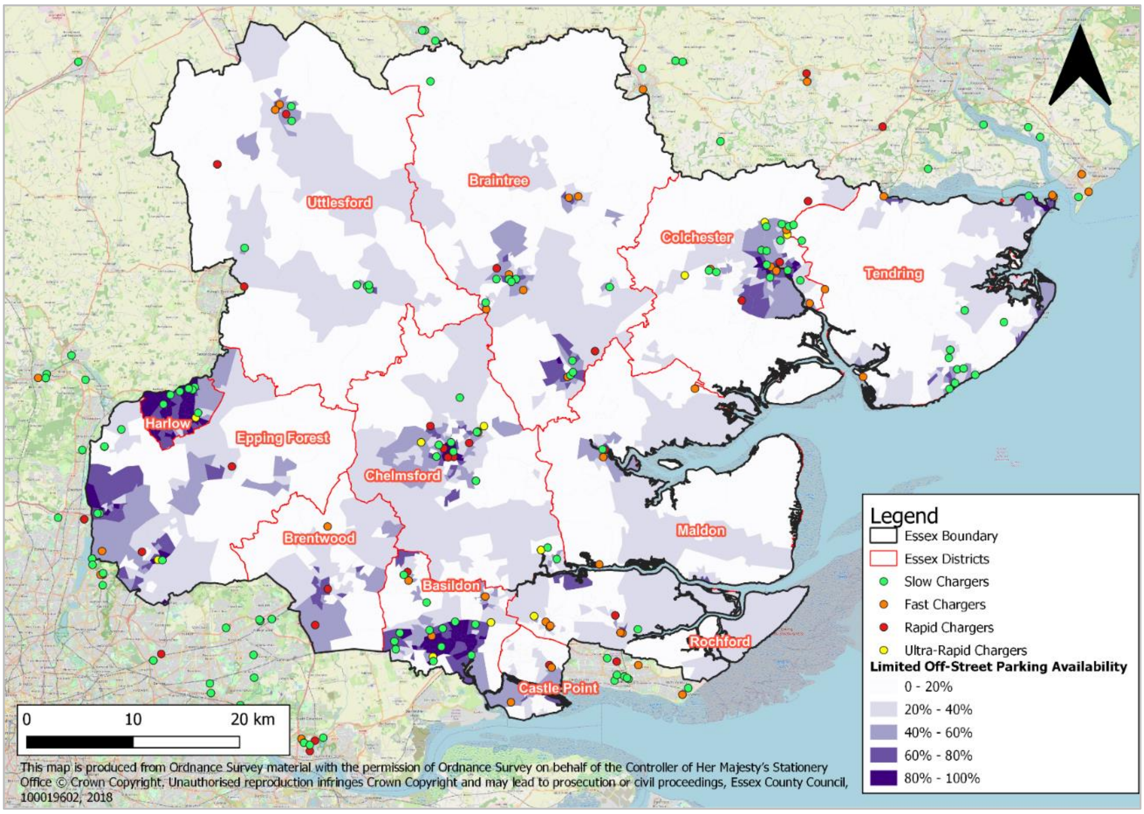

Figure 5-2: Limited off-street parking availability in Essex and the existing charging infrastructure (NOMIS)

The average proportion of properties with limited residential off-street parking in districts across Essex is 36%. Areas such as Harlow and Braintree have higher average concentrations of between 40-55%, as shown in Table 5-2, which can rise to nearer 90% in more central urban parts of these districts . Other areas reflecting above-average densities include the cities of Chelmsford and Colchester, as well as the town of Epping Forest. This may be reflective of their urban natures, which often have higher density accommodation in the form of flats and terraced housing. As previously discussed, these housing types are less likely to have private driveways and spaces in communal residential car parks are often limited.

Table 5-2: Rank order of average proportion of dwellings with limited off-street parking by district

Rank	District	Average % dwellings with limited off-street Parking
1	Harlow	55%
2	Braintree	40%
3	Basildon	38%
4	Chelmsford	38%
5	Colchester	36%
6	Epping Forest	36%
7	Tendring	35%

Rank	District	Average % dwellings with limited off-street Parking
8	Uttlesford	33%
9	Brentwood	32%
10	Castle Point	29%
11	Maldon	29%
12	Rochford	29%

5.2.2 Demographic Analysis

There is an established link present between income levels and the uptake of EVs in large part due to the higher cost of EVs versus Internal Combustion Engines (ICEs) and limited second-hand market. Price parity for EVs is expected to be achieved by the mid-2020s due to the falling price of batteries and increasing supply of vehicles. For the purpose of understanding where stronger uptake of EVs may come forward, Census 2011 data regarding deprivation levels from the Office for National Statistics (ONS)[7] has been collated and mapped in Figure 5-3 alongside the existing charging infrastructure in Essex. The data is used to inform the EV uptake modelling in Section 7 however, this strategy also considers how a balanced network of user types can be provided across the county.

Indices of Multiple Deprivation (IMD) Decile 1 represents the most deprived 10% of areas in England and Decile 10 represents the least deprived 10% of areas in England. Figure 5-3 shows that overall levels of deprivation across Essex are low, however, there are some areas within the 10% most deprived areas of England such as Harlow in the west of Essex, areas to the southwest of Clacton-on-Sea, areas to the north of Tendring and also areas to the east of Basildon such as Vange and Pitsea. These areas lack charging infrastructure, indicating a socio-demographic driven imbalance in the availability of EV charging facilities, which is likely to be due to the perceived commercial viability. Charge point operators may avoid more deprived areas as lower income households are perceived to be less likely to own an EV and therefore less likely to require charge points nearby.

7 Mapping income deprivation at a local authority level (ONS, 2019)

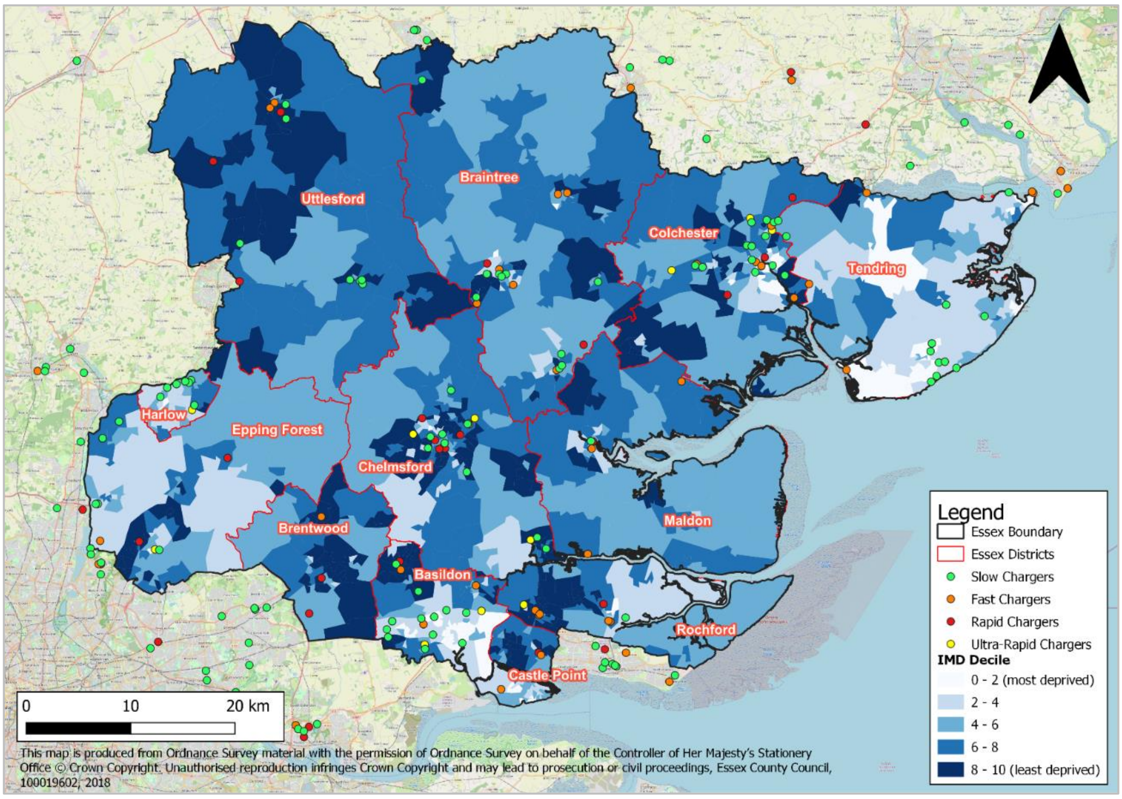

Figure 5-3. Index of Multiple Deprivation Levels across Essex – Deciles (MHCLG)

5.2.3 Plug-in BEV and PHEV Car Ownership Analysis

Table 5-3 and Figure 5-4 show the number of licensed plug-in cars in Essex, broken down into BEV and PHEV from 2018 up to June (Q2) 2023. The data shows there has been a steady increase in licensed PHEV's and BEV's in recent years. In 2018, there were a total of 2,381 plug-in BEV/PHEV cars, increasing to 10,930 in 2021 and 20,607 by the middle of 2023. The rate of uptake in Essex, in relation to overall UK plug-in ownership, has also increased from 1.38% in 2018 to 1.66% in 2023.

Table 5-3: Number of licensed Plug-in BEV & PHEV Cars in Essex and UK 2018 to 2023 (Source: DfT Table VEH0142)

Year	BEV	PHEV	Essex Total	UK Total	Essex % of UK Total
2018	1,086	1,295	2,381	172,819	1.38%
2019	1,643	1,807	3,450	236,950	1.46%
2020	2,877	3,002	5,879	398,811	1.47%
2021	5,673	5,257	10,930	690,933	1.58%
2022	9,439	7,463	16,902	1,032,990	1.64%
2023 (June)	11,681	8,926	20,607	1,240,361	1.66%

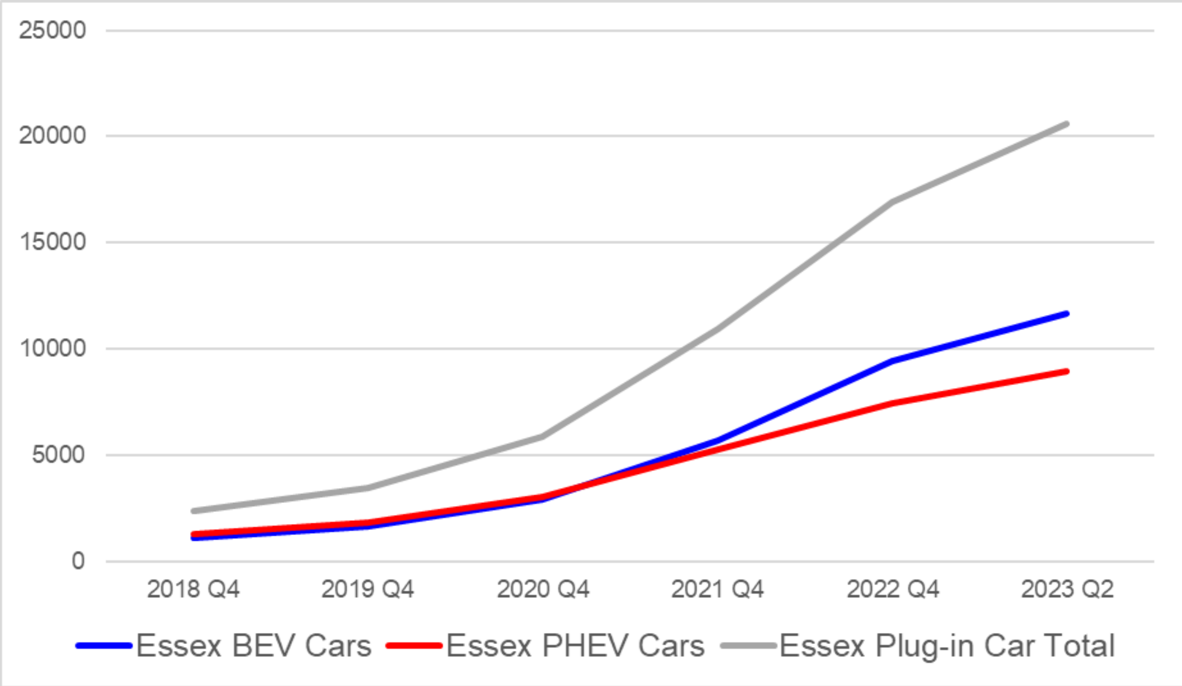

Figure 5-4: Number of licensed BEV and PHEV Cars in Essex from 2018 to 2021(Source: DfT Table VEH0142)

5.2.4 Plug-in BEV Ownership

This section of the report presents the percentage of BEV and PHEV ownership in Essex. Data from nomisweb has been analysed and mapped to show the levels of BEV ownership across Essex at the end of 2021 and is shown in Figure 5-5.

A review of this data suggests that there is an overall high percentage of BEV's in Essex with the highest percentages being found to the south of Braintree and to the east and south east of Chelmsford, and the lowest ownership in Tendring to the east of Essex and Harlow to the west. Lower rates of ownership in these areas are likely to be reflective of higher deprivation levels as both the towns of Harlow and Clacton-on-Sea are within the most deprived 10% of areas in England. Chelmsford and the areas surrounding it are within the 10% least deprived areas of England and are shown in Figure 5-5 to have some of the highest levels of BEV ownership supporting the perception that deprivation levels of an area influences the levels of EV ownership.

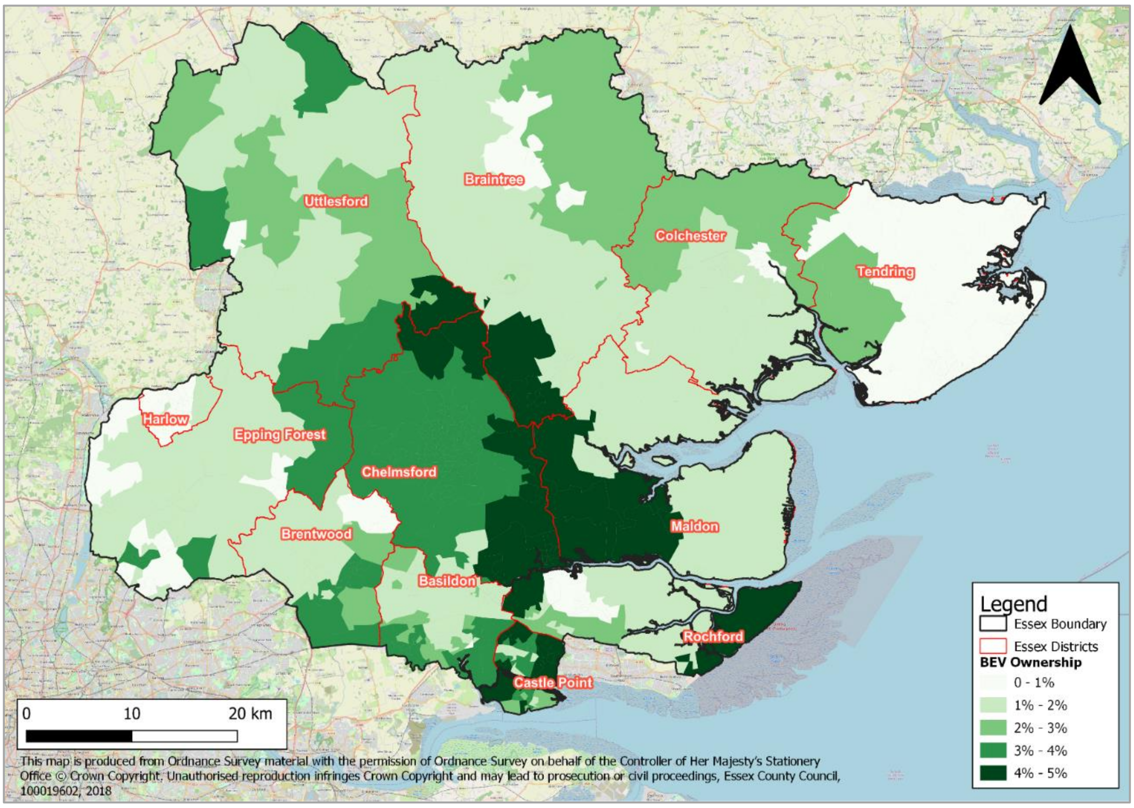

Figure 5-5. 2021 BEV Ownership in Essex (Source: DfT Table VEH0134)

5.2.5 Plug-in PHEV Ownership

Figure 5-6 shows PHEV ownership by Essex Lower Layer Super Output Area (LSOA) as a percentage of total cars within that LSOA for the end of 2021. Concentrations of PHEV ownership are similar to the higher rates of BEV ownership such as in and around Chelmsford, in Benfleet to the north of Canvey Island and also to the north of Colchester. Once again, according to Figure 5-6, these areas are within the 10% least deprived small areas in England, therefore the residents are more likely to be able to afford a PHEV in terms of purchasing, maintaining and charging.

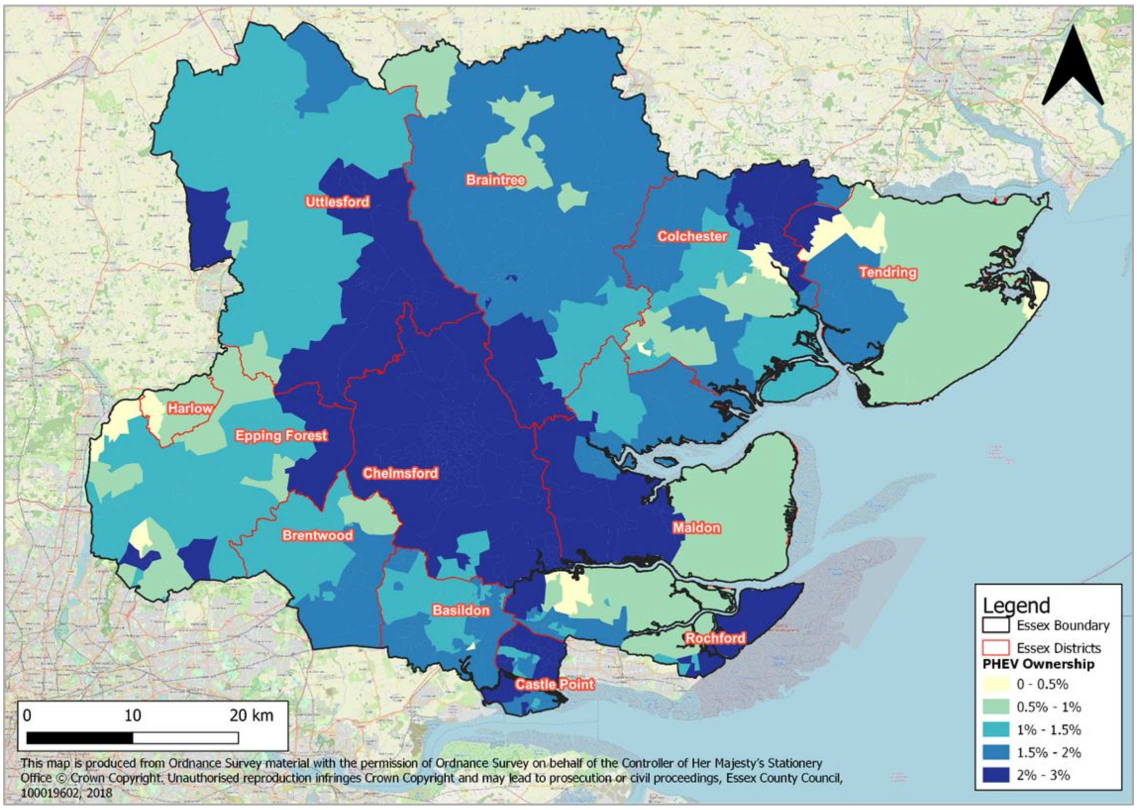

Figure 5-6. 2021 PHEV Ownership in Essex (Source: DfT Table VEH0134)

5.2.6 Commercial Sites – BP / Shell Forecourts and Supermarkets

Figure 5-7 illustrate the locations of BP and Shell forecourts, retail and supermarket sites in Essex. Figure 5-7 breaks these down by each district. The locations of BP and Shell forecourts were mapped as both commercial firms have plans to implement EV charging infrastructure at their forecourts in the future. Similarly, many supermarkets and retail facilities are working with charge point operators to install charge points. Supermarket sites similar or larger in size than a typical Lidl, with a car park were mapped, and retail sites such as shopping centres or retail parks with car parking were also mapped as the presence of a car park allows for convenient charging for EV owners whilst shopping. Data was gathered from Google Maps and cross-checked with the Shell and BP websites.

The majority of BP and Shell service stations and supermarkets are located along major roads in Essex such as the A12 and the A120. Districts where there are fewer BP and Shell Forecourts, and Supermarkets, such as Rochford and Maldon, could be a focus for public sector intervention in the future to help develop a geographically balanced network. There may be significant competitive pressures if charging facilities are installed near these existing BP, Shell, retail and supermarket sites, which will necessitate careful commercial assessment.

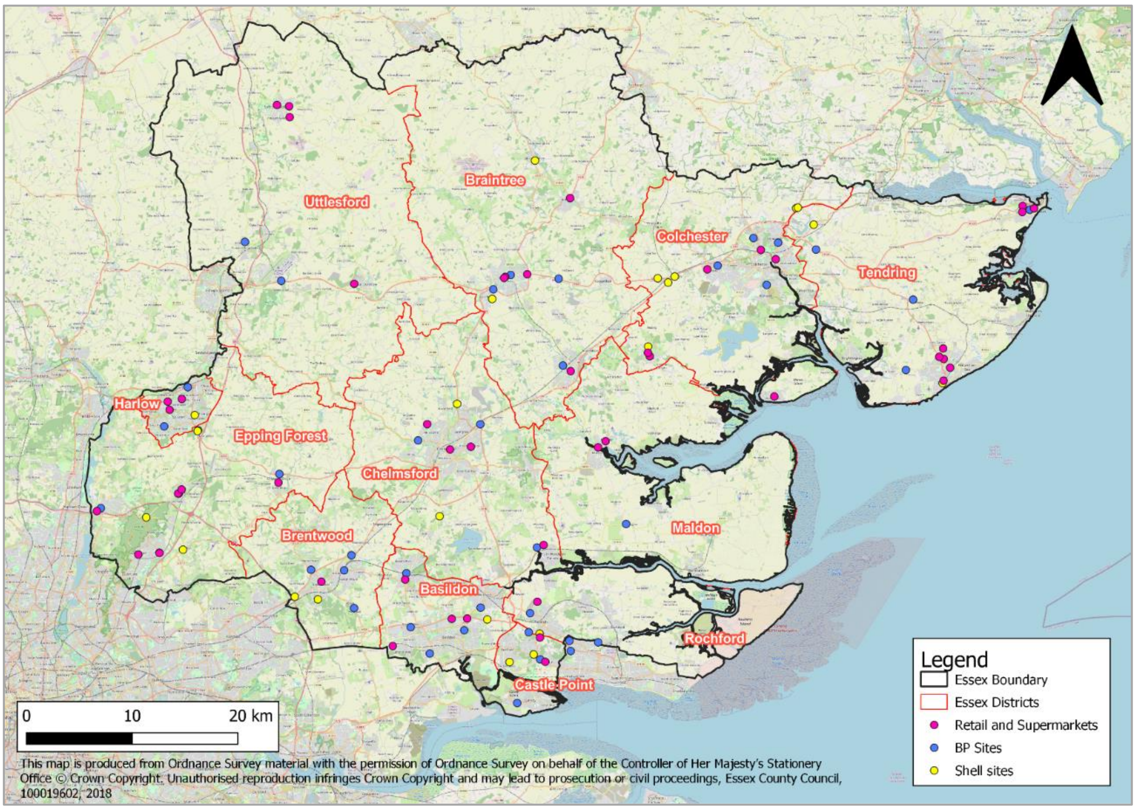

Figure 5-7. Shell Sites, BP Sites, Retail Sites and Supermarket Sites in Essex (Google)

Table 5-4: Number of BP, Shell and Commercial Sites in each District

District	No. BP Sites	No. Shell Sites	No. Commercial Sites	Total
Colchester	4	6	6	16
Tendring	4	2	8	14
Epping Forest	3	4	6	13
Braintree	4	2	5	12
Basildon	5	1	4	10
Chelmsford	3	1	4	8
Brentwood	4	2	1	7
Castle Point	3	2	2	7
Harlow	2	1	3	6
Uttlesford	2	0	4	6
Rochford	2	1	1	4
Maldon	1	0	2	3

5.2.7 NHS Hospitals

In common with other sectors, there is a programme of investment planned to decarbonise the NHS including fleet upgrades to EVs. Additionally, visitors and staff are likely to attend the hospital for a reasonable amount of time. For example, it can be anticipated that visitors are likely to spend an hour or possibly more at the hospital, which supports the case for investment in EV charge points in hospital car parks. EV owners can arrive and charge their vehicle while in the hospital. Further to this, charging hubs at hospitals could also support wider demands for EV charging in appropriate locations. NHS hospitals in Essex were identified using Google maps and the NHS directory[8] and plotted alongside existing charge points, as shown in Figure 5-8.

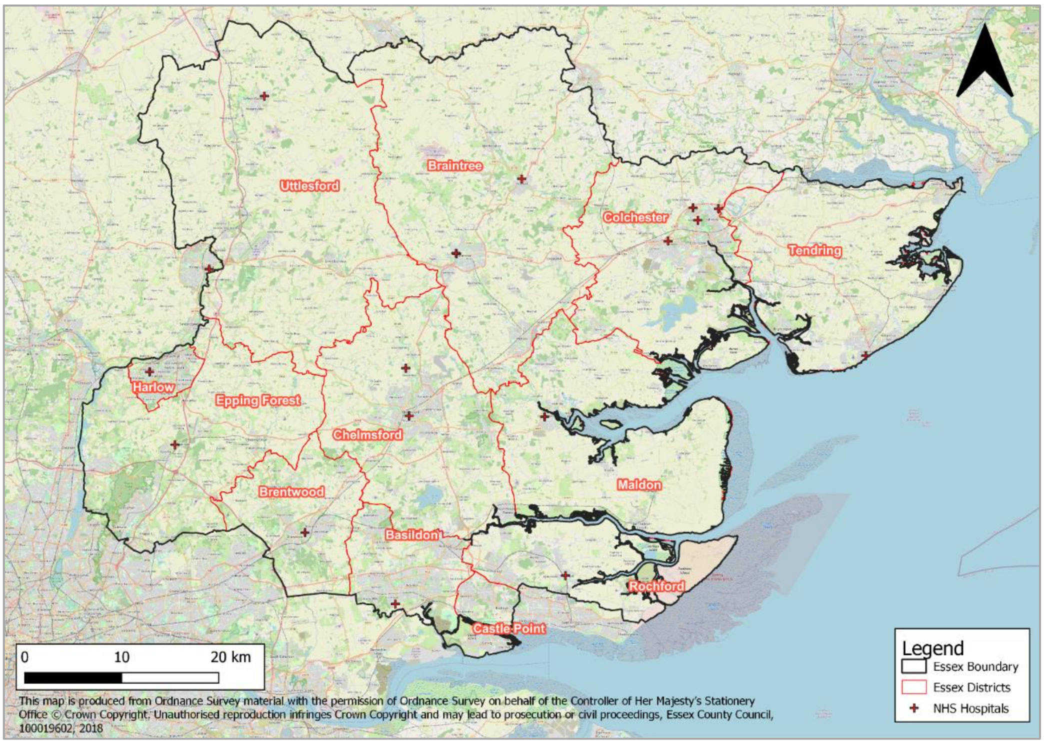

Figure 5-8. NHS Hospitals in Essex (NHS)

8 NHS Service Directories

5.3 Gap analysis by district

Table 5-5 provides a summary of the current situation, gaps and potential opportunities associated with EV uptake and infrastructure in each district within Essex.

Table 5-5: Summary of the current situation, gaps and opportunities by district

Basildon	
Current situation	Containing a relatively balanced mix of residential, retail and employment with the A127 to the north and the A13 to the south. The district contains a mix of some of the areas with the highest and lowest deprivation levels and contains a similar mix with regards to current levels of BEV and PHEV ownership.
Opportunities	Currently public EV charging infrastructure contains a mix of all speeds and is currently relatively well served for rapid chargers and contains a number of BP and Shell service stations that could help fill the need for on route/rapid charging. Basildon contains some areas with the lowest potential access to off street residential chargers in Essex

Braintree	
Current situation	Braintree district is relatively rural but with a significant amount of residential, retail and employment in Braintree town itself. Levels of deprivation are mixed, with both high and low areas. Current levels of BEV and PHEV ownership are low, and the district includes the A131 and A120 strategic roads.
Opportunities	Current public EV infrastructure is relatively high with a balance of slow, fast and rapid chargers. Access to off street parking is broadly high across the district, but this reduces in some areas of Braintree and Witham. For rapid on route charging the new Gridserve Electric Forecourt is located to the south of Braintree and there are a number of BP and Shell service stations that could help fill future need

Brentwood	
Current situation	Brentwood contains a mix of rural areas and Brentwood town itself which is largely residential with some retail. Levels of deprivation are comparatively low and current BEV and PHEV ownership is lower in the rural areas and high in Brentwood town. The A12 runs through the district providing access to the strategic road network.
Opportunities	Existing public infrastructure levels are relatively low, with no slow charging and a small amount of fast and rapid chargers. However, there is a relatively high access to off street parking. There are a number of BP and Shell service stations along the A12, which could provide opportunities for future rapid infrastructure.

Castle Point	
Current situation	Castle Point is geographically small and made up of 3 urban areas close to the A127 and A130. Levels of deprivation are relatively low and current BEV and PHEV ownership is high.
Opportunities	Existing public infrastructure levels are relatively low, which no slow charging and a small amount of fast and rapid chargers. However, there is a relatively high access to off street parking. There are also a number of BP and Shell service stations as well as supermarket/retail which could provide opportunities for further fast and rapid infrastructure.

Chelmsford	
Current situation	Chelmsford is a relatively rural district as a whole but contains the city of Chelmsford which has a significant amount of housing, retail and employment. The district, in general, has low levels of deprivation, with deprivation also being low in Chelmsford city itself and current BEV and PHEV ownership is relatively high. The district also includes the strategic road network and several key routes including the A12, A130, A414, A114 and A131.
Opportunities	Current levels of public EV infrastructure provision are relatively high for slow and rapid chargers, but there is a gap in fast speed chargers. This infrastructure is mainly centred within Chelmsford city, with a number of service stations, P&R and retail opportunities also located mainly around Chelmsford city.

Colchester	
Current situation	Colchester is a relatively rural district as a whole but contains the city of Colchester which has a significant amount of housing, retail and employment. Current BEV and PHEV ownership is relatively low, notably within the centre of Colchester city, which contains some areas with high levels of deprivation. Colchester includes the A12 strategic road.
Opportunities	Current levels of public EV infrastructure provision are relatively high with a balanced mix of rapid, fast and slow speeds. This infrastructure is mainly centred within Colchester city as well as some in the vicinity of the A12. There are also a number of BP and Shell services stations along the A12, Colchester football club P&R as well as supermarkets and retail within Colchester city, that could provide further commercial infrastructure.

Epping Forest	
Current situation	Epping Forest contains a mix of mainly rural, residential and some retail. Current levels of BEV and PHEV ownership is low in the more rural areas and higher in residential areas. It includes both the M11 and M25 motorways, as well as the key A414.
Opportunities	There is some provision for rapid charging infrastructure around the trunk road as well as a number of public slow chargers located mainly to the west of the district and nearer to London. There are a number of service stations and retail/supermarkets in the district which could provide opportunity for further commercial rapid and fast infrastructure provision.

Harlow	
Current situation	Harlow is a built-up district in Essex, containing a mix of housing, retail and employment. Current levels of BEV and PHEV ownership are low and the district, broadly, has a comparatively high level of deprivation. Harlow has access to the M11 and includes sections of both the A1025 and A414 major roads.
Opportunities	Existing public charging infrastructure is mainly slow speed and focused to the north of the district around Edinburgh Way. Harlow as a whole has comparatively limited access to off street parking with 90% of households in some central urban areas. There are number of supermarkets and service stations which could help expand future fast and rapid infrastructure.

Maldon	
Current situation	Maldon is a more rural district and uptake of BEV and PHEV varies significantly. Deprivation levels are relatively low although there are higher levels in the town of Maldon itself. The A414 is a key route linking Maldon to Chelmsford and provides opportunities for on-route charging.

Opportunities	There is currently a relatively low provision of public charging infrastructure, reflecting its more rural nature and high amount off access to off street parking. There is some provision of slow and fast chargers in the town of Maldon. There are limited commercial opportunities, which are mainly focused on Maldon.

Rochford	
Current situation	Rochford is a more rural district containing a number of villages to its west, it has relatively low current BEV and PHEV ownership levels and as a district contains a mix of areas of low and high deprivation. The A127 is the main route through the district.
Opportunities	There is currently a relatively low provision of public slow charging infrastructure, however, there is high access to off street parking. There is some provision of fast and rapid chargers around the towns of Rayleigh and Rochford. There are some commercial opportunities for future infrastructure, mainly around Rayleigh.

Tendring	
Current situation	Tendring contains relatively low current BEV and PHEV ownership levels and contains some areas with high levels of deprivation. The district includes key strategic roads such as the A120 and also the A133
Opportunities	There is currently a relatively good balance of public infrastructure at a district level across different charging speeds, with a number of BP/Shell Stations near the strategic road network and retail sites for potential future commercial route/rapid and destination/fast infrastructure

Uttlesford	
Current situation	Uttlesford is a more rural area of Essex and levels of BEV and PHEV ownership varies significantly. The district contains relatively low levels of deprivation. The district includes M11 motorway as well as the A120
Opportunities	There is currently a good balance of public provision across different charging speeds, mainly focused on Saffron Waldon and Stansted Airport. Commercial opportunities for future EV infrastructure are mainly around retail in Saffron Walden and some BP/Shell stations near the M11/A120

5.4 Provision for other modes

5.4.1 E-Scooters

ECC began trialling e-scooters in December 2020 with the company Spin. Spin was acquired by Tier Mobility who have operated the e-scooter trial in Essex since June 2022. The trial operates in three areas including Basildon, Chelmsford and Colchester. As of March 20023, and since the trial began, over 1.5 million trips have been made by e-scooter in Essex. Utilisation data shows that this translates into roughly 3 trips made per e-scooter per day. There is a proposal to extend the trial until May 2024. At the time of writing, privately owned e-scooters remain illegal to ride in public and further feasibility work is being undertaken by the UK Government to understand the safety and legislative framework for operating private e-scooters.

5.4.2 E-Cargo Bikes

Since receiving funding from the DfT e-cargo bike fund and Energy Saving Trust, Colchester Borough Council have introduced six e-cargo bikes as a green alternative for businesses. An e-cargo bike is an electric delivery bike with purpose-built storage. The bikes come in various shapes and sizes to meet different cargo needs. They offer a sustainable, low cost, environmentally friendly way of delivering goods and services. The bikes reduce emissions by 90% and 30% relative to diesel and electric vans respectively. Crucially, e-cargo bikes deliver around 60% faster than vans in city centres a study by the University of Westminster shows.

5.4.3 Digital Demand Responsive Transport (DDRT)

DRT is shared transport that responds to demand, it usually involves small minibus vehicles suited to rural roads. DRT differs to local bus services as DRT is flexible and can divert on/off route to collect and drop off passengers within their operating area. Digitalisation has led to the evolution of DDRT which involves a passenger app (Travel Essex), a dashboard for managers, and driver app etc. ECC have six electric minibuses as part of the Digi Go bus trial. The trial will run for two years with the aim to become commercially viable. DDRT provides a viable option particularly in rural areas that are traditionally more dependent on car travel.

5.4.4 Park & Ride

There are three park & ride sites in Essex with EV charging infrastructure at two of the sites in Chelmsford including:

- 3 slow charge points at Chelmer Valley
- 3 slow charge points at Sandon
- There is currently no charging infrastructure at the Colchester site.

There are also wider opportunities that could be considered to support alternative and cleaner fuel buses or provide charging infrastructure to support shared mobility and on demand travel options including the Digi Go service, e-bikes or e-scooters.

5.4.5 Bus Electrification

There are currently only two electrified buses in Essex and very few are fully Euro Six compliant. The majority of the Essex bus fleet is aging and below the Euro Five standard. Most buses in Essex are hand downs from more profitable areas that already have 5-10 years of service. The lack of profit generated by the sector is a significant barrier to investment. Other barriers to electrifying the fleet include a lack of depot space for EV charging and grid capacity. Research shows the lifecycle cost of bus electrification is less than the diesel saving up to 10% on the total cost over 25 years[9]. However, the significant upfront investments costs and low patronage remain a barrier. ECC remain committed to exploring bus electrification, for example £60m of investment is being sought to transform the Basildon bus fleet to zero carbon.

There are also broader strategic decisions to be considered and made around the best way to decarbonise passenger transport as a whole such as electrification or hydrogen fuels. Essex will need to consider the evidence and work with others, including central government, to understand how these decisions can be successfully translated into the Essex bus network in the longer term.

5.5 ECC Vehicle Fleet Decarbonisation

ECC are working with Mitie to develop an EV charge point strategy with the aim of identifying the type and quantity of charge points required to facilitate fleet decarbonisation across the ECC estate. At present the ECC fleet consists of 362 fleet vehicles and 141 commercial vehicles. Of those vehicles ECC have six BEV minibuses as part of the Digi Go bus trial and 3 BEV electric company cars. There are currently no EV charge points at ECC depots.

5.6 Summary

- As of 2022 there is mix of over 300 public facing chargers in operation in Essex serving a mix of slow to ultra-rapid user types.
- There are small clusters of rapid chargers in some locations such as Chelmsford and Colchester. There are more slow chargers in Essex in areas around Harlow, Braintree, Colchester, Basildon and Clacton-on-Sea.
- There is an overall high percentage of BEVs across Essex, with the highest percentages between 3-5% being found in Chelmsford and to the north and east of the city, as well as around Benfleet to the east of Basildon and Churchend in the southeast of Essex.
- There is a range of fuel forecourts and retails sites at which further EV charge points are likely to be provided by the private sector, with the majority of these locations centred in areas such as Colchester, Chelmsford and Braintree and along major roads such as the A12 and the A130 corridors.

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[9] Life Cycle Cost Analysis for Electric vs Diesel Bus Transit (International Journal of Technology, 2019)

- Around 36% of households in Essex have limited or no access to off-street parking. In some central urban areas of Basildon and Harlow this can rise to between 80-90%.
- Trials illustrate that there is demand for e-scooters as an option for shorter journeys.
- E-cargo bikes are being used in Colchester as an alternative for urban freight transportation.
- Bus electrification remains difficult to achieve due to the significant upfront costs and the broader discussions around the best way to decarbonise passenger transport as a whole.

6 Stakeholder Engagement

Building on the evidence base, experience has shown that stakeholder engagement and feedback is a crucial component to obtaining local knowledge regarding the region's EV context. This section summarises the key outcomes of two stakeholder events to discuss the proposed strategy with external District partners and then separately with internal Council officers from different teams.

We also include the outcomes of initial discussion with four charge point operators (CPOs) to incorporate views from the commercial sector and identify potential opportunities for Essex. The operators include.

- Liberty Charge
- Trojan Energy
- ChargePoint
- Ubitricity

6.1 External District Partners Workshop

An initial workshop was undertaken on the 12th September 2022 with the borough and district councils in Essex. The key themes and opportunities identified by workshop participants are summarised below:

- We must enable car transport but not encourage - EVs must be considered but not at the top of the hierarchy.
- Encouragement of active travel as part of the overall package
- Transport hubs and park and rides are of great importance.
- We need data collection to support infrastructure needs e.g., evidence through resident, business and visitor surveys - where do people travel to and stay for certain periods of time, where do they charge, if not at home?
- Utilise districts and borough local knowledge in supporting ECC with charge point site selection.
- Link to ECC's Everyone's Essex Strategy
- Engagement with council and housing association estates is key.
- Look more holistically at electric mobility and look at a range of modes and solutions such as community micro hubs, e-car clubs and shared mobility.
- Combine charge point opportunities with renewable generation opportunities.
- Public sector needs to facilitate investment by the private sector.

6.2 Internal Essex Officers Workshop

A second workshop was undertaken on the 3rd October 2022 with officers from ECC. The key themes and opportunities prioritised by workshop participants are summarised below:

- Deliver a fair EV transition that provides a network that is accessible of all residents.
- Align with emerging LTP4 priorities and integrate with the suite of other supporting strategies to support these goals.
- Expand EV strategy focus as the current transition to electric cars will not be enough to meet decarbonisation goals. The EV Strategy needs to feed into the wider decarbonisation narrative of reducing demand and modal shift to public transport and active travel.
- Developing and integrating EV with network of mobility hubs at key interchanges and in local communities to support modal choices and decarbonisation goals.
- Engage and collaborate with distribution network operator, UKPN, with regards to the power supply to address local and strategic distribution issues e.g., do bus depots have adequate supply to the grid to support future PT conversion
- Role of strategy to support bus use, improved services and greening the fleet.
- Making use of council and local partner assets e.g., car parks and village halls

6.3 Charge Point Operators

Table 6-1: CPO Engagement Findings

CPO	Comments
Liberty Charge	• Liberty Charge (LC) believe a mix of charge points should be implemented during the rollout of charging infrastructure, meaning varying speeds and an even geographical spread. • Clusters of 4 to 6 on-street outlets is the optimum number, which LC will consider expanding in the future, as well as providing passive provision to future proof. LC recommends investing in dropped kerb and charge point flush solutions, where barriers exist at carriageway level. This makes the infrastructure more accessible to people with disabilities. • Working with car clubs, such as Enterprise, is a method of offering cost effective solutions for residents. LC have a strong preference to work collaboratively with local authorities in identifying and delivering sites, rather than local authorities choosing sites by themselves. • LC are working with Virgin on the VPACH (Virgin Park and Charge) project. As a result of the project LC now follow an approach of connecting to a new DNO supply or existing power supplies in fibre cabinets depending on which is most cost effective for the given location.
Trojan Energy	• Trojan Energy offer products and full CPO services specialising in innovative on-street charging solutions such as their DoorSTEP project.[10] • Trojan's charge points are fully compliant with both OZEV's on-street schemes ORCS (60% funding) and the new LEVI programme (50% funding). Hub systems can be delivered to councils, on the public highway - or any private entity on its own land. • The CPO are able to offer charging solutions that are fully funded, in conjunction with their partner RAW. In this scenario, the investors are independent in the entire process from inception to maintenance. In contrast, Trojan are also willing to support ECC in bidding for governmental funding, such as the ORCS and LEVI funds. In this process, ECC will have a greater involvement in decision making when assessing suitable sites, tariffs, and targeted use cases for example.

[10] Trojan Energy Launch Project to Unlock Domestic Tariffs For On-street Electric Vehicle Charging (LCRIG/Trojan Energy, 2021)

CPO	Comments
	• Trojan have developed their system through engagement with disability forums and their product has the potential to be less impactful on the surrounding footway which may benefit footway users and in particular groups with disabilities. • Trojan Energy's charge points use a cloud-based charging system that allows the development of bespoke pricing models that can react to LAs policy preferences e.g., allowing preferential rates for some user groups.
ChargePoint	• ChargePoint (CP) provide full-service charging for both AC (slow/fast) and DC (rapid), which is available to cars and other vehicle classes such as HGVs/Buses. • CP's philosophy is that charging should mimic refilling an ICE with petrol, maintaining the hub approach. • CP support the creation of groups of users, providing charging for a group of employees, or local businesses. Multifunctionality is key for CP as this angle brings business opportunity and collaboration between private and public investment. • CP suggest ECC partner up with private providers as they are forecasted to be the most significant provider of charge points. • CP currently have a partnership with Green King pubs, who have around 50 sites in Essex. CP are currently in the process of implementing charging infrastructure in Green King car parks, many of which are in rural areas, proving a potential opportunity to service isolated residents.
Ubitricity	• Ubitricity aim to support people without access to private parking, with a focus on discrete residential on-street charging solutions involving the retrofitting of chargepoints into electrical street furniture, such as lampposts and bollards. • The slow charging (5kWh) solution takes approximately an hour to retrofit and so far, around 3400 chargepoints have been implemented in London, with a high concentration in the east of the city in close proximity to the Essex border. • Ubitricity locate target areas by assessing existing demand and EV ownership. The CPO tries to avoid looking at affluence, as they aim to deliver charging inclusivity. • The CPO is currently running a partnership with the NHS, implementing slow chargepoints in carparks for staff and visitors. With three large acute hospitals in Basildon, Chelmsford and Southend, and smaller hospitals in Braintree, Maldon, and Orsett, there is a potential for ECC to capitalise on this partnership.

7 Forecasting Analysis

7.1 Overview

Initial forecasting has been undertaken to reflect recent user trends and potential future technology and wider policy changes that will affect the rate at which people transition to EVs. This has been used to derive a projection of the likely EV uptake for cars and LGVs and the potential level and type of infrastructure needed in different future scenarios. **Please note** that all forecasting was completed in advance of recent Government policy changes to the phasing out the sale of new ICEs from 2030 to 2035. Reference should be made to Section 1.2 and the Limitation Statement at the beginning of this document regarding the application of the findings set out in this Chapter.

This chapter outlines the approach to the EV forecasting used and projections at a countywide and district level to illustrate likely trends for:

- EV demand for high, medium, low and modal shift EV uptake scenarios
- Likely number of on-street, destination and on-route charge points to meet different levels of projected demand.
- Changes in carbon emissions from cars and LGVs
- High-level energy demand

At this stage, given the availability of data and a rapidly evolving EV landscape, there is still a high degree of uncertainty with any forecasts and the outputs discussed in this chapter should be treated as initial estimates for guidance purposes only and not targets. It is recommended that the outcomes of this modelling are refined going forward, as more data becomes available, and also used to complement wider transport and carbon quantification forecasting as part of an integrated approach to achieving the Council's overall transport vision and net-zero targets.

7.2 Forecasting approach

The approach to forecasting is based on understanding how the overall vehicle fleet will transition to EVs by creating a forecasting model to reflect how a new technology will transition into an already existing fleet. This is generally driven by two key characteristics as summarised in Table 7-1.

Table 7-1: Model key characteristics

Characteristic	Description
The rate at which new vehicles are purchased	This determines the “churn” of vehicles within the fleet overall. If few new vehicles are being purchased (e.g., due to a recession) then there will be a substantial slowdown in the transition to EVs as the population of vehicles is not being replaced
The probability of new vehicle purchases being an EV	If the fleet is to transition to EVs, the probability of each new vehicle being an EV should increase to 100%.

There is a strong relationship between average income and new vehicle purchase rates. Income data from across the county was used to generate variable rates of new vehicle purchases at a Middle Layer Super Output Area (MSOA) level.

A choice model has then been used to apply a systematic method of choosing between multiple options, and the associated benefits, to derive the probability of each new vehicle purchase being an EV. Policy decisions to end the sale of ICEs and PHEVs are then factored in to limit the level of choice available.

From this combination of models, it is possible to create a stock flow equation which governs the movement of vehicles into and out of the vehicle fleet. Essentially, the fleet in 2021 is based on the fleet in 2020 plus the net change of all new vehicles from 2021 minus the number of vehicles scrapped in 2020. This has then been applied to each subsequent year with new vehicles composed of a mix of ICE and EV based on the modelled rate and probability of EV uptake:

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

Figure 7-1 illustrates an indicative projection of EV uptake up to 2040 to demonstrate how the number of EVs in the fleet lags behind the 2035 policy change that all new vehicles sold in the UK will be BEVs. The projection highlights that, even if Government targets are met, the vehicle fleet could still contain approximately 75% ICEs in 2030, 50% in 2035 and 25% in 2040.

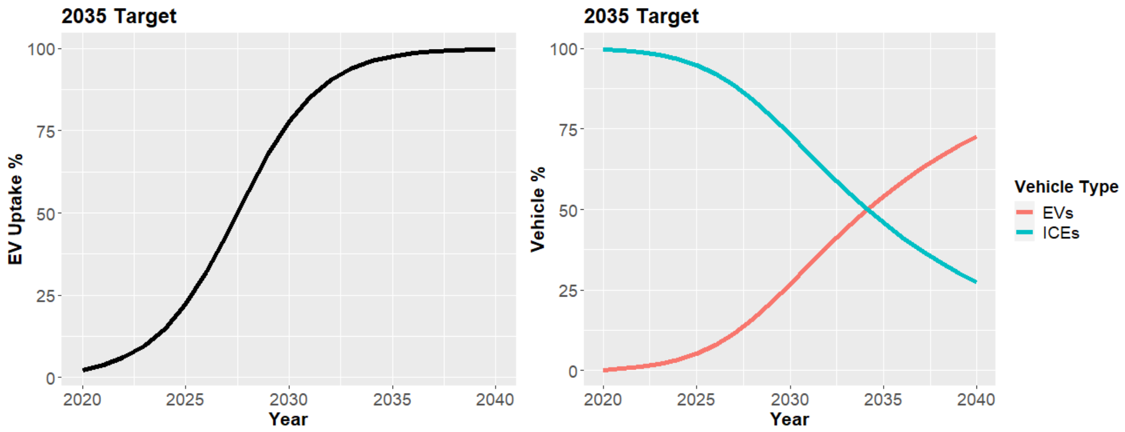

Figure 7-1 Indicative Comparison Between Uptake % and Overall Fleet %

7.3 Forecast scenarios

7.3.1 Private vehicles

A range of scenarios have been considered to account for the level of uncertainty around available data, modelling variables and advances in technology to understand what different futures might look like. These cover ‘Low’, ‘Medium’ and ‘High’ private EV uptake projections that generally align with the range of potential pathways, set out in the ‘Transitioning to zero emission cars and vans: 2035 delivery plan’[11] (HM Government, 2021), to achieve their ambitions. Figure 7-2 illustrates these potential pathways for both ULEV (PHEV) and zero emission vehicle (ZEV)* private car uptake, showing a predicted range of distribution for each vehicle type (shaded in yellow and blue) and the level of uncertainty (shaded in brown).

**Due to prevalence of BEV and uncertainty over other zero emission fuels at this stage, BEV is the only vehicle type considered for the ZEV (e.g. excludes hydrogen) transition at this stage for the purposes of forecasting.*

[11] Transitioning to zero emission cars and vans: 2035 delivery plan (HM Government, 2021)

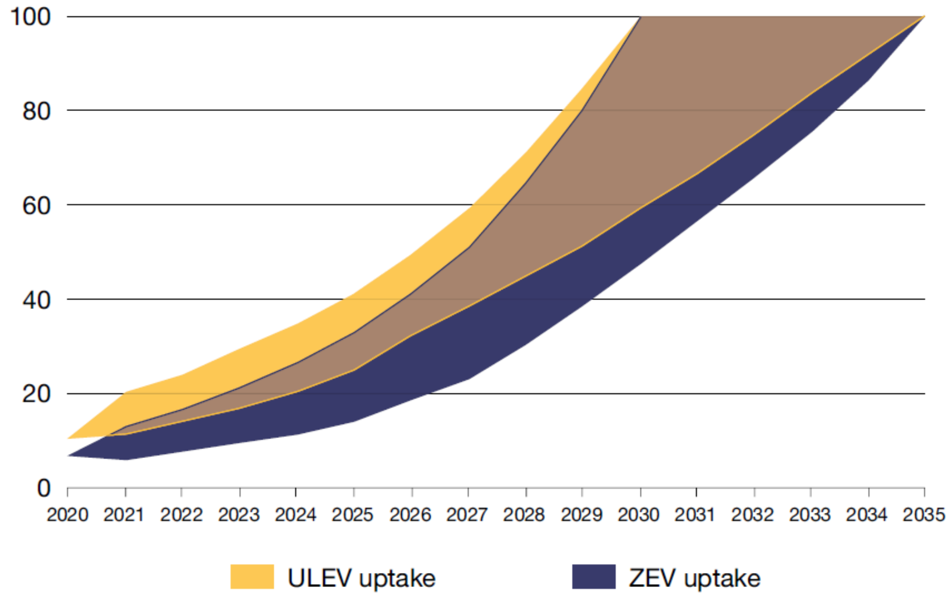

Figure 7-2: Potential pathway – Percentage of new car sales accounted for by Ultra Low Emission Vehicles (ULEVs) and Zero Emission Vehicles (ZEVs) (HM Government, 2021)

A similar approach has been applied to private LGV uptake using the projected ranges taken from the Government delivery plan shown in Figure 7-3.

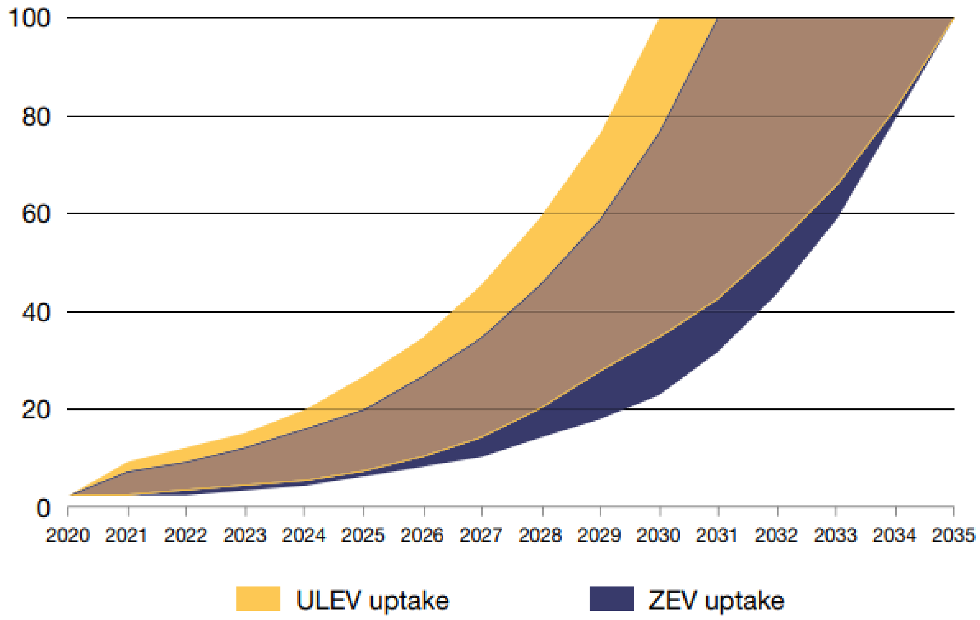

Figure 7-3 Potential pathway – Percentage of new van sales accounted for by Ultra Low Emission Vehicles (ULEVs) and Zero Emission Vehicles (ZEVs) (HM Government, 2021)

7.3.2 Company vehicles

The uptake of new company EVs has historically been at a faster proportional rate than the private market by approximately 2 years. The same curves have been accelerated by 2 years to calculate projections for company car and LGV uptake of ULEV (PHEV) and ZEV (BEV).

7.3.3 Scenario descriptions

The scenarios for 'Low', 'Medium' and 'High' uptake apply the Government policy targets and the varying levels of expected ULEV (PHEV) and ZEV (BEV) uptake on the following basis:

- **High –** assumes an optimistic ZEV (BEV) uptake, at the upper end of the projected range, reaching 100% of all new car sales by 2030.
- **Medium –** assumes a more moderate ZEV (BEV) uptake, in the middle of the projected range, reaching 100% of all new car sales by approximately 2032.
- **Low –** assumes that ZEV (BEV) uptake will be at the lower end of the projected, reaching 100% of all new car sales by approximately 2035. This is the latest by which all new vehicles will be ZEV (BEV).

7.3.4 Sustainable mode shift test

An additional test has also been undertaken to look at variation in overall vehicle uptake to reflect the wider transport vision for the county and a future mode shift to higher levels of active travel and public transport use.

This is a high-level and assumption-based test at this stage, that will need further consideration in future modelling, and represents basic reductions in overall purchase and usage across all vehicle types, based on:

- A 5% reduction in vehicle purchases in urban areas representing higher levels of accessibility to key services by public transport and active modes.
- A 2% reduction in vehicle purchases in rural or remote areas representing lower levels of accessibility to key services by public transport and active modes.

7.4 Forecast EV uptake in Essex (2022-2045)

7.4.1 Vehicle trends

- The forecast cumulative uptake of ICE, BEV and PHEV vehicles in Essex, across high, medium and low scenarios, are shown in Figure 7-4 and

. This represents the total number of vehicles, for all body types, keepership and fuel composition in the fleet between 2022 and 2045. **Appendix F** includes the individual graphs for private or company keepership, fuel composition and body type.

The transition from ICE to EV varies across the scenarios with the transition point (where number of ICEs in the fleet is less than number of EVs) occurring between 2030 and 2035 across the scenarios.

The transition point for BEV and PHEV ownership (where number of PHEVs in the fleet is less than number of BEVs) is also varied. EV ownership in the medium and high scenarios could generally favour BEVs in the next 1-2 years, whereas, in the low scenario it might not be until around 2034.

The potential variation between private or company keepership and body type (see **Appendix F**) shows that:

- company vehicles transition at a faster rate than privately owned vehicles.
- cars transition faster than LGVs.
- EV LGV ownership in the high scenario could favour BEVs immediately, but in the medium scenario it could be around 2030/2031 and in the low scenario it might not be until 2036/37

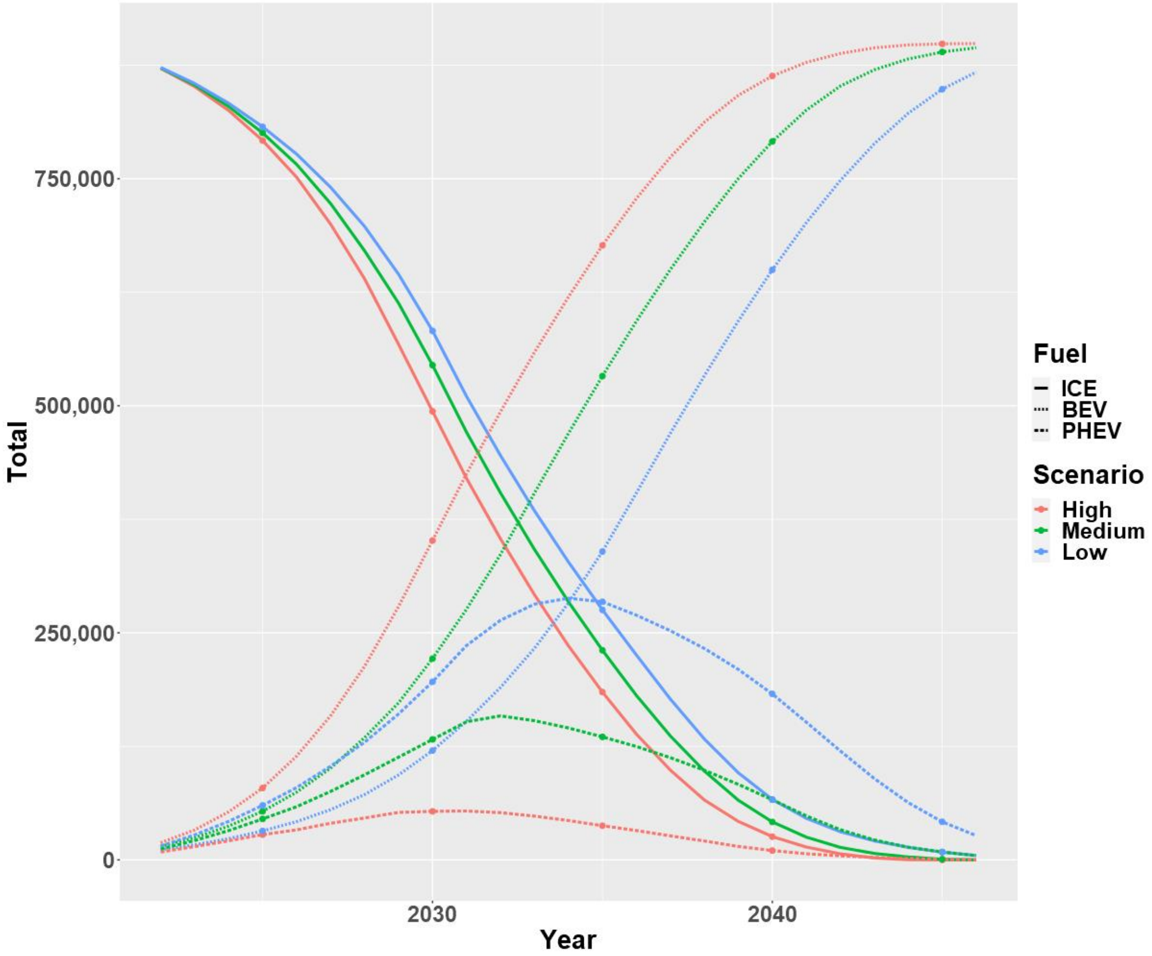

Figure 7-4 Forecast cumulative total EV car and LGV uptake by scenario and fuel in Essex

Table 7-2 Vehicle uptake total number by scenario, fuel and key horizon year in Essex

Scenario	Low			Medium			High		
Fuel	ICE	BEV	PHEV	ICE	BEV	PHEV	ICE	BEV	PHEV
2025	807,000	31,800	60,000	800,000	53,500	45,100	792,000	79,100	27,800
% fleet	90%	4%	7%	89%	6%	5%	88%	9%	3%
2030	582,000	120,000	196,000	545,000	222,000	133,000	494,000	352,000	53,400
% fleet	65%	13%	22%	61%	25%	15%	55%	39%	6%
2035*	275,000	339,000	284,000	231,000	533,000	135,000	185,000	677,000	37,600
% fleet	31%	38%	32%	26%	59%	15%	21%	75%	4%
2040*	66,500	650,000	183,000	41,700	791,000	66,200	25,600	863,000	10,200
% fleet	7%	72%	20%	5%	88%	7%	3%	96%	1%

**Years where total number of EVs exceed total number of ICEs in fleet*

7.4.2 2030 Spatial analysis

The forecasted uptake rates for EVs across Essex is shown by area density in Figure 7-5 and per capita in Figure 7-6 at an MSOA level in 2030 to understand the high-level emerging EV spatial trends.

The high-level analysis of EV density (Figure 7-5) provides an indication of areas which could have a more concentrated level of EV uptake and potentially will be more economical to provide for. The greatest levels of EV density are observed across the smaller urban MSOAs in Chelmsford, Colchester, Harlow and Basildon.

EV uptake in the larger rural MSOAs is notably less dense and dispersed across wider areas with longer journey distances. This highlights the inherent difficulty of providing public-facing infrastructure in rural settings and achieving critical mass to provide economical solutions.

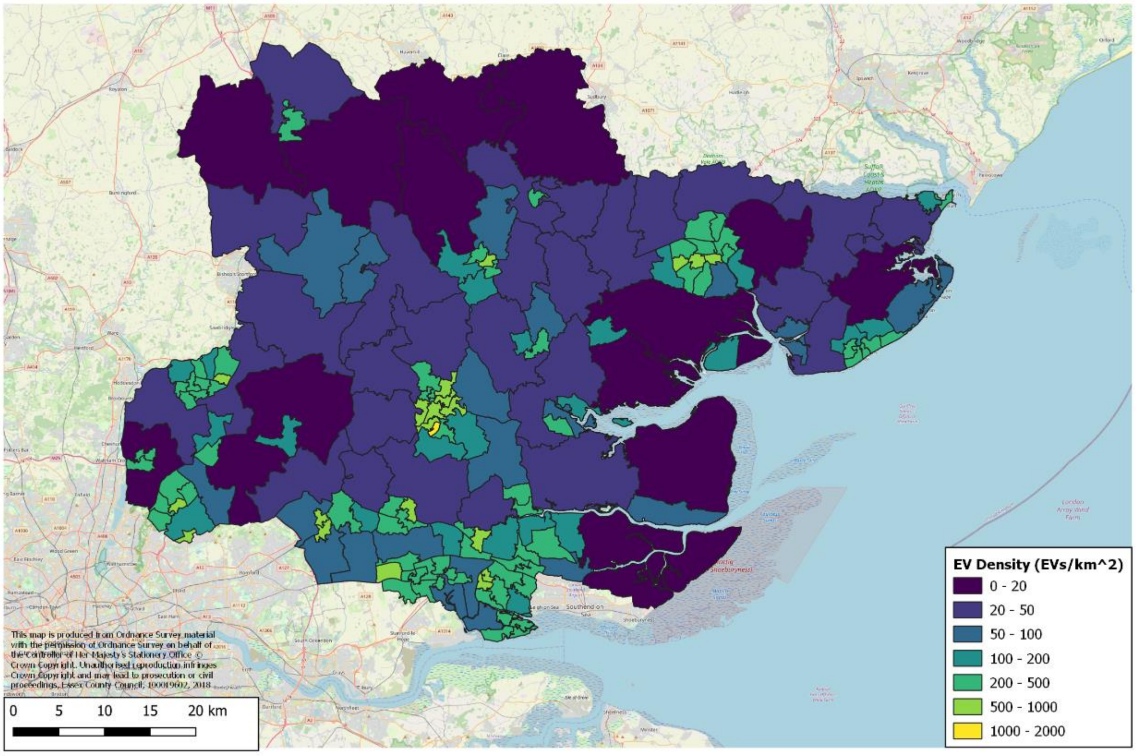

Figure 7-5 2030 EV uptake per km²

This high-level analysis of EV per capita (Figure 7-6) provides an indication of where EV uptake is likely to be at a higher rate. Although there is a not a direct one to one relationship, areas of higher rates of EV ownership tend to be in the more rural and less densely populated areas of Essex. Acknowledging there are a range of variables this could potentially be attributed to:

- Affordability in more densely populated urban areas with higher levels of deprivation (see Figure 5-3 IMD map) including parts of Colchester, Harlow, Basildon or smaller towns of Waltham Abbey and Clacton-on-Sea
- Accessibility to key services via public transport and active travel is higher in urban areas with a lower propensity to own a car (ICE or EV)

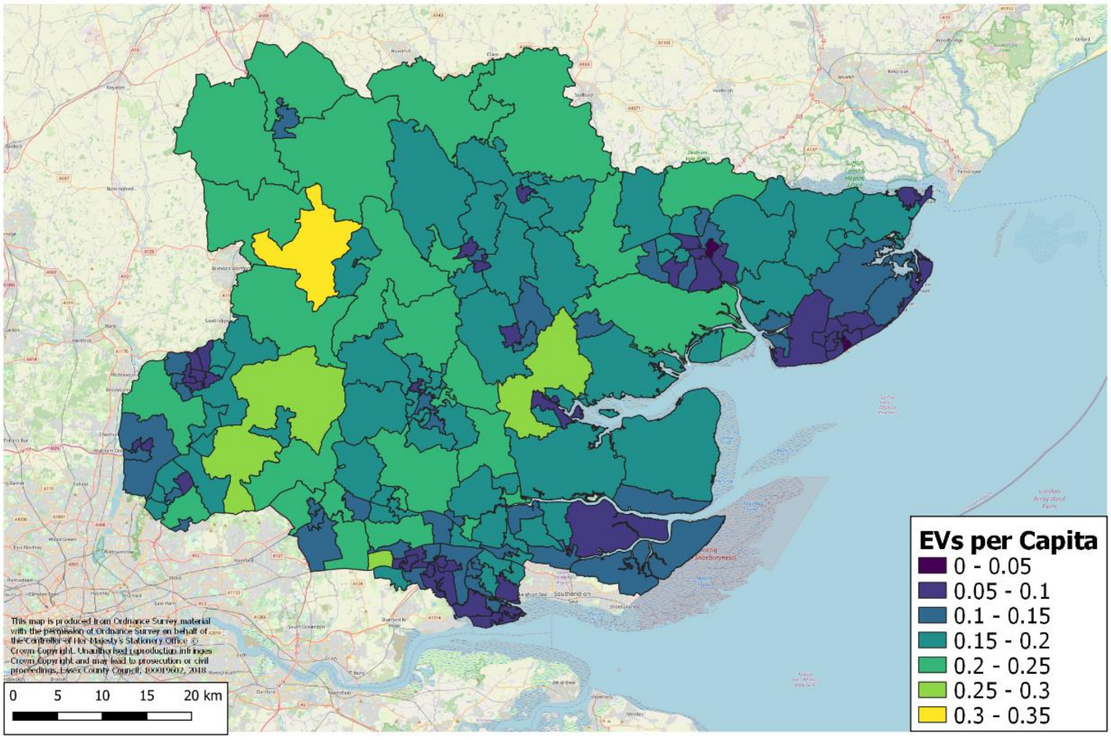

Figure 7-6 2030 EV uptake per capita

The high-level spatial analysis identifies a key challenge for EV infrastructure provision in the coming years. Urban areas will typically see a lower rate of uptake of vehicles but at a higher density with the potential to generate a critical mass, greater efficiency and commercial viability. Rural areas could see higher rates of uptake but at a more dispersed level with longer journeys and a higher overall demand, with greater geographical spread, for EV charging and energy.

7.5 Forecast energy demand

The overall EV energy demand (giga watt hours (GWh) per year) in Essex for each scenario is illustrated in Figure 7-7 and summarised in Table 7-3. This provides a very high-level indication of the electrical energy supply likely to be needed to serve forecast EV uptake in Essex up to 2045.

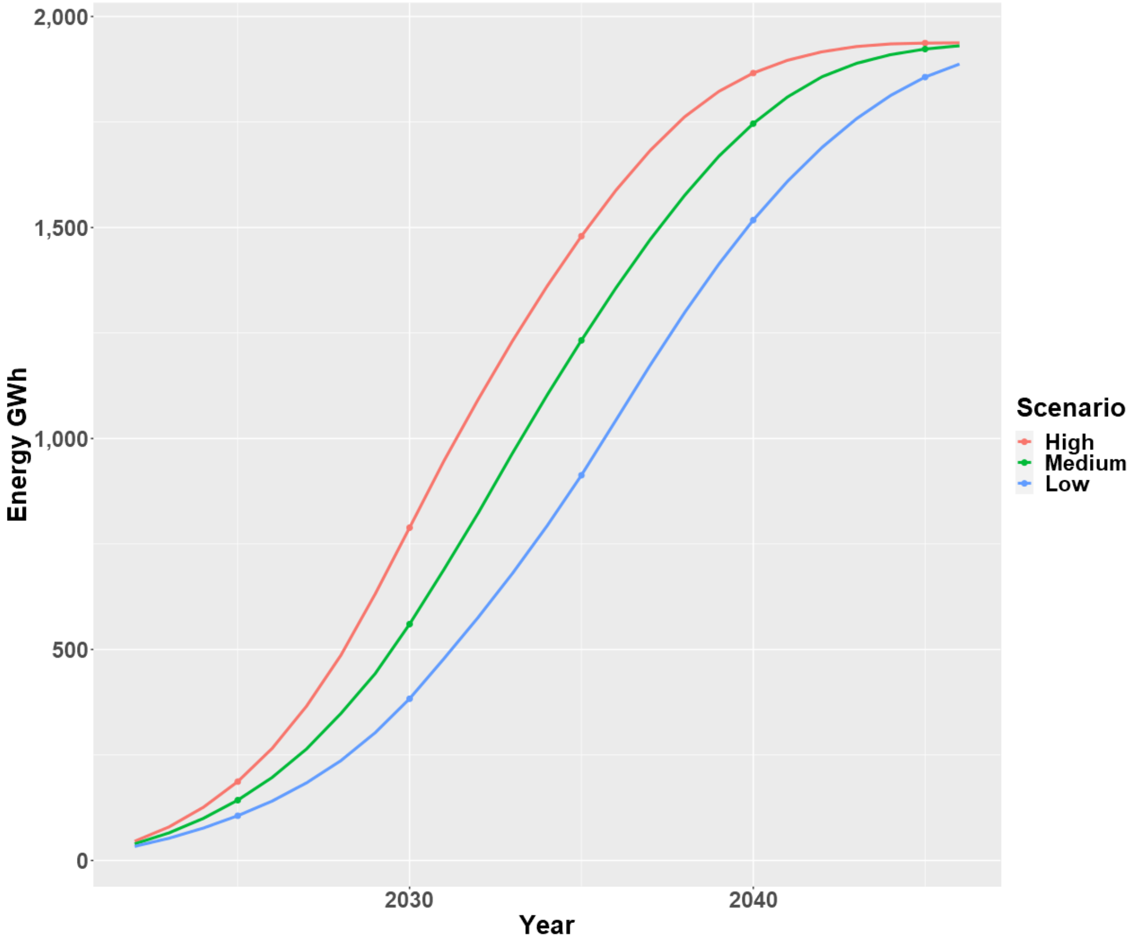

Figure 7-7 Forecast EV energy demand for all EV cars & LGVs by scenario in Essex (GWh/yr)

Table 7-3: EV electricity energy demand (GWh/yr) for Essex by scenario and body type

Scenario	Low		Medium		High	
	Cars	LGVs	Cars	LGVs	Cars	LGVs
2025	97.8	8.3	131	12.4	170	17.4
2030	346	37.4	502	58.3	704	84.8
2035	807	106	1090	144	1300	175
2040	1330	189	1530	215	1630	232

The analysis indicates that around 400-800 GWh/yr could be needed by 2030 and 1,500-2,000 GWh/yr could be needed beyond 2040 to support the low to high EV uptake scenarios. For context and generalised comparison purposes, an independent energy baseline study[12] undertaken by Element Energy for

[12] Essex Baseline and Pathway to Net Zero (Element Energy, 2021)

ECC / ECAC, and using a different set of assumptions, indicated that energy consumption for a largely EV car and van fleet could be around 2,000-3,000 GWh/yr by the late 2040s in their 'Green Transformation with modal shift' scenario (see Figure 20, page 43 of Element Energy study), which is in a broadly similar range to the forecasting outlined in this section. The study also highlights that anticipated electricity consumption by 2040, across all sectors in Essex, could be around 8,000-9,000 GWh/yr (see Figure 18, page 37 of Element Energy study). The overall electricity demand of EV cars and vans could therefore be around 25%-30% of the total electricity energy consumption beyond 2040 across Essex.

The highest energy requirement is for private cars across each scenario. The total energy requirements, under all scenarios, converge to the same point in mid to late 2040s. This represents a theoretical future point at which almost all vehicles have been converted to EV, with some residual PHEV and even fewer ICE vehicles. Although there is a convergence in future years, it is important to consider the total energy demand in 2030 for private cars, where the energy demand in the high scenario is almost double that of the low scenario, with over 660 GWh/yr compared to 320 GWh/yr. This could represent a substantial variation in the required infrastructure in Essex for shorter to medium term energy planning purposes.

Figure 7-8 provides an indication of the likely energy demand (GWh/ year) for each MSOA area. This highlights the potential challenge around higher rates of EV uptake, longer journeys in larger and greater overall energy demand and delivering the necessary energy supply, in the right place as efficiently as possible, across more dispersed rural areas.

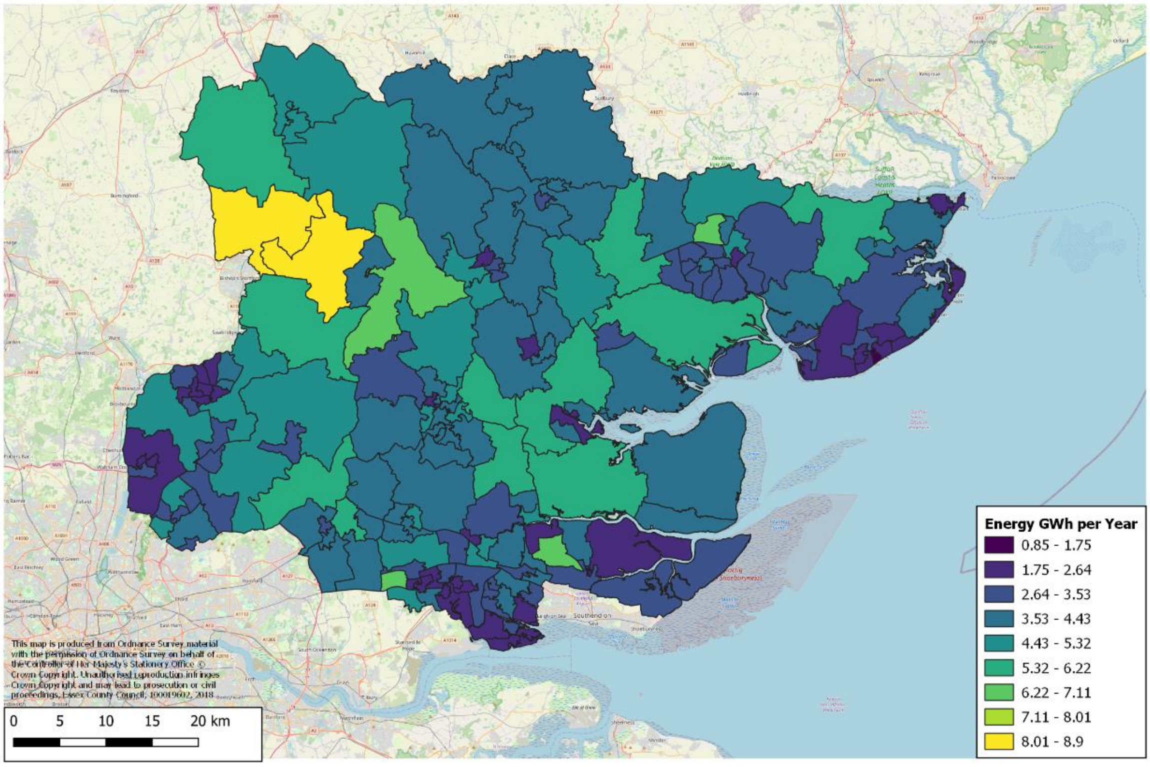

Figure 7-8 Expected Energy Demand in Essex

7.6 Forecast Carbon Reduction

An indication of the likely rates of reduction in carbon emissions at the tailpipe is shown in Figure 7-9. This presents the percentage reduction from current 2022 levels of carbon emitted for cars and LGVs for each scenario. Although the eventual level of carbon emissions will converge by the mid-2040s, for each scenario it will not happen at the same rate, meaning the lower and medium uptake scenarios will emit higher overall levels of carbon across the same period as the high scenario.

For the high uptake scenarios, the vehicles will transition sooner, which will lead to cumulative benefits in terms of the overall carbon savings when compared to the lower uptake scenarios. This variation between the different uptake scenarios is particularly prevalent pre-2035 but will continue, at a decreasing rate in subsequent years.

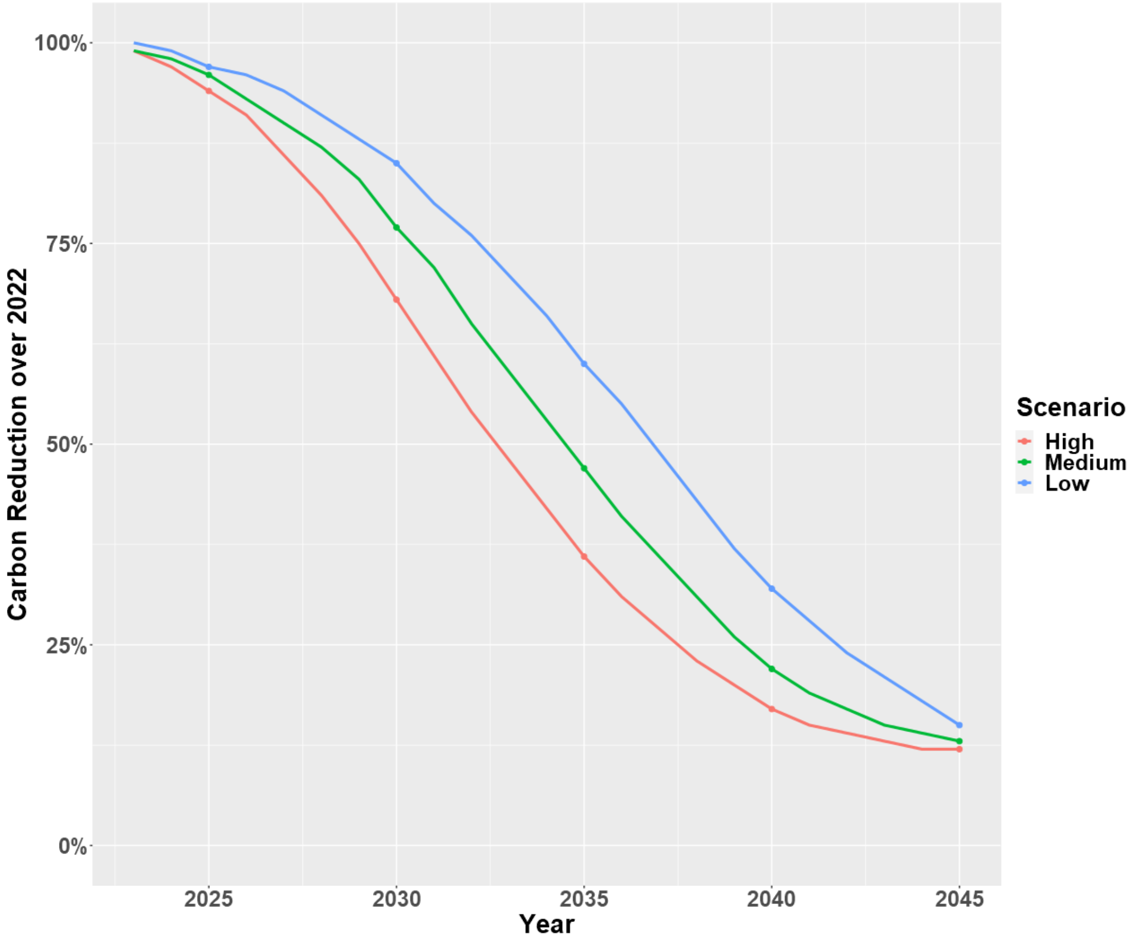

Figure 7-9 Forecasted Cumulative Carbon Emissions by Scenario

The analysis also demonstrates that by the mid-2040s the forecast uptake rates of EVs will have only removed 85% of the carbon emissions at the tail pipe from cars and LGVs with a diminishing rate of reduction, or 'flattening of the curve', beyond 2045. This reinforces the evidence put forward by the UK Climate Change Commission (UK CCC)[13] that electrification as part of a combination of different carbon abatement interventions that will be needed to achieve a balanced pathway to net-zero by 2050, including:

- Reducing the need for travel
- Shifting trips to more sustainable options
- Other zero emission fuels
- Low carbon energy supply
- Carbon offsetting technologies

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[13] The Sixth Carbon Budget – The UK's path to Net Zero (UK CCC, December 2020)

7.7 Sustainable modal shift test

The potential future reduction of car travel, through sustainable mode shift and reducing the overall need to travel, is a key focus of any wider transport strategy in the county to be complemented by the uptake of EVs. An additional high-level test has been undertaken, using the medium scenario, to explore the impact of initial mode shift assumptions, to public transport or active modes, on EV uptake and tailpipe carbon emissions. As explained earlier, this includes an average 5% reduction in vehicle purchases in urban areas and 2% in rural and remote areas. It is important to note that this is a very high-level test for information purposes at this stage and it is recommended that further testing is undertaken of different levels of mode shift, journey types, distance travelled and changes in overall demand for travel.

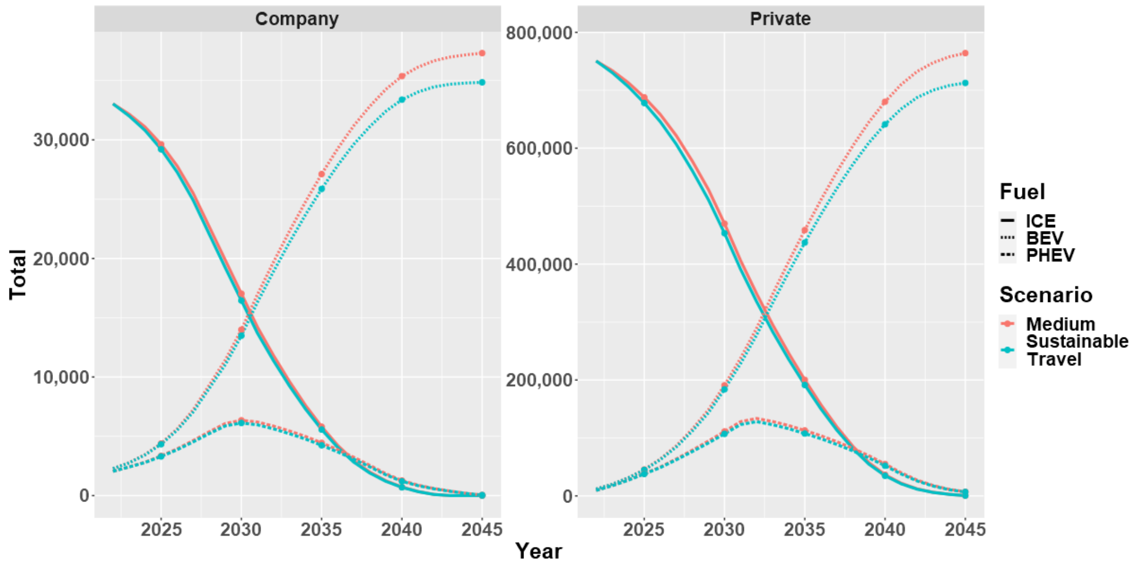


Figure 7-10: EV uptake medium scenario v sustainable mode shift test

The results for this test are shown alongside the medium scenario uptake in Figure 7-10 by keepership and fuel type. The impact is negligible leading up to 2035 due to the lag in uptake of new vehicles and sustainable mode shift having less impact on ICE ownership already present in the fleet. Beyond 2035, the impact of sustainable modal shift has a more notable, albeit marginal, impact on vehicle uptake. This generally highlights that future switches to sustainable travel could impact the total number of EVs in the fleet more than the ICE totals.

This level of impact of the mode shift test on carbon reduction is illustrated in Figure 7-11. The cumulative carbon emitted by all cars and LGVs for the medium scenario compared to the mode shift test is similarly marginal.

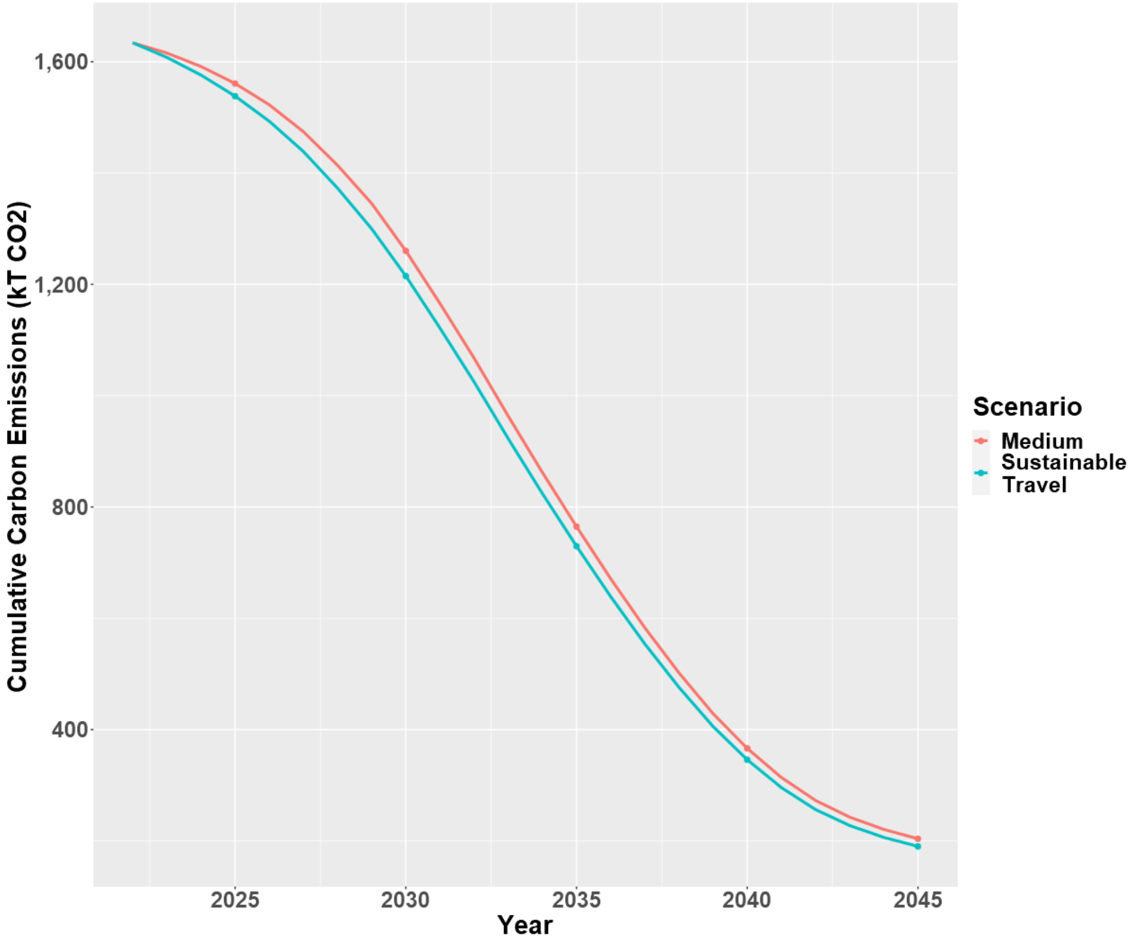


Figure 7-11 Forecast cumulative carbon emissions medium scenario v sustainable mode shift test

7.8 Planning for charging infrastructure

The forecast scenarios have been used to provide initial information on the different types of charging requirements across Essex at a district level. This has been done by predicting the annual kWh at each district for three different use cases:

- Residential Charging: This uses an assumed vehicle km driven per year, combined with vehicle efficiency, to derive an overall energy demand. This is then proportionally distributed to those areas with limited off-street parking.
- Destination Charging: Similar to Residential Charging, this generates an assumed energy for destination charging, based on the likely movement patterns.
- On Route Charging: This assumes that all current expected on-route charging is distributed amongst those charge points near the main roads.

The analysis is at a high-level to provide a broad order of magnitude of likely charge point demand across the scenarios and a useful indication of the demand across the mix of different use cases and distribution across the county at a district level.

7.8.1 Countywide charging infrastructure

The three use cases correspond to the low, medium and high scenarios, presented previously, with the energy demand for both BEV and PHEV cars / LGVs. The demand for charging infrastructure is summarised at a countywide total level up to 2045 and for the different use cases for each of the scenarios in Table 7-4 to Table 7-5.

The majority (65%) of this demand will be for the private residential off-street use case, which will generally be outside the control of the Council and delivered by residents and the commercial sector. The next highest (27%) demand will be the residential on-street use case, which the Council will be directly involved in and responsible for the roll out of some of this infrastructure. The lower demands (<10%) for on-route and destination charge points will be delivered largely by others with some intervention from the Council on property within their estate and through engagement with commercial providers or National Highways.

Table 7-4 Forecast countywide charging infrastructure requirements – Low Scenario

Year	Residential Off Street (Slow)	Residential On Street (Slow)	Destination (Fast)	On Route (Rapid)
2025	2345	858	172	81
2030	8302	3174	597	254
2035	19531	7708	1416	591
2040	32238	12970	2349	973
2045	39137	16085	2880	1187

Table 7-5 Forecast countywide charging infrastructure requirements – Medium Scenario

Year	Residential Off Street (Slow)	Residential On Street (Slow)	Destination (Fast)	On Route (Rapid)
2025	3165	1144	228	102
2030	12131	4631	867	366
2035	26372	10398	1901	793
2040	36992	14994	2700	1117
2045	40364	16789	2990	1232

Table 7-6 Forecast countywide charging infrastructure requirements – High Scenario

Year	Residential Off Street (Slow)	Residential On Street (Slow)	Destination (Fast)	On Route (Rapid)
2025	4140	1488	293	132
2030	17076	6512	1216	513
2035	31655	12470	2281	952
2040	39373	16136	2893	1196
2045	40599	16959	3014	1241

The projected demand profile for overall charging infrastructure requirements in each of the scenarios is illustrated in

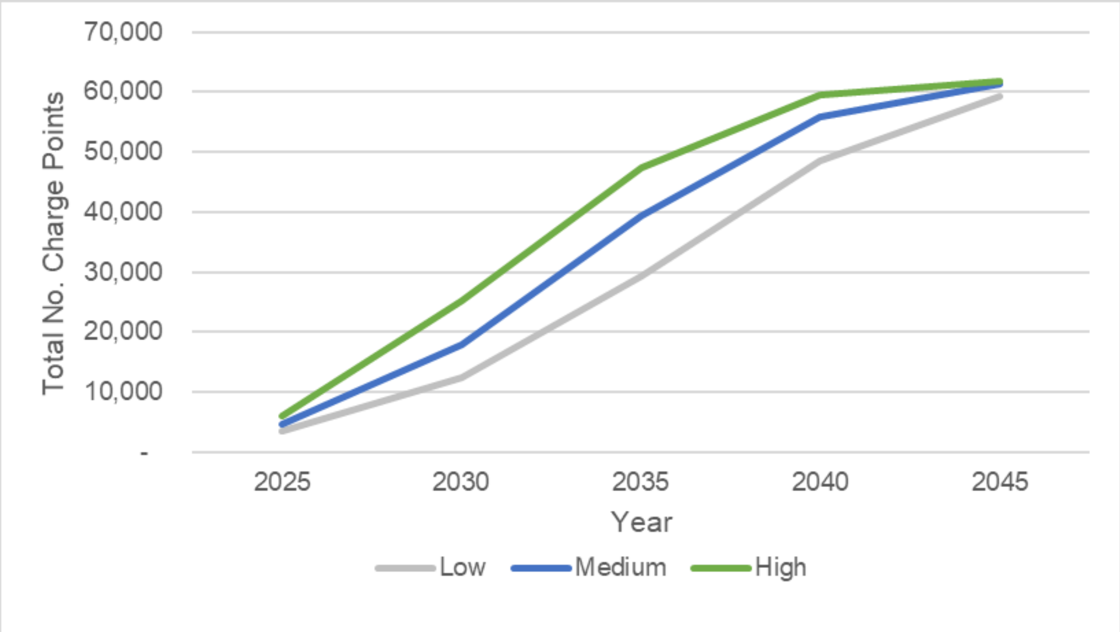


Figure 7-12. This generally reflects the EV uptake profiles and shows a convergence in demand for all scenarios by the mid-2040s. Planning in the intervening years could be more varied with the demand for infrastructure around 60% more in the high scenario compared to the low scenario in the mid-2030s. This equates to approximately 20,000 additional charge points in total, including, 5,000 additional on-street charge points.

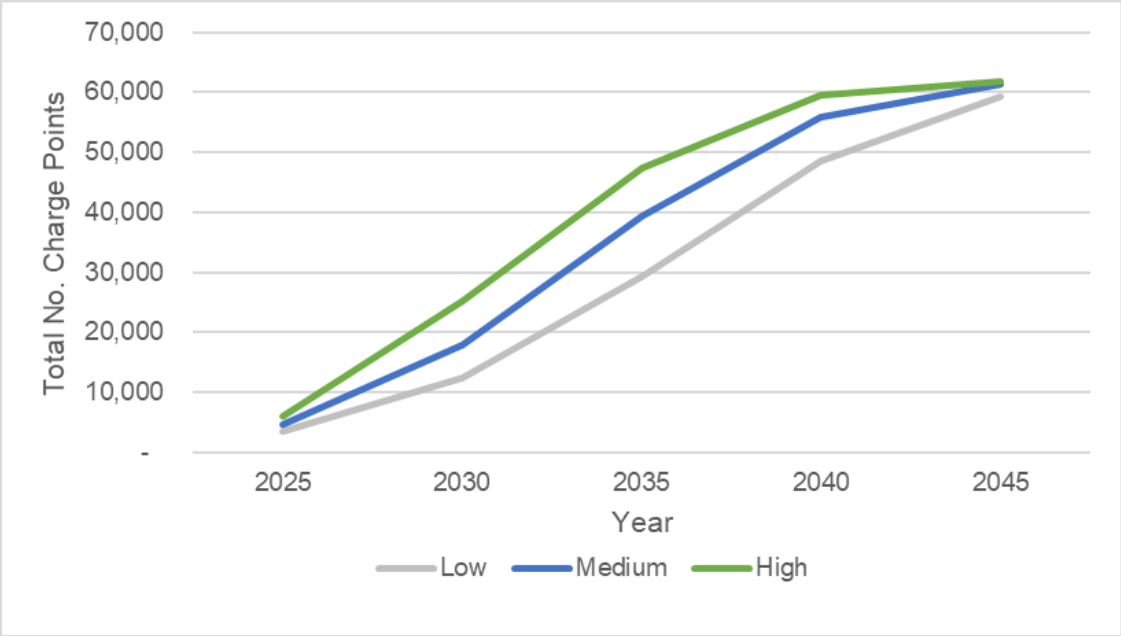


Figure 7-12 Forecast demand profile total charging infrastructure requirements by scenario

7.8.2 District charging infrastructure

The analysis has explored how the countywide demand is proportionally (%) distributed at the district level. This has been done for the medium scenario only for information purposes and Figure 7-13 shows the different levels of demand for each of the use cases in the Essex districts.

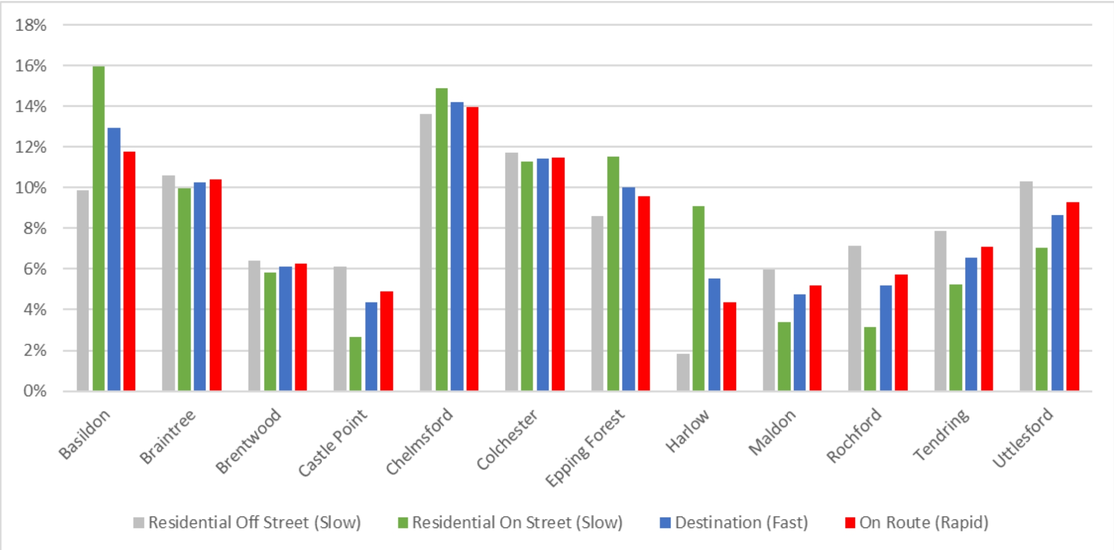


Figure 7-13 Forecast demand profile total charging infrastructure requirements medium scenario only

The analysis indicates:

- Overall demand for infrastructure will be highest in Chelmsford, Basildon and Colchester respectively
- The lowest levels of demand will be in Harlow, Castle Point and Maldon
- Basildon and Harlow have proportionally lower levels of off-street demand and higher on-street demand than the other districts, reflecting their higher distribution of housing stock with limited access to private off-street driveways and parking.

The outcomes of the analysis provides a useful indication of where the Council could have a greater impact within the context of the strategy vision and objectives e.g., Basildon and Harlow are two of the districts with areas of higher income deprivation and also likely to have the highest demand for residential on-street charging demand.

7.9 Wider EV Forecasts

Transport East, with support from Arup, have undertaken initial forecasting of EVs on the network for the East of England to develop a 'People focused Approach to Understanding Future Travel'[14]. This uses initial high-level transport modelling and applies the DfT 'Vehicle-Led Decarbonisation' scenario from their Uncertainty Toolkit for transport appraisal[15]. While not directly comparable to the EV uptake forecasting undertaken for the Essex strategy, given the different approaches, it does provide key outputs which are worth considering within the context of Essex.

In summary the Transport East work highlighted:

- A baseline 2040 forecast, with limited additional policy intervention, of 33% EV car and 12% EV LGV on the road network
- A 'High EV 2040 forecast of 88% EV car and 81% EV LGV on the road network – this is broadly similar to the medium scenario of 88% EV presented in the forecasting undertaken for the strategy earlier in this section (see Table 7-2)
- CO_2 emissions from cars and LGVs will reduce by 71%, from current levels, in the 2040 'High EV' scenario. Highlighting that EVs are only part of the solution and other interventions are needed to reach net zero.
- In 2040 HGVs could be the largest contributor to transport related CO_2 emissions unless and EV or clean fuel solution is identified for freight

[14] A People Focused Approach to Understanding Future Travel (Arup & Transport East, 2022)
[15] TAG Uncertainty Toolkit (DfT, 2022)

- There is a risk that a high uptake of EVs could lead to increased car travel and the replacement of trips made by sustainable modes by car trips.
- Achieving the 'High EV' scenario will be challenging.

7.10 Summary

This section provides high-level forecasts to project possible levels of EV uptake, potential energy demands, changes in tailpipe carbon emissions and likely infrastructure requirements for three distinct scenarios up to the mid-2040s. An additional test, accounting for the impact of some sustainable modal shift on vehicle purchases, has also been undertaken to integrate the analysis with the wider transport agenda.

The analysis illustrates:

- Even if the Government policy targets are met, the vehicle fleet could still contain approximately 75% ICEs in 2030, 50% in 2035 and 25% in 2040 due to the inherent lag in vehicle purchasing rates and changing to an EV.
- Company vehicles transition at a faster rate than privately owned vehicles and cars transition faster than LGVs.
- Providing for EV energy demand presents a number of challenges around higher rates of EV uptake in rural areas where journeys are longer and delivering the necessary energy supply, in the right place and as efficiently as possible, will be more difficult across more dispersed rural areas.
- The electricity energy demand of EV cars and LGVs will reach 25% of overall consumption across different sectors in the county by the mid-2040s.
- EV uptake will only reduce the carbon emissions at tailpipe, for cars and LGVs, by 75% and a range of other interventions will need to be considered as part of a balanced pathway towards achieving net-zero.
- The impact of sustainable mode shift is less likely to impact on vehicle purchases in the short to medium term but will have some marginal impact on EV uptake around 2040 and beyond. Noting that more detailed analysis and modelling is needed around sustainable mode shift.
- The greatest (65%) demand for infrastructure is likely to be residential off-street charge points, which is largely outside of the control of the Council, with the exception of new development.
- Residential on-street charging is likely to be the second highest demand (27%) for infrastructure. There are likely to be opportunities to address inequalities in districts such as Basildon and Harlow with high levels of housing without private drives and areas with higher-than-average levels of deprivation.

All forecasting is at an early stage and acknowledges that there are a number of variable economic drivers, technology advances and policy decisions that are likely to impact on the results going forward. The forecasting is therefore for information purposes at this stage, subject to change and should be updated as part of wider LTP4 and carbon quantification modelling going forward.

8 Developing an Action Plan

This chapter assesses a list of measures against the vision and objectives of the strategy, set out in chapter 2, to develop a prioritised action plan for the Phase 1 Strategy. The action plan focuses on what can be delivered within the immediate strategy timeframe, of the next 2-3 years, but also considers potential actions that can help prepare for more medium to longer term interventions to complement subsequent refreshes of the strategy.

8.1 The role of the public sector

The private sector will continue to play a pivotal leading role in expanding the EV charging network. There is a longer-term goal to work towards a self-sustaining network through private investment and the right policy framework. However, more will need to be done in the shorter term to deliver the right type of infrastructure, in the right locations and to remove barriers to EV uptake.

The Council and UK Government will have a role to fill gaps in the market that the private sector may not fill, including:

- Delivering an inclusive network that meets our Everyone's Essex plan to level up the county.
- Overcoming delays in delivery in less profitable and commercially unattractive areas
- Address interoperability issues across the multiple EV charge point operators.
- A well maintained and high-quality network
- A fairly priced network, with easy-to-understand payment options, that delivers value for money to users

Equally, there is a need to avoid an oversupply of publicly funded infrastructure in the wrong place that:

- Undermines the promotion of walking, cycling and public transport.
- Leads to underutilised assets and ongoing cost burden of operation and maintenance.
- Directly competes with and discourages private sector investment.
- Does not align with the objectives and priorities of the Phase 1 Strategy

The Council's role will be to lead by example and ensure best practice is applied to the roll out of publicly funded EV charge points, guide design and increase accessibility to improve the customer experience and encourage the private sector to follow.

8.2 Assessment of potential measures

There are a wide range of measures that could be considered and a list of measures have been drawn up that provides a balance with the role of the public sector and also enables others to deliver infrastructure in alignment with the Council's priorities. These have been categorised in the following themes to cover different use case, geographical locations, modes and policy considerations:

- Improve Provision of Charge Points for the Residential Use Case
- Improve Provision of Charge Points at Destinations
- Integration of EV with Sustainable Transport and Shared & Future Mobility Options
- Fleet Electrification
- Policy, Guidance & Standards

Each measure has been given a 'Red', 'Amber' or 'Green' (RAG) rating based on the following and an approximate short-, medium- or longer-term timeframe:

- **Green** – measure generally meets the majority of strategy objectives, and it is reasonably deliverable by the Council or others in the next 2-3 years
- **Amber** – measure meets some objectives and / or is harder for the Council or others to deliver in the next 2-3 years.
- **Red** – measure meets few / or none of the strategy objectives and / or is very unlikely to be deliverable.

The overall RAG scoring of an initial list of potential measures ECC could directly deliver are set out in Table 8-1 and an initial list of potential measures ECC could help enable are set out in Table 8-2. **Appendix G** includes additional details of the RAG assessment of the measures against the individual strategy objectives.

Table 8-1: Potential measures ECC could deliver – Short List

Theme / Category	User Case Category	Type	Rationale	Role of ECC	Sequencing	Overall
Improve Provision of Charge Points for the Residential Use Case	Publicly Accessible On-street charging	Rural settlements and smaller towns	Providing charge points for residents who do not have off-street charging within areas as noted within evidence base. Some research points towards significant proportions of EV drivers requiring charge points conveniently located near to priorities. In rural areas residents may be more reliant on car travel. Need to consider the impact on streetscape and ensure footway users are not impacted by any installations. On-street charging could assist with transitioning the Council's fleet to EV by providing workers with the ability to charge their vehicles while on the network.	ECC to deliver as Highway Authority	Short 0-2 years	
		City centres and large towns	As above, however within more urban areas consideration would also need to be given to ensuring charge points do not encourage car trips into centres by commuters and visitor using these public charge points, in addition to ensuring footway users are not impacted. Evidence demonstrates that some of the most popular publicly accessible locations for EV charging are key destinations in town and city centres 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 that have relatively small batteries	ECC to deliver as Highway Authority	Short 0-2 years	
Improve Provision of Charge Points at Destinations	Essex Property	Libraries, country parks, schools	As key destinations, charge points in these locations can facilitate top up charging. In particular, this could be a potential solution in more rural areas in which there is limited access to charge points and limited public car parks in which to install infrastructure.	ECC to review and deliver on own land	Short 0-2 years	
Integration of EV with Sustainable Transport and Shared & Future Mobility Options	Shared and Future Mobility	E-car clubs	This measure would support the development of an e-car club/s in Essex, giving flexible access to EVs. Charge points could be installed to support e-car clubs.	Potential to deliver in partnership with Districts and operator	Short 0-2 years	
		E-scooters	There are currently e-scooter trials in Basildon, Colchester and Chelmsford. Subject to evaluation of these trials and UK Government enacting legalisation these trials could be continued and potentially expanded into more areas in Essex. Early research shows that e-scooters can be attractive to residents in lower income areas by providing low cost and flexible accessibility to jobs and services.	ECC granting licences to operate on public highway (subject to legislation)	Short 0-2 years	
		E-bike share	Similar to car clubs there is potential to establish an e-bike share scheme giving low cost and flexible access to e-bikes to improve accessibility.	ECC working in partnership with operators	Short 0-2 years	
		E-cargo bikes	Establishing an e-cargo bike scheme that enables businesses to trail e-cargo bikes and potentially tap into wider support, advice and funding. This could reduce last mile logistics and deliveries as part of a wider programme of freight consolidation.	Potential to deliver in partnership in Districts and other partners	Short 0-2 years	
	Interchanges	P&R	Potential to integrate with mobility hubs and explore options to implement EV charge points for onward travel by P&R or other sustainable modes.	ECC and P&R operator would need to jointly deliver.	Short 0-2 years	
	Public Transport	Develop an Essex strategy for the transition of park and ride / local bus fleets to EV	The development of a business case and specific proposals for the transition of Park and Ride / local bus fleets to EV would be in line with the Government's Bus Back Better Strategy and a crucial first step in providing low carbon public transport. The provision of charging infrastructure for the Essex Park and Ride and fleet of public buses will support the uptake of EVs for the users of the park and Ride and the local bus network.	ECC to lead development of strategy and business case through engagement with operators	Short 0-2 years	
		Digital demand responsive transport	A trial scheme is currently operating in Essex through the Rural Mobility Fund and there could be potential to expand this trial more widely in the future.	ECC to shape future plans and work with operators	Medium 2-5 years	
	Active Travel	Avoiding negative impacts on active travel	In addition to the measures proposed regarding e-bikes, a key focus for future roll out of EV charge point is to avoid any unintended negative impacts on pedestrians and cyclists through poor location and design. Additionally, as noted above, careful consideration of the strategy for identifying charge points should support prioritisation and promotion of active travel modes above EV, particularly in urban areas.	ECC to deliver as Highway Authority	Ongoing	
	Mobility Hubs	Delivering Mobility Hubs to bring together various modes to improve sustainable transport choices	By integrating various modes of travel this will make multimodal journeys more feasibility and attractive. This would also enable residents in more rural areas who rely on car travel (and EVs) to switch to more sustainable modes on the outskirts of urban areas. There is potential for delivering hubs at public transport interchanges and within communities.	ECC to lead development of strategy and business case and work with operators	Medium 2-5 years	
Fleet Electrification	Council Fleet	Develop Council EV Fleet transition strategy	Build on ongoing work to replace the existing ECC fleet with EVs and develop longer term strategy to develop and maintain a consistent and efficient approach to transition and explore funding opportunities.	ECC to shape future plans	Short 0-2 years	
		Continued replacement of council fleet with EVs	Continuing to replace the existing ECC fleet with EVs would be viewed as the Council 'leading the way' in future vehicles whilst also increasing visibility of EVs across the region.	ECC continue delivery	Short 0-2 years	
		Identify suitable sites for charge points	This may include depots, Council sites, residential locations and on-route areas to continue support for uptake of EVs within the Council owned fleet. Promote these sites within the Council to increase the overall EV uptake of employees as they will be publicly available.	ECC to plan in conjunction with CPO	Short 0-2 years	
Policy, Guidance & Standards	Transport Policy / Strategy	Overarching supportive transport strategy that fits EV within the wider hierarchy of modes	ECC is preparing to develop a new LTP4 in response to new DfT guidance with an emphasis being placed on prioritising sustainable modes of travel. Consideration is also being given to adopting the 'Place' and 'Movement' framework to ensure streets are designed in an appropriate way to match the street type.	ECC to develop strategy and policy	Short 0-2 years	
	Planning Policy	Spatial Planning Policy	Review Local Plan and Planning Policy to ensure that expectations for provision of EV charge points by developers is robust and sufficiently ambitious.	ECC and Districts to review respective documents	Short 0-2 years	
	Design Guidance	Overarching EVCI Design Guide	New development, on-street, off-street, charging types, technologies design guide of what and how EEC expects EVCI to be delivered	ECC	Short 0-2 years	
	Procurement	Contract procurement	By building on existing and new contracts, ECC and District partners would be able to influence providers of services by specifying EV within transport services to be delivered.	ECC and Districts	Short 0-2 years	

Table 8-2: Potential measures ECC could enable – Short List

Theme / Category	User Case Category	Type	Rationale	Role of ECC	Sequencing	Overall
Improve Provision of Charge Points for the Residential Use Case	Private Accessible On-street charging	All Locations without access to off-street private parking	Exploring innovative options for private on-street connections for those without access to off-street parking to allow users to access their own private electricity supply. Need to consider the impact on streetscape and ensure footway users are not impacted by any installations.	ECC to work with CPOs and promote opportunities to residents	Short 0-2 years	
	Off-street charging	Private homes	Overnight and longer dwell times of vehicles are typically suited to slow chargers that can typically be installed off home power supplies. Research shows that charging at home on a driveway comprises a significant proportion of charging events.	Although this style of charging is a fundamental element of the network, at present the commercial sector is fully servicing demand and therefore there is no requirement for ECC involvement for the existing housing stock which has off-street parking.	N/A	
		Off street car parks	For residents who do not have off street parking and live near to car parks, installing charge points in these locations could service demand. The evidence base shows there are dense areas of flats and terrace housing clustered in urban areas, particularly Harlow and Basildon, that are likely to require on-street charging or alternative public charging car parks close to homes.	Support District partners	Short 0-2 years	
		Explore peer to peer sharing economy	Various 'peer-to-peer' charging platforms (where those with EV chargers make them available for others to use, such as Co-charger) can improve access to charging for residents who don't have off street parking.	Promote to residents	Short 0-2 years	
Improve Provision of Charge Points for On-route	On-route charge points	Strategic Road Network	The opportunity for top up charging is highly valued, particularly for when longer distance journeys are required on the Major/ Strategic Road Network. The lack of such infrastructure could delay the uptake of EVs. Given that battery capacities are increasing, the need for on-route charging away from the Strategic and Major Road network is likely to be limited however there may be exceptions in deep rural areas of Essex. In strategic locations ECC or partners could release land assets to investors / CPOs for the establishment of EV charging forecourts such as the facility in Braintree.	National Highways leading roll out	Short 0-2 years	
		Major Road Network		Support District partners	Short 0-2 years	
		County primary roads		Support District partners	Further consideration needed	
		Rural routes		Support District partners	Further consideration needed	
Improve Provision of Charge Points at Destinations	Settlements	City and large town centre car parks	Top up charging at key destinations will support journeys to work and for other everyday purposes such as retail and leisure. There is however a need to balance this off against wider placemaking objectives and encouraging sustainable modes for trips into urban centres.	Support District partners	Not proposed	
		Periphery of city and large town centres	As above, however locating charge points on the periphery rather than within urban centres would link better with wider policy aims of encouraging sustainable modes of travel.	Support District partners	Short 0-2 years	
		Smaller settlement car parks	As above, top up charging at destinations can play an important role in facilitating the transition to EV. This may also support the vitality of smaller town centres and villages by encouraging visitors.	Support District partners	Short 0-2 years	
		On-street locations in city / town / village centres	As above, this could service demand for top up charging however this could conflict with placemaking objectives and cause issues for people on residential streets.	ECC to deliver as Highway Authority	Not proposed	
	Employment	Employment / business car parks	As above, top up charging at destinations can play an important role in facilitating the transition to EV, particularly for people with no off street parking at home. ECC's Local Transport Plan states that 30% of local residents live less than 3 miles from their job. Major centres in Essex therefore serve their own population and their associated rural catchment areas. For both urban and rural residents, top up charging at key destinations will support journeys to work, as well as for other everyday purposes such as retail and leisure, at least in the short term.	Although this style of charging is a fundamental element of the network, at present the commercial sector is fully servicing demand and therefore there is no requirement for ECC involvement for existing employment locations.	Short 0-2 years	
	Community Property	Village halls, community centres, leisure centres, healthcare	As key destinations, charge points in these locations can facilitate top up charging. In particular, this could be a potential solution is more rural areas in which there is limited access to charge points and limited public car parks in which to install infrastructure.	Dependent on-site location	Short 0-2 years	
	Retail / leisure	Supermarkets / retail parks / private leisure / attractions	As above, top up charging at destinations can play an important role in facilitating the transition to EV.	No anticipated role for ECC in respect of private sector owned and operated retail sites	N/A	
Provide Shared & Future Mobility Options	Shared & Future Mobility	MaaS	A Mobility as a Service approach that enables flexible use of transport modes on demand could encourage a reduction in car ownership and promote more sustainable methods of travel, with e-car clubs playing a role in this. The concept has however yet to be proven to be commercially viable and deliverable outside of limited trials. There are also other practical aspects such as legislation which may need to be considered.	Potential to deliver in partnership in Districts and other partners	Long 5+ years	
Integrating with other modes	Interchanges	Installing charge points at public transport station car parks	Potential to integrate with mobility hubs and explore options to deliver EV charge points at station car parks and also secure overnight charging for local residents with no access to residential or on street. Longer dwell times of vehicles are typically suited to slow or fast chargers.	Rail station car park owners such as Network Rail / Train Operating Companies would need to deliver charge points.	Short 0-2 years	
		Freight micro consolidation hubs	Opportunities for freight consolidation hubs at key locations on periphery of larger urban areas to transfer to smaller e-modes including e-cargo bikes.	Potential to deliver in partnership with Districts and other partners	Short 0-2 years	
Fleet Electrification	Commercial fleet electrification (cars and light goods vans)	Incentivise the replacement, or retrofitting, of commercial fleets	Incentivising the replacement, or retrofitting, of commercial fleets (particularly LGVs) would greatly contribute to reducing carbon emissions. This could be achieved through promotional events that engage businesses on the benefits (cost savings and environmental benefits) of transitioning their fleet along with experience days where test drives can be offered. This measure would link with the provision of a public charging network as set out above.	ECC to work in partnership with Districts and EST to promote benefits and OZEV grants	Short 0-2 years	
	Taxi electrification	Develop strategy for transition of Hackney Carriages and Private Hire to EV	A streamlined strategy for electrifying the taxi fleet in the area would allow for early coordination between the public and private sector.	ECC to lead development of strategy and business case in consultation with taxi operators.	Short 0-2 years	
		Increase proportion of EVs in the taxi fleet - purchase new vehicles	Taxis contribute greatly to overall Green House Gas emissions, particularly around urban areas. Increasing the proportion of EVs in the taxi fleet through purchasing new vehicles and retrofitting existing ones would improve air quality in those areas.	ECC to engage and support where possible taxi operators	Short 0-2 years	
		Promote the retrofitting of taxis where possible			Short 0-2 years	
		Utilise/promote the Plug-in taxi grant			Short 0-2 years	
	Commercial fleet electrification (HGVs)	Supporting the transition of HGVs to EV Emissions-based parking scheme	As above, similar support could be provided as in the case with cars and LGVs.	ECC to work in partnership with Districts to promote benefits	Long 5+ years	
Policy, Guidance & Standards	Parking Policy	Emissions-based parking scheme	Explore emissions-based parking schemes.	Districts	Short 0-2 years	

8.3 Proposed list of Measures

The proposed list of measures that can potentially be delivered by ECC up to 2025 are summarised in Table 8-3. The list of measures that ECC can help enable the delivery of are summarised in Table 8-4.

Table 8-3. Measures Essex will look to deliver up to 2025

Theme	How we will deliver
Improve Provision of Charge Points for the Residential Users	Help deliver charge points for residents who do not have access to off-street charging, within priority levelling up areas, with a clear focus on areas with limited sustainable transport connections and a greater dependency on car travel.
Improve Provision of Charge Points at Destinations	We are developing a delivery plan to provide public-facing charge points across the Essex property portfolio, e.g., council buildings, libraries, country parks and schools, and will prioritise sites that support the objectives of this strategy and enable transitioning of the council fleet.
Integration of EV with Sustainable Transport and Shared & Future Mobility Options	We are developing a separate Mobility Hub design strategy to guide the scale and type of hub for different types of locations. We continue to develop the DigiGo DRT scheme, provide EVCPs at P&R sites and potentially link into the mobility hubs wider strategy. We will engage with partners and develop an Essex Strategy for how EV can contribute to the transition of P&R or local bus fleets to cleaner fuel.
Fleet Electrification	We are committed to leading by example and continuing to transition the Council's fleet as quickly and as efficiently as possible to meet our net-zero commitments.
Policy, Guidance & Standards	We are committed in our role to deliver policies and guidance that will shape future development and the delivery of infrastructure in the county. This strategy will inform our policy decisions and our design guidance that we would expect to be applied by our Local Planning Authority partners, developers and private charge point providers.

Table 8-4. Measures Essex will look to enable up to 2025

Theme	How we will work with others to deliver
Improve Provision of Charge Points for the Residential Use Case	We are engaging with charge point operators to explore innovative options for private on-street connections to allow residents, without access to off-street parking, can connect to their own electricity supply. Private residential off-street charging is a fundamental element of the overall network and at the moment the private sector will continue to take the lead on this.
Improve Provision of Charge Points for On-route	The opportunity for top up charging on key routes (Motorways, Trunk Roads, A-Roads and some rural routes) is highly valued and largely addressed by the private sector. There will be routes where opportunities cannot be delivered by the private sector due to land availability or perceived demand. We will continue to work with the private sector, and public sector partners (National Highways and Districts) to explore opportunities to use public assets for charge points or charging forecourts (such as the GRIDSERVE site in Braintree).
Improve Provision of Charge Points at Destinations	• We will work with our district partners and public transport providers (National Rail, train operating companies and bus operators) to explore opportunities for charging infrastructure on

Theme	How we will work with others to deliver
	the periphery of city and large town centres, smaller settlement car parks, Park & Ride and railway stations. • The private sector is largely catering for commercial employment, retail and leisure destinations and there is no direct delivery role for the County. • There are a number of public sector assets in smaller and less accessible locations, such as village halls, community centres, leisure centres and healthcare with secure car parking. We will work with parish councils, district partners and health trusts to explore where opportunities could complement the strategy.
Integration of EV with wider transport systems & fleet electrification	• Potential to work with National Rail and train operating companies to deliver mobility hubs, to provide first and last mile e-mobility solutions, and EV charge points at station car parks in locations that meet the strategy objectives. • We see the decarbonisation of freight and logistics as a wider issue where the Council will need to work different tiers of Government and the freight sector to deliver a longer-term strategy. • We will work with our district partners to develop an approach to support the transition of Hackney Carriages and Private Hire Vehicles to EV and identify opportunities for central grants and incentives to convert.

9 Commercial & Operating Models

This chapter sets our potential options for how charging infrastructure can be purchased, installed, and maintained and the recommended approach for Essex. More detailed information on Commercial and Operating models can be found in **Appendix H**.

9.1 Background

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

Much of the UK's charging infrastructure has 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 potential reductions in emissions.

9.2 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. Figure 9-1 illustrates the levels of risk and reward associated with different commercial models and

Table 9-1 summarises the key features of the 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.

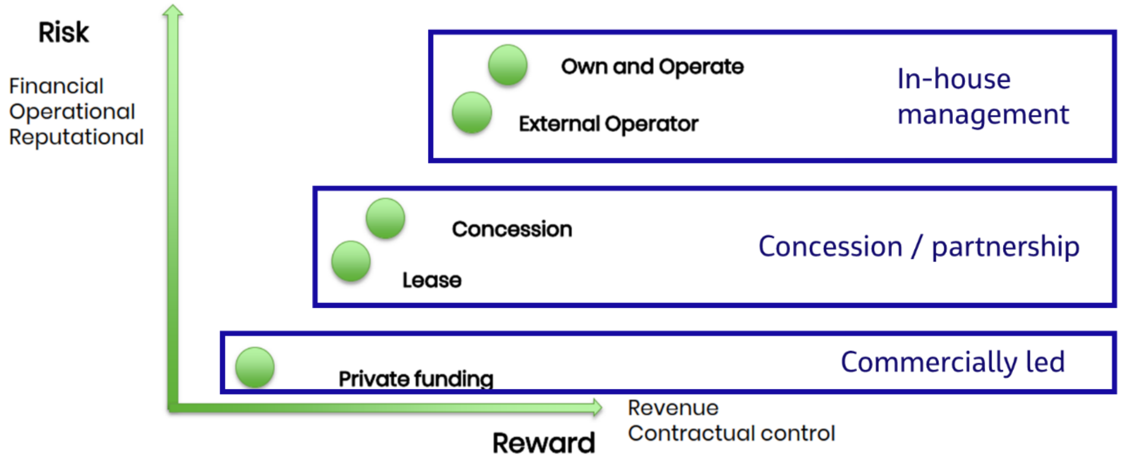


Figure 9-1 Illustration of the levels of risk and reward associated with commercial models

Table 9-1: Summary of EV Charging Commercial Models - UK

Model		Description	Features/ Risk
1	In-House Management	A Local Authority selects locations, purchases charging points and keeps any revenue.	• Purchase could include installation and ongoing maintenance. • OZEV grant funding could be used for residential on-street charging points. • Potential to ensure equity through providing in areas of market failure. • Appropriate for workplace and fleet installations where demand is assured. • Income for the 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 or offers a concession for 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 charge point annually. • Likely to be more suitable for rapid/ fast chargers near key destinations. • Publicly owned car parks/ land could be considered under this model. *Financial risk divested to suppliers/ operators but interested operators may be limited in some areas.*
3	Commercially Led	Private-sector suppliers use private land with limited or no Local Authority involvement.	• Rapid/ ultra-rapid charging points purchased and installed on private property (such as petrol station forecourts, private car parks, supermarkets, highway services, etc). • Requires sufficient capacity in the electricity network. *No financial risk to Local Authority. However, this approach will likely lead to gaps in provision where locations are less commercially attractive.*

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

9.3 Recommended Approach

Initial engagement with charge point operators (CPOs) has demonstrated interest for commercial investment in Essex, however, preliminary commercial modelling (as outlined in **Appendix H**) suggests that charge points will not be able to recoup their costs before 2025 at the earliest, even 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.

Therefore, a concession approach is recommended as this shifts risk onto the commercial operator in the initial period of time where EV vehicle uptake and charger revenue will be limited, while allowing Essex to maintain ownership of the underlying infrastructure,

When engaging with CPO’s it is recommended that a portfolio approach is followed, mixing high and low utilisation sites to help ensure that charging infrastructure is spread throughout the various districts of Essex and some of the more rural areas can be covered.

As current car park sites are owned by the local councils within Essex, it is recommended that a joined-up approach is undertaken, working with partners in the district, borough and city councils in order to maximise investment across the whole county.

10 Recommendations & Next Steps

This document sets out a technical evidence base in support of the Council's proposed vision and an initial strategy to support the transition to EVs and the delivery of charging infrastructure in the county. The strategy focuses on what the Council can start delivering in the shorter term, up to 2025, while giving some consideration to what could happen in the longer-term future of a rapidly evolving EV landscape. The technical evidence base is consistent with this and provides priorities for the short term but also information on potential uptake, energy and infrastructure requirements.

This section summarises the specific short-term recommendations for the strategy, coming from the analysis and to meet the Council's objectives. It sets out the next steps for engagement and EVs within the wider emerging transport strategy to be set out in LTP4.

10.1 Existing commitments

The Council will continue to engage and work with partners to:

- Seek opportunities for investment from local and central government funding similar to recent opportunities e.g., LEVI, ORCS and ZEBRA
- Lead by example and continue the transition of the Council's and their delivery partners' fleets.
- Build on the success of the Digi Go DRT service and look for opportunities to expand.
- Develop guidance for mobility hubs in a range of locations and how this can be integrated with EV infrastructure.

10.2 Potential infrastructure needs by 2025

A priority for the strategy will be to help deliver charge points for residents who do not have access to off-street charging, with a clear focus on levelling up and in areas with limited sustainable transport connections and a greater dependency on car travel. The Council will also look to deliver infrastructure at destinations or on-route where they have suitable sites within their estate. It is anticipated that residential off-street will be provided by the commercial sector, developers and by private individuals and these are not considered in detail by the Phase 1 Strategy.

Figure 10-1 illustrates the potential infrastructure requirements for these specific use cases in each district by 2025. This is taken from the initial forecast analysis in Chapter 7 and confirms that the strategy's main focus should be on demand for on-street residential charge points across the districts with a lower priority for destination and on-route infrastructure.

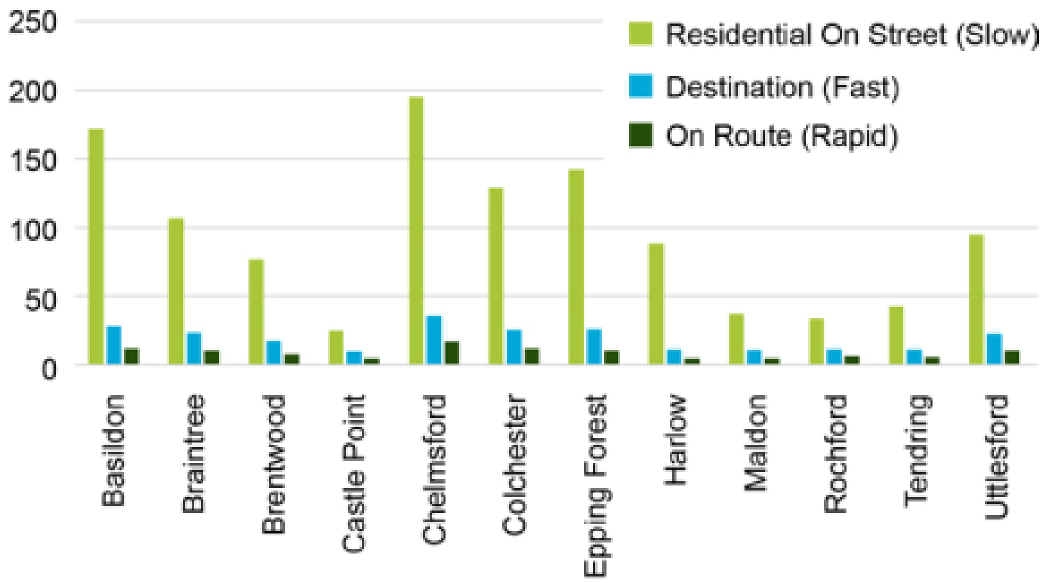


Figure 10-1 2025 potential district infrastructure requirements for on-street, destination and on-route

10.3 Geographical priorities

The following tables provide strategic considerations around the approach to delivering this EV infrastructure for different Essex geographies up to 2025.

Essex Wide
Essex contains a wide mix of districts containing built up and rural areas, varying levels of deprivation and varying levels of access to off street parking. This, coupled with individual district populations, results in a variety of levels of predicted EV infrastructure need in each district by 2025.
In broad terms there is generally a predicted need for further public slow charging infrastructure which should be a focus of the Council. There are a significant number of commercial opportunities to provide the predicted fast and rapid infrastructure through Essex via current BP and Shell service stations. These are typically located adjacent to the strategic road network and also within urban centres, supermarkets and other retail locations and so is an opportunity to address on route and destination charging needs.

Rural Districts with limited Strategic Road Network
Maldon and Rochford represent more rural districts and have a comparatively low provision of public charging infrastructure, have high levels of access to off street parking and are both on the lower end of the predicted EV infrastructure need for districts in Essex. The forecast for fast and rapid prediction being only slightly above the existing provision

The focus should be on a small increase of provision for public slow residential charging, given the high % of access to off street parking in the district. Given the more rural and spread-out nature and lack of strategic road network, these areas may not be as suited for large hub-based approaches as the larger urban areas and cities.

Rural Districts with Strategic Road Network
Uttlesford and Epping Forest districts have relatively good current levels of infrastructure in their urban centres/airport but also contain the strategic road network in their rural areas, namely the M11 and M25. Both districts have a relatively high level of predicted public infrastructure need and have a number of commercial opportunities for addressing on route charging.
This links into measures around the provision of on route charging facilities. As well as the M11 and M25, Essex contains a significant amount of A Roads and there is opportunity throughout the county for the provision of on route facilities alongside these roads.

Districts with limited Residential Off-Street Parking
Harlow and Basildon represent two districts where their individual LSOA's make up the entire top 10 of locations with limited access to off street parking. Both districts currently have comparatively good provision of public slow chargers and also contain a number of commercial opportunities in BP and Shell service stations and supermarkets. Both districts have a relatively large predicted future 2025 infrastructure need, with a relatively balanced mix of slow, fast and rapid chargers
This links into the potential measures around providing charging facilities for residents who do not have access to off street parking and improving EV accessibility. Consideration should also be given to placement of infrastructure and its impact on the footway. Given they are relatively built-up areas with low access to off street parking, Harlow and Basildon represent suitable locations for the introduction of mobility hubs, shared mobility areas and charging clusters in public car parks.

Districts with higher levels of deprivation
Tendring and Basildon represent the districts with some of the highest levels of deprivation in Essex. Both currently contain a relatively good current balance of public infrastructure at a district level across different charging speeds, with a number of BP/Shell Stations near the strategic road network and retail sites for potential future commercial route/rapid and destination/fast infrastructure.
This links into measures to consider that the transition to EV is inclusive and fairly priced and actively levels up the communities of Essex. Shared mobility hubs are also a possibility in order to encourage EV in low-income areas where uptake is predicted to be low.

10.4 Site prioritisation

It will be important to prioritise investment and site selection to meet the objectives of the Phase 1 Strategy and deliver value for money on any public funding. We will consider the following initial criteria as part of any site selection and prioritisation process in the future:

- **Equity** – alternatives to home charging in areas with restrictive access to home charging, limited access to sustainable travel options and higher levels of deprivation

- **Accessible** – opportunities to provide for disabled EV drivers with step free access and larger parking bays.
- **Affordable** – apply simple, transparent and convenient charging options for residential and public facing infrastructure that delivers a balance of fairness to the customer and a self-sustaining network.
- **Environmental responsibility** – targets air quality issues and provides opportunities for longer term adoption of innovative off-grid, on-site zero carbon supply solutions e.g., solar or battery storage
- **Resilient and reliable** – deploying the right equipment in the right place in accessible and maintainable locations.
- **Safety & security** – ensure EV charging infrastructure is well designed and located in secure locations so people will feel safe using the public network at all times of day and night.
- **Land availability** – prioritise use land within the control of the Council, or public sector partners, to minimise the risks of permissions, legal requirements and delays of installing on third-party land.
- **Electricity Supply** – availability and connection costs can vary from site to site and opportunities to reduce these costs and the necessary civil engineering works, such as mini-hubs or clustering charge points, will be considered.
- **Integration** – provides for a range of users and / or integrates with sustainable travel options and group charge points at mobility hubs, interchanges and park & ride sites.
- **Viability & risk** – engage with charge point operators and adopt an approach to minimise risk and ensure that charging infrastructure is distributed evenly throughout Essex to also cover less viable locations.

10.5 Design Guidance

There is a need to develop design guidance to standardise publicly funded EV charging bay layouts, signage and ensure that the infrastructure is accessible to all including disabled EV users. It is recommended that, where possible, the design guidance is also applied to new infrastructure installed by other providers and CPOs to deliver a standardised network of EV infrastructure across the county that is recognisable to the general public.

Any design guidance will need to be integrated with wider development and planning policy to ensure new development contributes to the wider infrastructure requirements within a consistent design framework.

10.6 Engagement

Public engagement

The strategy will be the first step to engage with the public to raise awareness of the Government phase out of petrol and diesel sales and eventually plug-in. It will also be an opportunity to demonstrate the availability of existing infrastructure and how the Council will help enable the delivery of reliable, convenient and accessible charging infrastructure.

The Council will consult on this initial strategy, prior to adoption, and undertake further engagement to understand how the demands of residents can be better met, maximise value for money from any investment and raise awareness of how the charging network is expanding across the county. The outcomes of this engagement will be fed into any future refresh of the strategy in the next 2-3 years.

Business engagement

The Council will undertake targeted engagement with both public and private sector employers, particularly in locations with poor public transport access, to encourage the use of the Government Workplace Charging Scheme (WCS) to establish and expand a workplace EV charging offer for their employees. We will look to coordinate demand in particular locations so any available funding can be targeted to create charging hubs to serve a range of different users. This could include local communities where off-street and on-street charging opportunities are limited.

Key stakeholders

Continuous and open dialogue will be essential with the district partners, NHS, Transport East, National Highways and the DfT to understand and coordinate cross-boundary opportunities and maximise any available funding in line with our Phase 1 Strategy. A district level user group could be set up with key officers to monitor progress and emerging best practice from elsewhere.

Engagement with charge point operators & providers

The Council will continue to engage and work with charge point operators and providers to explore how we maximise the opportunities for investment from local and central government funding similar to recent opportunities e.g., ORCS and LEVI grant schemes.

The Council will also look to engage with industry partners as we develop design and best practice guidance for the installation of infrastructure on public property and how we would expect others to deliver infrastructure across the county.

10.7 Monitoring

Monitoring progress and outcomes

The Council will need to ensure that they are making the most of public funding opportunities and any available investment aligns with the strategic objectives and principles of this initial strategy. There is also a need to monitor the geographic and demographic uptake of EVs and the expansion of the public and private charging network to ensure the different key user groups we have prioritised in this strategy are not being left behind. We will need to monitor key outcomes over the strategy horizon of the next 2-3 years including, but not limited to, the following examples:

- The level of public funding secured by the Council through Government grant schemes for the installation of electric vehicle charging infrastructure.
- The number of publicly funded charge points delivered by the Council and their partners.
- Expansion and number of registrations of private and public charge points in the county and how this compares with the projected level of need for different user types.
- How the delivery of charge points aligns with the objectives and principles of this strategy
- Rate of EV uptake across the county for different user groups, locations and demographics. How this compares with trends from other counties and Government forecast
- Rate of transition of the Council vehicle fleet to EV

Monitoring technology

Technology is rapidly advancing and continuously changing. The Council will need to understand these changes and how they will influence the charging network and how EV users charge across Essex. It is recommended that the Council use engagement with industry partners to keep up to date and enable the ongoing delivery of a network that is innovative, forward thinking and meets the needs of businesses, residents, and visitors to Essex.

10.8 Next Steps

While recognising the private sector will continue to play a key role in delivering the required infrastructure, the strategy highlights the need for public sector intervention to secure further essential Government funding and develop an inclusive network to meet a range of socially motivated objectives.

The strategy is very much focused on what can be done in the immediate future, up to around 2025, but will also start to lay the foundation for the longer-term future to fit with wider policy changes and respond to technology and innovation.

It is anticipated that the overarching strategy will be consulted on in early 2023 with adoption targeted towards late-2023. The document will need to be refreshed in line with the overarching transport strategy for Essex set out in the emerging in the LTP4 planned for adoption in 2024. This technical evidence base will also need to evolve and as highlighted throughout the document, further modelling will need to be undertaken to better understand future uptake trends and infrastructure requirements as the technology and wider policy framework evolves. This will all be undertaken through continuous monitoring, evaluation and engagement with a range of partners to understand what is working well and help the Council deliver an agile and proactive strategy.

Figure 10-2 illustrates the likely policy and technology timeline with the likely need to refresh the strategy once the overarching transport strategy has been set out in LTP4 in 2024.

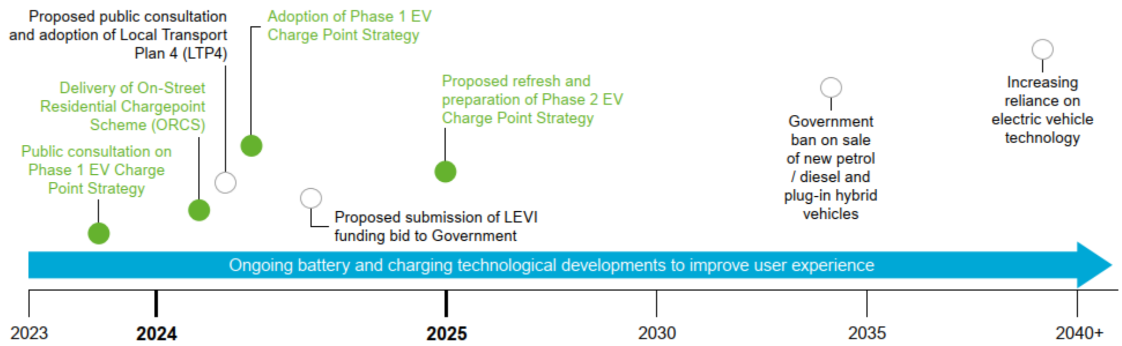


Figure 10-2 Illustrative future transport policy and EV technology timeline

Appendices

Appendix A: Further Policy Information

Recent National and International EV Developments

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[16]. 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 have been converted to the 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"[17].

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

16 Climate Change Act 2008

17 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

Battery Electric Vehicles (BEVs) and Plug-In Hybrid Electric Vehicles (PHEVs) totalling 10.7% market share in December 2020[18].

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 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 could remove the source of 91% of today's domestic transport GHG emissions[19]. 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 charge points.

The process of national EV developments is ongoing with a consultation ending recently on "Future of transport regulatory review: zero emission vehicles"[20]. This consultation aims to address transport regulation, particularly with regard

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

19 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

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

to those areas that are potentially outdated and not designed with new technologies or business models in mind.

Key National Strategy and Policy

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

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

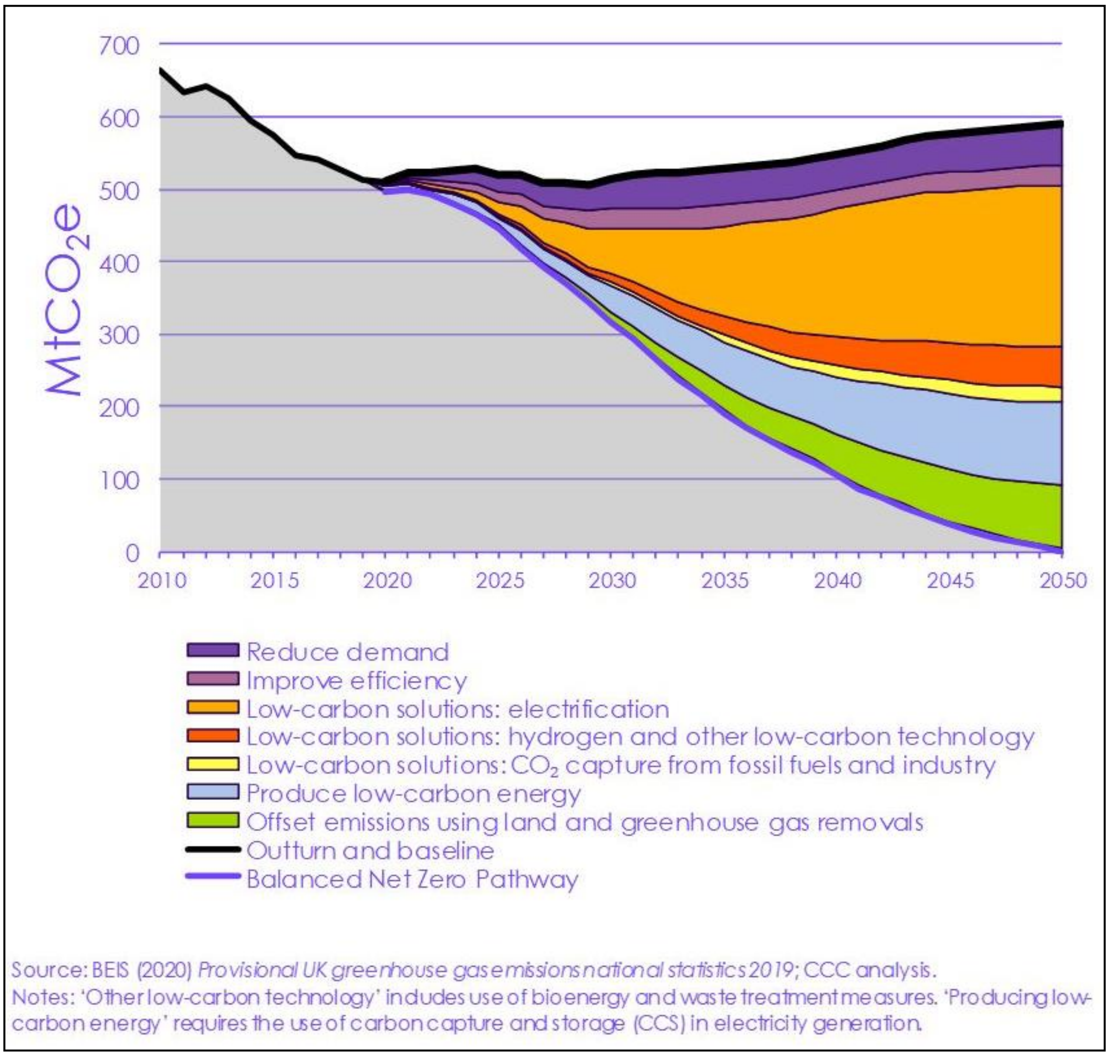
By 2030, it is expected that the network will be extensive and ready for more people to benefit from the switch to electric cars. We are planning for there to be around 2,500 high powered charge points across England's motorways and major A roads.

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

- *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 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.

- *Highways England Road Investment Strategy 2&3 (2020)* – Documents present the long-term vision for what the Strategic Road Network should look like in 2050, and the steps to help realise this alongside an investment plan. The document notes that the rise of electric vehicles is essential to achieving the target of net-zero carbon emissions by 2050, but also has the potential to encourage increased travel on our road network as the costs of driving fall.
- *Climate Change Commission's (CCC's) Sixth Carbon Budget (2020)* − Sets the limit on allowed UK territorial greenhouse gas emissions over the period 2033 to 2037. It is the CCC's duty under the Climate Change Act to advise on it by the end of 2020, following which it must be legislated by the middle of 2021. A chapter in 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 CO_2e by 2035 and to approximately 1 Mt CO_2e by 2050 (See figure overleaf).



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

- *National Planning Policy Framework (2019)* – Local parking standards for developments should consider adequate provision for EV charging in safe, accessible, and convenient locations.
- *Planning Practice Guidelines Paragraph 008 (2019)* – Planning conditions and obligations can be used to secure air quality mitigation, including infrastructure to promote modes of transport with a low impact on air quality, such as EV charging points.
- *DfT's Future Mobility: Urban Strategy (2019)* – Sets out the Government's strategy for tackling the challenges of urban mobility, including through a £400m funding package for EV charging points.
- *Energy Saving Trust's 'Positioning charge points and adapting parking policies for electric vehicles' (2019)* – Provides guidance on the installation of charge points along footways and the use of parking bays. Recommends a clear footway width of 1.5m and placement of chargers at the front of pavements to avoid tripping hazards and away from areas with significant

other street furniture. Alternatively, kerbs should be built out to maintain footway accessibility.

- *Committee on Climate Change (2019)* – In June 2019, the Government passed new laws to support a target of net zero emissions by 2050 in response to recommendations from the Committee on Climate Change (CCC).
- *DEFRA Clean Air Strategy (2019)* – Sets out the Government's plan to tackle all sources of air pollution, making our air healthier to breathe, protecting nature and boosting the economy.
- *Future Mobility Zones (2019)* – Outlines the Government's commitment to fostering experimentation and trialling through launching four Future Mobility Zones with £90 million of funding. The zones aim to demonstrate a range of new mobility services, modes, and models. They focus on significantly improving mobility for consumers and providing an exportable template to allow successful initiatives to be replicated in other areas.
- *Automated and Electric Vehicles Act (2018)* – Promotes the development and deployment of autonomous and electric vehicles, through large-scale investment in electric charging points and new rules ensuring vehicle compatibility, payment standardisation and guaranteeing reliability.
- *OLEV Road to Zero Strategy (2018)* – Outlines the ambition that every new car and van sold in the UK should be zero emission by 2040, and that the entire UK road fleet should be effectively decarbonised by 2050.
- *DfT Future of Mobility: Urban Strategy (2018*) – This strategy sets out the approach that Government will take to seize the opportunities from the changes happening in urban transport. It sets out the benefits which the Government aims for mobility innovation to deliver and the principles that will help to achieve this.
- *Air Quality Plan for Nitrogen Dioxide (NO_2) in the UK (2017)* – Sets out how the UK aims to reduce roadside nitrogen dioxide (NO_2) through a requirement for development of local plans for interventions in targeted areas where the problem is most severe.
- *Clean Growth Strategy (2017)* – Outlines how the government intends to implement its industrial strategy, focussing on clean growth and lower carbon emissions. It notes that the low carbon economy is predicted to grow 11% a year from 2015-2030, with transport a key sector in delivering this growth.
- *UK Industrial Strategy: Building a Britain fit for the future (2017)* − Sets out how the Government plans to build 'a Britain fit for the future' through helping businesses create better, higher-paying jobs with investment in the skills, industries, and infrastructure of the future. A key 'grand challenge' is decarbonising the economy to enable clean growth and capitalising on the opportunities to develop world leading skills and businesses in the field of future mobility.

- *Manual for Streets 2 (2010)* – Highlights the need to design footpaths to ensure accessibility and safety but does not address charging point placement specifically.
- *Climate Change Act (2008)* – Commits the UK to reducing emissions by at least 80% by 2050. This has since been amended to include a target of net zero emissions by 2050 (2050 Target Amendment – Order 2019). Although this has since been superseded in certain aspects, it provides important background context.

Local Policy

- *Essex County Council's Sustainable Modes of Travel Strategy (2020)* – Promotes the contribution towards the reduction of transport related emissions by rolling out EV charging infrastructure at workplaces and community spaces across Essex. The Strategy also breaks down the grants available to help achieve this.
- *Essex Green Infrastructure Strategy (2020)* – Highlights the requirement to include EV charging infrastructure when building new developments.
- *Essex County Council's Net Zero: Essex Carbon Neutral Strategy (2021)* – Describes the steps Essex is tacking to achieve carbon neutrality by 2050. This includes reducing travel and increasing sustainable travel choices. Where road journeys are essential the strategy highlights EVs as the preferred choice. This EV charging infrastructure Strategy will support the sensible use of EVs, hence help deliver the Net Zero Strategy.
- *Essex County Council's Local Transport Plan (LTP) (2011)* - The LTP is Essex's approach to transport in county. The strategy highlights the need to reduce carbon and the associated impact on the environment. The uptake of EVs is stated as part of this solution. This EV infrastructure Strategy will facilitate the uptake of EVs and therefore help deliver the LTP objectives.
- *Essex County Council's Local Transport Plan 4 Draft Outline (LTP) (2022)* – The new LTP will focus on 4 key themes: 1) decarbonisation; 2) supporting people health, wellbeing and independence; 3) creating sustainable places and communities; 4) connecting people, places and businesses. This strategy will identify the right mix of EV charging infrastructure to support communities and business throughout Essex. Therefore, this strategy will support the policy direct of the forthcoming LTP.
- *Essex County Council's Bus Service Improvement Plan (BSIP) 2021 – 2026 (2021)* – Outlines local issues faced by the bus network in Essex and how ECC intend to address them. Issues and symptoms include bus reliability, patronage and low passenger satisfaction. This strategy considers the short term next steps needed to explore the feasibility of electrifying buses and intermodal travel. This will support the BSIP strategic outcomes.

- *Essex County Council's Mobility Hubs and Halts Draft Design Guide (2022)* – ECC are in the process of drafting a design guide that will inform the delivery of mobility hubs and halts across the county. This EV strategy will support the mobility hubs objectives such as the integration of EV charge points at mobility hubs. This will encourage multimodal travel and a reduction in net car kilometres travelled.
- *Brentwood 2025 (2021-2022)* – States the EV charging infrastructure objectives to be reached before 2025, including a rollout programme to deliver 20 more EV charge points in the borough, and to ensure all new fleet vehicles are electric where practicable.
- *Brentwood Local Plan (2016 – 2033)* – Sets out the borough's commitments to on-street and off-street charging infrastructure implementation, broken down by use cases.
- *Basildon Local Plan (2020)* – Commits to requirement for all new developments to include, where practical, appropriate provision for electric vehicle charging points and sets out minimum standards for this.
- *Colchester Borough Council (2021-2023)* – Breaks down the borough's commitments to responding to the climate emergency, including the rollout of EV charging infrastructure, fleet decarbonisation and the creation of car clubs.
- *Colchester Borough Local Plan (2013-2033)* – Commits to the planning of innovative strategies for the management of private car use and parking including the promotion of car clubs, car sharing and the provision of electric car charging points.
- *Colchester Fleet Transition Forward Plan (2020)* – Details the council's fleet decarbonisation plan.
- *Chelmsford Local Plan (2020)* – Highlights the necessity for investment into car clubs and EV charge points, states that residential development should provide EV charging point infrastructure at the rate of 1 charging point per unit (for dwellings with dedicated off-road parking) and/or 1 charging point per 10 spaces (where off-road parking is unallocated).
- *Harlow Local Development Plan (2020)* – Puts emphasis on the need for decarbonisation, which will ultimately result in an increased uptake of electric vehicles. This must be supported by the electrical infrastructure of developments.
- *Braintree District Local Plan (2013-2033)* – States the requirement of measures and strategies designed to encourage people to make sustainable travel choices, highlighting the need for electric vehicle charging points and car clubs.
- *Basildon Council Air Quality Topic Paper (2017)* – Highlights the need to address the limited provision of EV charging infrastructure.

- *Maldon District Council Air Quality Action Plan (2020-2025)* – Sets out the measures being taken to ensure a rollout of EV charging infrastructure across fleets and commercial sites.
- *Castle Point Corporate Plan (2021-2024)* – Outlines a vision for Castle Point which includes providing EV charge points to support combating climate change.
- *Epping Forest District Council Green Infrastructure Strategy (2021)* - Seeks to protect the Forest and other ecological sites. Highlights rising vehicle emissions as a threat to the area, EV charging infrastructure will support EVs and hence reduce vehicle emissions district wide.
- *Rochford District Council Sustainability Strategy (2022-2027)* – Highlights that transport is the largest carbon emitter within the district. To reduce these emissions increasing the number of EV charge points is highlighted within the strategy.
- *Tendring District Local Plan 2013-2033 and Beyond (2021)* - Sets out the vision for future development in the borough. The local plan seeks to improve transport infrastructure in the area by sustainable means, provision of EV charge points in highlighted as a way of achieving this policy.
- *Uttlesford District Council Climate Crisis Strategy (2021-2030)* - In 2019 Uttlesford District Council declared a climate and ecological emergency. The council has committed to achieving net-zero carbon status by 2030, to achieve this the council has recognised growing the EV charging network as a priority.

Appendix B: Technology Roadmaps by Vehicle Type

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

Cars

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

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

Current EV Market - Cars

EV Model	Battery Capacity (kWh)	Range (miles)
Renault Zoe R110 ZE40	41/50	160/200
Nissan Leaf	40/62	140/250
Hyundai Kona	39	155
BMW i3 120 Ah	37.9	145
Tesla	60/100	300/400

Vans

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

Current EV Market - Vans

Make	Price	Mileage	Rapid Charge	Capacity (m3)
Peugeot Partner/ Citroen Berlingo	£23,030	106 (NEDC)		3.3-3.7
Peugeot e-Expert/Citroen e-Dispatch/ Vauxhall Vivaro-e	£49,465	205 (75kWh) 143 (50kWh)		>6.6
Peugeot e-Boxer/Citroen e-Relay	£49,335	>169 (62kWh)		8
Fiat E-Ducato	£59,699	>224 (79kWh)	No	10-17
Ford Transit (PHEV)	£24,395	35 (EV)		6
LEVC van (PHEV)	£46,500	58 (EV)		5
Maxus EV80	£24,614	119		11.6
Maxus e Deliver 3	£22,800	150		6.3
Mercedes e Sprinter	£51,950	71		10.5
Mercedes e Vito	£39,895	93	No	6.6
Nissan Env200	£20,005	124		4.2
Renault Kangoo ZE	£24,480	143		4.6
Renault Master	£57,040	124		13
VW Abte-Transporter	£42,060	82		6.7

Heavy Duty Commercial Vehicles

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

Buses

A variety of EV technologies are already used on buses, including battery electric, hybrid, plug-in hybrid, hydrogen fuel cell and biomethane models, enabling operators to choose appropriate low carbon technology solutions to meet their needs. The UK Government has provided funding towards the deployment of low emission buses through the Department for Transport’s Low Emission Bus schemes and Clean Bus Technology fund. There are two main types of electric bus − those that take power continuously from a source outside of the bus whilst travelling (e.g. overhead wires), and those that use energy stored on-board (usually in batteries). Hybrid electric buses use a combination of ICE and electric propulsion. It now seems that there are two options for urban buses which is BEV or FCEV. Rural buses could be different due to very isolated routes in terms of grid capacity.

Appendix C: Battery Charging Further Details

Battery Charging Capabilities

EV charging technology is evolving rapidly. Prior to 2016, most EVs charged at 3kW AC (called slow charging), which was adequate to fully recharge most batteries (typically up to 24 kWh) overnight. Then with the development of vehicles with 7kW on-board chargers came fast 7kW AC charging, and with the introduction of higher capacity batteries, the 22kW AC fast charging technology has since come to market.

This figure demonstrates the low power charging capabilities of PHEVs. When combined with the fact that PHEVs also have lower capacity batteries, along with the lack of new PHEV models due to arrive on the market, the implication is that PHEVs do not appear likely to contribute heavily towards demand for public charging facilities in the near future compared to BEVs.

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

The latest development in charging technology introduces charging at powers between 100kW and 350kW DC, referred to as ‘high-power charging’ − but few such plug-in vehicles are currently available in the UK, and most of these are currently high-priced executive cars. The majority of high-power charging solutions use the CCS DC socket/plug; however, a few have maintained the CHAdeMO socket/plug. Nissan, who have up to now remained with CHAdeMO, are leaving it for CCS in the future, however, many thousands of drivers still need CHAdeMO access.

The roll-out of high-power chargers at 150kW+ for public use is now beginning in the UK, and most are designed to also deliver 50kW DC charges to rapid chargeable vehicles to combat the current lack of high-power charging demand. Slow and fast AC charging solutions will continue to be required in the UK to support the recharging needs of the existing EV fleet. Of those rapid chargeable plug-in vehicles currently on UK roads, approximately 50% require the CHAdeMO connector, so new rapid chargers installed over the next 5 years will require both DC CCS and CHAdeMO connectors. However, it appears the rapid 43kW AC connector will have very low and declining demand going forward.

This 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.

PIV Supply Constraints

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

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

The UK Government is also concerned about the strength of the automotive industry, as it is an important contributor to UK employment, exports and GDP. Nissan introduced the Leaf to the UK in 2011, manufacturing all European volumes of battery and vehicle at its UK plant since 2013. The first model had a limited 24 kWh battery, which was a risk with the limited charging infrastructure available at that time. However, this led the way in Europe and was soon followed by Renault, Mitsubishi, BMW, Volkswagen and Tesla, and higher battery capacities are now becoming the norm. These market leaders are only now beginning to increase PIV model range but have yet to make significant volumes to satisfy the potential demand across the whole of Europe. Many vehicle manufacturers have made little or no significant impact on EV availability to date, although there is much talk in the press about new models to come with little evidence of significant production volumes for the UK. The Nissan announcement is significant but some of the volume is substitution.

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

The availability and cost (though less so than a few years ago) of Lithium-ion (Li-ion) batteries are limiting factors in PIV supply. Consequently, vehicle manufacturers are considering whether to make or buy the batteries for their models. Tesla has chosen to manufacture its own batteries and has launched associated energy business opportunities. Nissan set up its own European battery manufacturing facility to guarantee early supply for its vehicle production, but this has recently been sold. Most PIV manufacturers chose to rely on battery suppliers; however, battery manufacturing capacity within Europe is currently a small proportion of global volume, and Chinese companies own the majority.

Li-ion technology is 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 2028 to 2030, and many new battery manufacturing plants will then be required to supply the PIV volumes required to meet European targets, requiring significant investment and long-range planning. There is therefore still a substantial risk that PIV supply will stand in the way of achieving transport emission reduction targets in the UK. Recent activity has shown a rush to build battery plants across Europe. The recent announcement of the Britishvolt, plus the Envision AESC battery factories, both within the northeast of England, will help address the shortage.

Regions and LAs have little or no control over vehicle manufacturers' PIV allocations and compete against major cities such as London and Paris. However, meaningful incentives such as grants supported by public charging facilities and financial dis-incentives such as Low Emission Zones have been shown to increase demand in some countries, leading to increased proportion of PIV volumes produced by manufacturers such as Tesla and Nissan. In Norway, for example, incentives were very significant initially however this level of incentive has not been matched anywhere else.

Appendix D: Charging Technology Further Details

Charging Rates Overview

The most significant advances in BEV is the emergence of 800V electrical systems which achieve much faster charging and reduced weight, allowing them to travel further between charges. Porsche fitted an 800V system in their full-electric Taycan sports car, which was launched last year. Such systems enable greatly reduced charging times, as long as they are using fast chargers capable of working at up to 270kW. "If the charger provides 800V and a minimum of 300A, the Taycan can charge from five to 80 per cent in 22.5 minutes. 400V chargers typically provide 50kW only. The same charging capacity would need 90 minutes," said Otmar Bitsche, director of e-mobility at Porsche.

Hyundai cars based on the E-GMP platform will offer a maximum range of more than 310 miles per charge, with standard high-speed 800V charging capability (so far available only on the Porsche Taycan), allowing an 80% charge in as little as 18 minutes from a 350kW rapid-charger. These models are significant as they are more representative of the family car.

800V systems also allow a greater retention of power; a higher voltage allows a lower current to be used when charging the battery, which reduces overheating and allows better power retention. This contributes towards a greater driving range.

Charge Point manufacturers and charge point operators are now preparing for demands for higher charging infrastructure.

The top picture (in the image below) shows 50kWh rapid chargers at a motorway station of which there are normally 2, being replaced by 12 x 350kW. These charge points have the capability of adding around 100 miles of range in less than five minutes. The lower picture shows a similar progression by Shell from a single 50kWh rapid charger to now a forecourt of 10 x 175kWh rapid chargers.

Examples of Charging Forecourts

Miles per kWh

In theory, electric car economy can be calculated by using a car's battery capacity and its official range. For example, an electric car with a 40-kWh battery pack and a 100-mile range would have an economy/consumption figure of 2.5 miles/kWh. The actual range of an EV is dependent on a number of variables, for example: to what level the battery is charged, the capacity of the battery (kWh), the weather (windscreen wipers, aircon, heater active or not), time of day (headlamps on or off), the way you drive (aggressive or gentle). All of these will affect the range at a given time.

Currently the average car kWh per mile (kWh/mi) is around 4 miles/kWh depending on the vehicle.

With the average UK electricity price sitting at around 28p per kWh (August 2022) and if you assume an electric car will travel 4 miles per kWh on average, to travel 100 miles would cost around £7.00 or £0.07p/mile. (The cost to drive an ICE car is around £0.40p per mile, which we calculate by dividing average annual car running costs of £3,049 by average car mileage of 7,600 miles per year).

Fully charging a 60kWh electric car will cost around £18.00 (depending on where you live) and give you about 180 -240 miles of range depending on time of year/day etc.

Charging Connectors

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

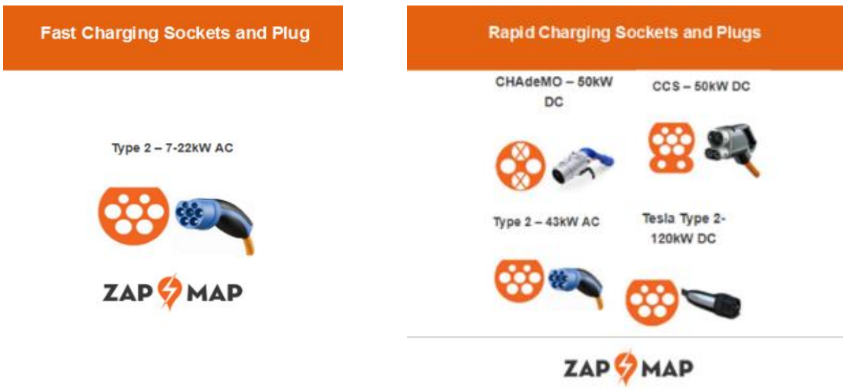
PIV cars and light vans are supplied with a charging cable used to connect the vehicle to slow or fast charge points. This cable has a plug specific to the vehicle on one end, and a suitable plug on the other end to connect to slow/fast charge points in the UK. Some vehicles have separate charging sockets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

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

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

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. Only Renault retains the 43kW AC system.

Tesla's 120kW supercharger socket/plug was designed to suit their bespoke battery solution. Tesla provides superchargers for public use and have now opened up their charging network to some non-Tesla vehicles.



Type 2 Socket and Plugs for Slow/ Fast and Rapid Charging in the UK (Source: Zap-Map, final figure to be improved)

Charging Protocols

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

The latest version available for use is OCPP 2.0.1, but version 1.6 (which can also be certified) is most commonly specified in procurement exercises in the UK currently and has been adopted across most of Europe, the USA and Asia. Most slow and fast chargers intended for public use in the UK are now OCPP compatible, but some old charge point models are not upgradeable and therefore risk becoming obsolete. This highlights the need to consider future proofing in recharging infrastructure deployment plans.

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

Furthermore, mandatory regulations have now been introduced (June 2022) for newly installed private charge points setting out the following smart functionality requirements

The Electric Vehicles (Smart charge Points) Regulations

Item	Purpose
Smart Functionality	Able to send and receive data and **increase/decrease rate of electricity** and **shift time** at which electricity flows. Must support Demand Side Response services (Grid Balancing).
Personalised Default Setting	User can set default charging hours with a pre-set charging schedule **that does not charge EVs at peak times.**

Item	Purpose
Cyber and Data Security	Basic security measures for **resilience to cyber-attack** and robust against physical damage.
Randomised Delay Function	Up to **10mins randomised delay** between information received and any adjustment of rate of electricity flowing through it. Ability for user to override delay.
Assurance	Any person / organisation selling a CP must provide **a statement of conformity and a technical file**, at the request of the regulator.
Supplier Interoperability	CPs must not be designed in a way that means they lose functionality when a consumer **switches supplier**.
Monitoring and Recording Energy Usage	A CP must measure or calculate the **electricity consumed and/or exported, the time the charging event lasts** and provide a method for the consumer to view this information.
Safety	CPs should operate in a way that **prioritises safety** smart charging behaviour.

The smart charging regulations recognises the potential that smart functionality within charge points brings to help manage peak grid demands.

Upgrading Existing Charging Infrastructure

In some instances, it may not be possible to 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 charge point operators' OCPP supported 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 either future replacement or alternatively removal (if not well utilised / a 'stranded asset'). In the long-term, ECC can choose to pay for the upgrades or enter into a contractual agreement with a supplier who may be willing to 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.

Smart Charging

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

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

- Power peak reduction: schedule and automatically control each vehicles' charging cycle to avoid peak power demand times and avoid exceeding maximum power supply capacity.
- Reduce investment costs: make optimal use of the existing power supply by controlling the charging speed of each charge point to prioritise specific vehicles and balance the available power across chargers to ensure each vehicle is fully charged ready for the next shift's activity.
- Energy cost reduction: cost-effectively schedule charging times to take advantage of time-of-use energy tariffs to reduce operating costs.
- Increase flexibility: use prioritised load balancing to deliver only the energy required to suit each vehicles' next shift requirement, and allow for extended shifts, increased range, late start/finish times, etc.
- Demand response: respond instantly to dynamic energy pricing and accelerate or reduce the energy consumption of the fleet accordingly to reduce operating costs.
- Integration of batteries and renewable energy sources: use stationary batteries as energy stores, charging them from renewable generation

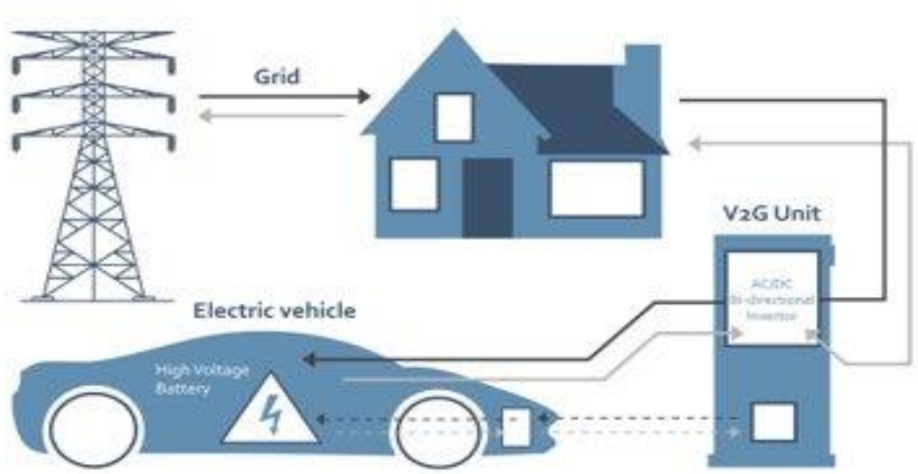
sources and/or when energy cost is low, and subsequently use that stored energy to recharge vehicles when energy costs are high.

- Reduce manual labour: removes the time-consuming and error-prone need to manually plug/un-plug vehicles at specific times.
- Improve PIV battery health: smart charging results in slower charging over the battery's life cycle, preserving its state of health and reducing long-term operating costs and environmental impacts.
- There are currently three levels of smart charging available:
- Basic load balancing distributes the available power capacity equally between all charge points to prevent overloading and high energy costs at peak times.
- Scheduled/static load balancing can also optimize charging schedules to take financial benefit from time of use energy tariffs.
- Dynamic load balancing can combine both static and dynamic data such as bus routes, next day plans and dynamic energy pricing to ensure the entire fleet is charged in time for individual departure at the lowest cost.

Vehicle to Everything

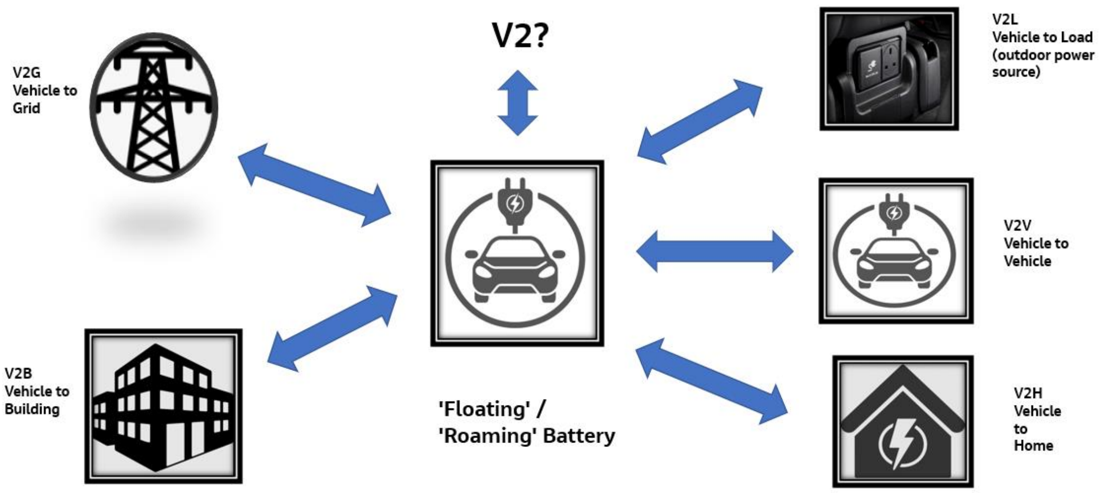
Furthermore, Vehicle to Everything (V2X) has emerged as a further innovation that could bring significant benefit to both the Consumer (in terms of energy savings/payments) and the Grid (through cost avoidance of building out heavy infrastructure to support mono-directional charging.

Vehicle to Everything Schematic



The most commonly referred to V2X use case is Vehicle to Grid (V2G) wherein a V2X enabled vehicle is connected to a V2G charging unit with energy discharged in reverse from the battery to the grid via a charger. In return there is potential for a customer to be paid for sharing energy back to the grid in particular to support peak grid demand.

The following image sets out further potential V2X use cases:



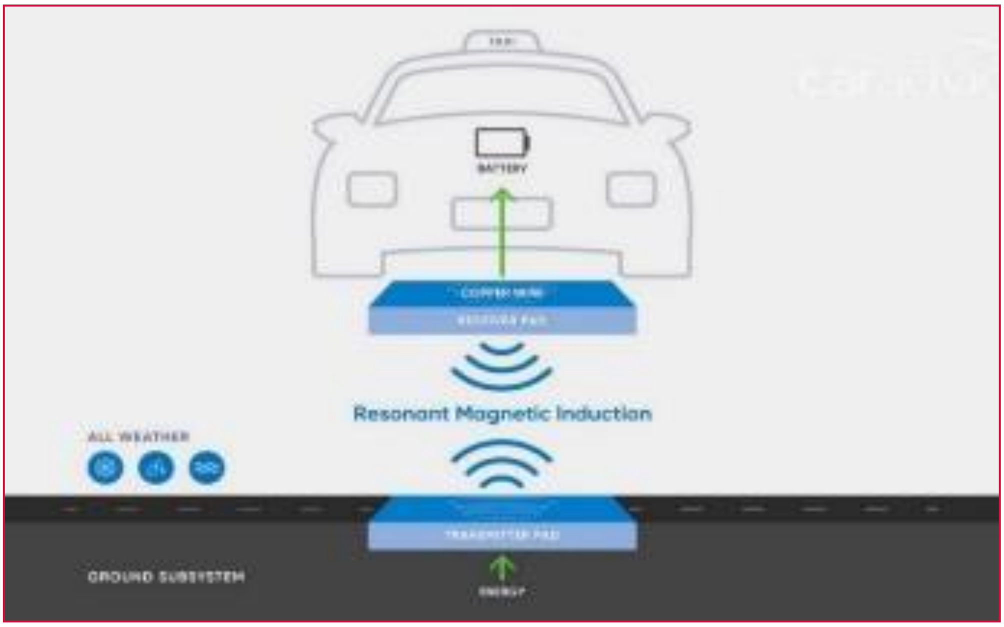
The figure above shows further V2X potential including - V2G (discharging spare energy from the EV battery back to the grid in return for a payment), Vehicle to Building V2B – discharging to a building for the consumption of the building (i.e. could be via workplace/visitor parking) in exchange for a payment, Vehicle to Home V2H where a consumer uses spare stored energy within the EV battery for home energy consumption (i.e. a resident could charge the vehicle overnight when energy is cheaper and discharge from the battery back to the home during the day, avoiding higher energy payments. The cost savings are increased when combined with solar and other renewable energy sources). Vehicle to Vehicle V2V where an EV could provide charge to another EV where their battery might have run low and Vehicle to Load V2L where the EV becomes an outdoor power source for a multitude of uses. It is still early in the V2X market with more automotive companies committing to developing V2X models, more charge point manufacturers developing V2X products and commercial use cases and new business models are still in development. Various V2X pilots have already demonstrated promising results showing significant savings for consumer and for grid (cost avoidance of grid reinforcement and heavy development thereof).

Appendix E: Induction Charging

Overview

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

Induction Charging



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

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

Induction Trials

A number of trials of induction charging are currently underway:

- England, Nottingham: Wireless charging for electric taxis waiting in their rank is to be trialled in Nottingham. The UK Government is putting £3.4m towards fitting five charging plates outside the city's railway station. The six-month pilot project will see 10 electric taxis fitted with the necessary hardware, and the scheme could be rolled out more widely if successful. Officials said electric vehicles were 'vital' to improving city air quality and making charging convenient was key. The Department for Transport said wireless charging was more convenient and avoided the clutter of cable charging points. (Source: BBC News online)
- Scotland, Edinburgh: Heriot-Watt University, located near Edinburgh, Scotland, is planning a trial of wireless charging using electric delivery vans. It is a joint project with the City of Edinburgh Council and Flexible Power Systems (FPS), and will involve specially adapted vans, with charging equipment from Momentum Dynamics. Innovate UK provided funding for the trial. The trial will also explore the concept of charging hubs, which could be shared among multiple fleet operators. "The project is testing the sharing of charging hubs among logistics, retailers, local government and university-owned commercial vehicles," said FPS Managing Director Michael Ayres. "These charging hubs require high use to be economically viable. The project uses powerful wireless charging to shorten the time vehicles need to be in the charging hubs." (Source: The Scotsman)
- Germany, Cologne: In the German city of Cologne, an inductive (wireless) charging project for taxis is being set up called the Taxi Charging Concept for Public Spaces (TALAKO, based on the German title). This is part of the SMATA feasibility project, launched in October 2020. For the new TALAKO project, six LEVC (London Electric Vehicle Company) electric taxis are to be converted for inductive charging. LEVC is responsible for making the famous London electric taxi cabs specially developed for the taxi industry. The vehicle has an electric range of 130 km and a range extender on board to extend the range by 500 km if necessary. When the Cologne project is in operation, six vehicles will be able to charge simultaneously. (Source: electrive.com)
- Norway, Oslo: Jaguar Land Rover will provide 25 Jaguar I-PACE models to Cabonline, the largest taxi network in the Nordics. The brand's performance SUV has been designed to enable Momentum Dynamic's wireless charging technology, making it the ideal vehicle to drive the initiative. A team of

engineers and technicians from both Momentum Dynamics and Jaguar Land Rover were engaged to help in testing the solution, and Cabonline signed up to operate the fleet as part of Oslo's ElectriCity programme. Taxi drivers need a charging system that does not take them off route during their working hours. Multiple charging plates rated at 50-75 kilowatts each are installed in the ground in series at pick-up-drop-off points. This allows each equipped taxi to charge while queuing for the next fare. The system, which uses no cables and is situated below ground, requires no physical connection between charger and vehicle, engages automatically and provides on average 6-8 minutes of energy per charge up to 50kW. (Source: jaguarlandrover.com)

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

Wireless Induction Charging Capability of EVs

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

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

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

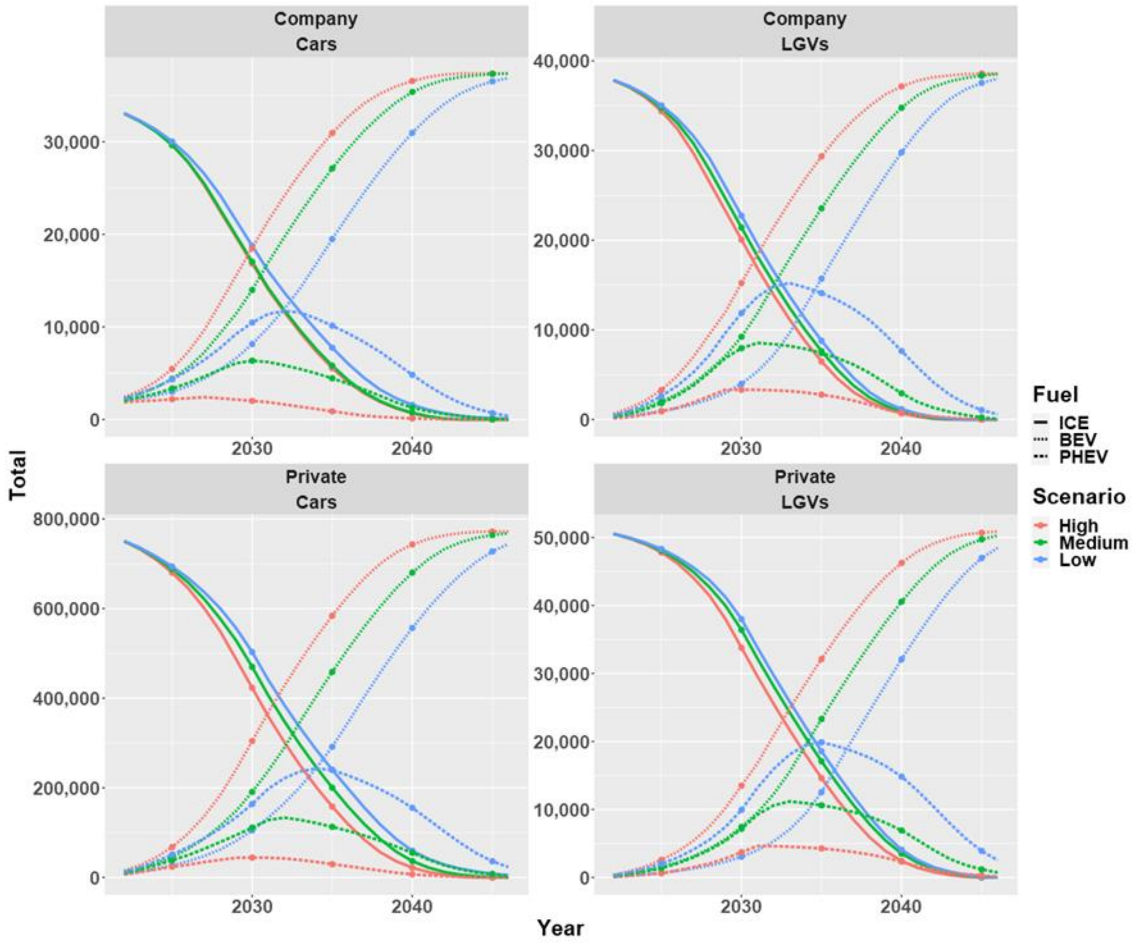
- If wireless charging is initially offered as an aftermarket add-on, then the required vehicle retrofit may have an impact on both vehicle warranty and insurance. The cost of installing the required infrastructure may suggest that installation will only be feasible as a hub consisting of multiple charging bays rather than single charge points in and around cities.
- The chicken and egg scenario − will car manufacturers want to introduce this option on vehicles if insufficient infrastructure exists? Likewise, will anyone want to introduce the infrastructure if no vehicles exist to use it? The vehicle manufacturers had to 'invest' in the current EV charging infrastructure, so are they likely to want to do it again?
- To go mainstream, wireless charging will need international standards. The Society of Automotive Engineers (SAE) recently announced the first global standard for wireless EV charging, which could help accelerate the technology's rollout. The standard, SAE J2954, applies to inductive charging

systems up to 11 kilowatts. As with existing SAE standards for other charging methods, J2954 will harmonise new systems, allowing for increased interoperability between hardware and vehicles from different manufacturers.

Note: Only BMW offer induction charging as an option on a 5 series hybrid.

Appendix F: Forecasting Outputs

Uptake for Company / Private / Cars / LGVs BEV / PHEV v ICEs



Appendix G: Scoring of Potential Measures

Delivered by the Council

Type	Objectives								Sequencing	
	1 Equitable	2 Healthy Environment	3 Resilient & Safe	4 Integrated	5 Connectivity & Demand	6 Creating better places	All	Deliverability	Short 0-2yrs Med 2-5 yrs Long 5+ yrs	Overall
Rural settlements and smaller towns	🟠	🟢	🟢	🟠	🟢	🟠	🟢	🟠	Short 0-2 yrs	🟠
City centres and large towns	🟠	🟢	🟢	🟠	🟢	🟠	🟠	🟠	Short 0-2 yrs	🟠
Libraries, country parks, schools	🟢	🟢	🟢	🟠	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
E-car clubs	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
E-scooters	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
E-bike share	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
E-cargo bikes	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟠	Short 0-2 yrs	🟠
P&R	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Develop an Essex strategy for the transition of park and ride / local bus fleets to EV	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟠	Short 0-2 yrs	🟠
Digital demand responsive transport	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟠	Medium 2-5 yrs	🟠
Avoiding negative impacts on active travel	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Ongoing	🟢
Delivering Mobility Hubs to bring together various modes to improve sustainable transport choices	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Medium 2-5 yrs	🟢
Develop Council EV Fleet transition strategy	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Continued replacement of council fleet with EVs	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Identify suitable sites for charge points	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Overarching supportive transport strategy that fits EV within the wider hierarchy of modes	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Spatial Planning Policy	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Overarching EVCI Design Guide	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Contract procurement	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢

Enabled by the Council for others to deliver

Type	1 Equitable	2 Healthy Environment	3 Resilient & Safe	4 Integrated	5 Connectivity & Demand	6 Creating better places	All	Deliverability	Sequencing (Short 0-2yrs, Med 2-5 yrs, Long 5+ yrs)	Overall
All Locations without access to off-street private parking	🟡	🟢	🟢	🟡	🟢	🟡	🟢	🟡	Short 0-2 yrs	🟡
Private homes	🟢	🟢	🟢	🟡	🟢	🟡	🟡	🟡	N/A	🟡
Off street car parks	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Promote peer to peer sharing economy	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Strategic Road Network	🟢	🟢	🟢	🟡	🟢	🟡	🟢	🟢	Short 0-2 yrs	🟢
Major Road Network	🟢	🟢	🟢	🟡	🟢	🟡	🟢	🟢	Short 0-2 yrs	🟢
County primary roads	🟢	🟢	🟢	🟡	🟢	🟡	🟢	🟡	Further consideration needed	🟡
Rural routes	🟢	🟢	🟢	🟡	🟢	🟡	🟢	🟡	Further consideration needed	🟡
City and large town centre car parks	🟢	🟢	🟡	🔴	🟡	🟡	🔴	🟢	Not proposed	🔴
Periphery of city and large town centres	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	Short 0-2 yrs	🟢
Smaller settlement car parks	🟢	🟢	🟢	🟡	🟢	🟡	🟢	🟢	Short 0-2 yrs	🟢
On-street locations in city / town / village centres	🔴	🟡	🟡	🔴	🟡	🔴	🔴	🟡	Not proposed	🔴
Employment / business car parks	🟢	🟢	🟢	🟡	🟢	🟡	🟢	🟢	Short 0-2 yrs	🟢
Village halls, community centres, leisure centres, healthcare	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Supermarkets / retail parks / private leisure / attractions	🟢	🟢	🟢	🟡	🟢	🟢	🟡	🟡	N/A	🟡
MaaS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	Long 5+ yrs	🔴
Installing charge points at public transport station car parks	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Freight micro consolidation hubs	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	Short 0-2 yrs	🟡
Incentivise the replacement, or retrofitting, of commercial fleets	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	Short 0-2 yrs	🟡
Develop strategy for transition of Hackney Carriages and Private Hire to EV	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	Short 0-2 yrs	🟡
Increase proportion of EVs in the taxi fleet - purchase new vehicles	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	Short 0-2 yrs	🟡
Promote the retrofitting of taxis where possible	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	Short 0-2 yrs	🟡
Utilise/promote the Plug-in taxi grant	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	Short 0-2 yrs	🟢
Supporting the transition of HGVs to EV	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	Long 5+ yrs	🔴
Emissions-based parking scheme	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	Short 0-2 yrs	🟡

Appendix H: Commercial and Operating Models Background Information

Background

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 9-1.

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 charge point manufacturers, such as Podpoint in the UK and Fastned in Holland, have launched Crowdfunding schemes with some success to fund their networks. In the case of some privately-owned recharging networks (such as Ecotricity's Electric Highway), revenue from other assets was used to cover the network's operation initially whilst demand was low. However, over time users have increasingly begun paying a charge for the service received.

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 chapter sets out options for selecting a charging point provider or set of providers.

Work within a Framework Contract

One possibility is to utilise a framework contract to allow local authorities to source charge points. 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 ECC. 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.

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.

Disbenefits

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

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 charging point in Essex.

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

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.

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).

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. ECC could request firms to offer prices for:

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

Benefits

- Firms could be invited to choose the locations where they would like to install charging points, which effectively pushes the risk of choosing a poor location onto the operator (e.g. failing to secure planning permission or failing to achieve sufficient demand for installed chargers).
- Ability to procure specialist providers for each type of charging infrastructure.

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.

Choosing Locations or Leaving This to Provider(s)

It is possible for the local authorities to choose the locations where its charging points would be installed in some of the options listed here. Whereas, other procurement and management models require this choice to be left at least partially in the hands of the operator.

If operators/ suppliers choose where they would like to place chargers, subject to 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 Essex 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 charging points.

A hybrid approach would be to package up a number of busier (more attractive) sites alongside a number of less desirable sites so that the more popular locations help to cross-subsidise the less popular ones.

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 charge points across Essex was considered. The charge points are not in specified locations; but are drawn from the population charging potential at evenly spaced percentile intervals (i.e., the least commercially viable charge point to be considered would be in position 90 out of 100 charge points, the next at position 80 and so on).

In reality it is unlikely that the charge points 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 charge point 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 charge point (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 charge points 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 charge point will be able to serve a total demand determined by:

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

The Charge Point Power is determined by the power rating of the charge point (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 charge point could realistically be expected to charge. For example, a charge point with a Max Utilisation of 50%, would be expected to be in use for no more than 12 hours in a day.

Commercial Models

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

- Model 1: ECC installs all ten charge points 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 charge points whilst ECC Council 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 charge points.
- Model 3: Private Companies install all ten charge points 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 charge points 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 charge points.

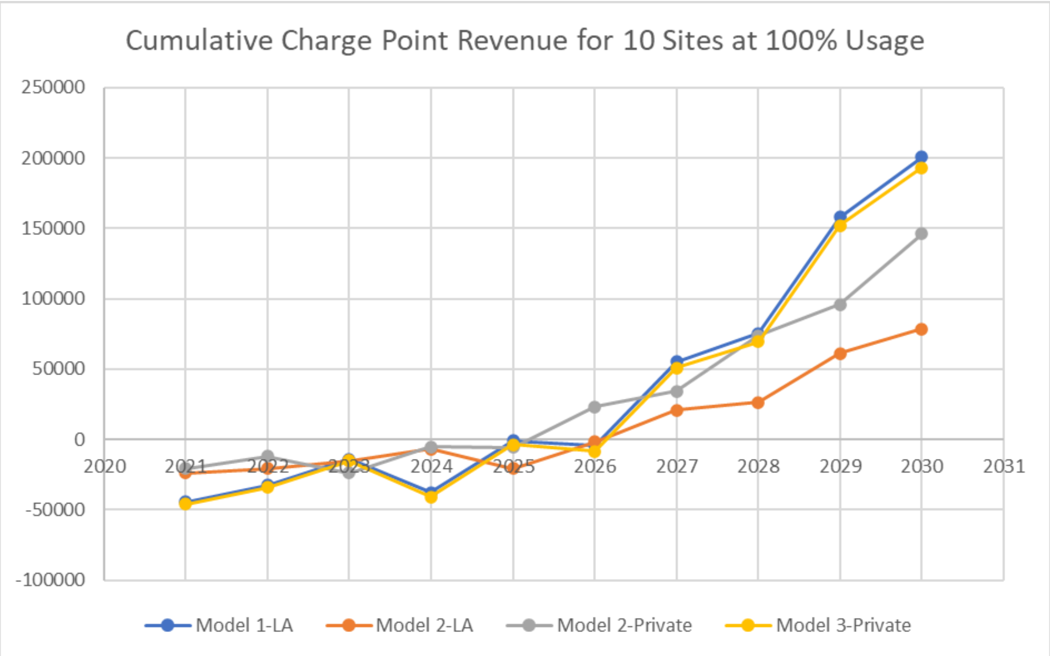
The cost of each charge point, and the subsequent revenue, is borne by the installing party. The exception is Model 2 where a commission is paid to ECC from the private installers. The price per kWh (£0.15) is assumed to be constant throughout each model.

The figure below 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.

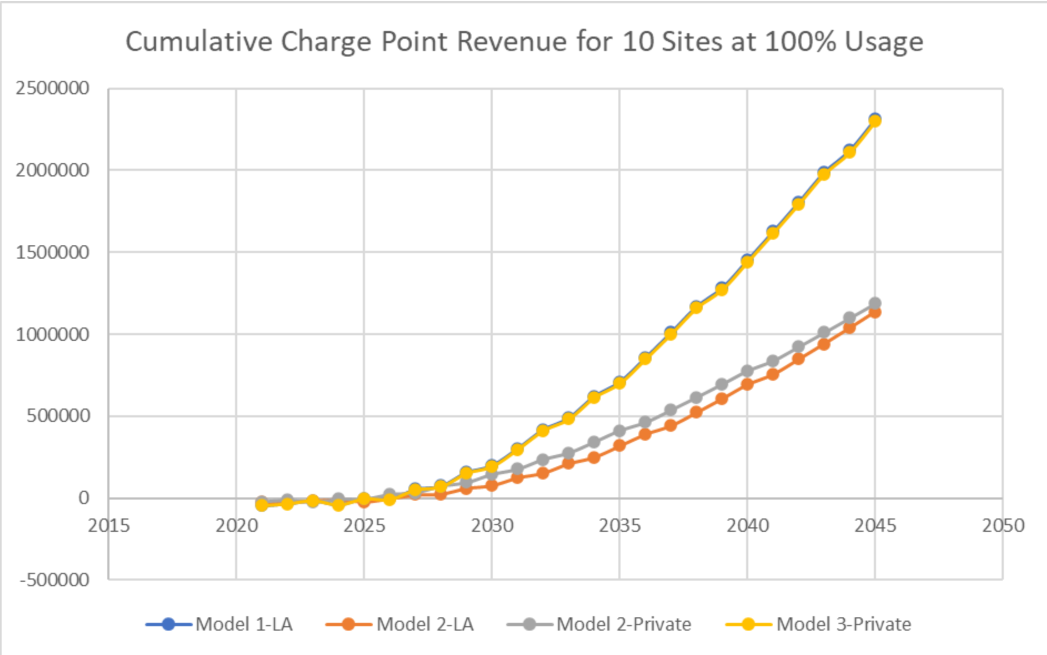
Model 2, a blended model between private and public installation, shows a much flatter revenue curve. Both private and public spend far less in the first five years, but also generate less income as the EV demand increases.

Cumulative revenue at standard EV charging demand (2021 – 2030)



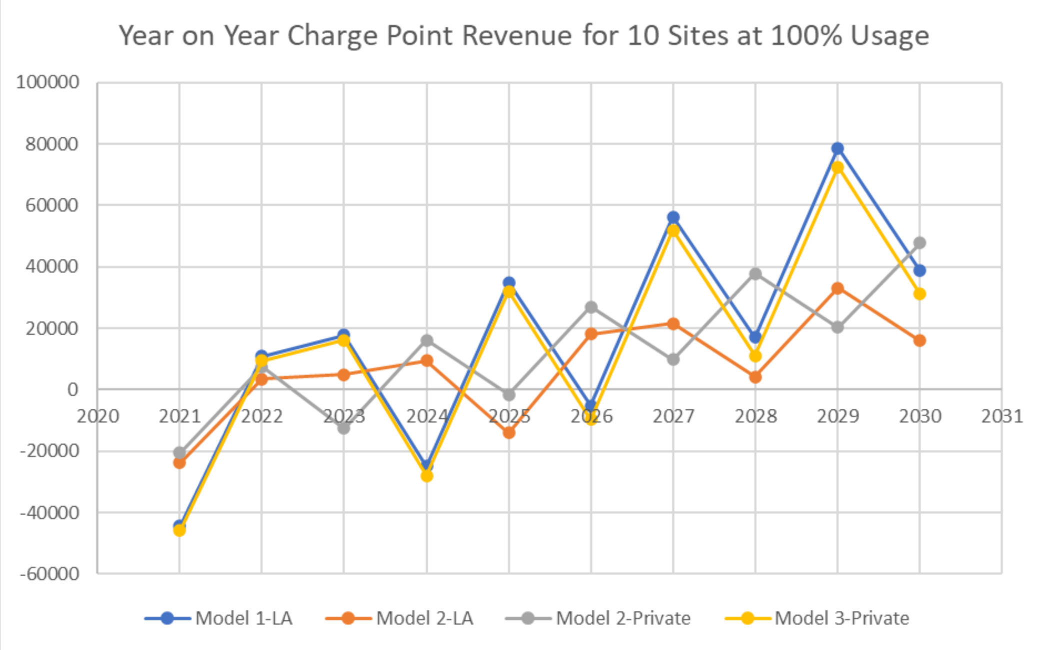
In the figure below, the future outlook has been expanded through to 2045. At this point, the cumulative net revenue generated across the 10 different sites has increased much more steeply, leading to each site generating a healthy profit. However, it is important to note that this is based on multiple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

Cumulative revenue between 2021 and 2045 (100% usage)



In contrast, the annual revenue between 2021 and 2031 in the figure below shows major fluctuations in revenue (and hence the reduction in total cumulative revenue). This is caused by the purchase and installation of charge points.

Annual Revenue



The figures in this chapter 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 chapter.

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.

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 charge points 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.

OZEV's On-Street Residential Charging Grant

This grant offers local authorities 75% funding towards the capital costs of procuring and installing charge points for residential areas, which must be available 24/7 and have dedicated parking bays covered by Traffic Regulation Orders (TROs). The Council (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.

OZEV's Workplace Grant

This grant is a voucher-based scheme designed to provide eligible applicants with support towards the upfront costs of the purchase and installation of EV charge points. The contribution is limited to 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 charge points. This could help to increase charging provision and EV uptake.