Evidence Base to Support EV Charge Point Strategy and Decision Making in Hull and East Riding of Yorkshire

Draft Report

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Contents

Executive Summary

Why has this report been produced?

Globally we are facing a climate emergency and the UK is committed to reducing Greenhouse Gas emissions to net zero by 2050 in response to recommendations from the Committee on Climate Change (CCC). COP26 hosted in Glasgow during November 2021 is bringing the challenge into sharp focus with the science underpinning projections of future impacts becoming ever starker and pressing. Hull City Council and East Riding of Yorkshire Council are committed to reducing carbon emissions and improving air quality in alignment with the Government's plans to phase-out the sale of new petrol and diesel cars / vans. Electric Vehicle (EV) charging infrastructure investment is a key part of Local Transport Plans for both councils, Hull City Council's 2030 Carbon Neutral Strategy and East Riding Council's Local Plan.

EVs use an electric drivetrain to provide power to the wheels rather than carbon-based fuels, so they generate zero exhaust emissions and less noise whilst driving. In spite of the increased electricity requirement, EVs have a lower whole-life carbon footprint than petrol/diesel vehicles and given the UK's progress towards greener electricity generation these benefits will increase further in the future.

This study is intended to provide an evidence base to identify strategic locations for EV charge point installation and supporting actions by considering how Hull City Council, East Riding of Yorkshire Council and the Hull and East Yorkshire LEP can support the transition to EVs.

In many ways the transition to EVs will be influenced by factors outside the control of Hull and East Riding partners, and in some cases the UK Government. Overcoming multifaceted challenges regarding the global supply of batteries and vehicles, and the interlinked issue of EVs being comparatively more expensive than Internal Combustion Engines, will require a cross sector effort by both public and private sector organisations. **Hull and East Riding can however take strategic actions to ensure the local environment is fit for the EV future alongside wider cross sector working**.

What are the objectives of this study?

Through engagement with industry stakeholders and Council officers, and review of relevant data, strategies and policies, the following objectives for the study have been set:

- To contribute towards improved air quality and reduced carbon emissions from transport.
- To support the uptake of electric vehicles by individuals and businesses within Hull and East Riding.
- To guide and promote the provision of infrastructure that is accessible, safe, easy to use and represents good value for money both on installation and throughout its life.
- To help ensure infrastructure is sympathetic to the streetscape (off-street and on-street) through sensitive placement and appearance.
- To develop an EV offer in the context of a wider transport hierarchy.

What is the current situation with EVs in the UK?

Buying and driving an EV can feel intimidating for many people and there is a general lack of awareness about the benefits and practicalities of driving an EV. There are however some real word barriers and constraints to transitioning the private car fleet to EVs that have been taken into account when developing this study as explained below:

- **Range of vehicles –** One common perceived barrier to driving an EV is the real-world range of vehicles before recharging is needed. However, new buyers of EV are experiencing much greater range than early adopters and typical ranges have gone from less than 100miles to 200+miles. 200+ miles electric range is more than adequate for the vast majority of UK drivers daily driving requirements which are below 20 miles per day, meaning they don't need to recharge every day. Even company car users whose annual mileage is quoted as 17,500 miles typically don't exceed 70 miles daily so electric range should be adequate for most daily mileage requirements.
- **Choice of vehicles is expanding –** in April 2021 there were 117 EV models available on the UK market with a good degree of choice across the various classes of cars and increasingly small vans.
- **Price of vehicles –** EV prices generally remain high, although a number of models have come to the market in 2021 priced under £40K with battery capacities up to 60 kW. The second-hand EV market is still small though and many independent second-hand dealerships leave this limited market to franchised dealers. Due to the falling

price of batteries and increasing maturity of vehicle production techniques it is estimated that price parity between EV and petrol/diesel vehicles will occur in the mid-2020s.

- **Charging of vehicles –** One of the most often cited barriers is the lack of charging infrastructure. Currently, there is a range of charging infrastructure types and connectors which differ across vehicle manufacturers and models, however all manufactures (with the exception of Tesla) are working towards the Open Smart Charging Protocol meaning charging types and connectors will become standardised in the coming years. The provision of charge points is also cited as a key barrier, and further information on this locally in Hull and East Riding is provided in following sections.
- **EV charging technology is evolving rapidly –** Prior to 2016 most technology charged at 3kW alternating current (called slow charging), which was adequate to fully recharge most batteries (typically up to 24kWh) overnight. With the development of vehicles came fast 7kW alternating current charging, and with the introduction of higher capacity batteries, direct current fast, rapid and ultra-rapid charging technology has since become available that (providing the vehicle is compatible) recharges vehicles much quicker.
- **Supply of vehicles –** Consumers currently report long waiting times for EV purchases, and there have been instances of models removed from sale for periods in the UK due to an excess of demand over supply. This constrained supply also affects the price of EVs and has consequential impacts on low utilisation of charge points, leading to challenges for sustaining and planning a cohesive public charging network. The lack of production capacity is a global issue, originating in vehicle production plants and battery production facilities across the world. Investment in manufacturing facilities for batteries and vehicles is gathering pace with significant recent announcement in the UK, however further expansion of capacity is needed in the coming years.

What is the current situation with EVs in Hull and East Riding?

The Figure EX1 shows the number of registered EVs in Hull and East Riding up to Quarter 1 of 2021 and a projected trend line to 2030 based on the historical growth curve between 2011 and 2020. Registered EVs are higher in East Riding than Hull reflecting the larger fleet of registered vehicles and potentially more conducive demographics in terms of income levels. The projected growth curves to 2030 for registered EVs in East Riding would result in approximately 5000 vehicles and for Hull 1500 vehicles. This is significantly below the proportionate figures locally that would be required if the UK is to hit the forecasts produced by the Committee on Climate Change (approximately 76,000 vehicles for Easting Riding and approximately 40,000 for Hull). It is therefore clear that a significant acceleration in the uptake of EVs is required through the remainder of the 2020s to meet ambitious targets form decarbonisation.

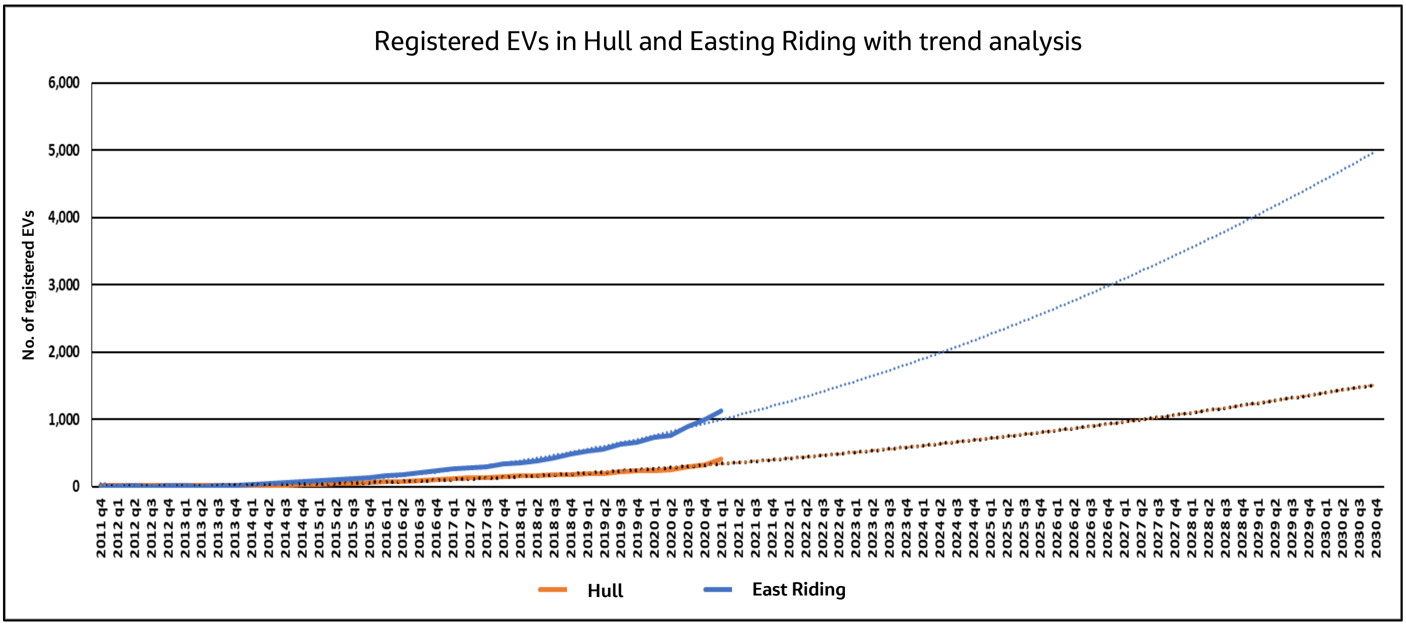


Figure EX1 – Registered EVs in Hull and East Riding with trend analysis

There is a reasonable spread of charging infrastructure already in both East Riding and Hull as seen in Figure EX2 below with 40 'rapid' chargers, 159 'fast' chargers and 8 'slow' chargers in operation at the time of writing. Clusters of charging points can be found in and around Hull City Centre, Bridlington, Beverley and Goole. Figure EX2 also shows there are a range of future sites that may come forward in the future independently (commercial sites) through investment by supermarkets and charge point operators.

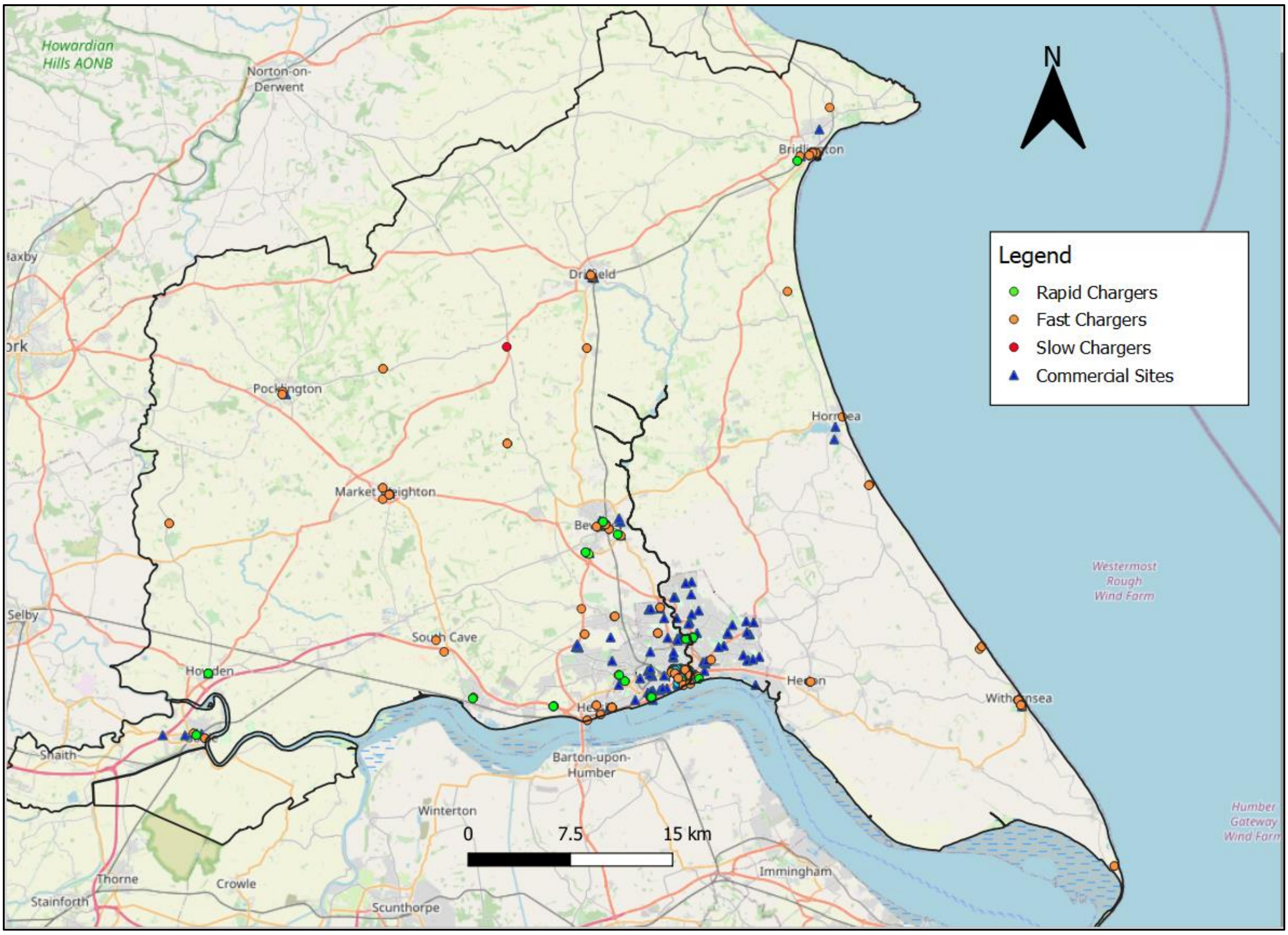


Figure EX2 – Current provision of charging points in Hull and East Riding and potential sites that may come forward through investment by supermarkets and charge point operators

How may the situation with EVs in Hull and East Riding change in the future?

The key driving force behind the siting of EV charge points is knowledge of where EVs will want to charge. To inform recommendations on providing a balanced and high-quality charging network a forecasting model has been used to consider the uptake of EVs in Hull and Riding over the coming years. Figure EX3 shows that by 2030 the model is forecasting approximately 37,000 EVs in East Riding and approximately 25,000 EVs in Hull with an increase in the growth rate of EV uptake in the second half of the 2020s. The model has also forecasted growth levels within individual areas of Hull and East Riding reflecting varying demographic factors, the availability of off-street parking, and travel patterns.

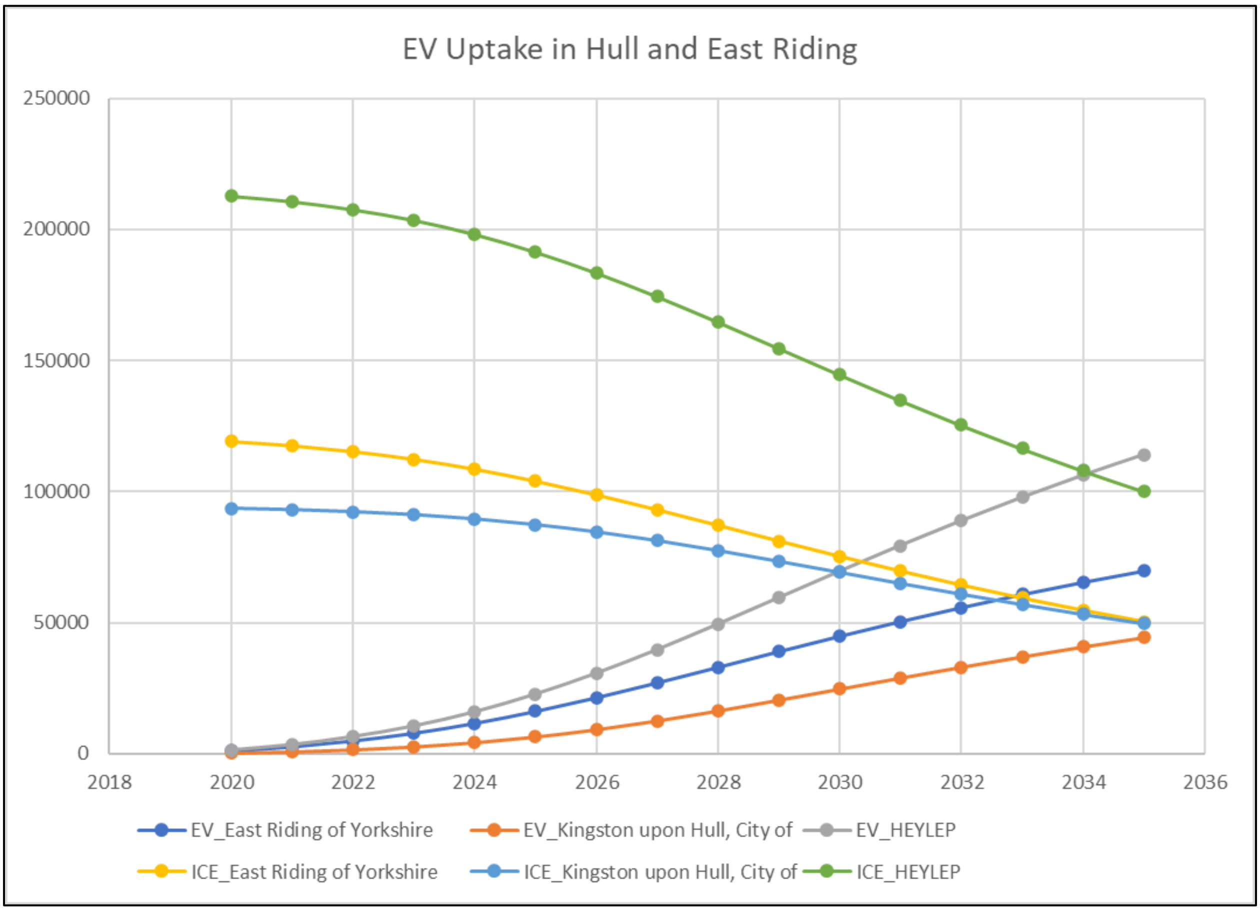


Figure EX3 – EV uptake in Hull and East Riding

What recommendations does the study make?

Drawing on a range of evidence and analysis conducted in this study a range of strategic and site-specific recommendations are made to create a conducive EV environment to support the uptake of EVs into the future. Table EX1 sets out the key strategic recommendations, the rationale underpinning this and recommended timescales.

Recommendation	Rationale	Timescale
1. Provide a balanced base charging network that gives residents, visitors and fleet operators the confidence to transition to EV. Using the site recommendations detailed in this study, provide a base level of infrastructure to encourage uptake. Using the model detailed in Appendix A approximately 1 - 4 rapid chargers are recommended in the Hull area and approximately 4 - 11 in the East Riding based on currently registered EVs. Under this model by 2025 approximately 26 - 75 rapid chargers would be required in the Hull area and approximately 55 - 149 in the East Riding.	Although there is no empirical link at present between the provision of charge points and uptake of EVs, public opinion surveys consistently show the *opportunity* to charge at publicly available points is highly valued. As the supply of vehicles increases it will be important to give users confidence that facilities exist to support their journeys. With increasing battery capacities, the ability to charge quickly on rapid chargers (or in time-ultra rapid) will be important. Additionally, residents who do not have access to off-street parking will require public facilities.	Provision of a base network in the short term to 2023. Monitoring of utilisation and engagement with commercial sector to determine further phases of infrastructure to be brought forward over the medium to long term.
2. Future proofing technology and the operating model deployed in future phases	Although the demand for ultra-rapid charging is currently limited by the low	Integrate requirements for keeping pace with

Recommendation	Rationale	Timescale
of infrastructure roll out and procurement of commercial partners / contracts.	numbers of models with this capability, and the technological solutions for vehicle to grid and inductive charging are relatively immature these elements are likely to play a key role in the future.	innovations into contracts in the short term. Delivery of ultra-rapid chargepoints in the medium to long term (2025+).
3. Monitoring technological development and maturity of solutions to address use cases that are currently problematic such as HGVs.	These use cases although problematic at present are still key to meeting policy aims.	Monitoring over short to long term.
4. Conduct procurement of strategic commercial partner through developing a contract to leverage land assets to secure investment.	A coordinated and consolidated procurement exercise maximising the scale of the opportunity is likely to realise best value and leverage investment.	Short term to 2023.
5. In tandem with developing a procurement exercise, seeking external funding from government from various current and anticipated funding sources.	Securing external funds from government would improve the business case for investment by reducing the funding required from Council budgets.	Short term to 2023.
6. Pursue the integration of EVs within the wider hierarchy of transport by seeking to reduce car use through e-car clubs, ultra low emission buses, shared and micromobilty, and potentially Mobility as a Service in the longer term.	Electrification of personal cars will play a key role in decarbonisation however this on its own will not achieve CO2 reduction targets or tackle other issues such as congestion on roads, improving health / wellbeing, and placemaking within communities.	Ongoing through short to long term.
7. Further consideration should be given to engaging training and skills providers through a strategic and regional approach coordinated through the HEY LEP. This should include mapping current training and skills providers across the range of skills required in the EV sector and understanding key content and geographical gaps.	This would assist in both meeting market demands and take advantage of opportunities to foster skilled employment opportunities in this sector.	Short term to 2023.
8. Continuous engagement and joint working with Northern Power Grid to address key points of weakness in the power network including the sites noted in the site assessment chapter.	Provision of cost-effective power connections will be fundamental to the delivery of charging infrastructure.	Ongoing through short to long term.
10. Utilise the Hull Smart City Platform to integrate utilisation data of charge points to provide a feedback loop to inform future phases of deployment. Additionally, the data aspect can also be tied into various regulatory frameworks necessary for the installation and utilisation of charge point infrastructure. This is an overlooked blocker on the path to a truly integrated EV offering with aspects such as Traffic Regulation Orders leading to delays in the installation of EV Infrastructure.	Ensuring the data from charge points is integrated into the Hull Smart City Platform will enable the tracking of usage levels, allowing for dynamic monitoring and reaction, thereby bringing forward further phases of charge points in a timely way.	Short term to 2023.

Table EX1 – Key strategic recommendations, the rationale underpinning this and recommended timescales

1. Introduction

This report is intended to provide an evidence base for the local authority areas of Hull and East Riding to identify strategic locations for Electric Vehicle charge point installation by considering:

- How Hull City Council, East Riding of Yorkshire Council and the Hull and East Yorkshire LEP can support the transition to Electric Vehicles (EVs).
- Background information and the existing electric mobility environment.
- Strategic locations for installing EV charging infrastructure and how suitability for this installation may vary across different location types.
- The different delivery models that are available for the installation of charge points.

In addition to these high-level Purposes and Aims set out within the initial specification for this work, we have also investigated aspects such as developments of EV technology, the forecasting of EV uptake, training and reskilling requirements and analysed mobile phone data for segments of the study area.

To achieve this, the report has been developed in a systematic manner, with a series of distinct, but related, stages. The initial stage was a high-level policy review across the international, national and regional level to ensure that the strategy could be placed in this wider policy context. A similar approach was undertaken for the technological review and the potential for skills and training. The next stage was a review of the Hull and East Riding baseline, both in terms of data and charging behaviour / attitudes. The results from this were fed into the geospatial modelling which was used to underpin the process of site identification and assessment. Detailed site assessments were finalised through a more in-depth look at each site, including connection costs to the power network and qualitative assessments.

Parallel to this, the results from the EV baseline analysis and geospatial modelling were used to inform potential options for the deployment of commercial models to install, operate and maintain charge points. The final stage of the study sets out an action plan with strategic and site-specific recommendations for Hull and East Riding.

This study has been commissioned by the North East and Yorkshire Energy Hub that is a collaboration of six Local Enterprise Partnerships accelerating the transition to 'Net Zero' and a future of clean growth through local energy delivery. The Energy Hub is responsible for:

- Delivering energy strategy across the region.
- Supporting and accelerating the development of local and regional, low and zero carbon energy projects across 31 local authority boundaries.
- Delivering significant investment programmes such as public sector decarbonisation.
- Bringing forward business cases that can attract investment in energy infrastructure.
- Sharing best practise across a national programme; and developing a pipeline of innovative projects to support the region's clean growth agenda.

Hull City Council and East Riding Council are committed to reducing carbon emissions and improving air quality in alignment with the Government's plans to phase-out the sale of new petrol and diesel cars and vans. EV charging infrastructure investment is being held core to the transport plans of both councils, with Hull City Council's 2030 Carbon Neutral Strategy (2020) and East Riding Council's local plan. This report has been developed to directly support the aim of reducing carbon emissions by accelerating the transition to electric, and supports the ambitions outlined within the Humber Clean Growth Local White Paper (2019), which sets out the region's vision and ambitions to achieve net zero carbon emissions by 2040.

1.1 Document Structure

- **Chapter 2: Policy and Strategy Review –** A review of current national, regional, sub-regional and local policy and legislation in relation to electric vehicles and charging infrastructure.
- **Chapter 3: Technology Review –** A review of electric vehicle and charging technologies.
- **Chapter 4: Charging Behaviours and Attitudes –** Details of the research conducted into charging behaviours and attitudes, outlining the results of the North East Drivers Survey.
- **Chapter 5: Skills and Training Needs for Electro-Mobility –** Outlines the focus areas for training, the summation of levels, current catalogues of training and the further and higher education considerations.
- **Chapter 6: Hull and East Riding EV Baseline –** A breakdown of the existing charging infrastructure in the region, conditions that will influence demand, EV ownership, commercial conflicts and opportunities, fleet hotspots and supplementary stakeholder feedback.
- **Chapter 7: Geospatial Modelling** – A review of data, spatial and temporal model results, and commuting and travel pattern analysis.
- **Chapter 8: Strategic Priorities –** Outlines the measures to be implemented as part of this study, including consideration of sequencing and future uncertainties.
- **Chapter 9: Commercial and Operating Models –** An overview of the proposed commercial models, the integration of such with modelling results, and a review of viable funding models.
- **Chapter 10: Site Assessment –** Breaks down the criteria used for site assessment, the site scoring and the infrastructure recommendations.
- **Chapter 11: Action Plan –** Outlines a high-level timeline of recommended measures and key actions to be taken in the short, medium and long-term, and key next steps.

2. Policy and Strategy Review

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

2.1 Recent National and International EV Developments

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

The prevailing strategy of the UK government up to November 2020 regarding emissions was to commit to reducing greenhouse gas emissions by at least 80% of 1990 levels by 2050 through the Climate Change Act 2008[1]. It 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 at least these goals following its departure from the EU. Grams of CO_2 per km driven is the primary measure used by the EU to enforce improvements in new car and van fleet emissions. EU regulations enable fines on vehicle manufacturers based on their average new car sales emissions. The current maximum threshold for new car sales is 135g CO_2/km driven, reducing to 95 g CO_2/km from 2021. The EU recently announced even tighter targets for new cars and vans to be achieved by 2030 through its Clean Mobility package.

The UK Government's ultimate vision is that every new car and van sold in the UK will be 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[4]. The UK's current objectives are set out in "Decarbonising Transport – A Better Greener Britain"[4].

To this end, the UK's Committee on Climate Change (CCC) targeted the Ultra-Low Emission Vehicle (ULEV) market to reach 9% share of new vehicle sales by 2020 and 60% by 2030. The UK did indeed exceed its 2020 target, with Battery Electric Vehicles (BEVs) and Plug-In Hybrid Electric Vehicles (PHEVs) totalling 10.7% market share in December 2020.

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

Following the Council meeting, a joint statement was released stating that road emissions currently account for over 10% of global greenhouse gas emissions, and emissions are continuing to rise. Therefore, the rapid transition to zero emissions vehicles is vital to meeting the goals of the climate Paris Agreement. The globe is currently not on track and

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

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

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

[4] UK Government https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1002285/decarbonising-transport-a-better-greener-britain.pdf

consequently the pace of the transition needs to dramatically increase. A fleet of fully zero emission road vehicles will remove the source of 91% of today's domestic transport GHG emissions[4]. 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 current consultation underway on "Future of transport regulatory review: zero emission vehicles"[2] This consultation aims to address transport regulation, particularly with regard to those areas that are potentially outdated and not designed with new technologies or business models in mind.

2.2 Current State of play with Charge Points and EVs

To understand how rapidly the vehicle market is changing, it is instructive to look at the numbers for EVs.

In Figure 2 - 1 we can see that the total number of EVs registered in the UK has increased to approximately 0.5 million in 2021. Perhaps surprisingly, this uptake in electric vehicles continued throughout the pandemic with sales of EVs (both BEV and PHEV) in the UK continuing to increase. This was coupled with a larger increase in the percentage of EV sales up to 15%+ as a proportion of total vehicle sales. However, this is likely due to the suppression of vehicle sales due to the pandemic, and as such should be not yet be regarded as a wider trend.

[2] https://www.gov.uk/government/consultations/future-of-transport-regulatory-review-zero-emission-vehicles/future-of-transport-regulatory-review-zero-emission-vehicles

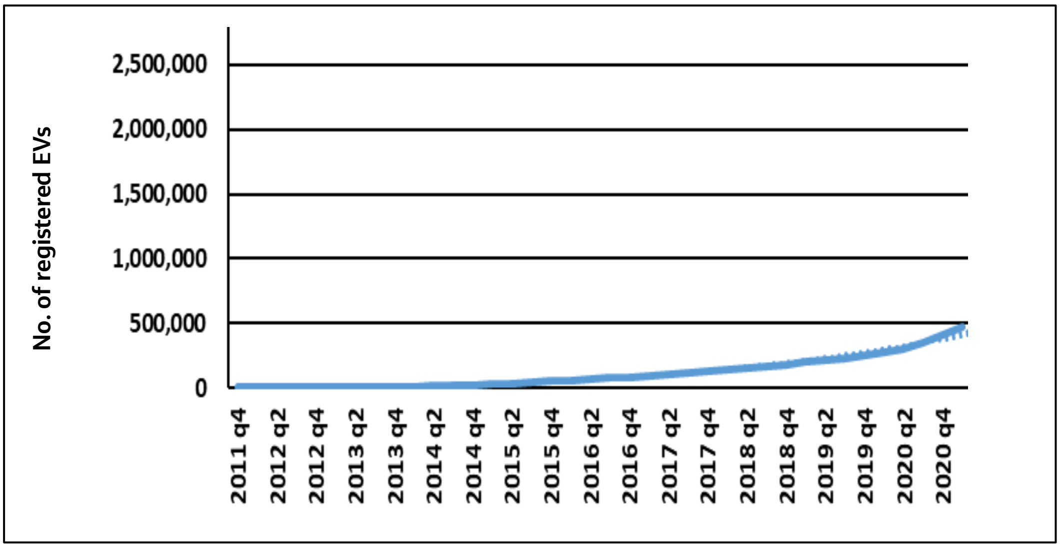


Figure 2 - 1: EV registrations in the UK

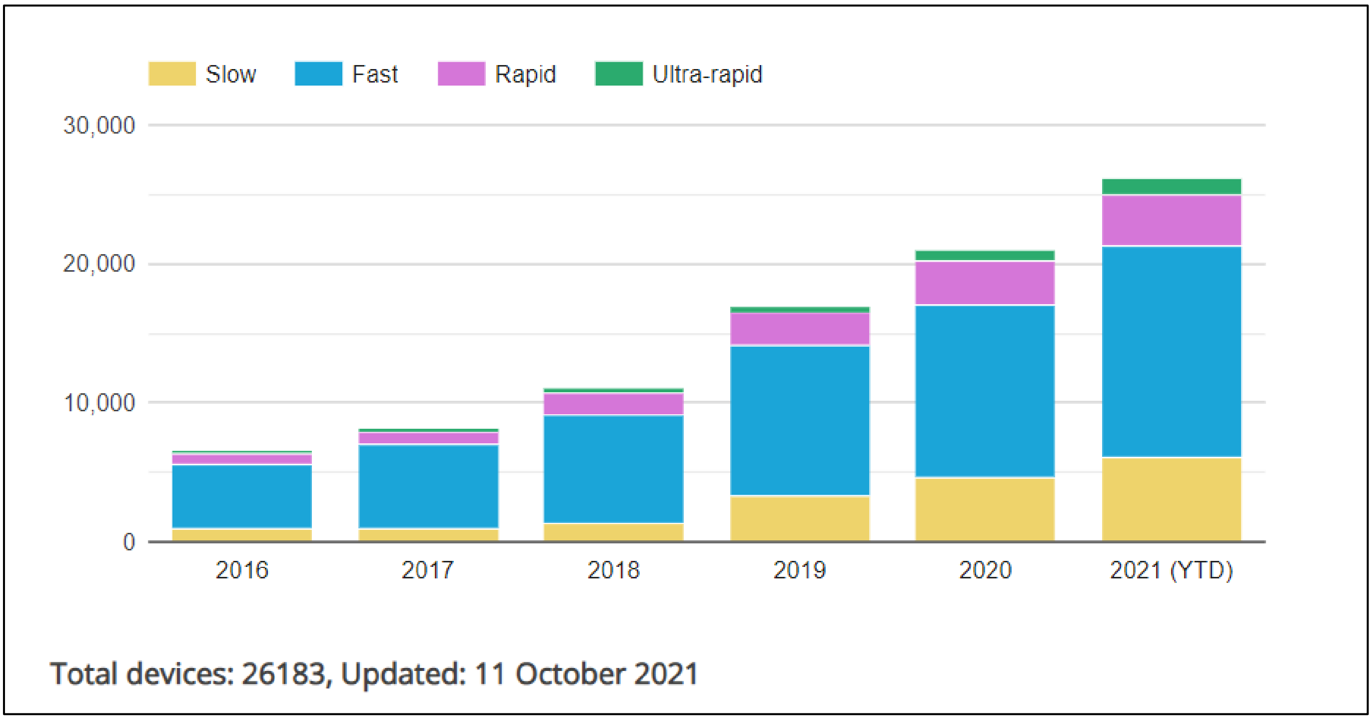


Figure 2 - 2: Number of Public Charge Points by Sped (2016 – to date) (ZapMap)

The data in Figure 2 - 2 shows that the absolute number of public charge points is increasing year on year and keeping pace with registrations. There is however an uneven spread of charge points with investment skewed towards more commercially attractive locations, and utilisation rates of publicly available charge points is still relatively low in the UK.

2.3 Key National Strategy and Policy

The following key UK strategies and policies help to set the foundation for EV growth and promotion in Hull and East Riding of Yorkshire:

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

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

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

  - 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.

- *DfT Decarbonising Transport: A Better, Greener Britain (2021)* – Presents the path to net zero transport in the UK by 2050, the wider benefits it can deliver, and the principles that underpin the approach to delivering it. In addition, this strategy outlines the commitments and actions needed to decarbonise transport.

  - All non-zero emission HGVs (>above 26t) are expected to be phased out by 2040, with lighter HGVs (from 3.5t up to and including 26t) being phased out by 2035.

  - The sale of new petrol and diesel cars and vans (under 3.5t) will be phased out by 2030, and all new cars and vans will be fully zero emission at the tailpipe from 2035.

  - Consultations are being undertaken to determine a phase out date for the sale of new non-zero emission buses, as well as plans to determine a phase out date for the sale of new-zero emission coaches.

- *DfT Bus Back Better: National Bus Strategy for England (March 2021)*- Details how the government will spend the £3bn in long-term funding (announced in February 2020) to level up buses across England, outside of London.

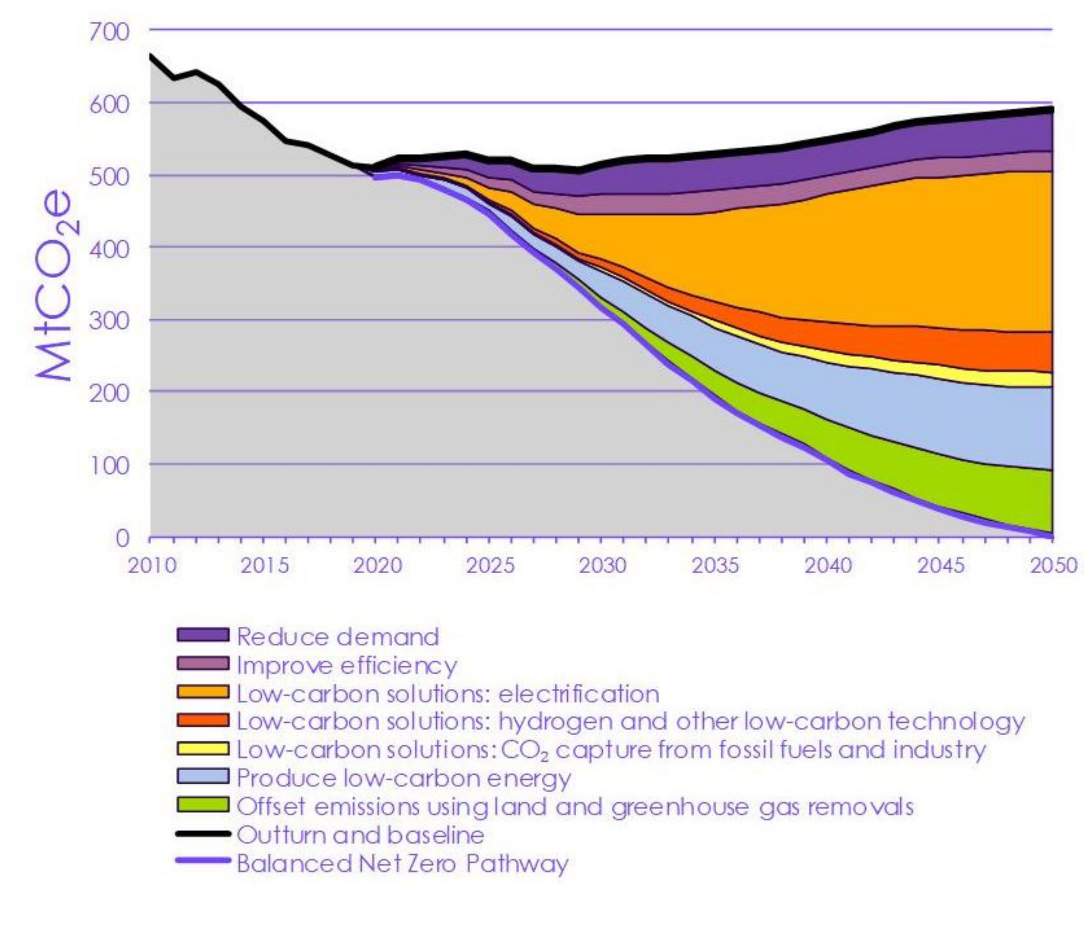
  - To unlock the substantial untapped potential in the existing bus service by making it easier to understand and use; to improve it, making it more reliable, more frequent and cheaper and to make greater use of new forms of provision such as demand responsive transports, to ensure that buses are an attractive alternative to the car.

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

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

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

- Surface transport is currently the UK's highest emitting sector. In the CCC's Sixth Carbon Budget Balanced Pathway, options to reduce emissions, including take-up of zero-emission technologies and reduction in travel demand, combine to reduce surface transport emissions by around 70% to 32 Mt CO_2e by 2035 and to approximately 1 Mt CO_2e by 2050 (See illustration in Figure 2 - 3 below).



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

Figure 2 - 3: Sources of abatement in the Balanced Net Zero Pathway for the surface Transport sector (UK CC)

- *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. However, on 3rd February 2020 the government brought the ban on new ICE car sales forward to 2035 which also prohibits the sale of new hybrid vehicles. This target was further strengthened in November 2020 to end new ICE car sales in 2030 (PHEVs in 2035).

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

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

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

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

- *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.

2.4 Regional

The following regional strategies and policies contribute towards the foundation for EV growth and promotion in Hull and East Riding of Yorkshire:

- *TfN Draft Decarbonisation strategy (2021)* – Sets out how TfN and partners across the North are committing to a regional near-zero carbon surface transport network by 2045. Supports TfN's key aims for improving localised air quality.

    - 55% reduction in emissions from 2018 to 2030, achieved mostly through mode-shift and demand reduction.
    - 95% reduction in emissions from 2018 to 2040, reflecting longer-term decarbonisation measures, such as a high proportion of zero-emissions vehicles in the vehicle fleet.

- *TfN Strategic Transport Plan (2019)* – Outlines the case for transformational transport investment across all of the North, to rebalance the UK economy and drive major improvements in strategic connectivity through the North.

    - To support move to electric vehicles, TfN calls for a rapid increase in the number of public charging points across all parts of the North, as part of improvements planned to the North's road network and through close engagement and collaboration with energy providers.
    - Current and future electric vehicle drivers must be able to easily locate and access electric vehicle charging infrastructure that is affordable, efficient, and reliable.

- *Northern PowerGrid Innovation Strategy (2020)*: Sets out the broader direction of the refreshed strategy for 2021-23. Updates the innovation strategy that was laid out in 2014 before the start of RIIO-FD1 in 2015. Innovation priorities are decarbonisation, reliability, and value for money within a balanced portfolio.

    - Decarbonize own operations by simple deployment of new technologies such as electric vehicles in our fleet.
    - Install electric vehicle and vehicle-to-grid chargers at a number of its own sites.

- *Northern PowerGrid Digitalisation Strategy and Action Plan (2021):* Sets out to embrace powering the region with sustainable, long-term investments that unleash the potential of innovation, digitalisation, people and collaboration, as well as to develop the digital capabilities required to meet the challenge of net zero and develop the functions of Distribution System Operations.

2.5 HEY Sub-Region

In addition to the National and Regional policies/strategies it will also be important to consider the key polices and strategies within the HEY sub-region. The UK is an area with wide disparities within relatively short distances, and the HEY region is no different. Capturing this will be important.

- *Humber Clean Growth Local White Paper (2019)* – Sets out the region's vision and ambitions to achieve net zero carbon emissions by 2040.

    - Decarbonising Humber's transport will require a range of initiatives including increasing the uptake of electric vehicles which currently lags behind the UK average, supported by an expansion of charging points; and switching rail, buses, and goods vehicles away from carbon-heavy diesel propulsion.

- *Humber Transport Plan (2018)* – Forms part of the strategic evidence base for the Humber and sets out the priorities for the regions transport system, to be implemented over the next 10 to 20 years.

- *Humber Local Energy Strategy (2020):* Identifies thirteen targeted project interventions to achieve the twin goals of decarbonisation and clean growth, as part of a high-level action plan for the Humber. Capitalises on local strengths to build out the UK's first regional Hydrogen Economy in tandem with Carbon Capture Use and Storage.
    - The Humber aims to align itself to the national trajectory for decarbonisation – it will need to reduce emissions to 9.117 $MtCO_2$ by 2032 through utilising carbon capture technology to decarbonise regional industry and facilitate the foundations of a Hydrogen Economy in the Humber by 2032.
    - Build-out large scale Ultra-Low Emission Vehicle charging infrastructure – A target of 10,000 on-street charging points will be necessary to enable members of the public to charge their vehicles conveniently.

- *Humber Estuary Plan (2021):* Sets out a framework for the next phase of collaboration to grow the Humber Estuary economy. The framework will build on the progress the region has made over the last ten years and will be based on the following shared strategic opportunities; Accelerating clean growth, developing the Humber's ports and manufacturing clusters, Managing the Humber Estuary asset, and Attracting and delivering new investment.
    - To be a net zero carbon industrial cluster by 2040, and significantly lower carbon by 2030, whilst protecting strategically important industries and maximising benefits for local communities and businesses.
    - Humber is well placed to scale up supply of alternative fuels, such as hydrogen and ammonia, to the volumes required to support refuelling of ships, as well as trains and road vehicles.

- *Hull & East Yorkshire Local Skills Report (2021):* Seeks to set out the current skills priorities for the local economy and highlights the importance of partnership working across the new HEY geography and with neighbouring LEP areas reflecting the shared travel-to-work/travel-to-learn patterns that exist.

2.6 Local

The following existing local strategies and policies help set the foundation for EV growth and promotion in Hull and East Riding of Yorkshire:

- *Hull and East Riding Net Zero Roadmap (2021)* **–** The Net Zero Roadmaps have been developed following an analysis of emissions reduction potential across Hull and East Riding of Yorkshire's key sectors, which assessed emission reduction pathways under three future energy scenarios. The roadmap provides a detailed view of the measures that will need to be taken if Hull and East Riding of Yorkshire are to achieve the emissions reductions outlined in the most ambitious scenario assessed.
    - The 'Leading the Way' scenario for Hull aims for carbon neutrality by 2030 with 55% of private cars electrified and by 2025 27% of private cars electrified.
    - The 'Leading the Way' scenario for East Riding aims for 40% of cars electrified by 2030 and 20% of private cars electrified by 2025.

- *Hull 2030 Carbon Neutral Strategy (2020)* – Based around eight interlinking themes setting out 34 challenges which provide the points of focus for Hull activity over the next ten years to become carbon neutral by 2030. The mobility theme focusses on transport including:
    - Deliver public electric vehicle charging infrastructure within car parks and for properties without off street parking.
    - Decarbonise the Council's fleet vehicles.
    - Opportunities within Hull to install solar canopies on surface car parks to generate power for electric vehicle charging.

- *East Riding of Yorkshire Environmental Policy (2020)* – Sets out how East Riding is committed to protecting the environment and preventing pollution across its services and operations, such as reducing the environmental impact of Council vehicles and business travel.

- *Kingston upon Hull City Council Air Quality Strategy (2017)* – Sets out air quality aims and policy options to further improve air quality in Hull from today into the long term. Highlights the need to increase electric vehicle charge points on streets and in car parks.

- *Hull Local Transport Plan (2011 – 2026)* – Outlines a vision for transport in the city together with the transport policies and strategies needed to deliver the vision. Highlights the growing need to provide electric vehicle charging infrastructure.

- *East Riding of Yorkshire Local Transport Plan (2021 – 2039*) – Sets out a comprehensive framework within which the council and its partners can plan transport improvements in the East Riding over the next 18 years. The Plan outlines commitments to supporting low carbon travel, such as public transport and electric vehicles.

- *Hull Local Plan (2016 – 2032)* – Guides new development in the city for the next 15 years, up to 2032.
  - New residential developments of 50 or more new homes are expected to provide electric chargepoints. Developments of below 50 new homes, electric chargepoints are encouraged.
  - New non-residential/commercial developments under 5,000 square metres are encouraged to have provision for electrical charging points. Non-residential developments of over 5,000 square metres are expected to provide electric chargepoints.

- *East Riding Local Plan (2012 – 2029)* – Includes policy around enhancing sustainable transport including electric vehicles.

2.7 Policy Gap

Although many aspects of a supporting EV policy and strategy framework are covered through the national, regional or local policies, there are still areas where an increased focus would be beneficial.

The first aspect, and one which the HEY LEP region is more than equipped to tackle, is the potential usage of data and data policy to drive the future EV environment. The Hull Smart City project is already showing the benefits of a coherent data platform, but there is the risk of it turning into a demonstration of what is possible and interesting with the data, rather than being utilised to drive specific goals. **A key future action is recommended to be incorporation of utilisation data of EV charge points to dynamically monitor consumer behaviour and consider the implications for further provision of infrastructure by type and locations**. The data aspect can also be tied into the, perhaps, more mundane aspects of the various regulatory frameworks necessary for the installation and utilisation of charge point infrastructure. This is an overlooked blocker on the path to a truly integrated EV offering with aspects such as Traffic Regulation Orders leading to delays in the installation of EV Infrastructure.

The final gap is perhaps a more overarching consideration. For any EV strategy to be successful, it needs to have a clear understanding of the goals which it is trying to achieve, if those goals are actually possible within the scope of the strategy, and if there is a clear route to doing so. For example, the goal of accelerating EV uptake is a common one within EV Strategies, but it is something which is likely not within the immediate capability of any Local Authority or regional body. In the short-term EV uptake will be driven by manufacturing constraints. Hence, a more successful strategy may ask "How do we ensure that the environment is fit for the EV future?" rather than "How do we bring about the EV future?" As one is possible, and the other is not.

At the national level OZEV are consulting during October / November 2021 on the prospect of mandating for Local Authorities, Charge Point Operators, or landowners to be responsible for installing appropriate charging infrastructure. This legislation would give government the power to introduce requirements in four areas:

- A statutory obligation to plan for and provide charging infrastructure.
- Requirements to install chargepoints in non-residential car parks.
- New powers to support the delivery of the Rapid Charging Fund.
- Requirements to improve the experience for electric vehicle consumers.

The upcoming £950m Rapid Charging Fund is intended to future-proof electrical capacity at motorway and major A road service areas in England.

2.8 Summary

	Policy	Vehicle Sales	Charge Point Implementation	Net-Zero / Decarbonisation	Emissions Control	Development Standards	Green Growth	Mode Integration	Future Mobility
National	*End of sales of new petrol and diesel cars by 2030 (2020)*	✓							
	Government vision for the rapid charge point network in England, published (2020)	✓	✓						
	DfT Decarbonising Transport : A Better, Greener Britain (2021)	✓	✓	✓	✓		✓	✓	✓
	DfT Bus Back Better: National Bus Strategy for England (March 2021)							✓	
	Highways England Road Investment Strategy 2&3 (2020)			✓	✓				
	Climate Change Commission's (CCC's) Sixth Carbon Budget (2020)	✓			✓				
	National Planning Policy Framework (2019)		✓			✓			
	Planning Practice Guidelines Paragraph 008 (2019)		✓						
	DfT's Future Mobility: Urban Strategy (2019)	✓	✓	✓	✓	✓		✓	✓
	Energy Saving Trust's 'Positioning charge points and adapting parking…… ' (2019)		✓			✓		✓	
	Committee on Climate Change (2019)			✓					
	DEFRA Clean Air Strategy (2019)				✓				
	Future Mobility Zones (2019)							✓	✓
	Automated and Electric Vehicles Act (2018)	✓	✓						✓
	OLEV Road to Zero Strategy (2018)	✓	✓	✓					
	Air Quality Plan for Nitrogen Dioxide (NO_2) in the UK (2017)				✓	✓			
	Clean Growth Strategy (2017)				✓	✓			
	UK Industrial Strategy: Building a Britain fit for the future (2017)					✓	✓		
	Climate Change Act (2008)								
	The trajectory of policy/strategy at a national level is providing a strong and supportive policy framework that is increasingly mandating the phase out of ICEs. Moving forward, responsibility is being put on charge point operators and local authority operators to provide a balanced network that is intuitive and easy to use. The electrification of transport should also be seen as part of a package of policies to support the decarbonisation of transport including demand management through sustainable and active travel and the potential adoption of alternative fuels including hydrogen, more likely focussed on heavier utility vehicles.								
Regional / Sub Regional	*TfN Draft Decarbonisation strategy (2021)*			✓	✓				
	TfN Strategic Transport Plan (2019)	✓	✓	✓					
	Northern Power Grid Innovation Strategy (2020)		✓	✓					✓
	Northern Power Grid Digitalisation Strategy and Action Plan (2021)		✓	✓					✓
	Humber Clean Growth Local White Paper (2019)		✓	✓				✓	✓
	Humber Transport Plan (2018)	✓	✓		✓			✓	✓
	Humber Local Energy Strategy (2020)		✓	✓	✓				
	Humber Estuary Plan (2021)			✓	✓		✓		✓
	Hull & East Yorkshire Local Skills Report (2021)						✓		✓
	At a regional and sub-regional level national policy is being translated to create a solid foundation for the transition to EVs. Key elements include TfN's support for electrification of the vehicle fleet, Northern Power Grid's plans for strengthening the power network, and Hull / East Yorkshire sub-region's commitments to bring forward a zero carbon economy and electrification.								
Local	*Hull and East Riding Net Zero Roadmap (2021)*			✓			✓	✓	
	Hull 2030 Carbon Neutral Strategy (2020)	✓	✓	✓	✓				✓
	East Riding of Yorkshire Environmental Policy (2020)				✓				
	Kingston upon Hull City Council Air Quality Strategy (2017)		✓	✓	✓				✓
	Hull Local Transport Plan (2011 – 2026)		✓	✓					✓
	East Riding of Yorkshire Local Transport Plan (2021 – 2039)				✓			✓	
	Hull Local Plan (2016 - 2032)		✓			✓	✓		
	East Riding Local Plan (2012 – 2029)	✓	✓						
	Locally, both Hull and East Riding's transport strategy framework is strongly supportive of transitioning to EVs, and in the case of Hull there is additional emphasis placed on EVs sitting within a wider integrated and sustainable transport offer including significant modal shift to public transport and active travel. The Hull and East Riding Net Zero Roadmap sets out a clear and ambitious vision for decarbonisation including the transition to EVs.								

Table 2- 1: Policy / Strategy Summary Matrix

What is the key relevance to HEY?

On national, regional and local levels, policy is becoming increasingly supportive of the implementation of EV charging infrastructure, pushing for an extensive charging network and a zero-carbon future.

What are the key lessons for HEY?

There should be a focus on ensuring that the environment is fit for the EV future; preparation should start now.

What are the implications for HEY strategy?

In order for the HEY region to hit the targets set on all policy levels and to ensure it is ready for the ending of ICE sales in 2030, this study must incorporate the key dates in this policy review and ensure they are considered in the action plan.

How should this inform HEY decision making?

Decision making must take into consideration the environmental objectives, planning and development standards, and transport goals to ensure the target dates laid out in this policy review are met.

3. Technology Review

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

Throughout this chapter, and indeed the wider study, 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 were stopping and starting, idling, and over-revving of ICE vehicles in queues produces high concentrations of emissions.

3.1 Electric Vehicle Trends

The UK, and the planet as whole, is facing a climate emergency and consequently in June 2019 the UK committed to net zero carbon emissions by 2050 in response to recommendations from the Committee on Climate Change (CCC). Currently there is a major industry / purchasing shift from diesel to petrol engines as diesel is now categorised as 'dirty'. Both have environmental impacts and deleting both options (in combination with uptake of other sustainable options such as active travel and public transport) will improve both air quality and carbon emissions.

Diesel engines emit less 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 it also performs better than petrol engines. As a result, less fuel is used to travel the same distance, thus reducing CO_2 emissions. Most estimations indicate that diesel engines emit about 10% less than the petrol engines of the same category. However, petrol results in lower emissions than diesel in terms of many other sources of pollution, such as fine particles (like PM10 and PM2.5), NO_2 and NO_x although this gap has narrowed as diesel engines and emission regulations have improved.

Whilst Nitrous Oxide and Methane are contributors to greenhouse gasses, it is CO_2 which is the main component of greenhouse gas emissions which trap heat in the atmosphere causing global climate change. The transport sector currently generates the highest proportion of CO_2 emissions in the UK, due to the increasing miles driven by ICE vehicles that burn carbon-based fuels and consequently emit CO_2 from their exhausts. The transport sector has made the lowest contribution to UK greenhouse gas emission reduction, only achieving a 4.6% from 1990 to 2019, making it a prime target for future regulation. The UK Government has just published a Green Paper on a New Road Vehicle CO2 Emissions Regulatory Framework for the United Kingdom.

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

EVs are currently the only mature technology offering a workable alternative to ICE vehicles, through 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 has to plug in.
- 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.

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, longer term financial savings or company policy. Early research shows that EV consumers preferred to charge at home overnight or at work during the day, which suggests a low current demand for public recharging services. Most early EV adopters have off-street parking enabling them to charge at home overnight, although this capability is greatly curtailed in some residential areas. 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 commentators say there has to be more chargers, they cannot specify what 'more' actually consists of. The rapidly emerging high-power charging hubs provides an offer to drivers, which was not available before, and early feedback 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 much research was based. Ranges have gone from less than 100 miles to 200+ miles. A new situation has arisen where large-scale private finance is going into rapid charge hubs to maintain the current behaviour of going to a fixed point to 'fill up'.

Year	Total BEV Sales	Total PHEV Sales	Total BEV + PHEV Sales	Total Car Sales	% BEV	% PHEV	%Total	BEV Growth	PHEV Growth
2013	2,512	1,072	3,584	2,264,737	0.1%	0.0%	0.2%		
2014	6,697	7,821	14,518	2,476,435	0.3%	0.3%	0.6%	4,185	6,749
2015	9,934	18,254	28,188	2,633,503	0.4%	0.7%	1.1%	3,237	10,433
2016	10,264	26,643	36,907	2,692,786	0.4%	1.0%	1.4%	330	8,389
2017	13,597	33,666	47,263	2,540,617	0.5%	1.3%	1.9%	3,333	7,023
2018	15,474	44,437	59,911	2,367,147	0.7%	1.9%	2.5%	1,877	10,771
2019	37,850	34,734	72,584	2,311,140	1.6%	1.5%	3.1%	22,376	-9,703
2020	108,205	66,877	175,082	1,519,016	7.1%	4.4%	11.5%	79,355	32,143
Total	**204,533**	**233,504**	**438,037**	**1,880,5381**					

Table 3- 1: SMMT figures

Table 3-1 shows the growth of BEV and PHEV since 2013. With such a low national population of BEVs (204,533 end of 2020 (SMMT)), which is 0.58% of the UK car population, the normalising of driver behaviour is some way off. There was a clear increase in 2020 of BEV but this was only 70,355 out of 1.5 million total vehicle sales.

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

3.2 Electric Vehicle Technologies

EVs use onboard electricity to provide power to the wheels and by doing so are much more efficient. In the UK, despite the extra power requirement from electricity generation, 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.

3.2.1 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 are many acronyms used to refer to vehicles that are capable of emitting lower emissions than pure ICE vehicles.

A brief explanation of each of the main 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. Full EVs have no combustion engine, and therefore zero tailpipe emissions, producing 0 grams CO_2/km when driven – these pure EVs are sometimes referred to as **Battery Electric Vehicles (BEVs)**.

- **Hybrid Electric Vehicles (HEVs) –** 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. Consultation/ lobbying is ongoing to as to whether these vehicles will be banned post 2030. This is an important point as a favourite of mini-cab and private hire drivers is the Toyota Prius hybrid. 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.

- **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.

Only those electric vehicles that plug into an electricity supply to recharge the battery are relevant to the EV recharging infrastructure discussed in this report. The specific vehicles that require EV charging points are those that draw electricity from plugging into charge points, incorporating Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). For simplicity, this document refers to EVs as the charging demand for PHEVs is unlikely to be of the same scale as that for BEVs and so EV is used as a simplification.

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

- **Ultra-Low Emission Vehicles (ULEVs) –** This term is used in the UK to refer to any motor vehicle emitting extremely low levels of emissions, currently set at 75g CO_2/km driven or less. UK targets are set for ULEV uptake and statistics are reported quarterly at local authority level.[3]

- **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) –** 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. While FCEVs are not considered within this study, they have been included in this section to complete the EV offering. If FCEV do come into wider usage in the future, they will require a whole new dedicated infrastructure. Over the last 10 years, only 263 FCEVs have been registered.

3.2.2 EV Technology Roadmaps

The UK Automotive Council has developed long-term technology roadmaps[4] 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, charging infrastructure will be required for the majority of vehicles in the overall fleet for the next several decades.

3.2.2.1 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.

[3] https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01
[4] https://www.automotivecouncil.co.uk/technology-group-2/automotive-technology-roadmaps/

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 below provide some context regarding range for some currently popular EVs.

EV Model	Price	Battery Capacity	Range
Renault Zoe R110 ZE40	£26,788	41/50 kWh	160/200 miles
Nissan Leaf	£25,044	40/62 kWh	140/250 miles
Hyundai Kona	£32,511	39 kWh	155 miles
BMW i3 120 Ah	£38,785	37.9 kWh	145 miles
Tesla Model 3	£42,500	60/100 kWh	300/400 miles

Table 3- 2: Examples of current EV market for cars

3.2.2.2 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 CO2/km by 2020. For a long time, there were relatively few EV van models currently available in the UK and only in very low volumes. Manufacturers such as Nissan, Renault and Citroen offer EV vans and have recently been joined by new models from LDV and Mercedes, with Ford, Volkswagen and LEVC announcing models coming soon to the UK. The table below shows the current market range.

Make	Price	Range	Space Capacity (m3)
Peugeot Partner/Citroen Berlingo	£ 23,030	106 miles	3.3-3.7
Peugeot e-Expert/Citroen e-Dispatch/Vauxhall Vivaro-e	£ 25,000	148-211 miles	>6.6
Peugeot e-Boxer/Citroen e-Relay	£ 49,395	169 miles	8
Fiat E-Ducato	£ 59,699	224 miles	10-17
Ford Transit (PHEV)	£ 24,395	35 miles	6
LEVC van (PHEV)	£ 46,500	58 miles	5
Maxus EV80	£ 24,614	119 miiles	11.6
Maxus e Deliver 3	£ 22,800	150 miles	6.3
Mercedes e Sprinter	£ 51, 950	71 miles	10.5
Mercedes e Vito	£ 39,895	93 miles	6.6
Nissan eNV200	£ 20,005	124 miles	4.2
Renault Kangoo ZE	£ 24,480	143 miles	4.6
Renault Master	£ 57,040	124 miles	13
VW Abte-Transporter	£ 42,060	82 miles	6.7

Table 3- 3: Current EV market

3.3 EV Availability

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

There are now 117 plug-in car models available on the UK market (as of April 2019):

- 55 plug-in hybrids (PHEV).
- 60 full battery electric models (BEV).

The question of PHEV longevity within the marketplace, when compared with BEV, may be determined by the additional cost, average price (£10,000 more than the average BEV) as noted in Table 3- 4 and the complexity of manufacture.

Topic	Value
Total vehicles	117
BEV numbers	60
BEV average price	£31,847
PHEV average price	£41,100
BEV average battery size	50.5kWh
PHEV average battery size	13.3kWh
BEV van numbers	13
PHEV van numbers	1

Table 3- 4: EV market headlines

The recent dominance of PHEVs in the UK market is similar to most European countries – however, other countries such as Norway and the Netherlands have seen the opposite due to their more favourable BEV incentive schemes. The table below shows that BEV in 2019 caught up with PHEV and in 2020 significantly outsold PHEV.

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
Total	**204,533**	**233,504**

Table 3- 5: BEV and PHEV sales over time

The second-hand EV market is still very small, making up less than 0.2% of auction sales in 2018,[5] 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 the relatively poor real-world range shown by early model BEVs 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 the UK's larger cities, including Greater Manchester.

3.3.1 Battery Capacity

Analysis of the BEV vehicles on the market shows how battery capacity is growing. The first Nissan Leaf was 24kWh which increased incrementally to 30kWh, 40kWh and 62kWh. There will however be a legacy of lower capacity batteries within the fleet from earlier models sold in previous years that consequently have lower mileage ranges. Whilst this will affect the average range of the vehicles currently in the BEV fleet, it will become less of a concern as the existing fleet is increasingly dominated by vehicles bought within the past few years, due to the increase in sales, year on year.

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

Battery range	Number of vehicles
Up to 40kWh	23
40 to 50kWh	13
50 to 70kWh	10
70 to 90kWh	9
90 to 100kWh	5

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

3.3.2 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. AC (Alternating Current) is the typical form of power supply available from any standard charge point installed at a domestic location. 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.

Typically, PHEVs exhibit a lower power charging capability. 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 (Direct Current) 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.

3.3.3 BEV Supply Constraints

Consumers currently report long waiting times for plug-in vehicle (BEV) purchases, and there have been instances of models removed from sale for periods in the UK due to an excess of demand over supply. Reports such as these can 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 BEVs, 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 BEV model range but have yet to make significant volumes to satisfy the potential demand across the whole of Europe.

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 BEVs available. More favourable incentives in countries such as Norway have driven BEV demand to such an extent that vehicle manufacturers could be confident to redirect large percentages of European BEV 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 BEV 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 BEV 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 BEV 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 BEV market until 2028 to 2030, and many new battery manufacturing plants will then be required to supply the BEV volumes required to meet European targets, requiring significant investment and long-range planning. There is therefore still a substantial risk that BEV 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 Britishvolt building a battery facility in the UK will help address the shortage.

What are Li-ion batteries?

A lithium-ion battery is a type of rechargeable battery that is charged and discharged by lithium ions moving between the negative (anode) and positive (cathode) electrodes. Batteries can be charged and discharged again and again. Because lithium-ion batteries are suitable for storing high-capacity power, they are used in a wide range of applications including electric vehicles.

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 BEV volumes produced by manufacturers such as Tesla and Nissan. In Norway, for example, incentives were very significant initially however this level of incentive has not been matched anywhere else.

3.4 EV Charging Technology

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

3.4.1 The need for recharging infrastructure

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

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

There is much debate about who should provide recharging infrastructure, how many, of what type and where, and several different solutions have now been implemented by public and private organisations in the UK. 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.

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. 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 in total 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 DNO applications had to be made as original quotes had expired as these only last for 90 days. These installs proved to be extremely difficult to deliver and focus transitioned to installing chargepoints at workplaces and hubs.

3.4.2 Charge Points

The most well-known element of EVSE is the charge point – also referred to as 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 3- 7 provides a summary of the different types of charge point currently available in the marketplace.

Common Charge Point Names	Power Output (kW)	Current / Supply Type	Socket / Plugs	Charging Duration (40kW battery)	Use Cases
Slow	<7	AC	Type 2 Socket	13 hours	Destinations
Fast	7 – 22	AC	Type 2 Socket	2 to 5 hours	Destinations

Common Charge Point Names	Power Output (kW)	Current / Supply Type	Socket / Plugs	Charging Duration (40kW battery)	Use Cases
Rapid	43 -50	AC	AC – Type 2	30 minutes to 80%	On-route
		DC	DC – CHAdeMO		
		DC	DC – CCS Captive cables with plugs attached		
High Power	100	DC	Tesla 120kW	TBC depending upon vehicle	On-route
		DC	CCS 150kW+		

Table 3- 7: Charging point types

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

This was followed by the development of rapid chargers rated at 50kW, which were initially only suited to a few 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. Discussions are underway to open the Tesla network to other users. The wider roll-out of 150kW+ charge points for public use is now beginning, but the few vehicles designed to draw such high-power are high-priced executive models. To combat this business model limitation, high-power charge points are designed to be backwards compatible, so they can also deliver 50kW DC charges to rapid chargeable vehicles.

3.4.3 Charging rate

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. The charging operators are now preparing for the higher charging.

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

Figure 3- 1: Examples of charging forecourts

3.4.4 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.

BEV 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.

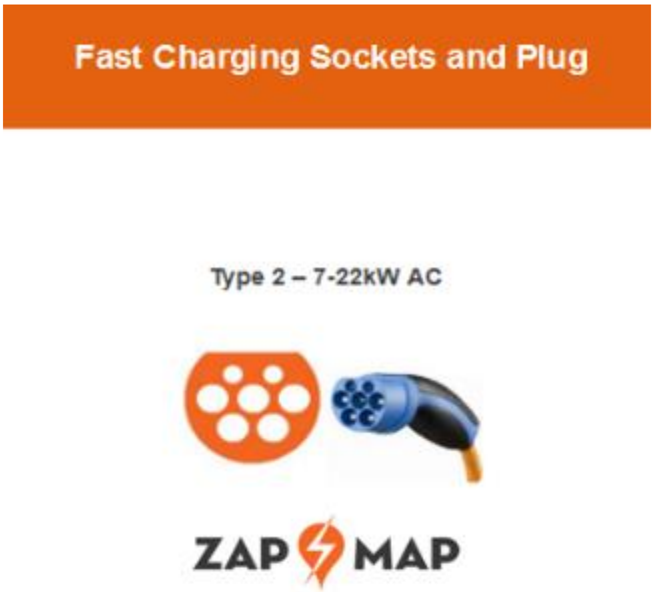


Figure 3- 2: Type 2 socket and plug for slow and fast charging in UK

Rapid and high-power chargers do not use the cable supplied with the vehicle. Instead, these chargers are fitted with tethered cables and connectors that plug directly into the vehicle due to the high power being delivered. There are four socket/plug formats used for rapid and high-power charging in the UK. Most vehicle manufacturers use the CHAdeMO or CCS DC socket/plug for rapid and high-power charging. Only Renault retains the 43kW AC system although this is being phased out.

Tesla's 120kW supercharger socket/plug was designed to suit their bespoke battery solution. Tesla provides superchargers for public use.

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

3.4.4.1 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 BEV drivers, be flexible to needs of various stakeholders and cost less to run as new developments are shared easily and quickly. The use of a common protocol can enable communication between any recharging equipment and any wider system in the future.

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

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

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

There are currently three levels of smart charging available:

- Basic load balancing distributes the available power capacity equally between all charge points to prevent overloading and high energy costs at peak times.
- Scheduled/static load balancing can also optimise charging schedules to take financial benefit from time of use energy tariffs.
- Dynamic load balancing can combine both static and dynamic data such as bus routes, next day plans and dynamic energy pricing to ensure the entire fleet is charged in time for individual departure at the lowest cost.

3.5 Emerging Wireless / Induction Charging Technology

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

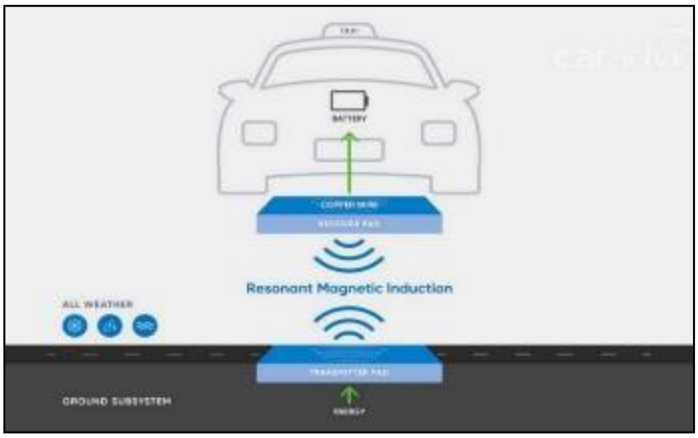


Figure 3- 4: Induction charging

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 utility providers 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.

3.5.1 Induction Trials

A number of trials of induction charging are currently underway:

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

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

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

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

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

3.5.2 Wireless Induction Charging Capability of EVs

Most, if not all, of the top vehicle manufacturers have stated that they are likely to offer wireless charging capability in the future. However, wireless charging is yet to be built into any model of BEV 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.

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.

3.6 Overview

3.6.1 EV Trends

- Increasing battery sizes will reduce 'range anxiety' amongst consumers and is likely to assist with the transition from ICE vehicles to EVs.
- PHEVs and BEVs are the only EVs dependent on charging infrastructure, however the bulk of demand for public charging points is anticipated to come from BEVs in the future.

- For successful uptake, EVs must become more widely available and affordable.
- There are currently 117 plug-in car models available in the UK and the number of vehicle models is set to increase offering a high degree of choice for consumers.

3.6.2 EV Availability

- 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. The recent announcements in the past year will help address the shortage; however, further increases in battery and EV manufacturing facilities are required to bring forward the supply needed to meet ambitious targets for decarbonisation and EV uptake.

3.6.3 EV Charging Technology

- There has been a rapid evolution of charging technology – prior to 2016, most EVs charged at 3kW, however in 2021 we are seeing the rollout of 150kW+ public chargers, although there are still limited numbers of EVs capable of charging at this speed.
- 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 for a considerable amount of time. Rapid and high-power chargers suit on-route charging, quick recharging at destinations, and supporting the taxi trade due to their high-speed capabilities.
- The majority of high-power charging solutions use the CCS DC socket/ plug and new vehicle models are moving to this charge type instead of the CHAdeMO socket. Although chargers will require both socket types for at least the next five years, the move to one common charging solution will reduce confusion amongst consumers and increase their confidence in using the infrastructure.
- Smart charging could help to achieve a sustainable recharging market by cost effectively scheduling charging times, responding to dynamic energy pricing and integrating batteries and renewable energy sources. This could help to reduce operating costs of EVs and manage the load on the electricity network.
- Vehicle to Grid (V2G) technology can help utility providers handle increasing peak demand by using power from EV batteries that are connected to the network to top up the grid, which also provides a new source of value for the EV owner.
- Various national companies and national governments across the world are trialing 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. Existing vehicle models do not include this technology and therefore there is not an immediate requirement for this infrastructure.

What is the key relevance to HEY?

Ensuring technical specifications of charge points are correct and matched to user preferences is of paramount importance in developing a high-quality charging network, and consequently providing a supportive environment for the uptake of EVs.

What are the key lessons for HEY?

'Range anxiety' is very common amongst consumers; increasing battery sizes will reduce this and assist in the uptake of EVs. The bulk of demand for public charging is anticipated to come from BEVs in the future – for successful uptake however, they must become more widely available and affordable. The lack of EV production capacity is a global issue and will constrain the levels of EV uptake in the coming years.

What are the implications for HEY strategy?

This technology review has helped identify the appropriate types of infrastructure to support likely requirements associated with key vehicle trends such as increasing battery capacities. The constrained supply of vehicles has been taken into account in the modelling of future uptake of EVs.

How should this inform HEY decision making?

The type of charge points installed in the future should be cognisant of the key learnings outlined in this section to ensure infrastructure is matched with vehicle requirements, such as a demand for quicker charging associated with larger batteries. The constraints on vehicle supply should be taken into account when making decisions regarding the scale of charge points to be delivered in the short term.

4. Charging Behaviours and Attitudes

4.1 Case Study: North East Drivers Survey

This is a summary of the findings of a survey undertaken on behalf of the North East Combined Authority (NECA), which was one of the very first Plugged in Places projects along with Milton Keynes. It must be noted that the respondents are reporting on their experiences up to May 2019 and since then many changes in infrastructure and vehicles has happened which we know is changing behaviour. These advances will be referenced and examples shown.

The results recorded that 90.15% of respondents chose the option to charge at home. This is significant since slightly less people told us that they had access to off-street parking (75.75%). The next most popular options were in public car parks (73.61%) and at work (71.19%). Transport interchanges scored the lowest mark with only 27.32% choosing this option showing that multi-modal forms of charging linking to other transport methods is not featuring highly in people's minds.

Finally, the work investigated those who do not have off-street parking at home to charge. 24.25% of people surveyed answered no to this question. Out of these 48 people, not surprisingly the highest consideration that would put them off buying an electric vehicle was charge point availability. 75% said that this would be a concern for them. Only 29% agreed that there were charge points available to use (against 36% of overall respondents) and 87% agreed that they needed more charge points in their local area. Despite this 70% responded that they would expect to charge their car at home which could either be translated as they feel that they would not be able to purchase an electric car at this stage or that they would require a suitable alternative close to where they live.

4.1.1 Respondent's travel behaviour

The survey began by setting the scene of the current driving behaviour of respondents. 70.7% of respondents were travelling by car every day of the week with a further 7% stating every weekday. The survey asked the question of how many miles each individual was driving each week. It is interesting to note that 50% of respondents were driving under 100 miles a week showing that even with some of the lower range electric cars on the market, a charge per week would be adequate, as seen in Figure 4- 1. An additional 26% of all respondents were driving under 200 miles each week. Only 23.5% of drivers told us that they were driving over 200 miles each week. These mileages should be considered alongside the business model for the need for EV charging.

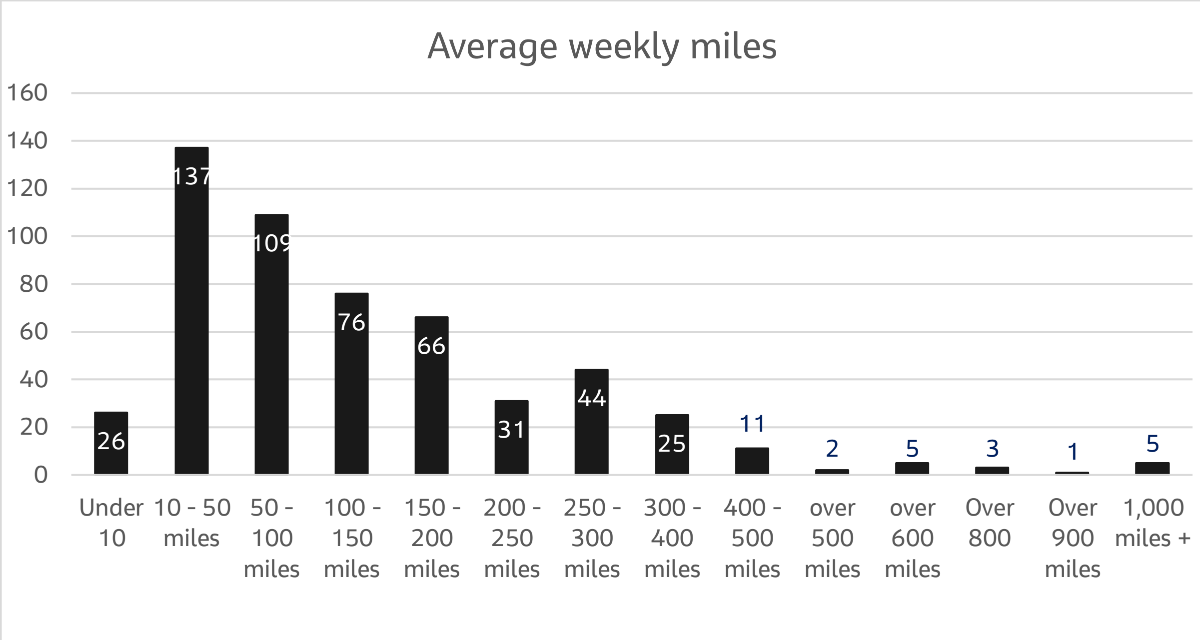


Figure 4- 1: Average weekly miles travelled by respondents to the North East Drivers Survey

The other aspect that can be seen from the responses is that on average daily distances travelled are quite short – 96% of daily journeys made were under 40 miles with journeys over 150 miles being made only monthly by 11% of respondents and less than 6 times a year by 84% of respondents.

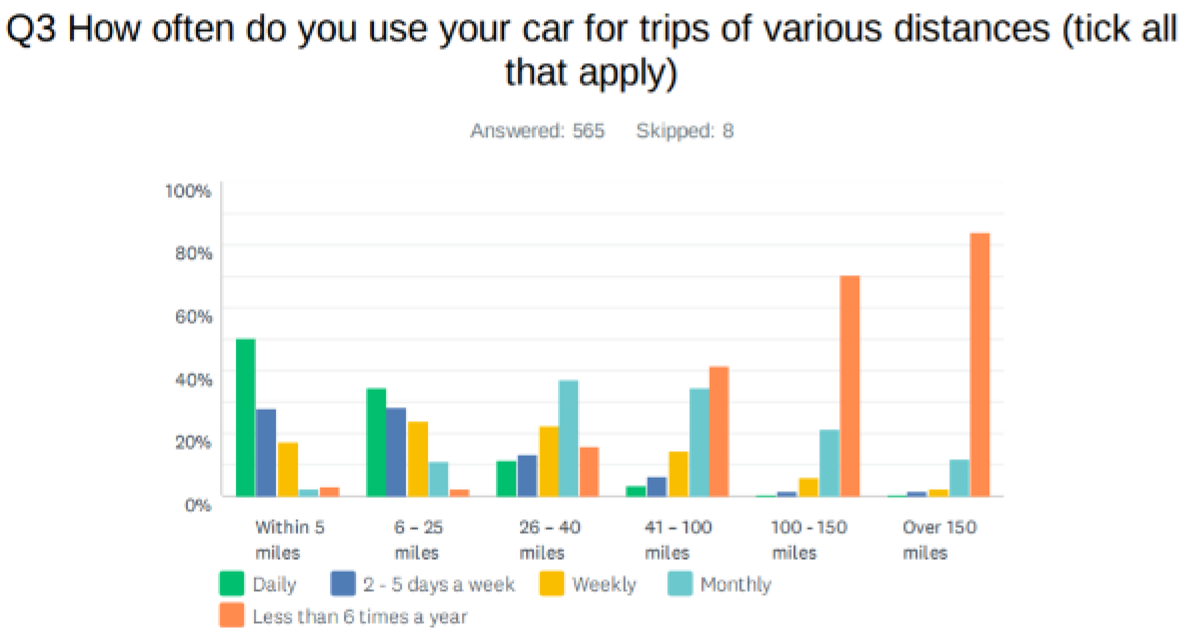


Figure 4- 2: How often respondents to the North East Drivers Survey use their cars for trips of various distances

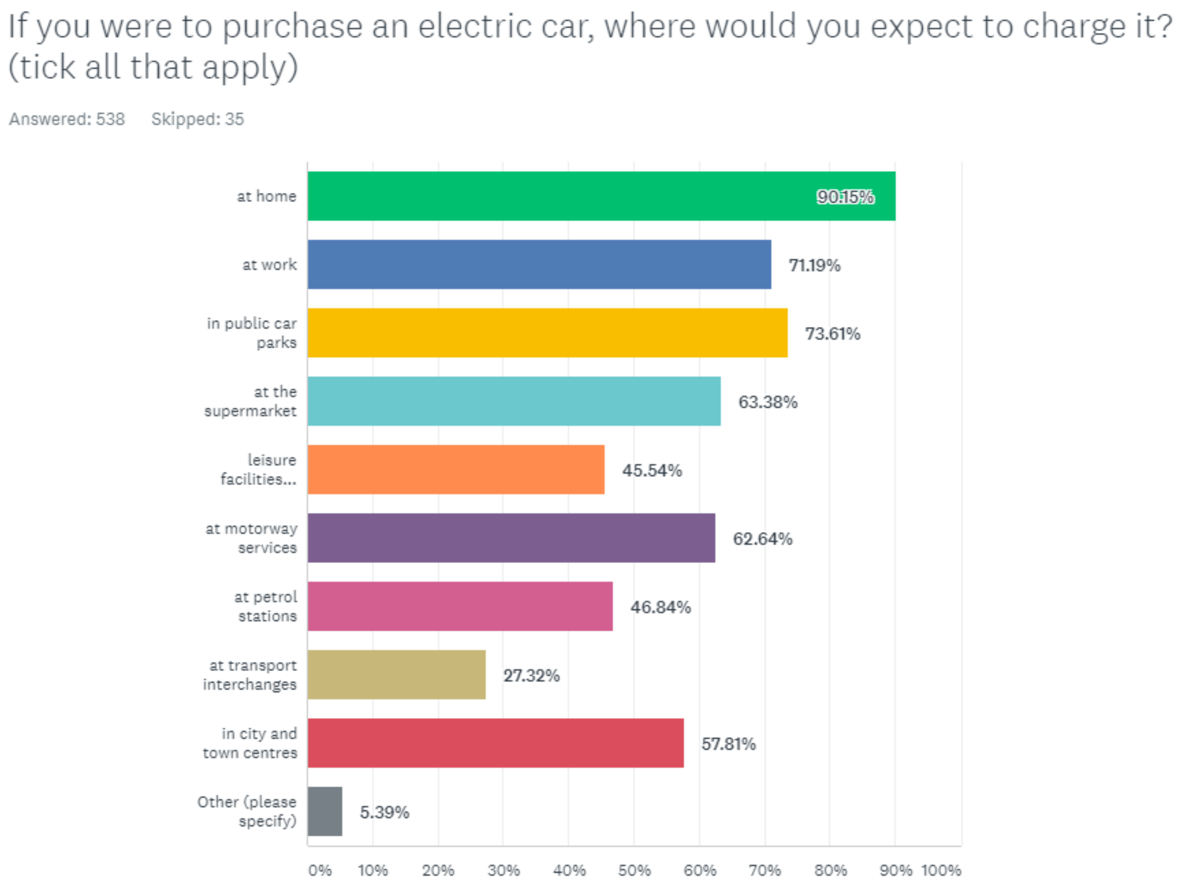


Figure 4- 3: NE EV driver's perceptions of public charging facilities: survey

Despite average daily mileage being well within the range of an electric car, NE EV drivers seem to value the reassurance of frequent charging top-ups. The majority (41%) of respondents charged their car a few times each week, however 27% reported charging most days and a further 25% said they charged every day. Although the majority of respondents

(88%) could charge at home, only 41% of charging was reported to take place there, well below the UK government's estimate of 80%. 11 respondents said they did not charge at home at all and one EV driver reported driving 30,000 miles in 2 years without home charging facilities. Responses indicated that 24% of charging took place using slow/fast public chargers and 20% using rapid chargers. This seems to suggest that people are knowledgeable and comfortable using the public network which provides an opportunity for revenue generation going forward. It is likely that the need for public charging will grow as drivers without off-street parking at home adopt EVs.

42% of respondents said that they were charging their car on the public network over 50% of the time. Reported use of rapid chargers varied - 21% of respondents said they used rapid chargers a few times each week, whereas 24% of respondents indicated no use of rapid chargers. The most frequent reasons given for not using rapid chargers were that they were not in the locations required (36%) and that they had other charging options available (17%). Interestingly only 2% of respondents cited waiting times as a problem for rapid chargers.

This diversity of charging location preferences reflects variety in drivers' home, work and leisure choices, indicating that a varied public charging network will be required to meet different needs.

Finally, 'hogging' chargers was also an issue for respondents including non-EV's parking in EV charging bays, and EVs parking in EV bays beyond the charge duration.

47% of respondents stated that the reintroduction of parking fees for EV's in Newcastle City Centre car parks had not affected their use of the public charging network. However, 42% said they now charged less on the public network and 3% said they had stopped using the public network altogether.

The majority (67%) of respondents drove a Nissan LEAF, evenly split between the 24kW and 30kW models.[1] Only 17% of respondents drove a PHEV. 87% of people reported using the EV as their primary car indicating some confidence in the electric range and charging facilities available, but 85% of use was reported to be for personal rather than business travel. Business vehicles typically travel higher annual mileage than personal vehicles so increasing EV adoption in business fleets could accelerate emissions reduction particularly in built-up urban environments.

4.1.2 NE EV driver's perceptions: interviews

All interviewees had reported experience of using the public network in the earlier survey. However, frequency of use varied widely from around 20% of charging time to others using the public network for 100% of their journeys. Respondents were categorised into two segments - those with and those without home charging facilities. 14 of the 21 interviewees were able to charge at home and only used the public network to top-up their home charging. However, 7 respondents could not charge at home and were therefore completely reliant on the public charging network.

4.1.3 EV drivers with home charging

For those with access to home charging, the interviewers initially sought to understand their motivations and need for the public network. Although the reasons varied, all 21 interviewees reported cost; convenience and speed. Of the three factors, the cost of public charging versus charging at home was the most frequent response. Being able to charge for free was seen as a major benefit to EV drivers and many interviewees saw this as an incentive for EV ownership even though many had the ability to charge at home.

4.1.4 Opportunistic charging

Many drivers noted that they did not go out specifically to charge but did so when the opportunity arose. Many talked about adapting their 'routine' to take the opportunity to charge e.g. charging when at the leisure centre or at the supermarket - making charging part of their week's routine tasks.

Being able to charge at work for free was seen as a major benefit to EV drivers. Two drivers were able to charge at work and both discussed the benefits that this brought as real incentives to driving an electric car - free electricity and the ability to park in a priority bay when the car park was often full.

The preference for rapid versus fast charging varied enormously amongst this group. Some drivers preferred the speed and convenience of rapid chargers and sought them out specifically as part of their charging regime and daily routine. Some drivers told us that they used rapid chargers to get a quick top-up at convenient times such as during lunch breaks or on the way home. On these occasions they were not taking a full charge - just enough to give them a range boost. This is important to recognise for the business model, because whilst a fixed fee is beneficial to the operator it would be a barrier to drivers displaying this top-up charging behavior which could cause a drop in utilisation and limit revenue.

4.1.5 EV drivers without off-street parking at home

The barrier of charging an electric car for those without off-street parking was raised by many drivers - even those with their own home charger who recognised the difficulties in increasing EV uptake. Four of the respondents said that at the moment they could not see how a transition for everyone to drive an EV could happen with the infrastructure as it is now. As one driver stated: *'People (in terraced housing) are reluctant to take that step. They live in what you'd describe as posh terraces and they could afford a mid-range EV. The infrastructure has to lead a bit, not to the point of having masses of stuff with cobwebs over them but being a little bit ahead of the demand and keeping that growing.'*

Reported charging behaviour was very different amongst the drivers without access to off-street parking who relied on the public charging network. All seven interviewees said they primarily charged at locations close to home, the majority chose to do so in the evening using 7kW fast chargers. Locations were dictated by the proximity of the charge point to home and most respondents walked up to 10 minutes to a charge point. This appeared to be the optimum distance for convenience to a driver.

Those without home charging were asked for their opinion about the future for residents without off-street parking. Although everyone mentioned lamp-post charging on residential streets, none believed that was the answer. Most felt that parking on their streets was difficult already and that it would be impossible to secure a parking bay next to a charger when it was needed. Most interviewees suggested was that there should be more overnight fast chargers installed at community locations. Other locations suggested were leisure centre car parks and park and ride locations.

Finally, a quarter of interviewees raised issues with time restrictions mainly on fast chargers particularly affecting those without off-street parking who needed a full charge. Supermarkets were the main culprit with individual drivers citing problems at Asda, Lidl and Sainsburys. However, others mentioned that they believed LA's were introducing time limits on their chargers too.

Two chose to charge at their local supermarket. One reported charging at the local Asda, just a five-minute walk from home, choosing to plug it in for 2 - 3 hours in the evening, combining it with a shop and returning home whilst it charged. However, parking time restrictions meant he rarely got a full charge at Asda so he made leisure choices based around destinations which gave access to a charger enabling him to top-up where he could. Another told us that they used their local rapid Lidl charger twice a week and combined it with a shopping trip.

4.2 Summary

- Drivers with the ability to charge at home also tended to use the public network because it was free and convenient – often with the added benefit of available parking bays in well placed locations.
- Incorporating charging into a routine has been important to many drivers with destinations such as supermarkets and leisure facilities offering charging facilities were noted.
- There had been a definite change in behaviour with declining usage of public infrastructure in locations where fees had been introduced.
- The preference for drivers without access to home charging was to charge in the evening, using a fast charge point, close to home.
- Respondents felt that a mix of charging facilities (ranging from slow to rapid) are needed to cater for different requirements.

What is the key relevance to HEY?

Understanding charging behaviours and attitudes informs implementation decisions and is key in planning an EV charging network that will maximise usage in both Hull and East Riding, catering for varying needs across the region.

What are the key lessons for HEY?

Destination charging is important to many drivers; incorporating charging into routines such as shopping or leisure visits is a common behaviour. Additionally, where fees have been introduced for public charging, a definite decline in usage has been seen. Emphasis should be placed on the need for a mix of charging facilities to cater for different requirements.

What are the implications for HEY strategy?

Understanding these behaviours inform the strategy on where to locate specific types of charging infrastructure based on the requirements of those of will be using it. Destination, on-route and residential parking behaviours must all be catered for with a mix of charger types.

How should this inform HEY decision making?

Decision making should incorporate the behaviours of those who will be using the infrastructure to ensure the highest possible uptake and the most useful service for communities in the HEY region.

5. Skills and Training Needs for Electro-Mobility

The UK automotive industry is undergoing a disruptive transformation, moving from the internal combustion engine to fully electric vehicles by 2035, and is being accelerated by the EU, UK government and local authority legislation/initiatives. Transition and growth of the industry could result in skills shortages at all levels, conversely, downturns/investment can provide opportunities. There appears to be a widespread lack of understanding of the scale of workforce upskilling needed to meet future demand for electric vehicles and the specificity of job type across the supply and service chains. This includes the volume of new workers needed to enter the workforce, the type and number of current workers who may need reskilling/up skilling, and an identification of parallel industries (oil and gas, food service) from which it may be possible to draw talent.

The UK has a robust and established skill delivery ecosystem, in both the public and private sectors. As a result, the current UK workforce has, and is currently being trained to a level, which for most with 'top up' training would allow a transition to a new EV workplace. The current trend of automation and codifying a process to minimise operator *tacit* knowledge or the division of labour, has created an industry methodology of 'up skilling' with *explicit knowledge*. This requires an entry 'ticket' of knowledge (*implicit*), followed by training in the key attributes of the specific process.

There are clearly opportunities with the transition over time of approximately 35m vehicles to Zero Emission tailpipe technologies. What is different is that many thousands of people will need upskilling simply to undertake their current role. Some industries my grow and some may disappear.

Currently there are no formal battery or electric machines specific training courses aimed at manufacturing / production, and the current training provision is delivered on economic return and not national need.

5.1 Focus Areas for Training

Our studies drew us to the conclusion that the types of jobs within this industry (and therefore training needs) were split into the key four phases:

EV Ecosystem	
Phase 1: **Manufacture**	Raw material sourcing • Electrode, electrolyte, separators • Cell manufacture • Module, pack and BMS • Vehicle applications • 2nd life and recycling • Manufacturing engineering • Design engineering
Phase 2: **Aftersales**	Servicing, repair, and recovery (mechanics) • First responders (fire brigade, paramedics, police) • Roadside assistance (breakdown service) • Educators for all of the above
Phase 3: **Second life**	Energy storage both domestic and grid support
Phase 4: **Disposal**	Final end of life

Within the context of Local Authorities, it is clear that not all of the above topics will necessarily need to be an area of formalised training, or indeed, experience. For example, cell manufacture and raw material sourcing is almost certainly not going to be a direct consideration for local government. Although the localised impact on industry and how the local education offerings for each topic may affect this, could be a consideration.

However, as EVs become more commonplace the Phase 2,3 and 4, these topics will begin to impact the general day to day working of local government and so it will be important for a more formalised training and education program to be in place to ensure that local government is ready to handle the transition to EVs.

The necessity of this for Servicing, Repair and Recovery for fleet operators and mechanics is obvious, but areas such as Energy Storage and End of Life disposal will require, for example, an understanding of the potential risks in battery storage. This will not only impact areas such as the disposal and storage of batteries on council owned properties, but also aspects such as planning permission for any new EV related businesses.

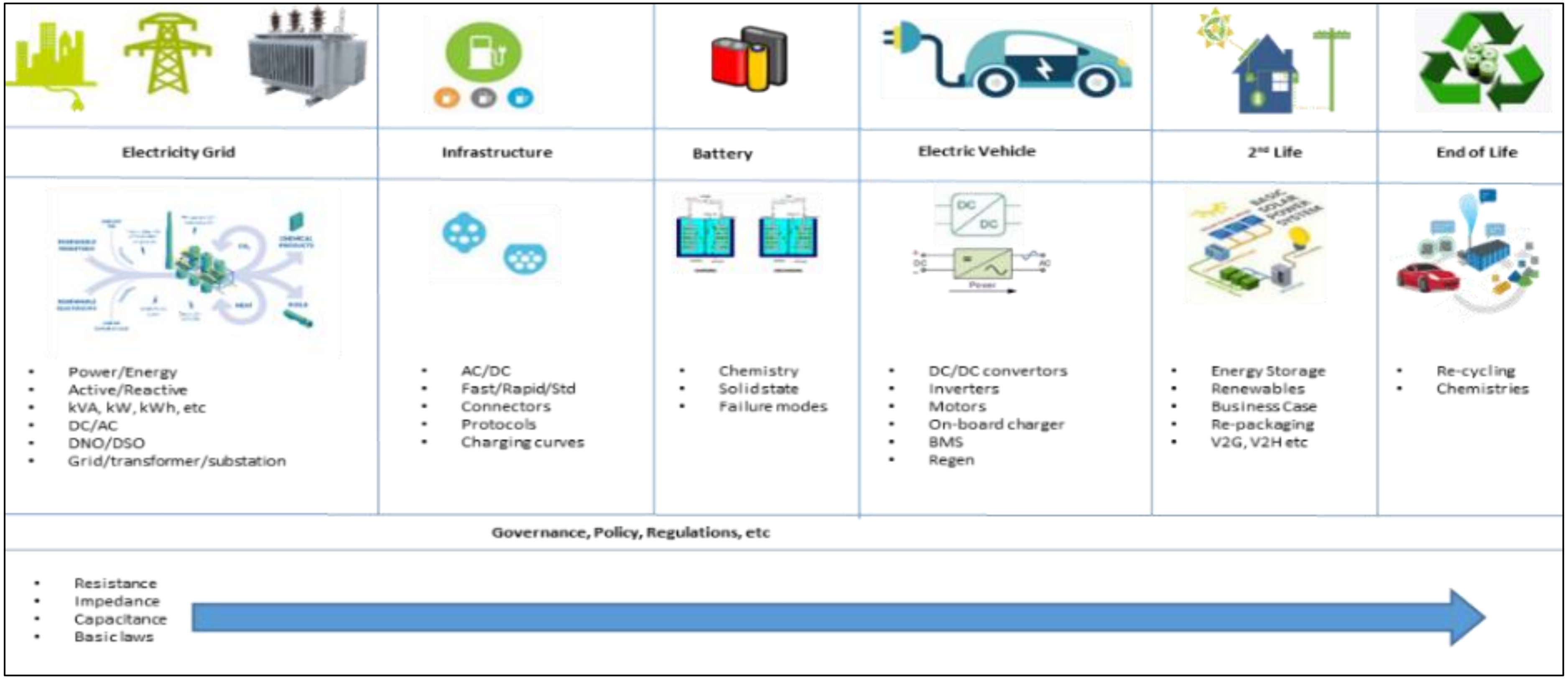


Figure 5- 1: Skill Focus Area

5.2 Summation of levels

In considering the training required for Hull and East Riding to effectively operate in the Electric Vehicle world, it is important to consider the exact level of training which will be required across different roles within government. This will allow local governments to both plan the upskilling of internal employees more effectively, and also more easily target future workers through knowledge of the key skills required for differing jobs.

- **Level 1**: Generalised staff with more limited, non-technical contact with Electric Vehicles.
  - An example at this level may be a worker handling the day-to-day booking/management of electric vehicles. A non-technical role, but one which requires a generalised knowledge of EVs
- **Level 2**: Manufacturing/production/service staff, for example those who move material, load/unload machines, assembly of packs.
  - This could include electric vehicle recovery teams who would need to know the specialist knowledge to safely recover and deliver vehicles.
- **Level 3**: Technicians, ensure equipment is delivering material safely to quality, volume and specification. This is an area, which relies on 'knowledge and understanding'. This level also covers vehicle repair.
  - The most likely role within local government may be electric vehicle repair and maintenance. A role which requires more specialised knowledge.
- **Level 4**: Engineers/Technicians can operate at level 3 and deliver some Level 5 activity.
  - Roles could include more senior technicians managing a team, or infrastructure installation specialists who may work alongside commercial operators.
- **Level 5**: Degree level is an area, which relies on 'specialist learning'
  - Degree level knowledge of electric vehicles, and the associated infrastructure, is unlikely to be necessary for the day-to-day operation but future planning may require a level of knowledge over and above that seen up to Level 4. However, experienced Level 4 engineers/technicians will be able to cover some of this.

Training and education gaps in the electric vehicle world are going to be caused by two basic connected factors.
A lack of training/education combined with a need for that training/education. Essentially, supply and demand. It is most likely that the greatest gap will be seen at the Level 3 and Level 4 points, as it is at these levels where there is both a strong need for personnel (unlike Level 5) but also a generalised lack of experience within the current work force.

5.3 Catalogue of current training

To understand how this potential gap in training/education may be covered, it is useful to consider the current range of courses available.

Below is a series of typical portfolios from a further education college in England, with regard to EV up skilling.

City and Guilds (FE): L3 Electric Vehicle Charging CG2919 (Domestic and Commercial)

> This is a course designed for fully qualified electricians covering the skills and knowledge necessary to install, test and inspect electric vehicle charging points. It functions as an addition to an already trained electrician and as such is a good example of upskilling.

Institute of Motor Industry (IMI): L1 Electric / Hybrid Vehicle Awareness

> A qualification for learners, including the 16+ age groups, to introduce the knowledge necessary for working safely around electric vehicles. This may include the types of Electric/Hybrid vehicles available and some of the typical hazards associated with EVs.

Institute of Motor Industry (IMI): L2 Electric / Hybrid Hazard Management for Emergency and Recovery Personnel

> A qualification for learners, including the 16+ age groups, to introduce the knowledge necessary for working safely around electric vehicles during emergency and recovery situations. Unlike L1, it deals with the knowledge necessary for safe working practices when an EV may be have been damaged.

Institute of Motor Industry (IMI): L2 Electric / Hybrid Vehicle Routine Maintenance Activities

A qualification for learners, including the 16+ age groups, to introduce the knowledge necessary for routine maintenance and repair activities. This would cover aspects of the vehicle not associated with high voltage components.

Institute of Motor Industry (IMI): L3 Electric / Hybrid Vehicle System Repair & Replacement Electric Vehicle E-learning course

A qualification for learners, including the 16+ age groups, to introduce the knowledge necessary for maintenance and repair activities in high voltage systems within electric and hybrid vehicles. This would allow the leaners to undertake a wide variety of EV repairs.

In addition to the above courses, there are also a range of courses covering elements related to the manufacturing of Electric and Hybrid vehicles. Whilst these are not directly relevant to the EV operations within local government, they do serve to highlight the breadth of education opportunities.

Awarding Body	Level	Title
EAL	Level 2	Diploma in Manufacturing of Vehicles with Electric Drive Systems
EAL	Level 2	Standby Battery Systems
EAL	NVQ	Diploma in Hybrid Vehicle Introduction and Environmental Improvements
EFSA	Level 1	Award in Electric/Hybrid Vehicle Awareness
EFSA	Level 2	Award in Domestic Electric Vehicle Charging Equipment Installation
EFSA	Level 3	Award in Electrically Propelled Vehicle Repair and Replacement

Table 5- 1: Other EV training and education

5.4 Further Education Considerations

Through our consultation with a number of UK manufacturers, we found that when it comes to developing FE skills current large employers' plants tend work with local colleges. At present, there are also some challenges facing the apprenticeship delivery model and the broader skills situation. This is in part due to the impact of the employer levy and the decision to allow this not to adhere to the internationally-recognised definition of an apprenticeship. This has led to a large number of delivery providers at large and a lack of understanding of what is being delivered by who.

The delivery process assumes a provider (college or private) will want to deliver the course however this is often not the case and each provider will make a decision based on demand and funding. With the content being delivered varying enormously in both the content and the standard of knowledge of the tutors, we would recommend a certified, standardised modules were required.

5.5 Higher Education Considerations

At present, Universities cannot act quickly with regard to degree content in this emerging technology, however they can bring in current industrial practice via visiting Professors or guest lecturers from industry, which it seems proactive universities do successfully. Universities are now seeing Degree Apprenticeships as a core product.

In general, the current practice within tertiary education is for Electric Vehicle, and general Electric Mobility, to be offered as a masters degree, with the requirement for the requisite undergraduate degree in the appropriate topic.

5.6 Summary

- Wider training needs: Any training centre must have a greater scope than just the battery per say and include associated technology such as charging infrastructure, power electronics, electric machines and second life.
- Recruitment: The conclusion from recruitment specialists is that there is no large-scale skill shortage of people with the base skills but a shortage of people with the required specific skills. This is particularly acute within the Level 2-4 range. Whilst people with the correct level of skills do exist there is a general lack and due to the jobs market self-regulating mechanism, short-term demand for specific people profiles has resulted in poaching of staff from similar industry, rather than training and upskilling.
- A recognition has been created for the need for not only technical competence but also organisational competence to ensure workforce safety.
- The UK has an existing talent pool of technicians which have the capability to transfer to EV technology and other 'green' industries which could cause a tension in supply.
- The implicit skills, which can be transferred from one technical sector to another, are already in existence in the UK.
- Training will be delivered when there is a business case which creates challenges for training providers.
- Further consideration should be given to engaging training and skills providers through a strategic and regional approach coordinated through the HEY LEP to both meet market demands and take advantage of opportunities to foster skilled employment opportunities in the sector.

The importance of technical training and education in this field is highlighted by the following quote:

> *"Technicians are the linchpins of the UK economy. They are skilled people who use their science, engineering or technology knowledge to identify and solve practical problems. They are the electricians and plumbers that we all rely on, but they are also crucial to the success of many of our country's future-growth areas, including the aerospace, chemical, digital, engineering and manufacturing industries….*
> *….However, whilst there has been significant effort and investment over several decades to improve the number of science, technology, engineering and maths (STEM) graduates, successive governments have turned a blind eye to an equally critical shortage of technicians in these same disciplines.*
>
> *Currently, over 1.5 million technicians are employed in the UK. The majority of these technicians are employed in engineering roles but there are also significant numbers working in science, health and technology. However, an ageing workforce means that 50,000 of our best technicians are retiring every year, and forecasts show we will need as many as 700,000 more technicians in the next decade to meet demand from employers."* Gatsby Foundation.[6]

[6] www.gatsby.org.uk/education/focus-areas/stem-skills-in-the-workforce

What is the key relevance to HEY?

The availability of skilled technicians will be key in delivering and maintaining the charging network and maintaining the EV fleet. Ensuring people are trained and qualified to do so will be critical in providing a consistent and high quality network.

What are the key lessons for HEY?

The training and learning curriculum is required to provide a series of short modules, covering all aspects of new technologies. The curriculum should be delivered through classroom or e-learning ensuring accessibility of the material and training, accredited and developed to a consistent and agreed standard again now being developed. This should be included within apprenticeship training and adapted to provide short models / CPD for the auxiliary and emergency services personnel and the service sector. Management training is also required – providing higher level courses on the overall topic of EV manufacturing and incorporating relevant CPD courses. Marketing these opportunities widely to the existing UK workforce and relevant and complementary companies is key.

What are the implications for HEY strategy?

There is a requirement to engage training and skills providers through a strategic and regional approach coordinated through the HEY LEP to both meet market demands and take advantage of opportunities to foster skilled employment opportunities in the sector is also recommended.

How should this inform HEY decision making?

Decision making orientated around education should take the need for EV technicians into account to advance the skill base of the region and ensuring it will be robust in years to come when infrastructure is more extensively rolled-out.

6. Hull and East Riding EV Baseline

This section describes the existing levels of EV uptake, the level of charging infrastructure, and presents a review of the key factors that can influence charging demand in Hull and East Riding. Key factors considered in this chapter include areas of limited off-street parking, income levels across the area, current charge points, and potential future locations.

6.1 Existing Charging Infrastructure

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

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

Figure 6 - 1 illustrates recent Zap-Map data from different regions of England. This data suggests the Yorkshire and the Humber region is comparable to other regions outside of the populous Southeast and Greater London, namely the West Midlands, East of England and Northwest.

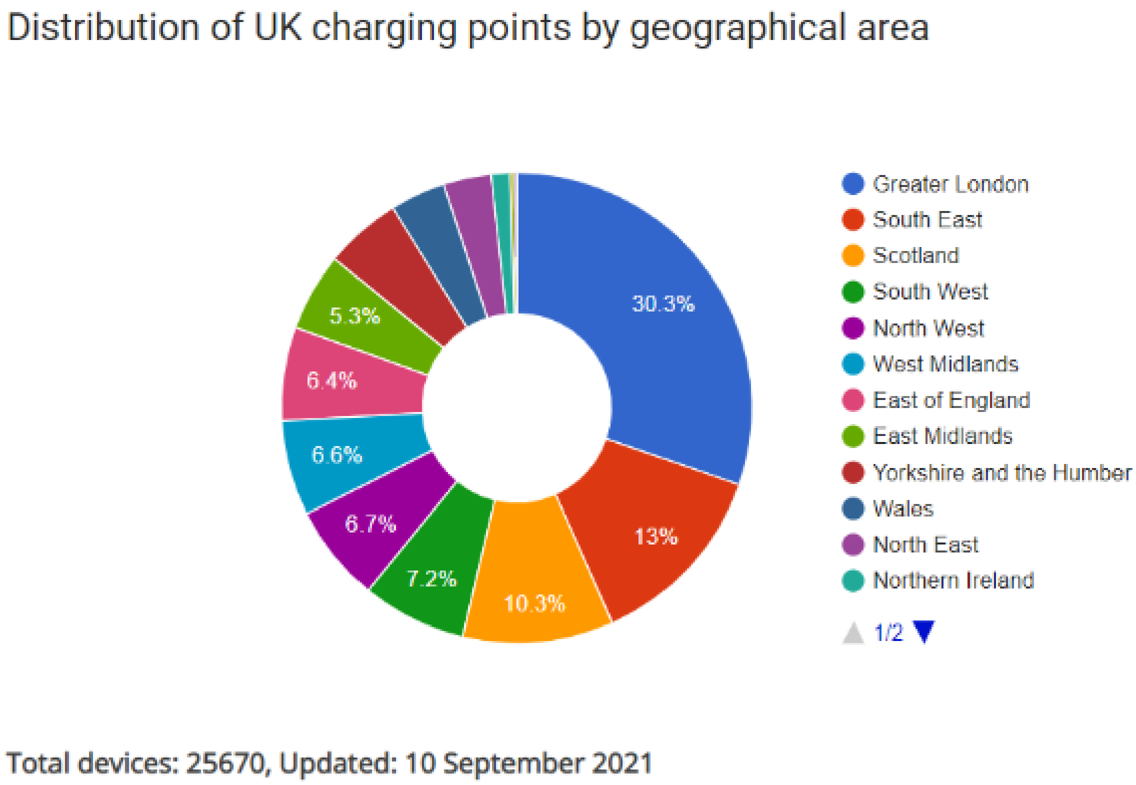


Figure 6 - 1:Total Connectors by Nation and Region (Source: Zap-Map)

According to the National Charge Point Registry (NCR), the UK has 18,251 charging outlets provided for public use, while Zap-Map reports 44,067 connectors from 25,670 devices in 16,201 locations.

Figure 6 - 2 shows the locations of existing EV charging points in Hull and East Riding. This map has been created using NCR and Zap-Map data, where the only available information is their charging speed/wattage and their coordinates. Figure 6 - 3 shows a deep-dive version of Hull city centre to allow a clearer image of charge points available.

There is a reasonable spread of charging infrastructure in both East Riding and Hull as seen in Figure 6 - 2 and Figure 6 - 3 with 40 'rapid' chargers, 159 'fast' chargers and 8 'slow' chargers in operation at the time of writing. Clusters of charging points can be found in and around Hull City Centre, Bridlington, Beverley and Goole, which is to be expected given the density of the areas. A number of these charge points have previously been commissioned by Hull or Easting Riding councils.

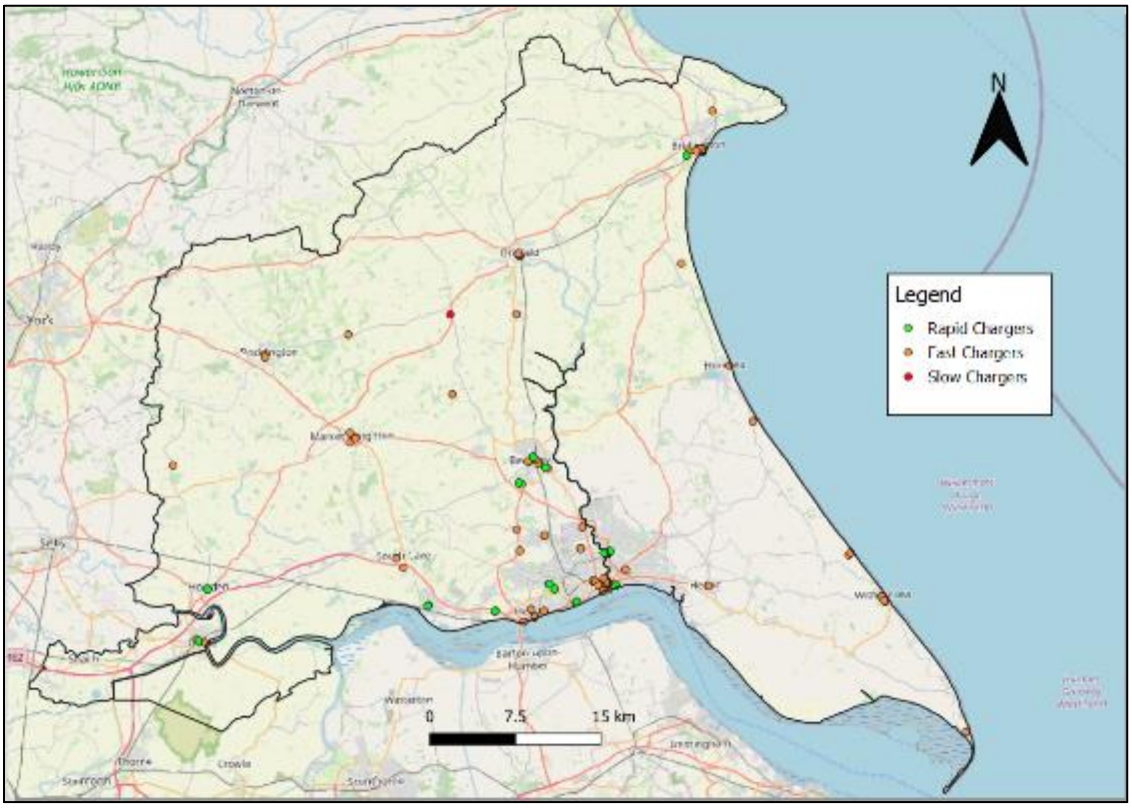


Figure 6 - 2: Existing Charging Infrastructure in Hull and East Riding

Figure 6 - 3: Existing Charging Infrastructure HCC deep-dive

The expected utilisation of any infrastructure to be installed in Hull and East Riding can be, at least partially, determined from the utilisation of the existing infrastructure. However, the data from the past year is perhaps unreliable due to exogenous circumstances and so can only be used as an indication of the potential future behaviour.

Figure 6 - 4: Usage of two Chargers

The data in Figure 6 - 4 shows how the usage of two chargers has rebounded from December 2020, when the UK was still in a national lockdown, through to July 2021 where restrictions have been lifted. It is likely that the July 2021 data is more indicative of the typical charge point usage.

Whilst it is difficult to draw trends from this data, it is interesting to note that the total charge delivered across two sites is approximately 200 kWh. Assuming a tariff of approximately £0.15 per kWh, this would translate to a total income from these sites of £30 per month. With typical installation costs running into £1,000s, it is clear that commercial viability is not achievable at this usage level.

The exact level of usage, and how this relates to the overall level of EV uptake will need to be monitored over a longer period of more stable usage.

6.2 Baseline conditions influencing future demand

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

6.2.1 Household type

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

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

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

The output of this analysis has been mapped, and Figure 6 - 5 shows the density of dwellings with limited off-street parking in the main towns and key service centres in Hull and East Riding, along with the existing charging points. Figure 6 - 6 shows a deep-dive version of Hull city entre to allow a clearer image of the level of off-street parking available.

The majority of areas without off-street parking are concentrated in denser urban areas, including Hull (city centre and residential areas), Bridlington, Beverley, Goole, and Hornsea. In comparison, there is a lower concentration of areas without off-street parking in the less dense rural areas across East Riding. East Riding has a larger geographic area, where the population is more dispersed and areas within East Riding reflect higher levels of income and a high rate of detached residential housing with private driveways.

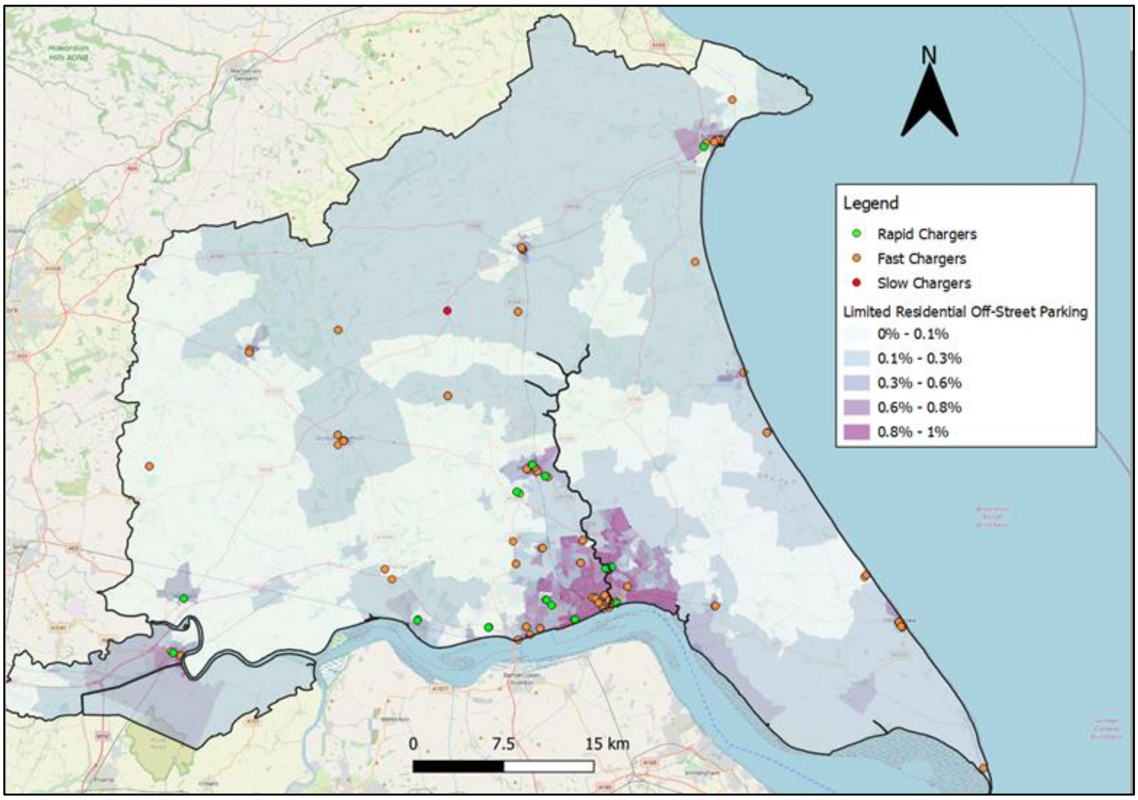


Figure 6 - 5: Existing Charging Points and Limited Off-Street Parking Availability

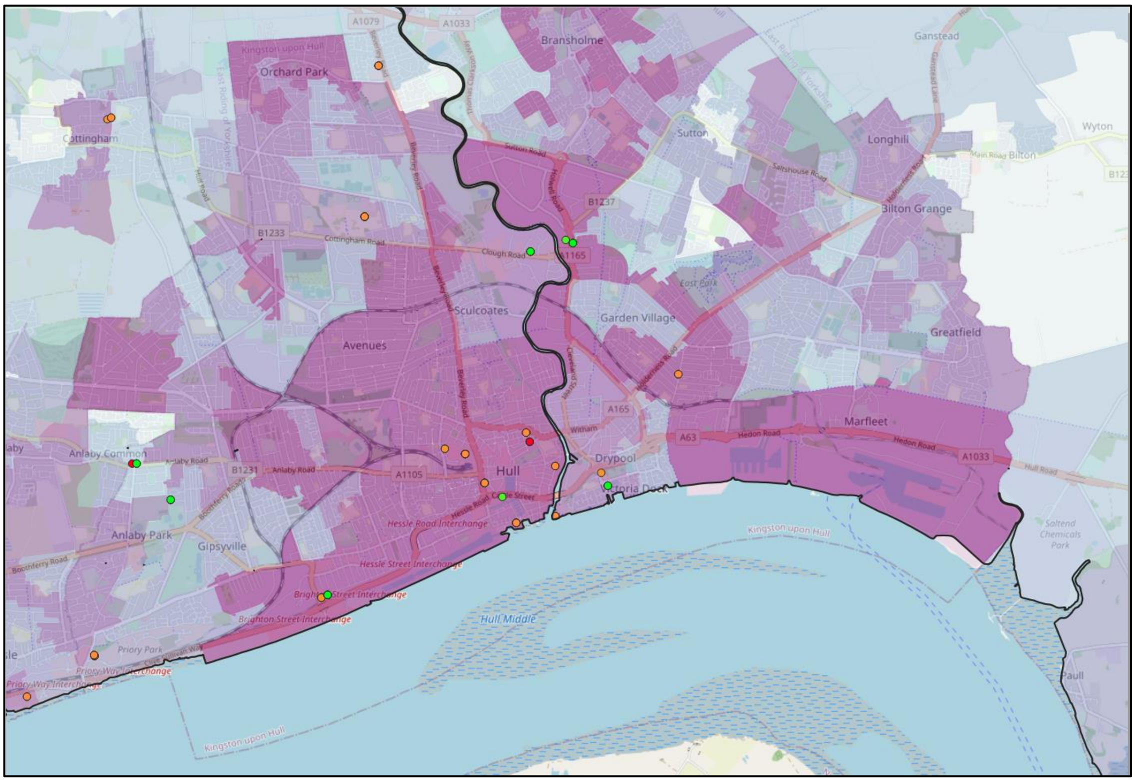


Figure 6 - 6: Existing Charging Points and Limited Off-Street Parking Availability HCC deep-dive

6.2.2 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 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, data regarding income levels from Office for National Statistics (ONS) has been analysed and mapped in Figure 6 - 7 and Figure 6 - 8 below, however this study also considers how a balanced network can be provided across the area.

Figure 6 - 7 presents a distinctive income level divide between East Riding and Hull, with the highest income levels concentrated in the rural areas of East Riding and the lowest income levels concentrated in more dense, urban areas including Goole and Hull. Coastal areas such as Bridlington and Withernsea are also associated with the lowest income levels across the study area. Interestingly, higher income levels can be identified on the western outskirts of Hull, however, as these areas were proven to have more access to off-street parking, this outcome can be expected. Areas of limited off-street parking are spread throughout Hull, however there are greater concentrations outside the city centre where housing type (e.g. terraces) lead to lower levels of off-street parking.

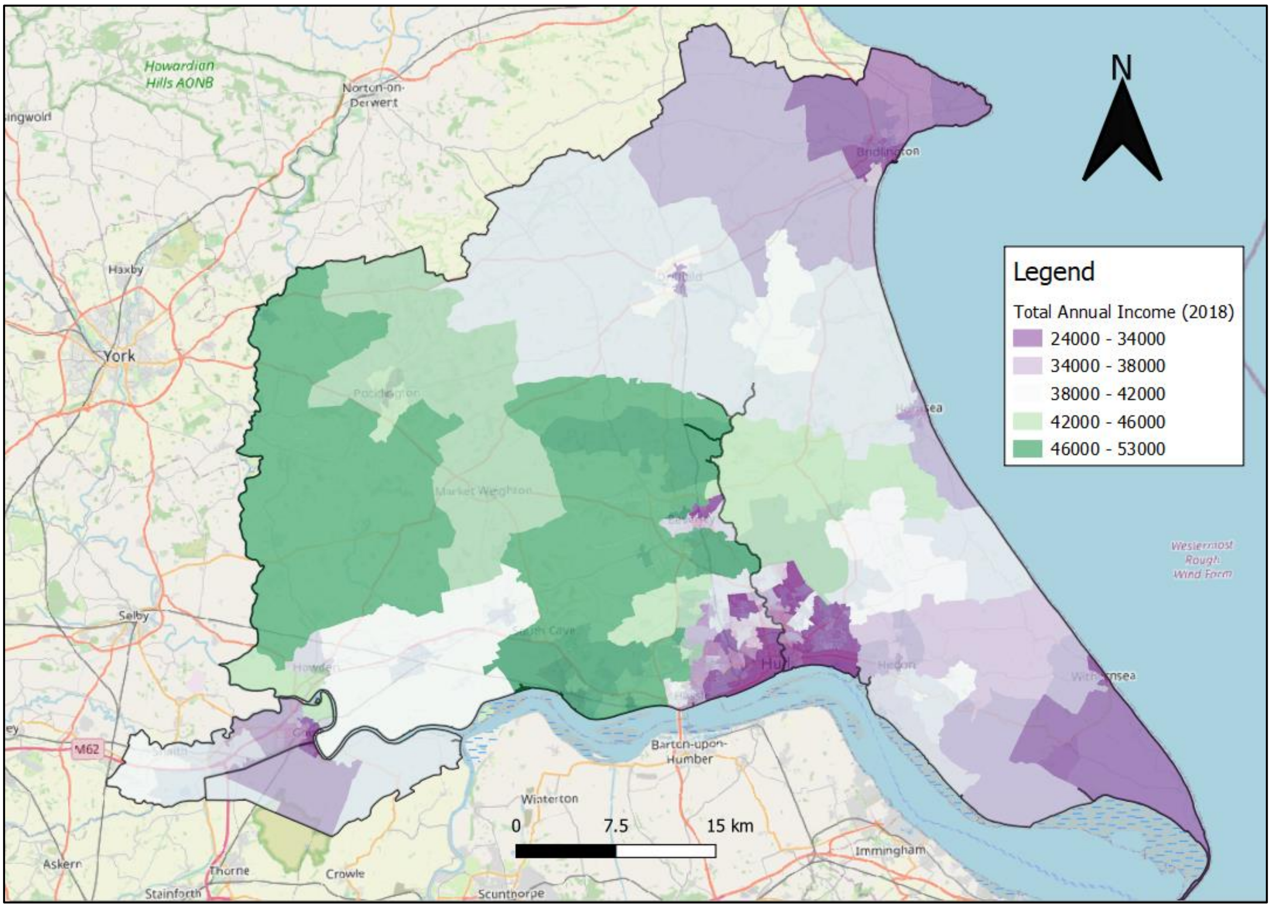


Figure 6 - 7: Total Annual Income in Hull and East Riding

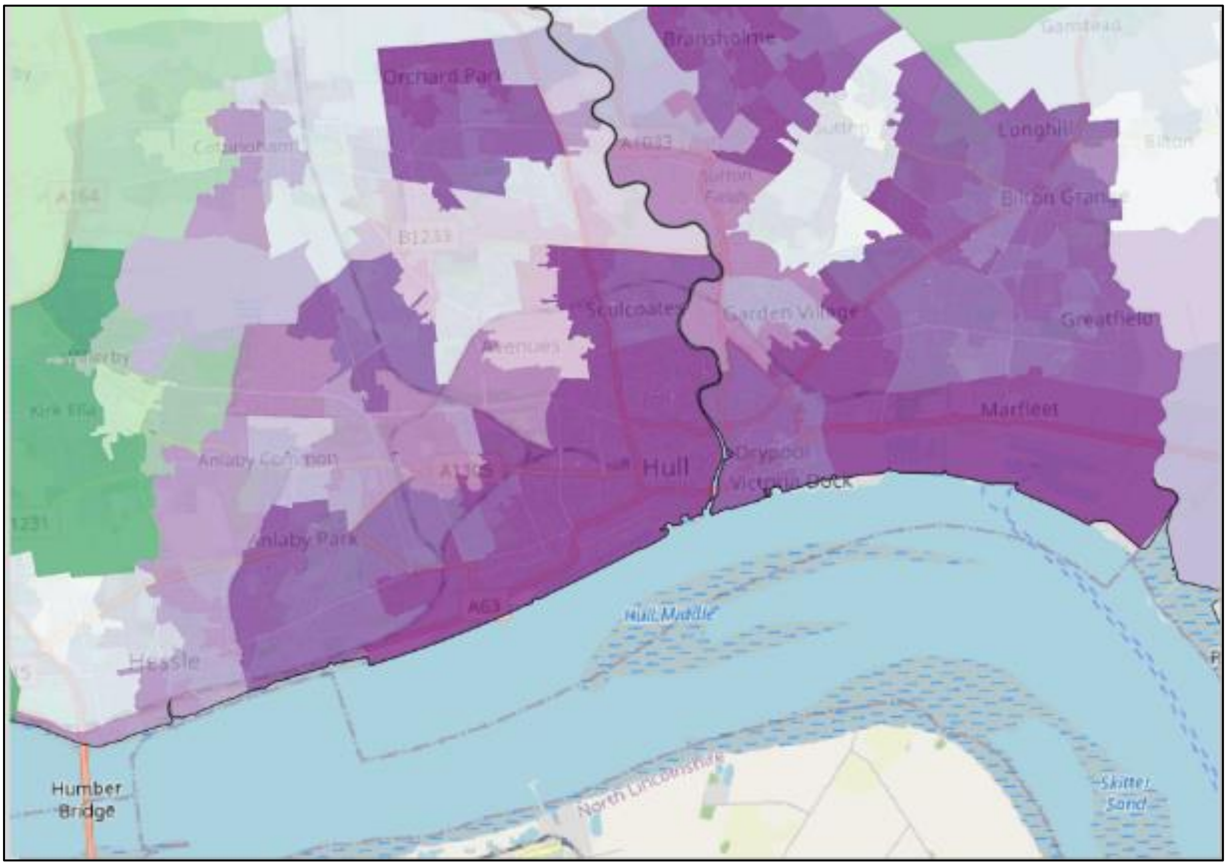


Figure 6 - 8: Total Annual Income HCC deep-dive

6.3 EV Uptake

6.3.1 Registered Vehicles

Figure 6 - 9 shows the number of registered EVs in Hull and East Riding up to Quarter 1 of 2021 and a projected trend line to 2030 based on the historical growth curve between 2011 and 2020. Registered EVs are higher in East Riding than Hull reflecting the larger fleet of registered vehicles and potentially more conducive demographics in terms of income levels. The projected growth curves to 2030 for registered EVs in East Riding would result in approximately 5000 vehicles and for Hull 1500 vehicles. This is significantly below the proportionate figures locally that would be required if the UK is to hit the forecasts produced by the Committee on Climate Change (approximately 76,000 vehicles for Easting Riding and approximately 40,000 for Hull). It is therefore clear that a significant acceleration in the uptake of EVs is required through the remainder of the 2020s to meet ambitious targets form decarbonisation.

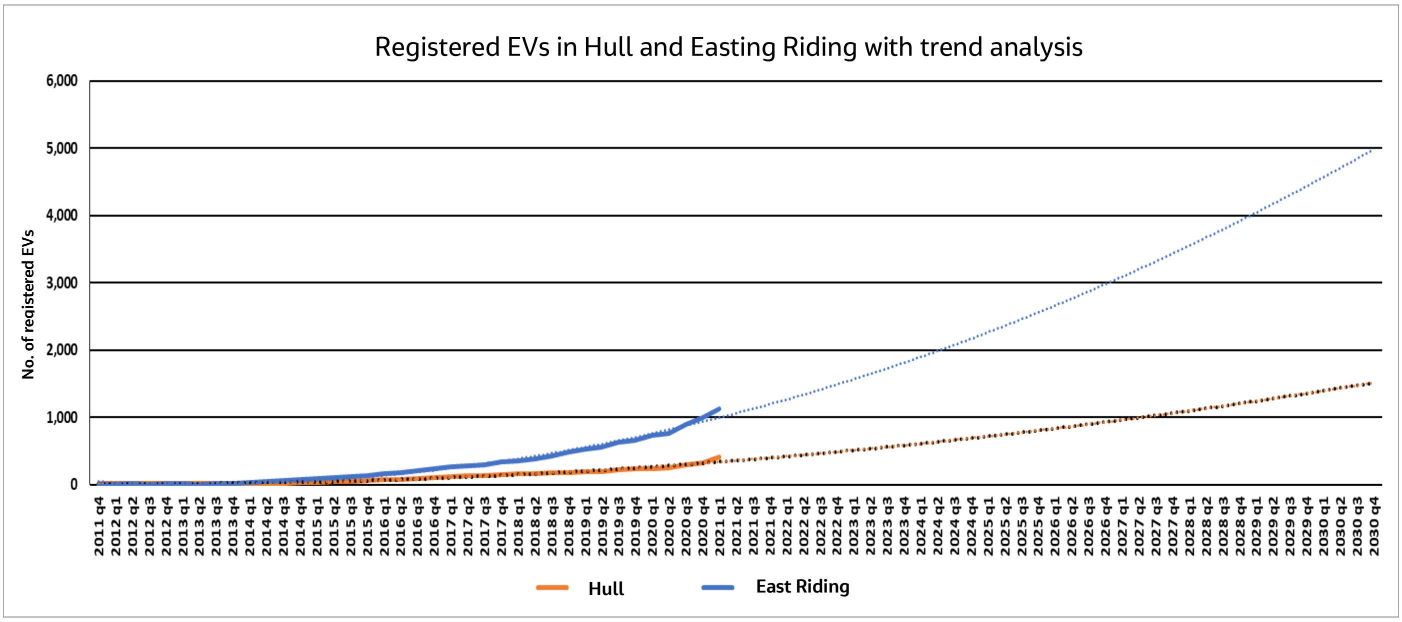


Figure 6 - 9: Number of registered EVs in Hull and East Riding up to Quarter 1 of 2021 with a projected trend line to 2030

6.3.2 BEV Ownership

Closely tied with the income analysis, this section of the report presents the percentage of BEV and PHEV Ownership in East Riding and Hull. Data from nomisweb has been analysed and mapped.

As presented in Figure 6 - 10 and Figure 6 - 11, there is an overall low percentage of BEVs across East Riding and Hull, with the highest percentages being found in Hull City Centre, the western outskirts of Hull and in the northwest region of East Riding. High rates of ownership in these areas are likely to be reflective of income level as EVs have higher price points for both new and used vehicles in comparison to petrol / diesel. Commuter journeys to York may also be a reason as to why higher rates are found in the Pocklington area. There also appears to be a relationship between journey distance to significant centres of employment and population, with higher levels of uptake in the vicinity of Hull and York, however it is difficult to draw firm conclusions on this.

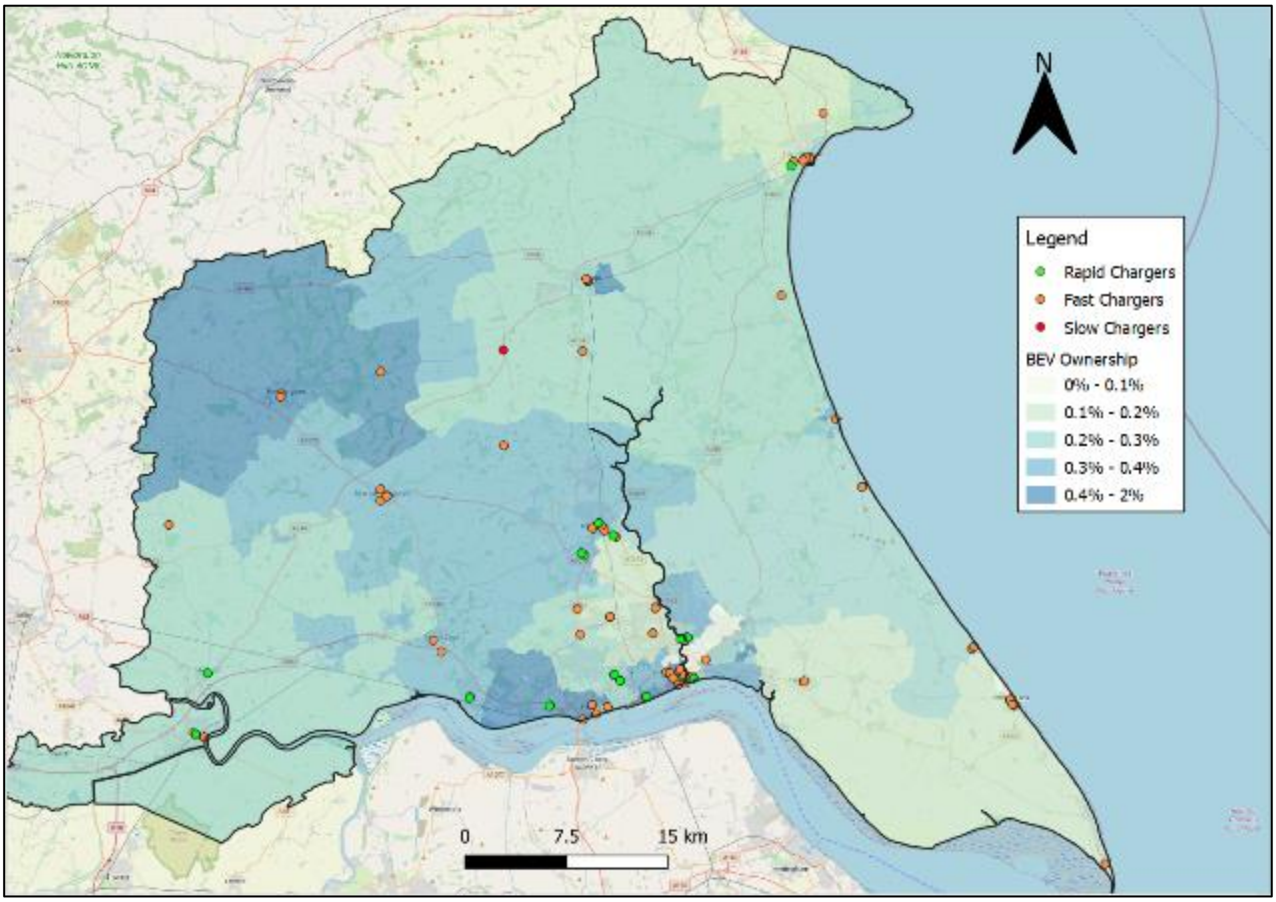


Figure 6 - 10: Existing Charge Points and BEV Ownership

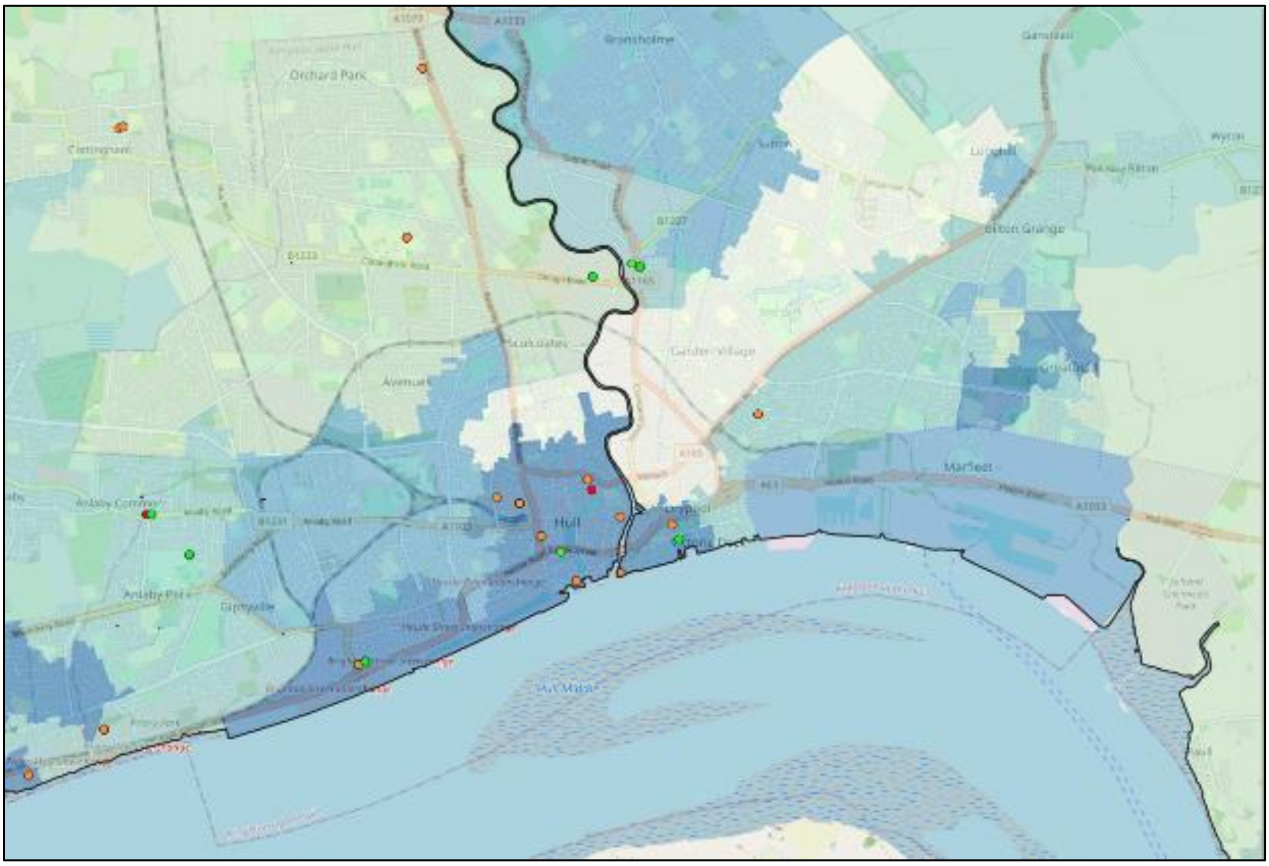


Figure 6 - 11: Existing Charge Points and BEV Ownership HCC deep-dive

6.3.3 PHEV Ownership

Similar to BEV ownership, Figure 6 - 12 and Figure 6 - 13 show an overall low percentage of PHEV ownership across East Riding and Hull. Higher rates of PHEVs are concentrated in rural areas across East Riding such as Pocklington and Market Weighton, as opposed to more dense urban areas. This outcome may be expected due to the following:

- Expense of PHEV's - areas in East Riding are associated with higher levels of income, therefore more people from those areas will be able to afford PHEV's than those from areas with lower levels of income.
- Large geographic area of East Riding – PHEVs may be better suited to the area as they provide both electric charge and petrol engine, increasing the range.

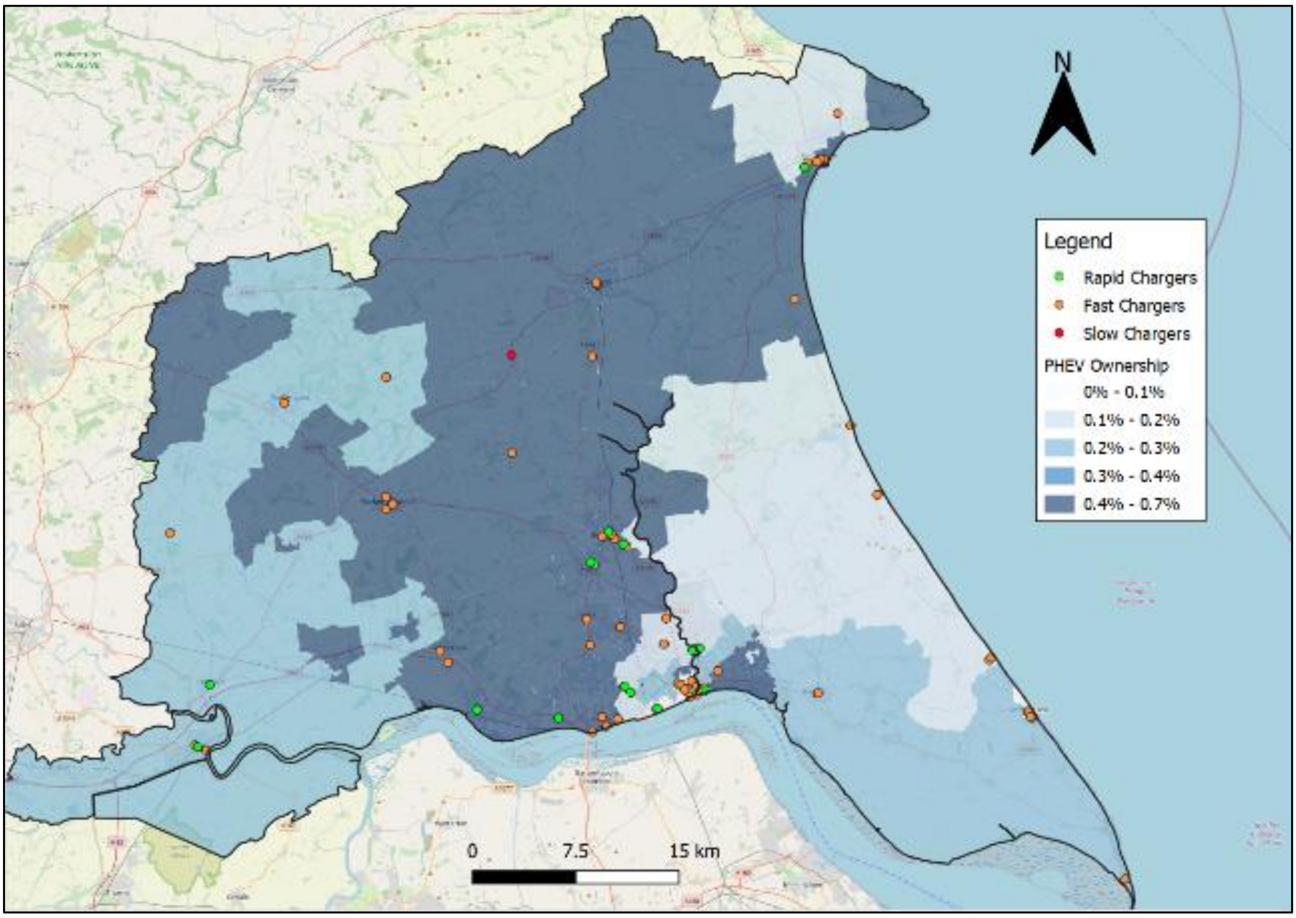


Figure 6 - 12: Existing Charge Points and PHEV Ownership

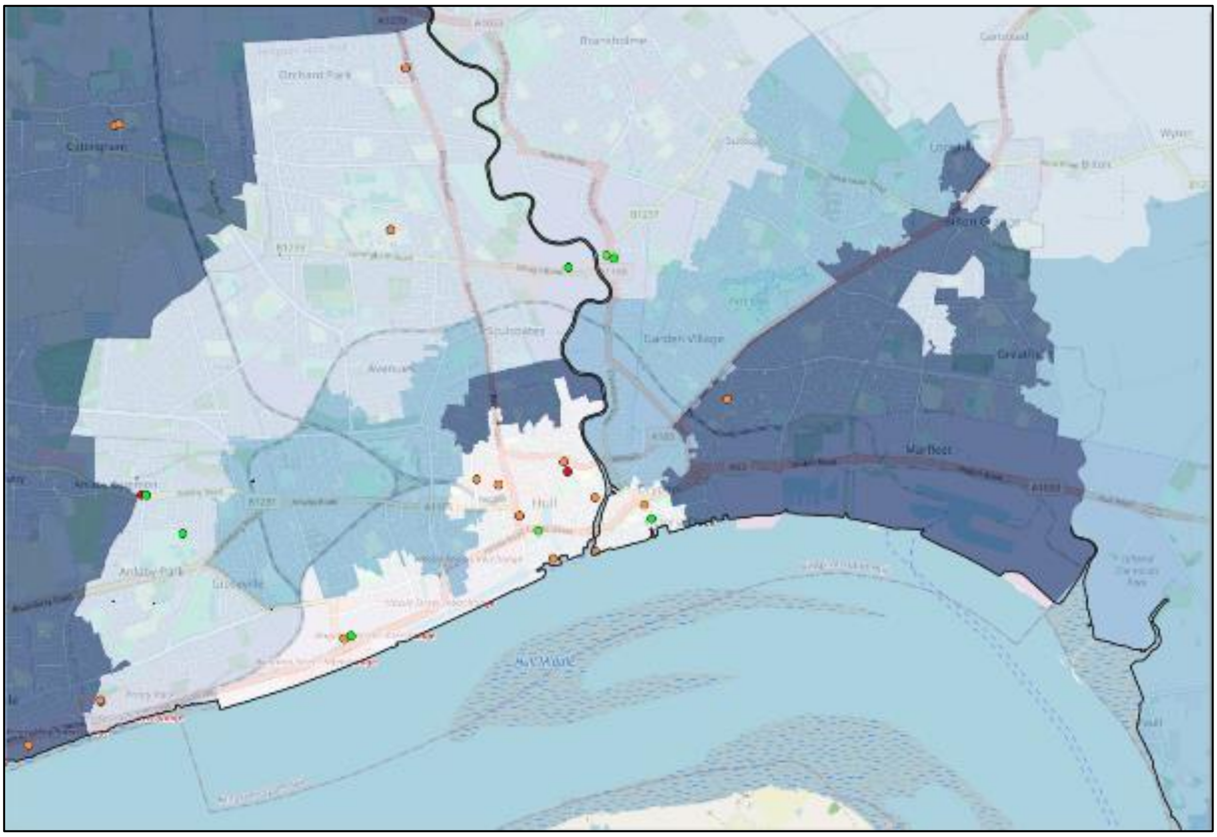


Figure 6 - 13: Existing Charge Points and PHEV Ownership HCC Deep-Dive

6.4 Council Owned Parking and Offices

Hull and East Riding Council owned parking, as well as council offices, were identified and mapped alongside existing charge points in the area, as shown in Figure 6 - 15 and Figure 6 - 14.

A number of sites already host charge points available to the public and/or council fleet vehicles, and further sites may also be suitable for the provision of charge points. The provision of charge points at these locations can provide a useful service to surrounding communities and businesses to help reduce stress on on-street locations. Further information on site assessments for these locations is provided in following chapters.

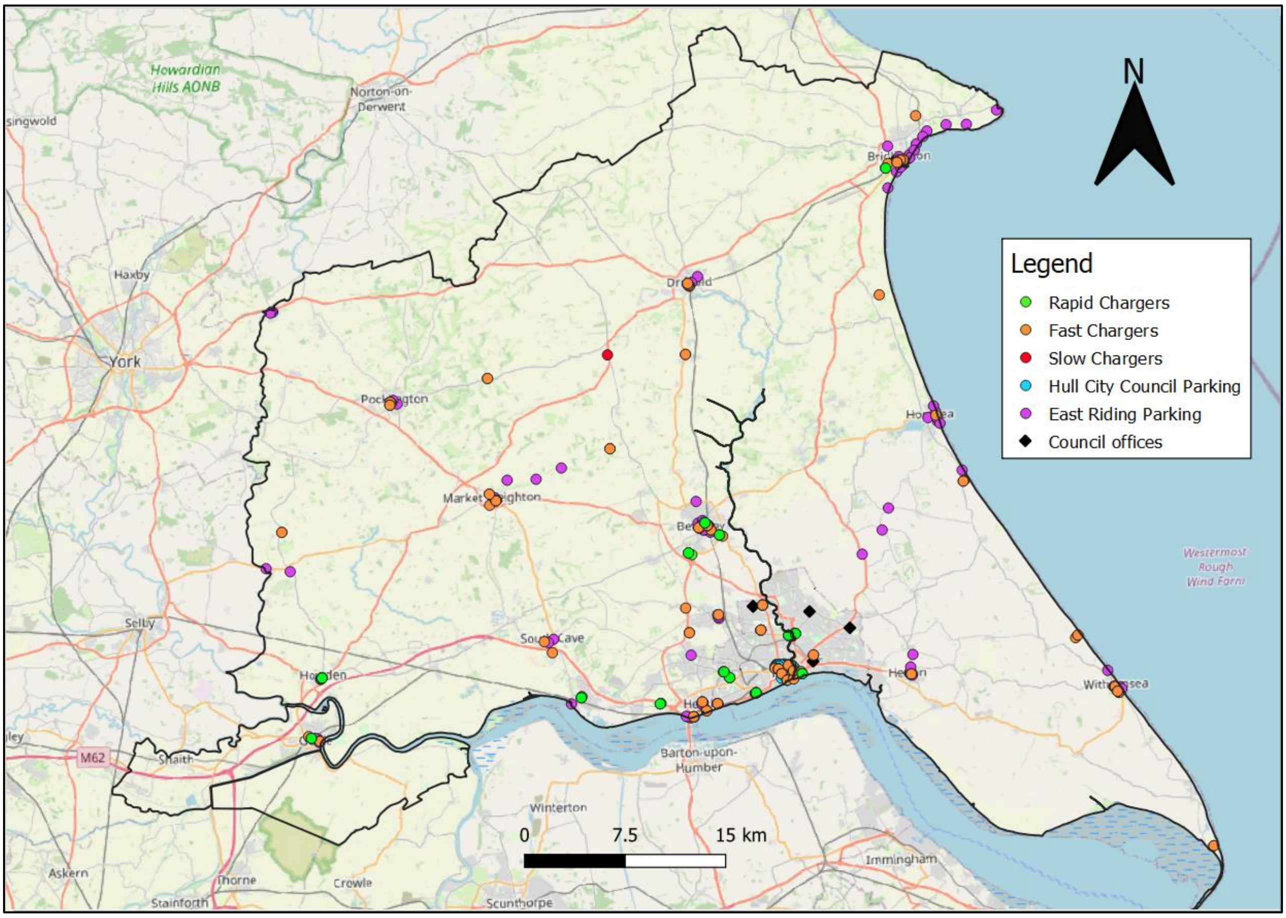


Figure 6 - 15: Existing Charge Points, Hull and East Riding Council Parking and Council offices

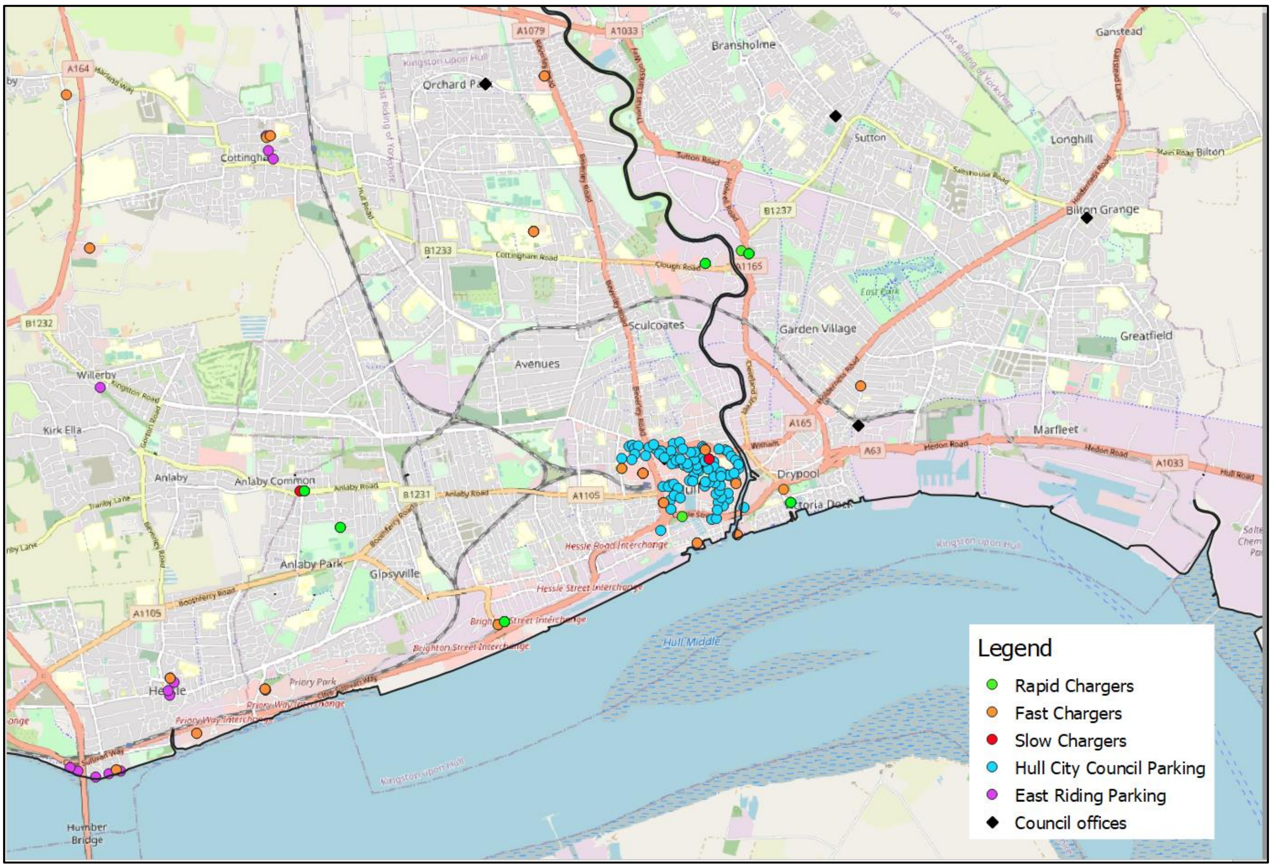


Figure 6 - 14: Existing Charge Points, Hull and East Riding Council Parking and Council offices HCC deep-dive

6.5 NHS Hospitals

In common with other sectors there is a significant programme of investment planned to decarbonise the NHS including fleet upgrades to electric vehicles. Additionally, visitors and staff are likely to stay at the hospital for a sufficient amount of time, which supports the reason for investing and implementing infrastructure in hospital car parks. EV owners can arrive, plug in their car to charge while in the hospital, and then leave and drive to their next destination with full charge. Further to this, charging hubs at hospitals could also support wider demands for EV charging in appropriate locations. NHS hospitals in East Riding and Hull were analysed using Google maps and plotted alongside existing charge points, as shown in Figure 6 - 16 and Figure 6 - 17. Publicly available charge points are planned to be installed at Hull Royal Infirmary with charge points to support fleet vehicles also due for installation.

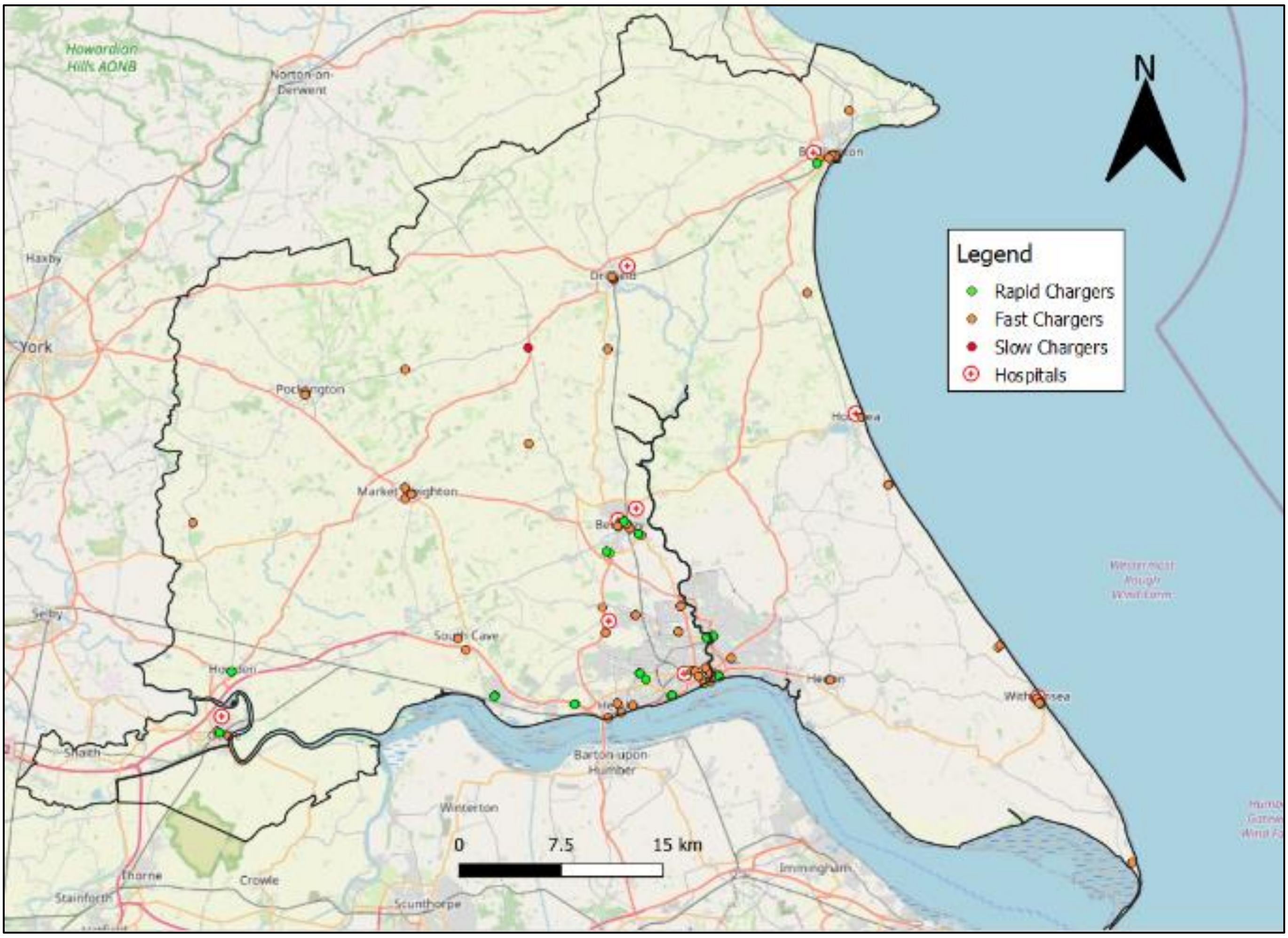


Figure 6 - 16: Existing Charge Points and NHS Hospitals

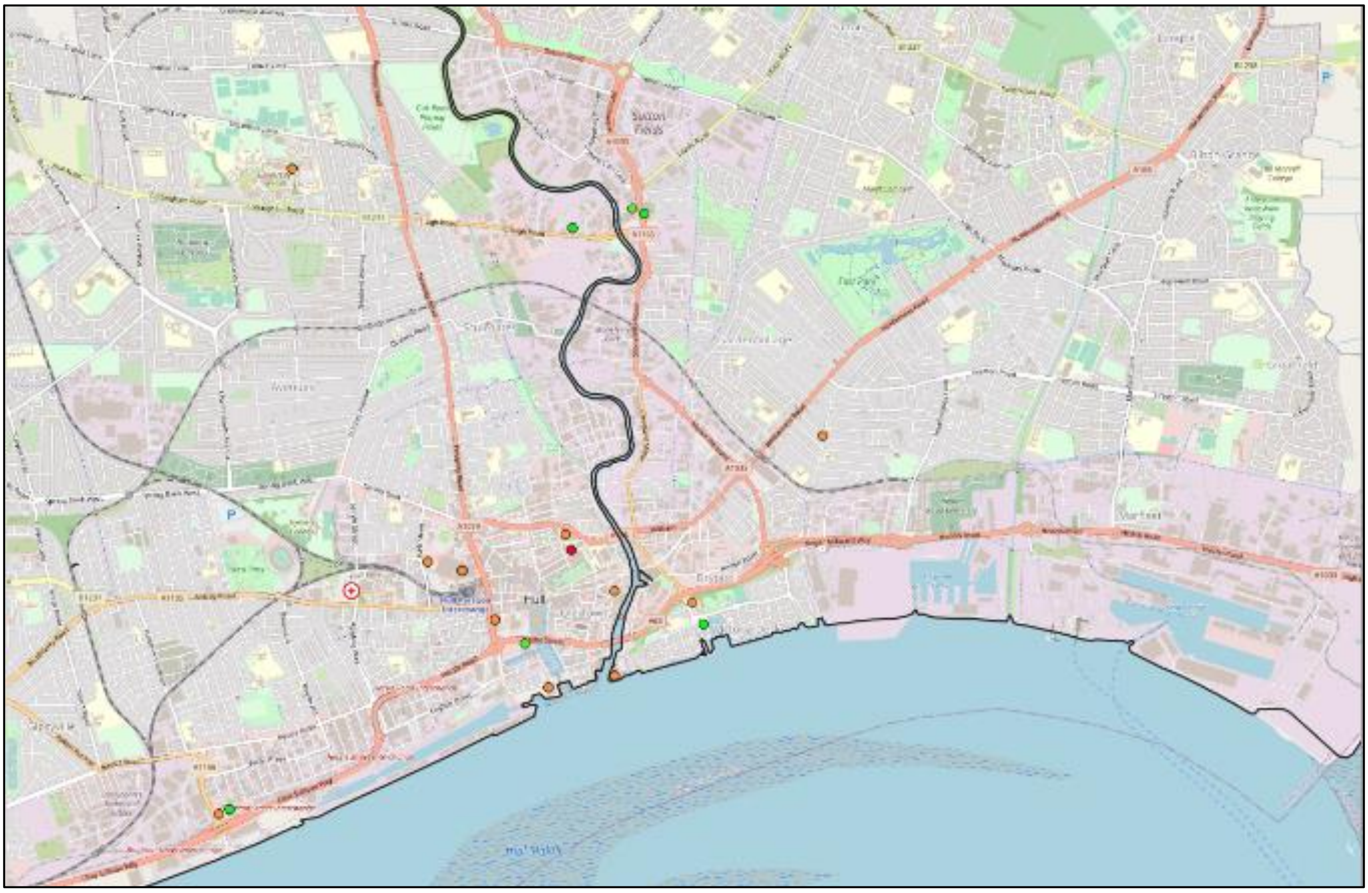


Figure 6 - 17: Existing Charge Points and NHS Hospitals HCC Deep-Dive

6.6 Potential Commercial Sites

Figure 6 - 18 illustrates the analysis and mapping of potential commercial sites in East Riding and Hull that may bring forward EV charging sites alongside existing charge points. These sites include BP and Shell forecourts with both companies committing to installing charge points, and supermarkets that are increasingly working with charge point operators to bring forward EV charging too. A large number of potential commercial sites are concentrated in and around Hull, with the main towns in East Riding hosting sites too. There is a notable lack of potential commercial sites in smaller towns in East Riding and the wider hinterland.

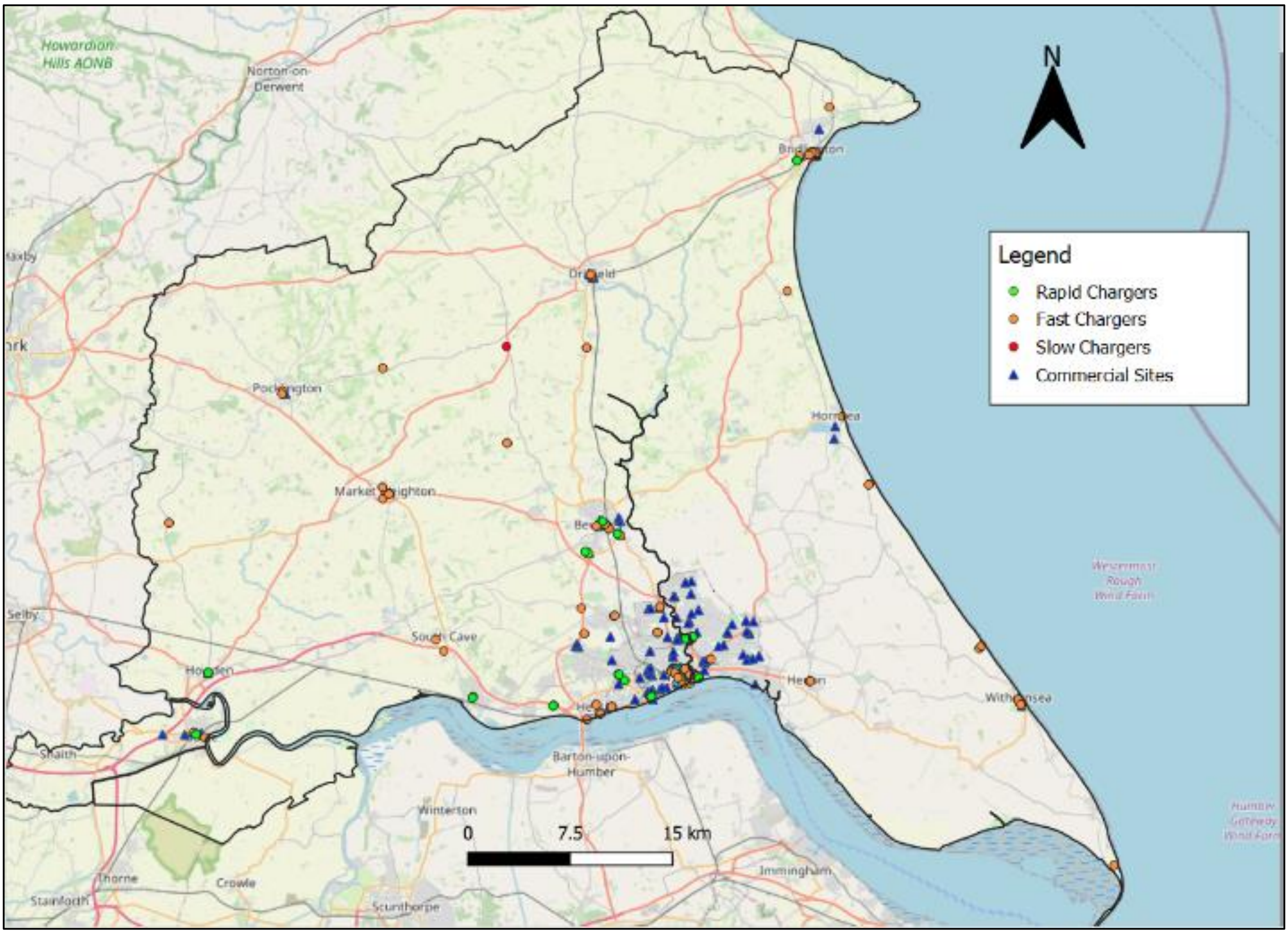


Figure 6 - 18: Existing Charge Points and Commercial Sites

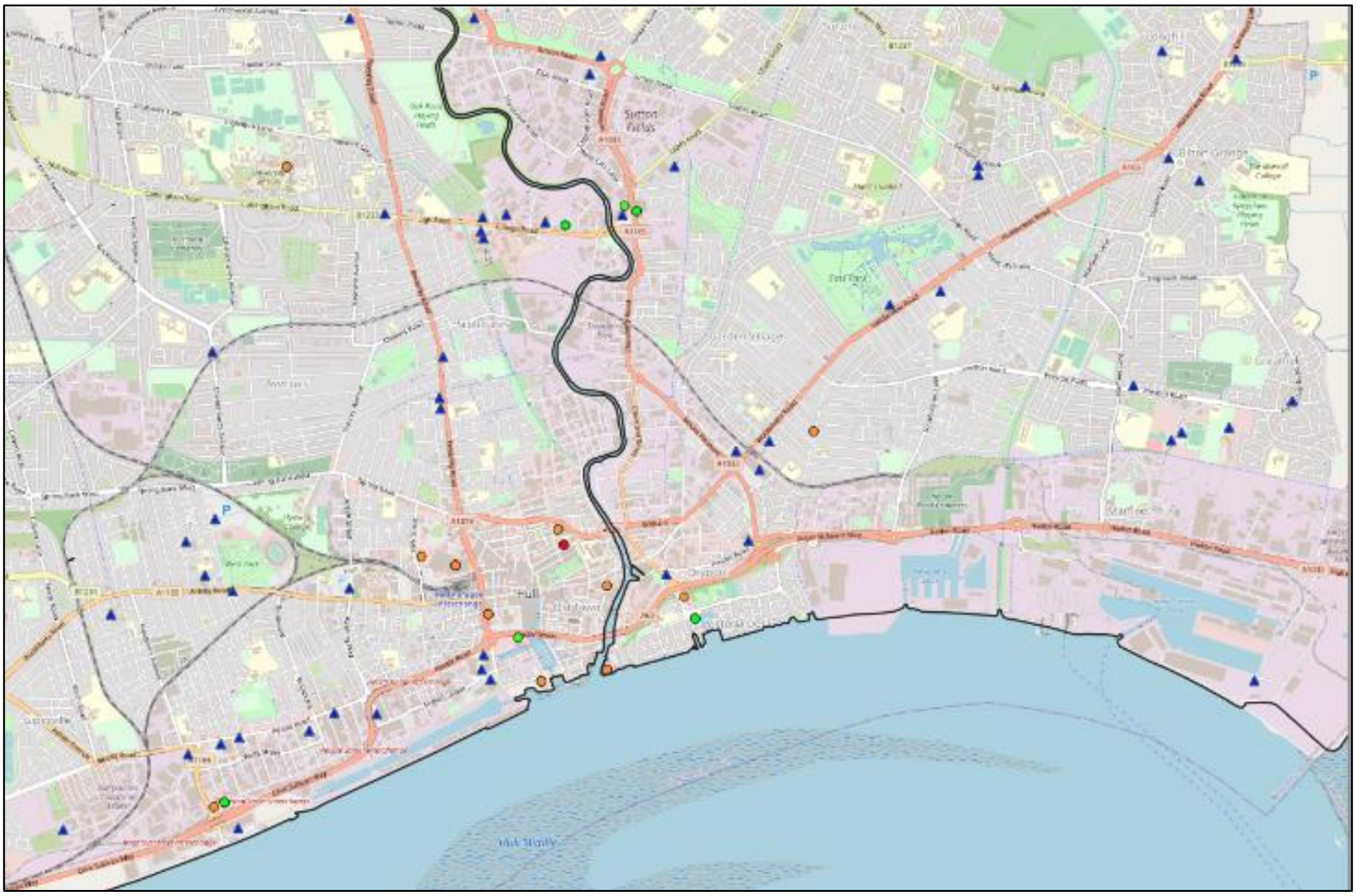


Figure 6 - 19: Existing Charge Points and Potential Commercial sites Hull Deep-Dive

6.7 Response to Stakeholder Feedback

Building on the GIS evidence base, experience has shown that stakeholder engagement and feedback is a crucial component in obtaining local knowledge regarding the region's EV uptake trends.

6.7.1 Workshop Feedback

The purpose of the EV Strategy Workshop was to engage with stakeholders and provide them with an overview of the study, including the key project stages, current progress, and subsequent next steps. This included the policy and technological context in order to identify and understand key trends, local issues, and opportunities, as well as data collection and analysis to inform the study. A summary of the key points is provided below.

- There are currently numerous barriers to EV uptake including:
  - EVs cost more than conventional ICEs and are therefore more attractive for higher income groups.
  - There is a lack of infrastructure in some places, however it is important to note that in a lot of places where there is infrastructure, utilisation is low.
  - Many homes do not have off-street parking although some workshop participants noted this is not a problem currently as 1) there are low numbers of EV owners, and 2) those who are lined up to purchase an EV are those who generally have driveways.
- There is a strong correlation between off-street parking and income, and a strong correlation between income and EV purchase and new vehicle purchase. Currently there are strong variations in EV uptake, between the different areas in the different local authorities, particularly in East Riding, where income levels are higher. In areas with higher income levels, there may not be the requirement for on-street infrastructure charging due to these areas being predominantly detached housing and hence, likely to have private charging points on their driveway. Subsequently, providing infrastructure in those areas is not necessarily the best option, and instead, targeting more dense urban areas with limited off-street parking, such as high-rise city centre flats and streets with terraced housing.
- Monitoring and analysing data sets and understanding journey patterns and people's behaviours is fundamental due to the following:
  - Consumer preferences for charging is evolving from charging at home every night to utilising the charging infrastructure at work, which are not on public charging maps as they are privately installed.
  - Investing and implementing charging infrastructure in areas of limited demand is likely to lead to limited revenues. For example, the Scottish Government implemented a significant number of charge points around the country, including shopping centres, petrol stations, and motorway services due to 'wanting a network which would allow anybody to drive anywhere'. However, little revenue has been brought in to maintain the charge points. It is important to note from this example that implementing infrastructure anywhere is not practical nor the best solution. Instead, analysing data sets and targeting areas where the infrastructure is most likely to be used.
- It is important to be aware that charge point operators are signing deals with companies that have numerous sites in the area such as supermarket chains, and therefore infrastructure will be implemented quickly in a short space of time. Therefore, when identifying areas which have a high EV uptake potential in order to implement infrastructure, this needs to be considered.
- One of the challenges we face with encouraging EV uptake is the media. There is a lot of unintended scaremongering around EVs e.g. short ranges of vehicles, and the challenging scenario of many people charging at the same time leading to a national grid failure, and unfortunately this has locked into people's minds. It is vital that the motoring public are informed with the right type of education and messages that they are buying a vehicle which does not need to be charged every day, and that there is suitable charging availability in many cases.

- It is important to help steer demand, but in a socially equitable way. It is about balance - we don't want to chase demand and implement infrastructure where the usage is highly likely to be very low for a number years, because that is not channelling behaviour change. Focus should be on areas where the demand is not quite there yet.

- There is an issue of affordability in Hull, with the city having a very high used car market. There will likely be a high rate of EV second-hand market cars which are recycled. This means there will continue to be an increase of EVs with relatively short ranges in Hull, in comparison to other areas of higher income, where the range for EVs will increase and the range anxiety will decrease, as newer EV vehicles are purchased.

The key points mentioned above will help shape recommendations and the final outputs of this study work, especially in terms of the local context.

6.8 Summary

- There is a reasonable spread of charging infrastructure in both East Riding and Hull, with 40 'rapid' chargers, 159 'fast' chargers and 8 'slow' chargers in operation at the time of writing, clustering in and around Hull, Bridlington, Beverley and Goole. This pattern is to be expected given the density of the areas but may also reflect lower income levels and limited access to off-street parking. There is however a lack of rapid charging in a number of locations as expanded upon in later chapters of this report.
- Commercial viability is not achievable at the current usage level.
- Household type: households with limited access to off-street parking will be unable to accommodate individual charging points and owners may therefore be discouraged to shift to EV's. The majority of areas without off-street parking are concentrated in denser urban areas.
- Demographics: 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 and limited second-hand market. There is an income level divide between East Riding and Hull, with the highest income levels concentrated in the rural areas of East Riding and the lowest income levels concentrated in more dense, urban areas including Goole and Hull.
- There is a low percentage of BEVs across East Riding and Hull. There are relatively higher rates of ownership in pockets across the region that are likely to be reflective of higher income levels as EVs have higher price points for both new and used vehicles in comparison to petrol / diesel.
- The projected growth curves to 2030 for registered EVs in East Riding would result in approximately 5000 vehicles and for Hull 1500 vehicles. This is significantly below the proportionate figures locally that would be required if the UK is to hit the forecasts produced by the Committee on Climate Change (approximately 76,000 vehicles for Easting Riding and approximately 40,000 for Hull). It is therefore clear that a significant acceleration in the uptake of EVs is required through the remainder of the 2020s to meet ambitious targets form decarbonisation.
- A number of Council owned car parks and offices already host charge points which are available to the public and/or council fleet vehicles, and further sites may also be suitable for the provision of charge points. The provision of charge points at these locations can provide a useful service to surrounding communities and businesses to help reduce stress on on-street locations. Further information on site assessments for these locations is provided in following chapters.
- A large number of potential commercial sites are concentrated in and around Hull, with the main towns in East Riding hosting sites too. There is a notable lack of potential commercial sites in smaller towns in East Riding and the wider hinterland.
- A range of feedback has been gathered through a stakeholder workshop and this is considered further in later chapters of this study.

What is the key relevance to HEY?

Understanding the current baseline network is key in identifying patterns and gaps which can then be targeted to support EV uptake.

What are the key lessons for HEY?

There is a low percentage of BEVs across East Riding and Hull at present. The projected growth curves to 2030 based on historical growth for registered EVs would result in approximately 5000 vehicles for East Riding and 1500 vehicles for Hull; significant acceleration above these levels in the uptake of EVs is required through the remainder of the 2020s to meet ambitious targets form decarbonisation.

What are the implications for HEY strategy?

Following the identification of infrastructure gaps, ownership levels and potential opportunities, this study reports outcomes of assessments in later chapters to fill these gaps. Noting the currently low levels of BEV, investment is required to create a conducive environment in the future to support an acceleration in uptake.

How should this inform HEY decision making?

Infrastructure implementation decisions should ensure a good coverage of Hull and East Riding filling key gaps in the current network, however the strong potential for further sites to come forward through the commercial sector should be recognised to ensure public funds are focussed on addressing market failures.

7. Geospatial Modelling

7.1 Overview of Model

The key driving force behind the siting of EV charge points is knowledge of exactly where Electric Vehicles will want to charge. So, to generate a reliable model for the infrastructure demand for charging, it is necessary to understand how the overall vehicle fleet will transition to EVs by creating a model for how a new technology will diffuse into an already existing fleet. The diffusion of the new vehicle models will be governed by two important characteristics.

- The rate at which new vehicles are purchased. This determines the "churn" of vehicles within the fleet overall. If few new vehicles are being purchased (due to a recession, say) then there will be a substantial slowdown in the transition to EVs as the population of vehicles is not being replaced.
- The probability of new vehicle purchases being an EV. If the fleet is to transition to EVs then the probability of each new vehicle being an EV, should increase to 100%. This will be directly related to the typical 2030/2035 targets that are prevalent across any countries.

However, too frequently, in discussions about EV uptake the focus is on the second question, with little consideration given to the implications of the first question

Therefore, for each question we need to determine a systematic technique to derive the two results required, the level of new vehicles and the change that that new vehicle is an EV.

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

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

The form of the logit choice model used in this work is a Binary Logit Choice Model, with changing variables over the two alternatives. This form of the model allows us to calculate the probability of choosing between two distinct, and exhaustive (meaning that the options represent the only options available to the purchaser, and they must choose one) options. The general form of this model is shown below.

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

Here, C1 represents Option 1, U1 represents the Utility of that choice (defined through a combination of income and EV price) and l is a parameter used to determine the sensitivity to change for the utility values within the logit choice model.

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

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

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

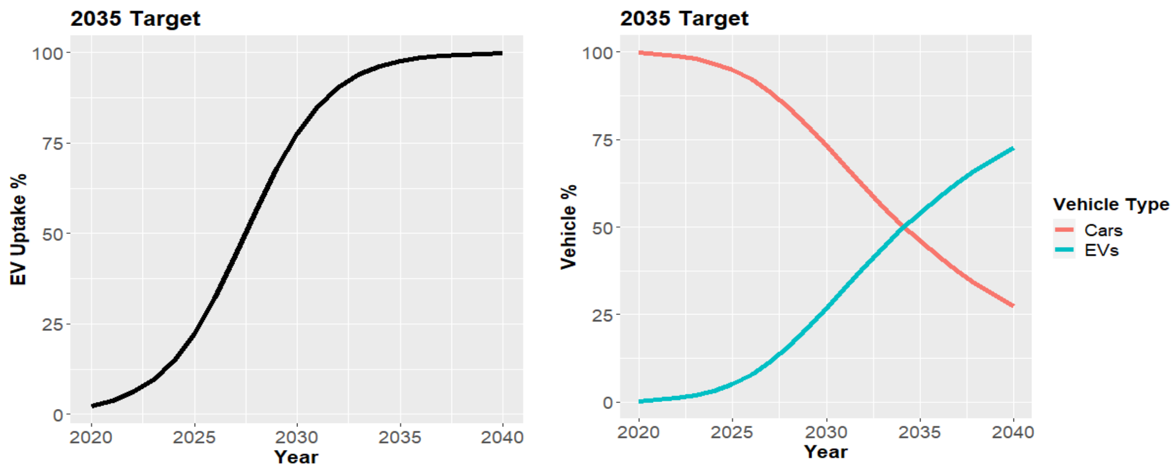


Figure 7 - 1: EV Uptake Targets

In Figure 7 - 1 we can see **the number of EVs in the fleet lags behind a potential 2035 goal** for full decarbonisation of the new vehicle fleet. Even though 100% of all vehicles sold are EVs by 2035, the fleet still only contains approximately 50%.

7.2 Data Review of Information Feeding into the Model

The model has been constructed, where possible, through the combination of publicly available data sets.

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

Table 7- 1: Model Data Inputs

7.3 Forecasted Uptake in Hull and East Riding

Figure 7 - 2 shows the forecasted numbers of EVs and Internal Combustion Engines in Hull, East Riding and collectively across both areas.

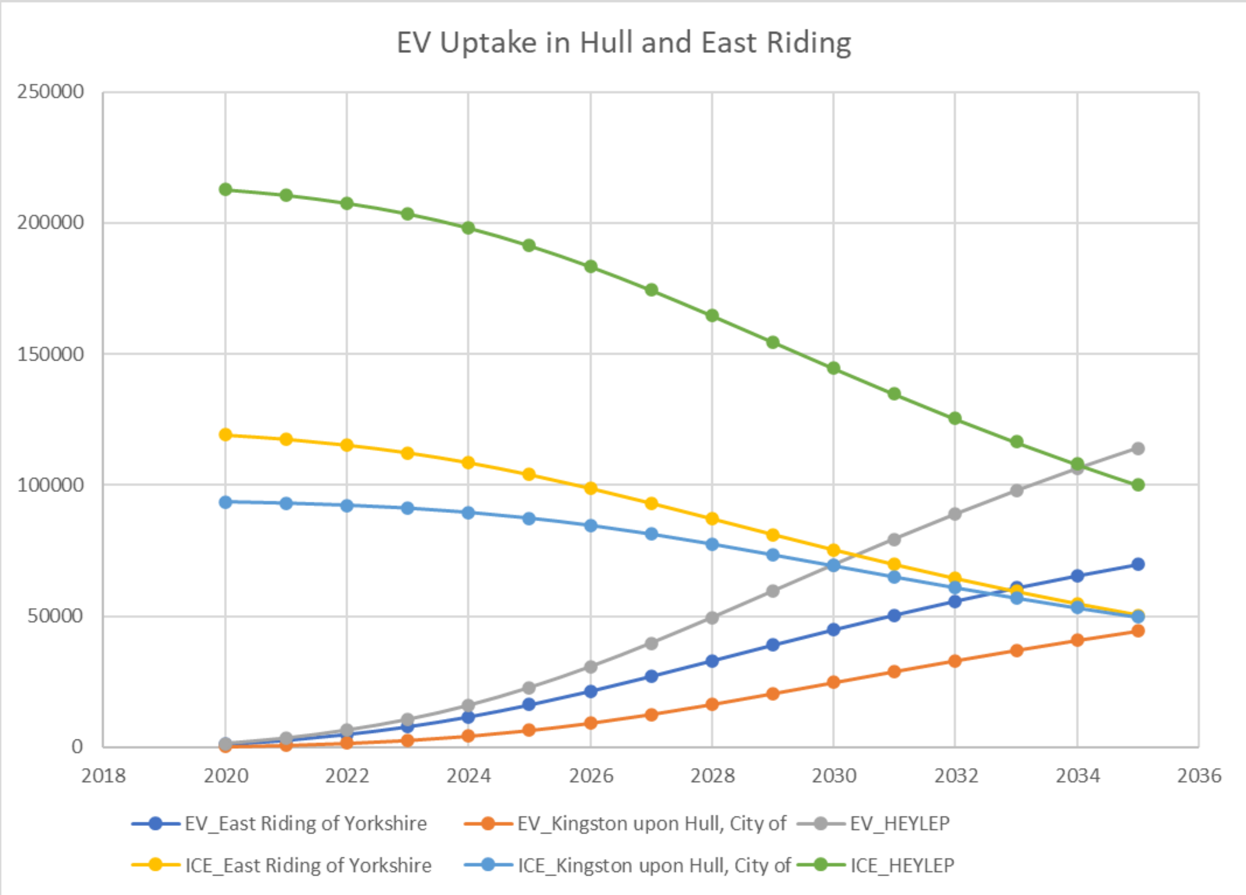


Figure 7 - 2: Forecasted numbers of EVs and ICEs in Hull, ER and collectively

Figure 7 - 2 shows the forecasted numbers of EVs and Internal Combustion Engines in Hull, East Riding and collectively across both areas. By 2030 the model is forecasting approximately 37,000 EVs in East Riding and approximately 25,000 EVs in Hull with an increase in the growth rate of an EV uptake in the second half of the 2020s. It must be noted that large uncertainties currently exist regarding the supply of EVs and purchasing behaviour as noted in earlier chapters of this report. These forecasts inform future recommendations in later chapters of the report, however further monitoring of EV uptake in recommended and caution should be used when using these forecasts to not place undue emphasis on absolute levels of forecasted EV uptake.

7.4 Spatial Model Results

The spatial results for EV uptake are shown in figures below for Kingston Upon Hull.

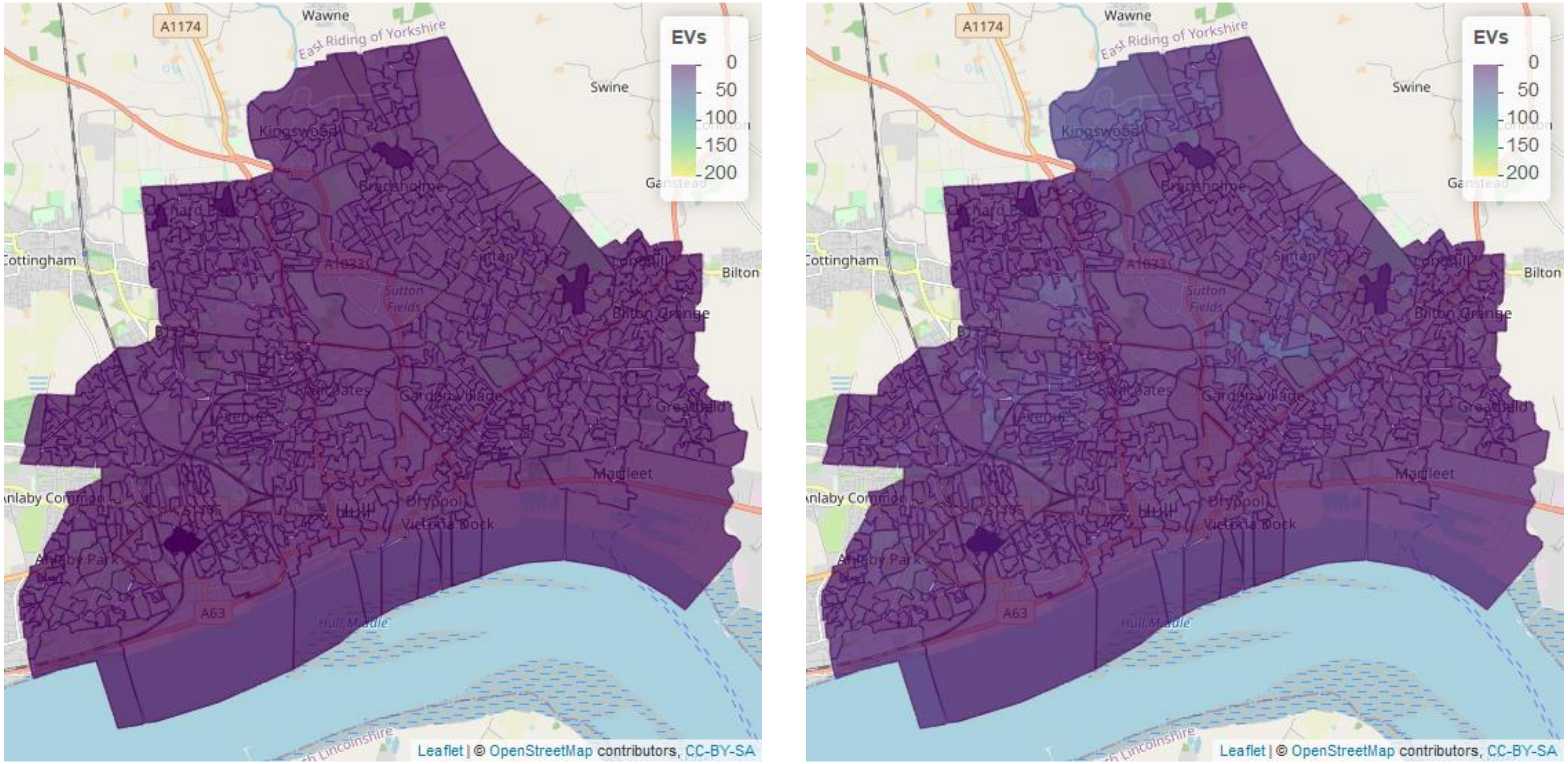


Figure 7 - 3: Spatial EV Uptake in Hull 2021, 26

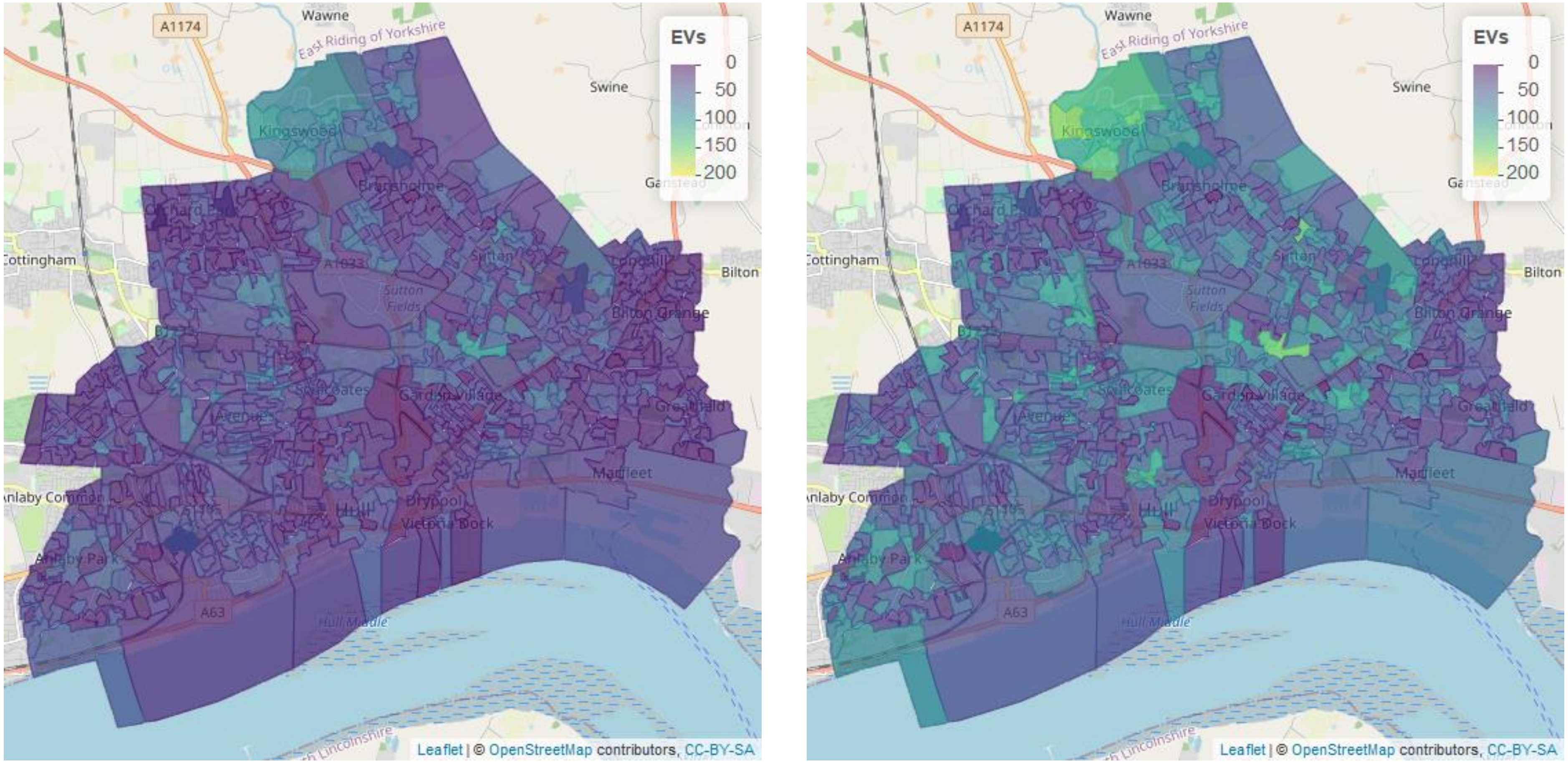


Figure 7 - 4: Spatial EV Uptake in Hull 2031, 36

It can be seen from the figure above that despite the large increase in the % of new vehicles being purchased as EVs, the absolute number of EVs within Hull remains relatively low and it is only at 2031 when the numbers begin to become substantial. This is a fundamental feature of any system which relies on the natural diffusion of new products into a system. We can also observe that the distribution of EVs within the Hull region is not evenly spread with some areas seeing 2-3 times as many EVs. This will have important impacts on the future viability of localised charging infrastructure that is intended to serve the residential use case.

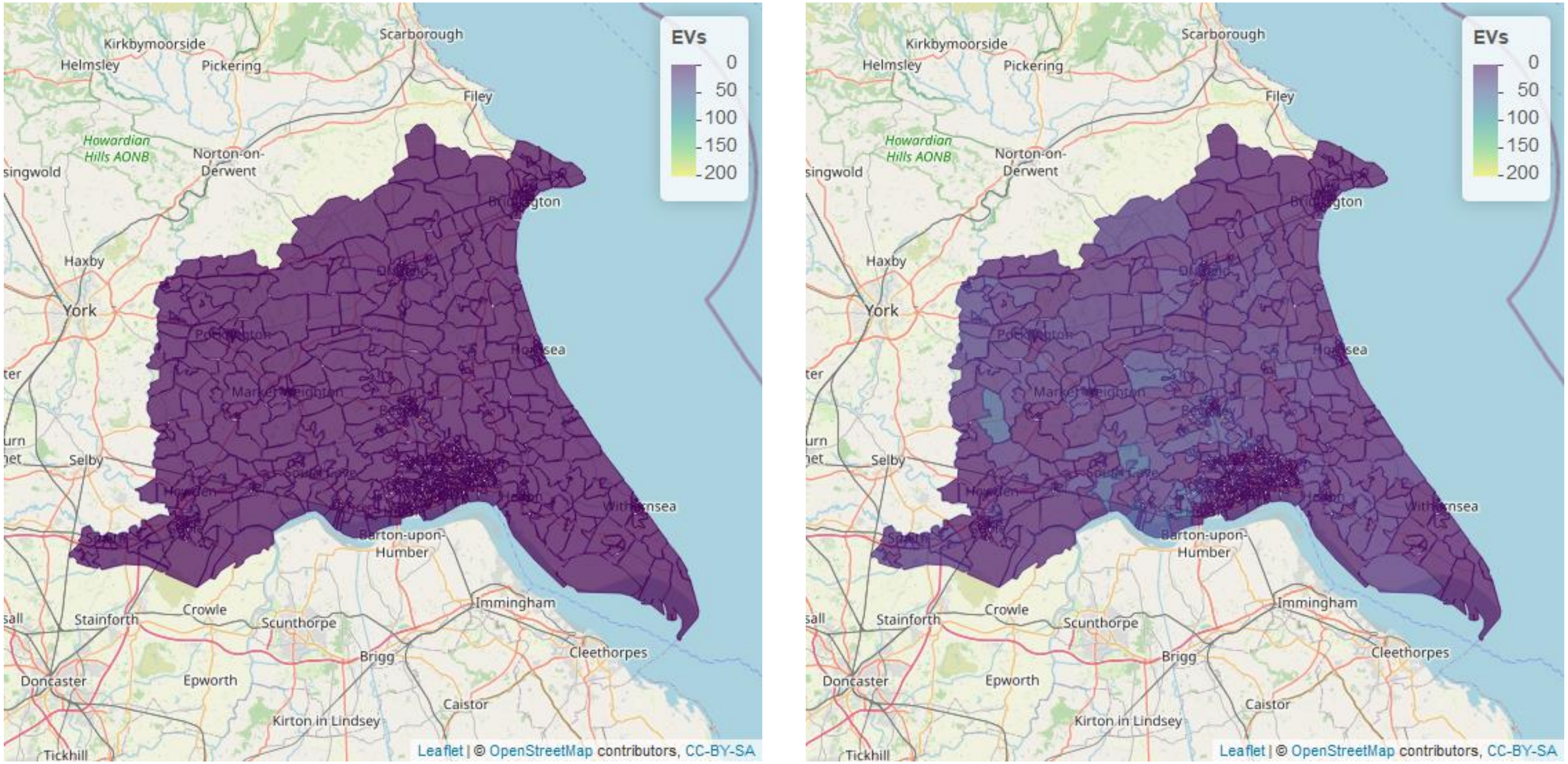


Figure 7 - 5: Spatial EV Uptake in Hull and East Riding Area 2021, 2026

In Figure 7 - 5 the distribution of Electric Vehicles until 2026 can be seen. As with Hull, there is predicted to be a generally low uptake although some pockets of increased uptake can be seen in the more outlying rural areas.

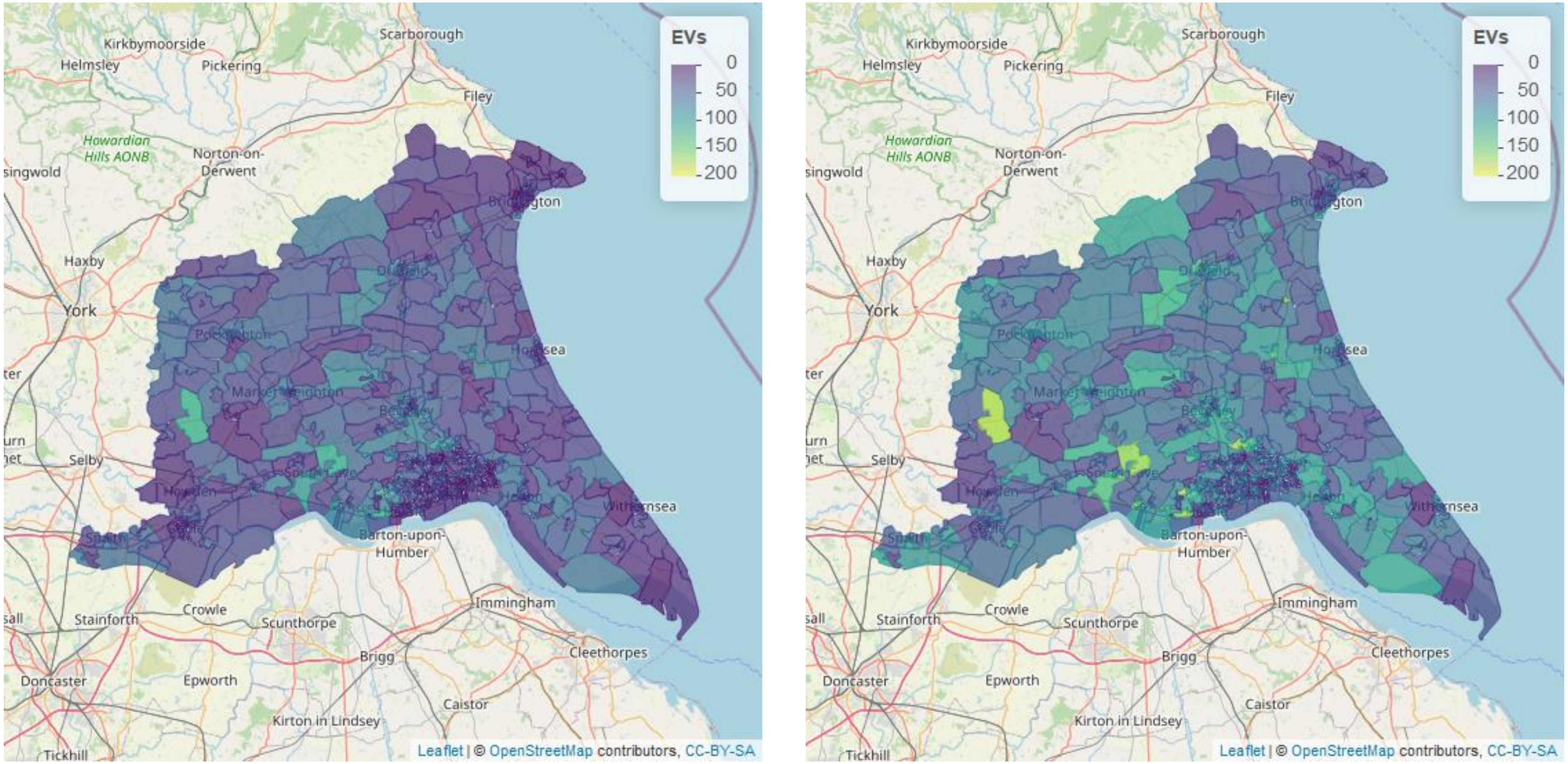


Figure 7 - 6: Spatial EV Uptake in Hull and East Riding Area 2031, 2036

A similar pattern to Hull is observed within the East Riding area for 2031 and 2036. Relatively lower increases are predicted until 2031, and at that point the uptake of EVs is forecasted to be stronger in specific locations that are predominately more rural in nature.

7.5 Commuting and Travel Pattern Analysis

It is not only the static demographics which will determine the potential requirements for charging infrastructure but also the movement of vehicles. Charging infrastructure is intended to serve transport, which is a fundamentally dynamic system, and so to more accurately determine the potential it is necessary to utilise movements within the HEYLEP area.

Within this study we have used the Mobile Phone Network movements data, supplied by HCC. Mobile Phone Network Data utilises the movement of mobile phones between different cell towers to construct a dataset which captures the movements of vehicles within the desired study area.

The dataset can capture multiple different aspect of travel including:

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

The OD data derived from the mobile phone data was used to generate three potential metrics.

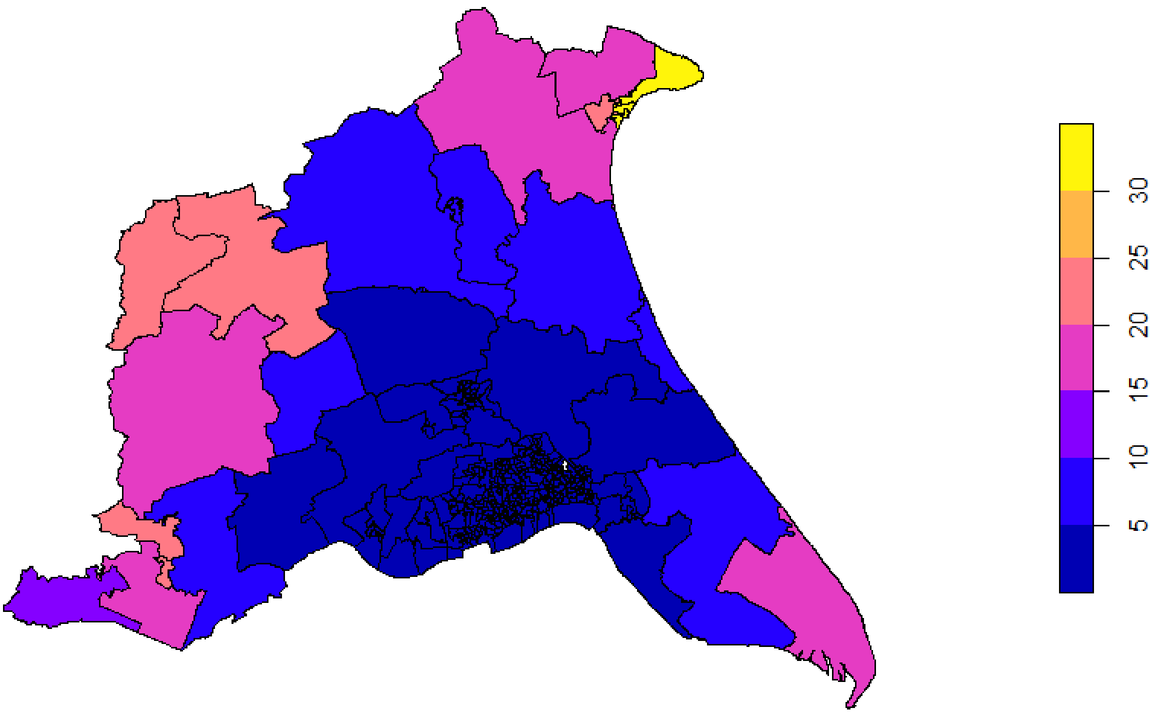


Figure 7 - 7: Ratio of Long to Short Journeys

In Figure 7 - 7 we can see that there are multiple areas of the HEY LEP zones which show a much higher ratio of Long to Short journeys, particularly towards the coastal and more rural areas. The prevalence of longer journeys would be a potential indicator that charging would be more necessary.

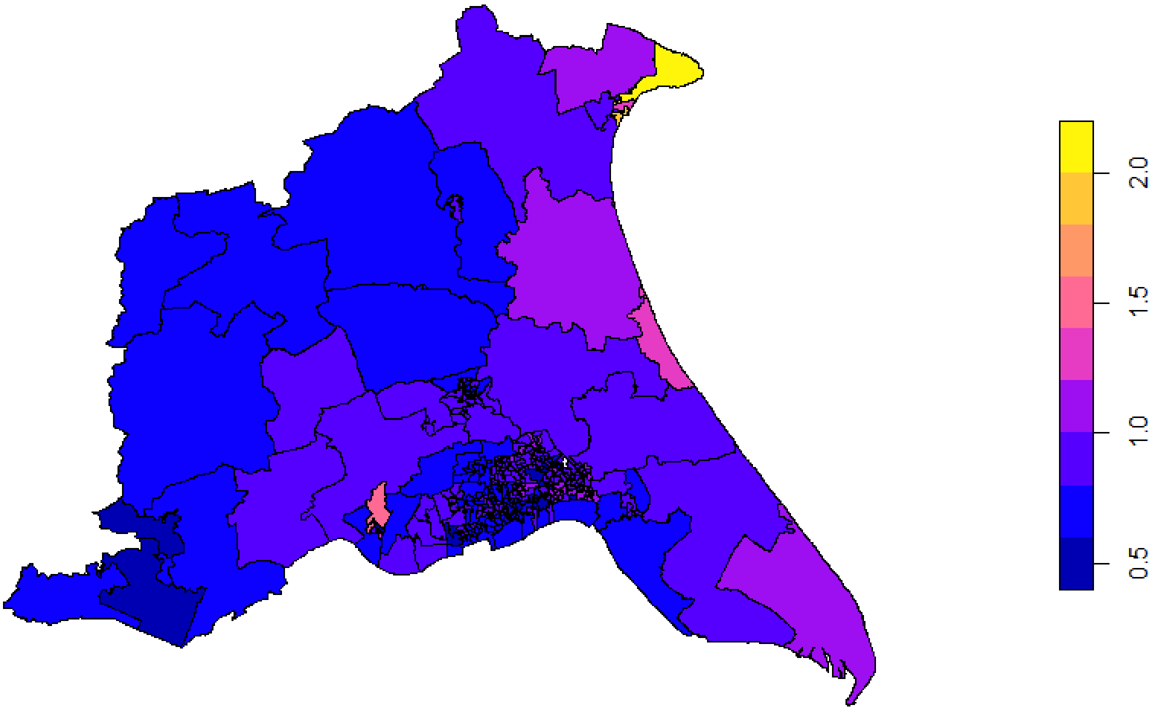


Figure 7 - 8: Ratio of Weekend to Weekday Journeys

In Figure 7 - 8 we can see the ratio of Weekend to Weekday journeys. The areas with a higher ratio are those where the trips during the weekend are greater than those during the week. It might be expected that weekend trips would be generated by leisure and other non-work related activities and so could serve as an indicator for charging during non-weekday time periods.

Although the general spatial area is relatively limited here, we can see that Bridlington, a coastal town and tourist hotspot has by the far the greatest ratio of weekend to weekday journeys.

It is instructive to compare the data for Bridlington against the predicted EV uptake for 2035. From this we can see that Bridlington is not expected to show a high level of EV uptake compared to the rest of Hull/East Ridings. Yet from the data shown in Figure 7 - 7 and Figure 7 - 8, Bridlington may be an ideal location for destination charging. This raises the possibility of creating multi-use charging infrastructure in Bridlington, suitable for both destination and public charging.

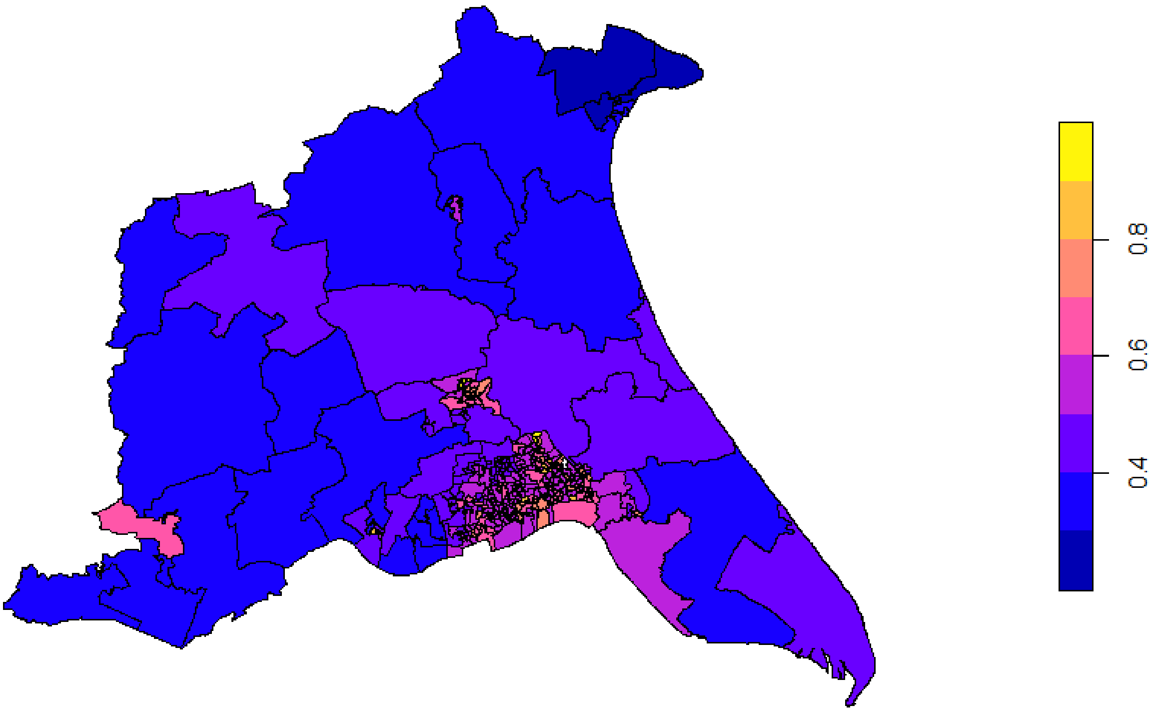


Figure 7 - 9: Ratio of Work to Non-Work trips

The final metric shown in Figure 7 - 9 is the ratio of work to non-work trips. If the weekend trips are being driven by non-work trips then we would expect this image to be the inverse of the weekend-weekday trip image.

We can see that this is the case with Hull forming the main area for work trips within the HEY LEP area. From this we could infer that the provision of charge points in these areas should aim to serve long term parking over the weekday period, and the provision of rapid charging may be unnecessary.

7.6 Parking Analysis

If charge points are to be installed in car parks, then it will be possible to use the underlying car park usage statistics to gain an understanding of how the future charge points may be used. Car parks typically have different profiles for arrivals, departures and length of stay and it is these parameters which may determine the best type of charge point to install.

For example, car parks which are associated with non-retail office employment may typically see people arriving at 08:00 and leaving at 17:30, having left their vehicle stationary in the intervening period. This would contrast with a car park associated with a super-market or shopping centre where the time of arrival would be typically later and for a much shorter duration. The first car park would be well served by a slower 7kW charger as it is cheap to install, and the lengthy duration of the vehicle’s stay would mean that it could receive the necessary charge.

Conversely, the shorter stay car parks would better suit a 50kW+ charger as there would be a much faster turnover of vehicles, which stay for a shorter time.

In addition, there would likely be a variation in the overall level of day-to-day usage, depending on who the car park is serving.

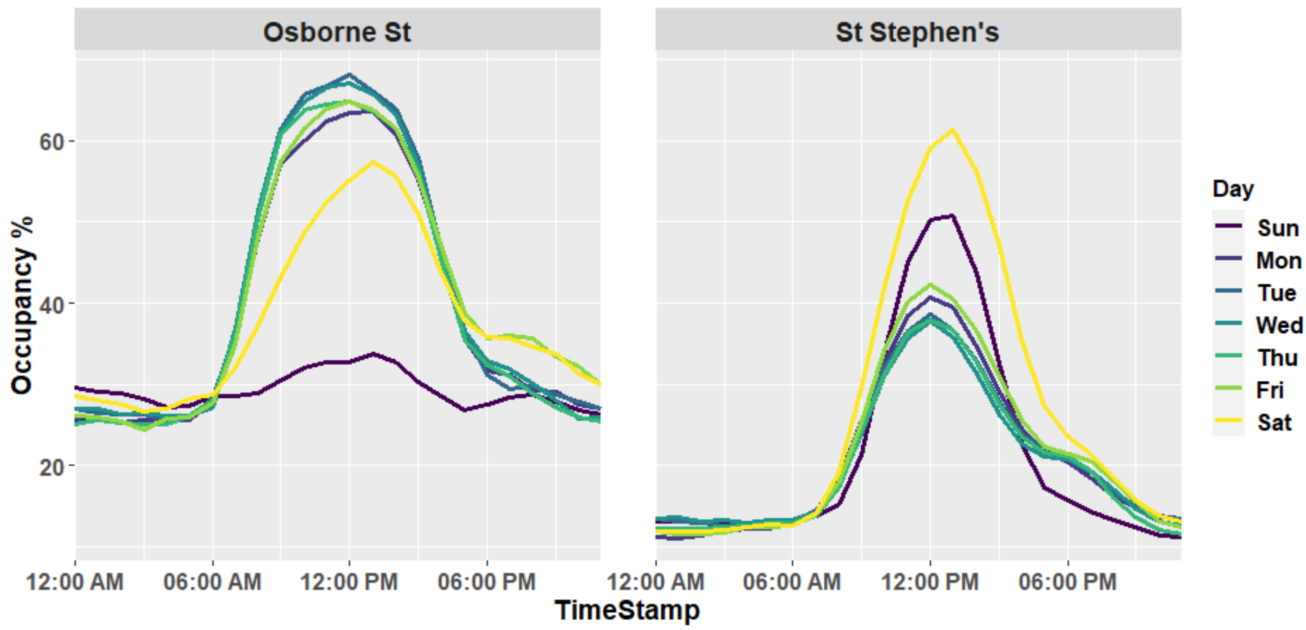


Figure 7 - 10: Parking Usage in two Hull car parks

This can be observed in Figure 7 - 10 we can see that there are two different distributions for Osborne Street and St Stephens (HCC operatored) in Hull with five points of interest to note.

- For Osborne Street, the overall level of occupancy is typically higher than in St Stephen's across all weekdays. This would indicate that a charge point in Osborne Street would see a higher level of overall usage.
- The weekday occupancy is higher than both the Saturday and Sunday occupancy for Osborne Street but lower in St Stephen's. This is in an indication that Osborne Street is serving the typical daytime workers of Hull, rather than the retail of leisure sector, with the pattern reversed for St Stephen's.
- The size of the parking peak is much narrower in St Stephen's as it is likely tied into retail/leisure activities rather than commuting.
- Osborne Street has relatively substantial levels of overnight parking. Depending on the arrival times of those vehicles, this could be a potential boon for off-peak charging.
- Both car parks exhibit a "shoulder" at approximately 6pm, indicating a divergence from the previous parking users. This could be from people who have finished work and are now parking at a different car park or usage associated with the Hull Arena (although the pandemic has restricted usage over the previous 18 months).

The results from this brief analysis clearly show that in terms of charge point usage, not all car parks are equal and to get the best results from charge point installation it will be necessary to both understand how existing car parks are being utilized, but also how to match any future installation to draw out the synergies with that usage pattern.

Further information, such as average dwell time, would greatly enhance such analysis.

7.7 Second-Hand Uptake

Generally, when considering EV uptake, the majority of the focus is on the purchase of new Electric Vehicles. This is, in many ways, natural as it is the influx of EVs into the overall vehicle marketplace that will determine the overall success of the push towards electromobility.

However, the final distribution of those vehicles, where they are parked on a night, where they are parked during the day, who owns them etc., will be determined also by how those vehicles are purchased second-hand.

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

However, from the RAC report "Car Ownership in Great Britain" (https://www.racfoundation.org/wp-content/uploads/2017/11/car-ownership-in-great-britain-leibling-171008-report.pdf) it is possible to see the average length of time that a new vehicle is owned for. If we assume that the new vehicle, once sold on, is then distributed across the local area purely weighted by the overall level of vehicle ownership, then it is possible to produce an EV population distribution.

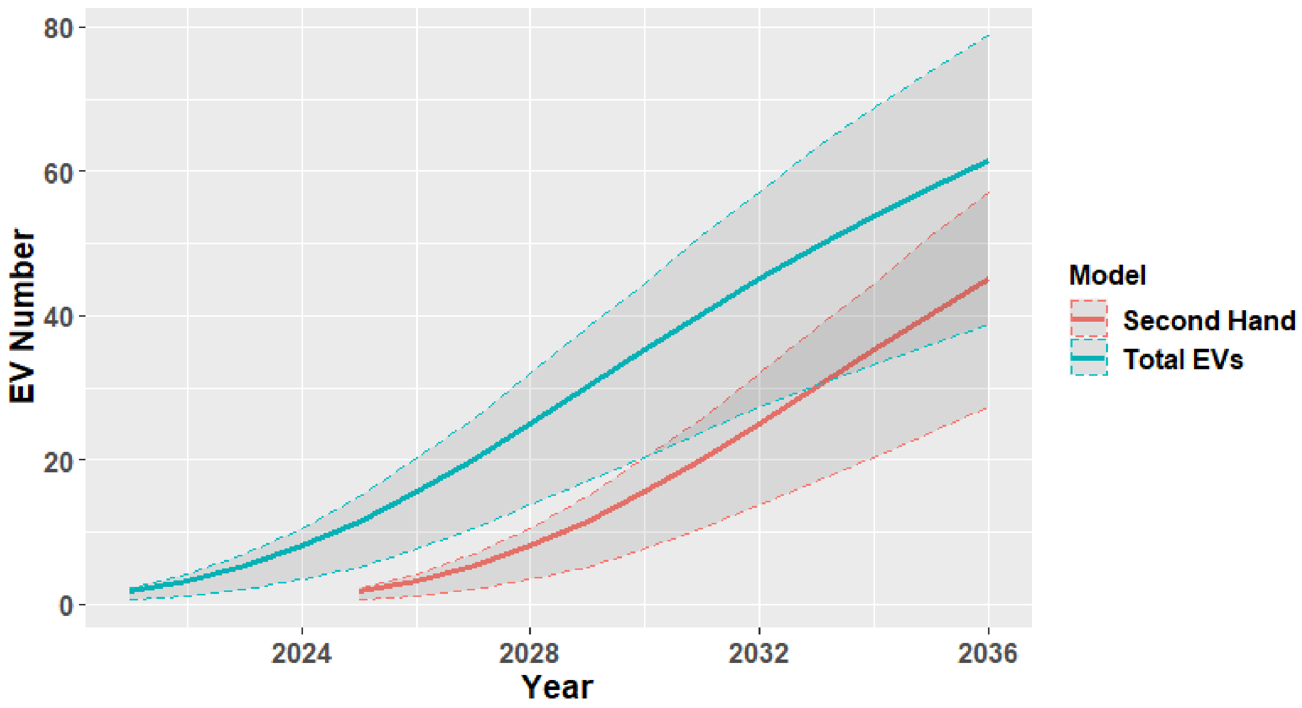


Figure 7 - 11: EV uptake rates in For New Bought and

In Figure 7 - 11 we can see how the total number of EVs which are second hand steadily increases from a small total number to a number forming a majority of the total EV numbers.

This demonstrates that whilst the focus on new EVs is understandable in the near term, beyond the 2030 point the majority of EVs will start to become second hand and so any analysis must take this into account.

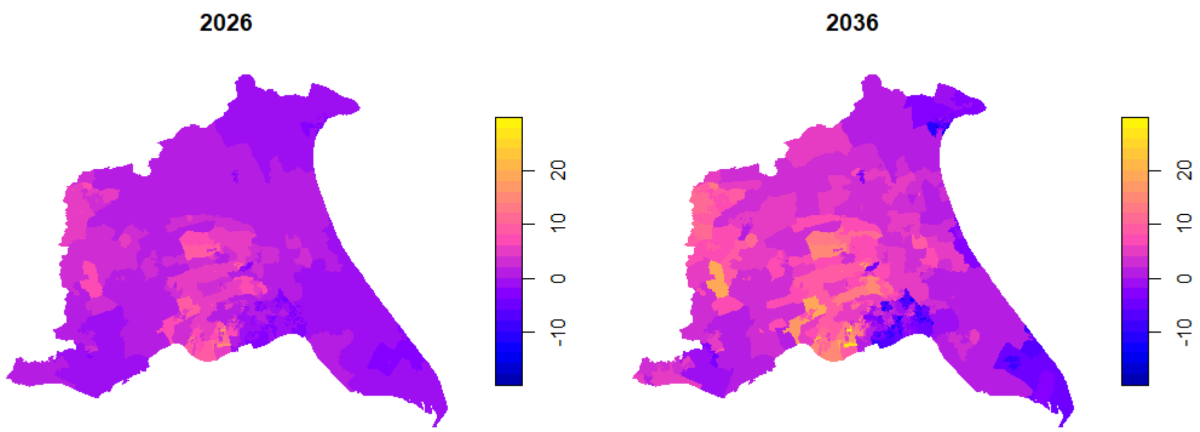


Figure 7 - 12: EV uptake Distribution

The impact on spatial distribution of EVs from second-hand vehicles can be seen in Figure 7 - 12. As might be expected, the inclusion of second-hand vehicles leads to a redistribution of EVs from the original high uptake areas to those which were not previously expected to see as much demand.

7.8 Summary

- The spatial and temporal EV uptake model showed that in all areas of Hull and East Riding, there would be relatively limited numbers of EVs to 2026 and then an acceleration to 2031.
- The areas which will see the highest uptake of EVs by 2031 are forecasted to be areas with higher incomes. The impact of this can be seen in Figure 7 - 13, where the overall EV numbers for each area in Hull and East Riding is compared to the income distribution. We can see the clear relationship between the two.

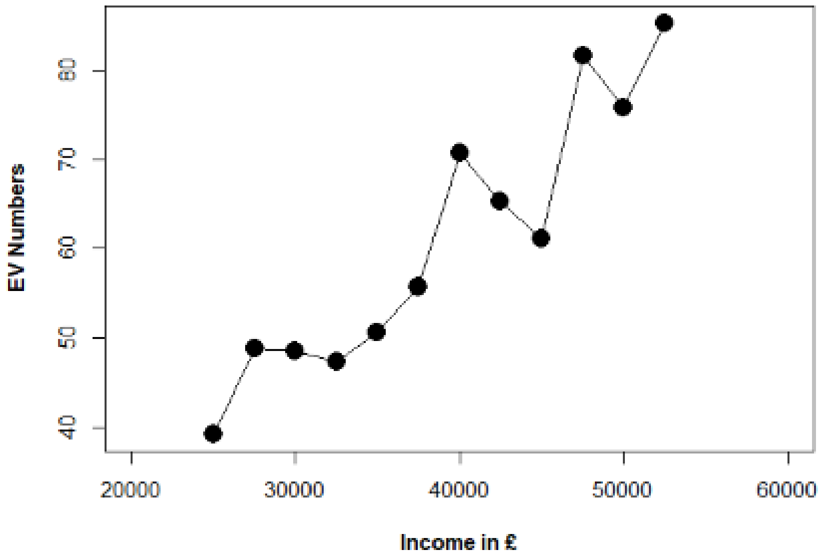


Figure 7 - 13: EV uptake rates in Hull and East Riding compared to income

- The overall conclusion from the spatial modelling is that the uptake of EVs within Hull and East Riding, and hence the demand for charging is spatially diverse and so it will be necessary to pull through the results from this modelling into the site assessments to ensure this is conducted with all available knowledge.

What is the key relevance to HEY?

Understanding the spatial distribution of future EV uptake in the HEY region allows for strategic planning of charging infrastructure.

What are the key lessons for HEY?

The spatial and temporal EV uptake model showed that in all areas of Hull and East Riding, there would be relatively limited numbers of EVs to 2026 and then an acceleration to 2031.

What are the implications for HEY strategy?

The results from this modelling has been pulled through into the site assessments to ensure this is conducted with all available knowledge and to target investment where needed.

How should this inform HEY decision making?

Results for this modelling should be used when making infrastructure decisions, as they can help determine the timeliness of potential investments.

8. Strategic Priorities

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

8.1 Study Objectives

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

- To contribute towards improved air quality and reduced carbon emissions from transport.
- To support the uptake of electric vehicles by individuals and businesses within Hull and East Riding.
- To guide and promote the provision of infrastructure that is accessible, safe, easy to use and represents good value for money both on installation and throughout its life.
- To help ensure infrastructure is sympathetic to the streetscape (off-street and on-street) through sensitive placement and appearance.
- To develop an EV offer in the context of a wider transport hierarchy.

8.2 Potential Measures

Table 8 - 1outlines EV infrastructure measures that could contribute to meeting the proposed objectives of this study. The rationale and future uncertainties for each proposed measure are also noted.

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
Increase number and distribution of charging points	Increase provision of rapid charging infrastructure for taxis in convenient locations.	Taxis contribute to air quality issues and carbon emissions, particularly near taxi ranks and key routes into Hull City Centres and towns across East Riding. Engagement with the Hackney carriage (HC) and Private Hire Vehicle (PHV) industry elsewhere in the UK shows that quick top-up charging using rapid chargers in convenient locations is important to enable taxis to transition to EV.	If technology around wireless charging develops further into a commercial proposition for taxis, charging infrastructure could be incorporated within taxi ranks or feeder areas.
	Provide charging infrastructure for buses.	In line with the Government's Bus Back Better strategy there is a desire to strengthen local buses and accelerate the move away from diesel to zero-emission buses. The strategy for England reflects the government support to Net Zero bus services.	There is still some uncertainty regarding whether electric or hydrogen will become the dominant technology for buses. Additionally, there is also uncertainty regarding the sustainability of local bus networks in some areas of the country (particularly rural areas such as East Riding) and the capacity to incorporate new technology.
	Provide charging points at car parks or on-street for key destinations – please see Chapter 8 for more details on sites presented and assessed.	Evidence shows that the public highly value the opportunity to top-up at publicly accessible charge points to complement the bulk of charging which is carried out at home. Without the public charging infrastructure in place, this could delay the uptake of EVs. Evidence demonstrates that some of the most popular publicly accessible locations for charging EV are key destinations where drivers can park for a significant period of time, such as Hull city centre. A high proportion of current vehicles (and in the short term) are anticipated to be plug-in hybrids which have relatively short ranges and older BEVs have relatively small batteries. Therefore, top up charging at key destinations will support journeys to work and for	There is uncertainty regarding the rate of EV uptake due to manufacturing capacities. In addition, price parity between EV and ICE is not expected until the mid-2020s which may continue to affect rates of transition. With increasing battery sizes and range the requirement for destination charging may reduce in the medium to long term. With increasing battery sizes and quicker charging times via higher powered chargers the requirement for charging at home may reduce with a move to a situation similar to Internal Combustion Engine

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
		other everyday purposes such as retail and leisure, at least in the short term.	refuelling. At present there is no firm evidence for this scenario however and the situation should be monitored as EV technology develops.
	On-route charging points on the Major Road Network.	As noted above, the opportunity for top up charging is highly valued, particularly for when longer distance journeys are required. Goole has been identified as a location with close proximity to key corridors. Without the infrastructure in place, this could delay the uptake of EVs and diminish the attractiveness of visiting Hull and the East Riding.	
	Provide charging points to support residents with limited access to off-street parking provision and charging, focussed on community hub locations.	Homes in areas with limited off-street parking may not have the option to introduce a household charging point and therefore will require alternative public charging points. From the baseline analysis there are notable areas of flats and terrace housing clustered in Hull, Bridlington and Goole which are likely to require on-street charging or alternative public charging car parks close to homes. Focusing on consolidated community hub locations would be more feasible than committing to installing charge points in front of all properties.	
	Introduce charging forecourts.	Significant sized charging forecourts are being trailed in a number of locations on a commercial basis. At present the business case for larger and more extensive hubs is uncertain due to questions regarding the uptake of EV in the short to medium term and how owners will charge their vehicles in the future.	

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
	Introduce charge points for the council's own fleet and potentially the grey fleet.	This will support the uptake of EVs within the Council's own fleet and any grey fleet. East Riding Council have named 20 sites spanning across Beverley, Withernsea, Pocklington, Goole, Market Weighton, Brough, Willerby, Hessle, Bridlington, Cottingham, Anlaby and Driffield, where they will be installing EV charging infrastructure to support the electrification of their fleet. The total number of charge points installed will be 24, all of which capable of charging 2 EVs at a time. Similarly, Hull City Council have confirmed 8 sites to implement 30 7kW charge points that will be dedicated to their fleet, and is currently looking at additional charge points aiming to decarbonise most vehicles under 3.5 tonne by 2025.	Price parity is not anticipated to be achieved by the mid-2020s however lower operating costs may offset this higher vehicle cost.
	Introduce charge points for HGVs.	HGVs comprise a significant proportion of traffic and are contributing to air quality issues and carbon emissions. However, at present there is a lack of commercially available EV options for HGVs.	There is significant uncertainty regarding whether electric or hydrogen technology can serve HGVs in the future, what shape this technology would take and the timescales involved.
	Charging infrastructure to support shared mobility / micro-mobility e.g. e-car clubs picking	As Hull City has relatively low-income levels and there is an opportunity to provide low cost, flexible access to EVs as part of a wider integrated transport offer that includes shared/micro-mobility solutions. For example, e-car clubs eliminate the need to own an EV and are orientated around demand driven principles, thereby suiting the requirements of those on lower incomes. For low mileage (less than 5000 miles per	There is significant uncertainty regarding the attractiveness of car clubs, particularly in lower income areas.

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
		year) it can be more cost effective to use car clubs rather than owning / leasing a vehicle.	
	Utilise the Hull Smart City Platform	Ensuring the data from charge points is integrated into the Hull Smart City Platform will enable the tracking of usage levels, allowing for dynamic monitoring and reaction, thereby bringing forward further phases of charge points in a timely way.	The primary uncertainties are associated with utilisation of charge points. Currently there is limited evidence regarding usage rates, who is using them, or the types of vehicles being charged. However, by monitoring the data, we can understand these aspects and use them to dynamically respond.
Local Policy Changes	Encourage EV transition through contract procurement	By building on new and existing contracts, the council would be able to influence the private sector.	Securing private sector / operator agreements to the new contractual terms.
	Local policy evolution	Creating an EV-friendly local policy background will allow the implementation of charging infrastructure to be both streamlined and hit the road running.	There is still some uncertainty regarding the national approach to mandating responsibility for ensuring appropriate charging infrastructure is provided with OLEV consulting on responsibilities for local authorities, charge point operators and landowners.
	Reviewing and developing parking standards for new developments	Revisiting HCC and ER's parking standards would allow the council to determine the absolute or relative number of EV charging points and parking spaces new developments are required to provide. It would also ensure equal accessibility of EV infrastructure for disabled residents in these areas.	
Engagement with the District Network Operator (DNO)	Continuous engagement and joint working with Northern Power Grid. Investigation of potential for distributed renewable energy solutions.	Following consultation with Northern Power Grid, the DNO does not consider there to be significant constraints on current power supply network across Hull and ER. it will be important to work collaboratively to address the challenges noted in this study and future proof key locations to address any supply issues as they arise. This will also help inform	As noted above, significant uncertainties regarding the supply and uptake of vehicles alongside the availability of V2G technology will affect the level of power required from the grid. Joint work with the DNOs should explore the impact of varying uptake

Theme	Potential Measure	Rationale for Measure	Future Uncertainty
		where supply may need reinforcing to support the future uptake of EVs.	scenarios to inform an assessment of likely upgrades to the network.

Table 8- 1: Potential Measures

8.3 Assessment of Measures

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

Theme	Potential Measures	Effectiveness	Deliverability	Cost Level	RAG Rating Justification	Sequencing
Increase number and distribution of charging points	Increase provision of rapid charging infrastructure for taxis in convenient locations			High	A greater number of strategically located charging points for taxis could encourage EV uptake giving drivers confidence that reliable and accessible charging infrastructure is in place. This measure would benefit from being developed as part of a broader EV Taxi Strategy. Although charging infrastructure cannot currently be sited on taxi ranks engagement with the taxi trade can identify locations at which breaks are regularly taken where rapid charging infrastructure could quickly recharge batteries.	Short – medium term
	Provide charging infrastructure for buses			High	Further engagement is required with industry stakeholders to determine the deliverability of transitioning buses to EV. Given the impact of the pandemic and historically declining levels of patronage careful consideration is needed regarding	Medium term

Theme	Potential Measures	Effectiveness	Deliverability	Cost Level	RAG Rating Justification	Sequencing
					how the costs of transitioning to EV can be accommodated, including the potential to secure grant funding. Detailed consideration would also be required into whether there is scope to install charging infrastructure at bus stations such as Hull Paragon Interchange for top up charging and within depots for overnight charging.	
	Provide charging points at car parks or on-street for key destinations			High	Providing charging infrastructure at key locations will give people the confidence to transition to EV. A mixture of slower and rapid charge points could be delivered at particular sites depending on the length of stay of users. OZEV grants are available for employers and these could be promoted through existing HCC and ER communication channels with employers.	Short term
	On-route charging points on the Major Road Network			High	This option is largely deliverable due to public sector land ownership and various potential funding sources for installation of charge points. This would also likely benefit fleet vehicles who need top up charging during daily operations. Public surveys point to the availability of top up charging being key to the uptake of EVs however there is some uncertainty regarding how well these charge points would be utilised in practice. Goole lies in close proximity to the M62, whilst the A1079 passes Pocklington, both proving to be a key on-route charging location in the East Riding region.	Short term

Theme	Potential Measures	Effectiveness	Deliverability	Cost Level	RAG Rating Justification	Sequencing
	Provide on-street charging points to support residents with limited access to parking provision and home charging, with a focus on community hubs.			Medium	This measure would increase the visibility of charging infrastructure and may increase confidence amongst residents for investing in EVs, particularly in areas of limited off-street parking. However, introducing on-street charging may be met with resistance from some residents, particularly if EVs have parking priority in spaces with charging infrastructure. This is particularly relevant to the City of Hull due to its high concentration of dwellings with limited residential off-street parking. For this reason, focusing on consolidated community hub locations is recommended. Concerns have been raised regarding cables trailing across pavements and charging units restricting footway width and solutions will be needed to ensure charging infrastructure does not negatively impact on accessibility for highway users. Detailed planning and engagement will be required to identify feasible locations.	Short – medium term
	Provide off-street charging points to support residents with limited access to parking provision and home charging			High	As above, this measure would provide a charging solution for people who do not have off-street parking to charge their vehicle. This measure would be more deliverable, for instance using council-owned car parks, but there may be challenges with off-street parking being distant from residential units that may affect the attractiveness of this charging infrastructure. This is likely to be the case in Hull City Centre, where council car park ownership is most dense, whilst the population is concentrated largely on the edges of the city centre. In contrast, the	Short term

Theme	Potential Measures	Effectiveness	Deliverability	Cost Level	RAG Rating Justification	Sequencing
					majority of areas in East Riding have off-street parking in close proximity to town centres and residential locations in abundance, therefore targeting these sites is key here.	
	Encourage and where possible support the introduction of charging forecourts			Very High (for funding of hubs by LA) or Low for engaging commercial partners	Due to limited EV uptake in Hull and East Riding in the short term and uncertainties regarding the medium / long term there is a question mark regarding the business case for large charging hubs. In the short term it is recommended that smaller clusters of charging infrastructure are provided (linking to the use cases outlined above) to give users the confidence a charge point will be available for use. For larger charging hubs is recommended that Hull and East Riding engage with commercial partners to seek charging forecourts to be brought forward by the commercial sector.	Medium term
	Introduce charge points for the Council's own fleet and potentially the grey fleet			Medium	This measure is already being considered by Hull and East Riding Councils and the sites set out in this study would improve further the availability of chargepoints for fleet vehicles.	Short term
	Introduce charge points for HGVs			N/A	Due to there being limited commercially available EV options for HGVs this measure is not recommended at this time, however the situation should be kept	Long term

Theme	Potential Measures	Effectiveness	Deliverability	Cost Level	RAG Rating Justification	Sequencing
					under review to understand future developments for electric or hydrogen technology.	
	Charging infrastructure to support shared mobility / micro-mobility e.g. e-car clubs picking			Medium	Relatively low levels of charging infrastructure would be required to support measures such as e-car clubs and this could double as publicly available charge points. Provision of e-car clubs could give flexible and low cost access to EVs and would complement local policy that emphasises the importance of an integrated transport offer.	Short term
	Utilise the Hull Smart City Platform			Low	As the platform is already established this would be a relatively low cost measure. The dynamic monitoring of utilisation would could bring multiple benefits in terms of ensuring the correct level and type of infrastructure is provided, and ensuring funds are not deployed unnecessarily.	Ongoing
Engagement with the District Network Operator	Continuous engagement and joint working with Northern Powergrid (NPG). Investigation of potential for distributed renewable			Low	Northern Power Grid has noted that power supply across both the Hull City and East Riding areas is considered largely sufficient for a region-wide rollout of EV charging infrastructure at present. NPG are however submitting an application for ED2 funding, which if successful, will be used to reinforce low and high voltage networks in response to an increase in demand for power, partly due to the higher uptake of EVs. This reinforcement will be implemented whilst NPG monitor the varying energy demands following the implementation of the charging infrastructure.	Continuous engagement recommended

Theme	Potential Measures	Effectiveness	Deliverability	Cost Level	RAG Rating Justification	Sequencing
	energy solutions.					
Local Policy Changes	Local policy evolution e.g. contract procurement and reviewing parking standards			Low	Ensuring policies are up to date could have a high impact at relatively low cost to guide developers and contactors to deploy their own funds in line with strategic objectives for electrification.	Ongoing

Table 8- 2: Assessment of Measures

9. Commercial and Operating Models

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

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

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

9.1 Summary of UK EV Commercial Models

There is a continuous spectrum of differing commercial models that could be followed in delivering or expanding an EV charging network. Table 9- 1 outlines the key features of three models, setting out how they work and the risk implications for a Local Authority.

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

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

Model	**Features / *Risk***
1. **In-House Management** – LA selects locations, purchases charging points and keeps any revenue	• Purchase could include installation and ongoing maintenance • OZEV grant funding could be used for residential on-street charging points • Potential to ensure equity through providing in areas of market failure. • Appropriate for workplace and fleet installations where demand is assured. • Income for the authority. • *If under-utilised, financial risk for the operation and maintenance falls on the LA* • *Interoperability with other provision needs to be factored in.*
2. **Partnership / Concession –** LA leases public highway or off-street parking bays	• Annual permit price plus possible up-front charge • Operator selects own locations and LA consults / approves / makes traffic order • LA may receive a small share of revenue from each charge point annually • Likely to be more suitable for rapid / fast chargers near key destinations • Publicly-owned car parks / land could be considered under this model

Model	Features / *Risk*
to private suppliers / operators	• *Financial risk divested to suppliers / operators, but interested operators may be limited in some areas*
3. **Commercially-Led –** Private-sector suppliers use private land with limited or no LA involvement	• Rapid / ultra-rapid charging points purchased and installed on private property (such as petrol station forecourts, private car parks, supermarkets, highway services, etc) • Requires sufficient capacity in the electricity network • *No financial risk to LA however this approach will likely lead to gaps in provision where locations are less commercially attractive*

Table 9- 1: Summary of EV charging commercial models – UK

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

Meanwhile, Public-Private-Partnership models (PPP) were used to establish national networks of rapid chargers, led by vehicle manufacturers with some funding from the European Union and the UK government. The PPP model is now favoured by many councils for all public charging provision. This is a form of model 2 in Table 9- 1.

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

9.2 Procurement Options

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

9.2.1 Work with 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 carrying out your own procurement may be avoidable if the offers available from providers through these frameworks are acceptable for Hull and East Riding and the relevant bidders are willing to extend their provision to an additional buyer / partner. A hybrid approach would be to carry out a mini-competition between those suppliers named on one of these contracts, which may lead to further benefits being offered by bidders particularly keen to be appointed.

PROS:

- 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.

CONS:

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

9.2.2 Undertake in-house procurement

As part of conducting a procurement process use can be made of documentation used for other past procurements by neighbouring or other similar LAs, amending for the local circumstances where necessary. 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 Hull and East Riding. 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).

PROS:

- 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 thereby avoiding the need to conduct further procurement exercises for a defined period of time, meaning funding secured from central government in the future could be deployed quickly and efficiently.

CONS:

- 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).

9.2.3 Seek exclusive operators for each type of charger

Firms offering different types of charger can be invited to tender for exclusive operating contracts for their chosen type of charger. Hull and East Riding could request firms to offer prices for either installation, or combined installation, operation and maintenance, of new charging points, or for contracts where the provider will fund, install, operate, and maintain new charging points.

PROS:

- 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.

CONS:

- By compartmentalising revenue generation opportunities this would likely decrease the attractiveness of the opportunity to the market, particularly for areas in which relatively low levels of infrastructure is required in the short term.

9.3 Choosing locations or leaving this to the provider/s

It is possible for the LAs 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 but reduces the opportunity to meet policy aims in Hull and East Riding such as delivering an equitable and balanced network. Alternatively, the LAs 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 LA-selected sites not leading to enough revenue or may insist on only installing and charging for the maintenance of charging points.

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

9.4 Integration of Modelling Results with Commercial Models

9.4.1 Commercial Modelling Introduction

To integrate 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, the 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 the HEY LEP will be considered. The 10 charge points are not in specified locations but rather 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 will in 2021 will be derived from the usage stats provided by Hull City Council for their recorded charge points in 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 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.

It should be noted that the price to the consumer of £0.15/kWh over the cost of purchasing the electricity is greater than the existing charge (£0.05/kWh) but this value represents the minimum at which all partners in all models break even by 2031.

9.4.2 Commercial Models

Three distinct commercial models have been chosen for this preliminary examination

- Model 1: Hull and East Riding 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 5 best charge points whilst Hull and East Riding installs at the other 5. 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 at all ten charge points, but pay a relatively modest fixed rent.

There are multitude of other models which could be proposed, but it is believed that these three models 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 of charge points installed determined by the total 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 barring Model 2 where a commission is paid to HEYLEP from the private installers.

The price per kWh is assumed to be constant throughout each model.

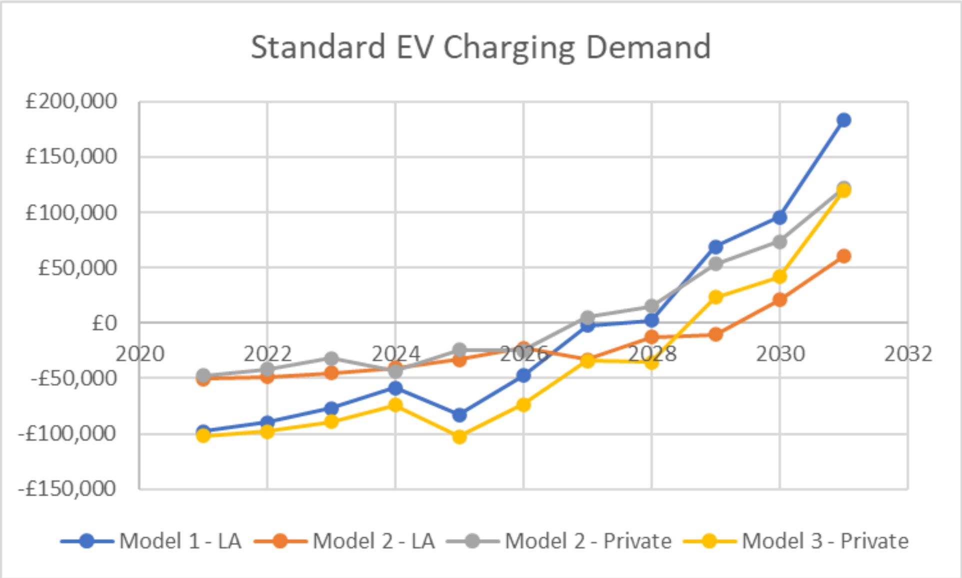


Figure 9- 1: Cumulative revenue at standard EV charging demand

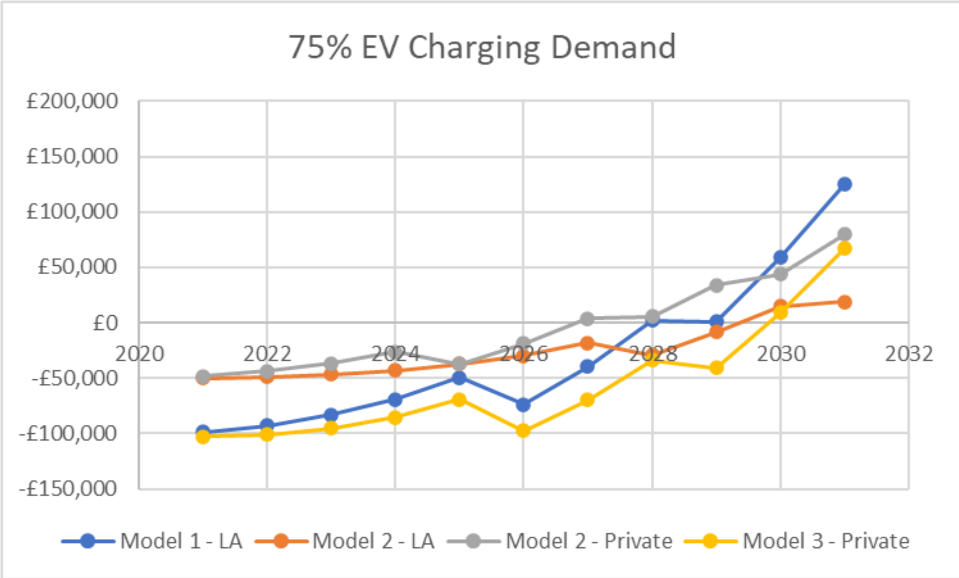


Figure 9- 2: Cumulative revenue at 75% charging demand

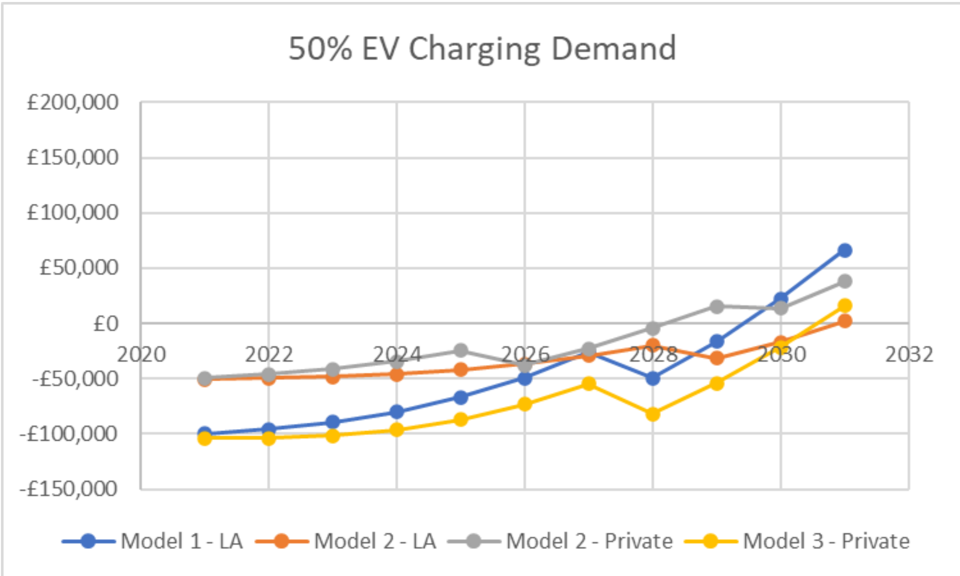


Figure 9- 3: Cumulative revenue at 50% EV charging demand

Figure 9.1 to 9.3 illustrate the fundamental risks involved in funding extensive EV infrastructure. Under the standard charging demand no models break even before 2028. After this point, both Model-1 and Model-3 begin to generate increasing revenue fuelled by the increasing uptake of EVs. This take off is much more modest in the 75% and 50% charging demand scenarios.

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 exogenous events may lead to a substantially reduced charging demand, thus leaving both public and private partners with a financial hole which may not be filled.

Model-2, a blended model between private and public installation, shows a much flatter revenue curve for both Private and LA installers. Both private and public spend far less in the first five years, but also generate less income as the EV demand increases. In fact, for the 50% charging demand scenario, both private and public charge points will generate barely any profit.

9.5 Review of Viable Funding Models

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

9.5.1 EV Charging Infrastructure Investment Fund (CIIF)

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

9.5.2 OZEV's On-street Residential Charging Grant

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

9.5.3 OZEV's Workplace Grant

This grant is a voucher-based scheme designed to provide eligible applicants with support towards the upfront costs of the purchase and installation of EV charge points. The contribution is limited to the 75% of purchase and installation costs, up to a maximum of £350 for each socket, up to a maximum of 40 across all sites for each applicant. Promotion of this grant scheme to employers within the region could help to complement the public charging network with workplace-based charge points, thus helping to spread the demand.

9.6 Summary

- Broadly speaking, it can be seen that the available commercial models for charge point installation and operation hinge around a series of key decisions: Who will install the infrastructure? Who will manage/maintain the infrastructure? Who will collect revenues? Who is responsible for site selection?

- Each of these questions is not necessarily answered with a single discrete entity but rather it is possible to construct a commercial model with some level of public/private ownership/responsibility across all four aspects.

- The exact nature of the relationship between public/private involvement for each aspect varies according to both the level of risk which each party is willing to take, and also the general level of ability of each part to provide the service necessary.

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

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

- If the aim is to create a self-funding network of charge points in the shortest possible time however, then it would make more sense for either Hull/East Riding or a private operator to install the minimum number of charge points, focusing on the most financially viable sites.

What is the key relevance to HEY?

Given the relatively low levels of BEV uptake at present and over the short term there are potential financial risks to the local authorities in terms of investing in costly infrastructure from which revenues do not cover costs. Charge points in Hull and East Riding appear unlikely to recoup their costs before 2025 at the earliest.

What are the key lessons for HEY?

There is significant potential to leverage investment for commercial charge point operators whom are willing to invest for the long term and shoulder revenues risks in the short to medium term.

What are the implications for HEY strategy?

A balanced approach is recommended that seeks to draw in external investment by offering a balanced package of sites to commercial charge point operators that minimises short to medium term revenue risks to the local authorities.

How should this inform HEY decision making?

The implications of low utilisation of charge points in the short to medium term should be carefully considered when deciding on a preferred commercial model and approach.

10. Site Assessment

10.1 Criteria for Assessment

The methodology for conducting the multi-criteria appraisal of sites is presented Table 10- 1 and Table 10- 2. Both lists of sites were identified in consultation with East Riding and Hull City Council officers.

Infrastructure feasibility assessments were carried out by Jacobs electrical engineers using the Northern Power Grid AutoDesign Tool to ensure that each site will have a sufficient energy supply to facilitate the proposed charge points. For off-street sites a requirement of 100kWh power needs were assessed reflecting the need for rapid chargers as identified in the evidence base, best practice of installing a cluster of chargers for resilience and/ or the need for significant banks of slow/fast chargers. For on-street locations assessments of 50kWh were made reflecting the constraints on installing multiple rapid chargers and the fact some on-street locations would serve predominately the residential use case through a collection of 7kWh chargers. It is recommended that further technical feasibility work is conducted including seeking budget estimate quotes from Northern Power Grid prior to progressing deployment of sites.

Classification	Sifting Criteria	Description
Off-Street Public	Capacity	Sites with a capacity under 30 spaces are removed from contention
	EV Uptake of Wider Area	Projected EV uptake of the LSOA and daily travel catchment
	Destination Charging Potential	Based on an assessment of future usage based on proximity to key facilities such as retail and employment locations
	On-Route Charging Potential	Whether the site is located in close proximity to routes used by high volumes of traffic requiring top up charging
	Residential Charging Potential	The expected charging demand that would be driven from residential parking
On-Street Public	EV Uptake of Wider Area	Projected EV uptake of the LSOA and daily travel catchment
	Residential Charging Potential	The expected charging demand that would be driven from residential parking rather than on-route or destination parking

Table 10- 1: Sifting criteria to identify short list

Classification	Sifting Criteria	Description
On or Off-Street Public	EV Uptake of Wider Area	Projected EV uptake of the LSOA and travel catchment
	Destination Charging Potential	Based on an assessment of future usage based on proximity to key facilities such as retail and employment locations
	On-Route Charging Potential	Whether the site is located in close proximity to routes used by Fleet vehicles and/ or high volumes of traffic
	Residential Charging Potential	The expected charging demand that would be driven from residential parking rather than on-route or destination parking
	DNO Supply	Is there sufficient capacity to accommodate EV infrastructure and cost estimates
	Commercial EV Charging Conflict	Proximity to existing charge points (e.g. nearby Shell Garages, Business Parks etc.)
	Security of Location	Review whether the location is well lit, fenced off, has barriers etc. that provides a secure location to park vehicles. Considering future improvements. Crime issues identified from data

Table 10- 2: Assessment criteria for 40-50 sites on the short list

10.2 Assessment of Potential Charging Sites

This section presents the scoring of each site in the two respective shortlists, and the reasons for why particular sites scored in the nature they did. The criteria below were used to assign each site a score:

- Site Security: Sites were scored 1-5 for security based on factors such as lighting, fencing, security barriers, CCTV, and proximity to surrounding developments. Sites scoring 5 were most secure, whilst sites scoring 1 were least secure and lacked the listed security measures.

- Commercial Conflicts: Sites were scored 1-5 on their potential for conflict with current and future commercial charge point investment. Sites located in close proximity to current chargepoints, or close to companies with future plans for charge point investment such as Shell and BP scored lower.

- Supply Cost: Following an assessment on the implementation costs for each site, sites were scored 1-5, 1 being the most costly (£40k-£50k), and 5 being the least costly (£0-£10k).

- Without Off-Street Parking: Model output scoring the site 1-5 based on the number of EVs predicted to not have access to private off-street parking i.e. those that would require some form of public charging infrastructure. Score is based on a rank between each area.

- Destination Demand (Employment & Retail/Leisure): Model output scoring the site 1-5 based on an assessment of future destination-based usage based on proximity to key facilities such as employment, retail and leisure locations.

- On-Route Demand: Model output scoring the site out of 5 on whether it is located in close proximity to routes used by fleet vehicles and/ or high volumes of traffic. In LSOAs that are home to key roads, the score was determined on the order of total flow on that particular road; 5 being the highest flow and 1 being the lowest. In LSOAs without a key road, a score of 1 was given.

- Local EV Uptake (within 1km): The model output for the projected EV uptake within 100m grids. Daily travel catchment calculations scored each site out of 5, 5 being high projected output and 1 being low.

10.2.1 East Riding Site Rankings

During the analysis of sites in East Riding, the settlement hierarchy used in the East Riding of Yorkshire Strategic Housing Land Availability Assessment was used to allocate a specific number of sites to each location in the region:

- Principal Towns: Beverley*, Driffield, Bridlington and Goole were allocated three sites.
- Towns: Brough, Hedon, Hornsea, Howden, Market Weighton, Pocklington and Withernsea, were allocated one site.

**Snaith is classified as a 'Town' in the settlement hierarchy, however East Riding County Council do not own any off-street parking sites in this area, therefore one additional space was allocated to Beverley, being home to the highest proportion of top-ranking sites.*

The highest-ranking sites in each location according to the sifting criteria in Table 10- 2 were put forward to the shortlist presented in Table 10- 3, in consultation with Easting Riding of Yorkshire Council officers. It can be seen from Table 10- 3 that towns such as Beverley, Driffield, Bridlington and Goole appear more likely to experience greater demand for charging facilities than some of the other towns appearing lower down in the table. The reasons for higher demand in Beverley and Driffield are likely due to higher income levels and greater levels of charging demand for the destination, on-route and residential use cases. Bridlington scored highly due to its high destination charging potential being a seaside town with various attractors. Goole may also achieve greater demand due to its on-route charging potential considering the proximity to the M62 strategic traffic route. However, an important consideration is that commercial charge point operators have installed rapid charging facilities in Bridlington, Beverley and Goole, as noted in the commercial conflict scores.

A number of sites would need significant strengthening of the power network including Eastgate in Driffield, North Street in Bridlington, Haven in Brough, Goodmanham in Market Weighton, and Lee Avenue in Withernsea.

Site Name	Location	Local Authority	DNO Supply	Security of Location	Commercial EV Charging Conflicts	Residential Charging Potential	Destination Charging Potential	On-Route Charging Potential	EV Uptake in Wider Area	Total Score
Cross Hill Car Park	Driffield	ER	5	4	5	5	4	5	5	**33**
Trinity Lane Car Park	Beverley	ER	5	5	2	5	5	4	5	**31**
East Riding Leisure Beverley Car Park	Beverley	ER	5	5	2	5	5	4	5	**31**
Beckside Car Park	Driffield	ER	5	3	5	3	4	5	5	**30**
Lord Roberts Road Car Park	Beverley	ER	4	3	2	5	5	4	5	**28**
Saturday Market Car Park	Beverley	ER	4	2	2	5	5	4	5	**27**
Langdales Wharf Car Park	Bridlington	ER	5	5	2	3	4	5	3	**27**
Wesley Square Car Park	Goole	ER	5	3	2	4	4	4	4	**26**
Eastgate Car Park	Driffield	ER	1	2	5	4	4	5	5	**26**
Thorn Road Car Park	Hedon	ER	4	4	5	3	4	2	4	**26**
Estcourt Street Car Park	Goole	ER	4	3	2	4	4	4	4	**25**
Burlington Crescent Car Park	Goole	ER	4	4	2	4	4	4	3	**25**
West Green Car Park	Pocklington	ER	5	2	5	4	4	1	4	**25**
Spa Slipway Car Park	Bridlington	ER	5	2	2	3	4	5	2	**23**
North Street Car Park	Bridlington	ER	1	3	2	4	4	5	3	**22**
Newbegin Car Park	Hornsea	ER	5	3	5	2	2	3	2	**22**
Haven Car Park	Brough	ER	1	1	5	5	3	2	4	**20**
Hailgate Car Park	Howden	ER	4	5	1	3	2	2	2	**19**
Lee Avenue Car Park	Withernsea	ER	2	2	5	5	2	1	2	**19**
Goodmanham Car Park	Market Weighton	ER	1	2	5	1	3	2	1	**15**

Table 10- 3: East Riding Shortlist

10.2.2 Hull

Following the application of the criteria in Table 10- 2 and in consultation with Hill City Council officers the shortlist shown in Table 10- 4 was identified.

In general sites located within or near to the centre of Hull score highly due to proximity to key attractors and residential areas with relatively higher levels of income and limited off-street parking. The majority of sites appear to have sufficient power capacity with relatively low cost (approx. 10k or below) connections although Kingston Street is the exception. Sites on the outskirts of the city centre score lower on commercial conflicts due to there being a number of sites installed by various chargepoint operators offering rapid charging.

Site Name	Location	Local Authority	DNO Supply	Security of Location	Commercial EV Charging Conflicts	Residential Charging	Destination Charging	On-Route Charging	EV Uptake in Wider Area	Total Score
Pryme Street Multistorey	Hull	HCC	5	5	3	5	5	3	4	**30**
Baker Street	Hull	HCC	5	4	3	5	5	3	4	**29**
Dock Street	Hull	HCC	5	5	3	3	5	4	3	**27**
Francis Street Car Park	Hull	HCC	4	3	3	5	5	3	4	**27**
Paragon Street	Hull	HCC	5	5	3	1	5	4	4	**27**
George Street	Hull	HCC	5	4	3	3	5	4	2	**26**
Osborne Street Multistorey	Hull	HCC	5	5	2	4	5	2	3	**26**
Nelson Street/Pier	Hull	HCC	5	4	4	3	5	4	1	**26**
Woodford Leisure Centre Car Park	Hull	HCC	4	4	3	5	3	1	5	**25**
Alfred Gelder Street	Hull	HCC	4	4	3	2	5	4	2	**24**
Lowgate Car Park	Hull	HCC	4	3	3	4	5	3	2	**24**
Osborne Street	Hull	HCC	5	2	3	4	5	2	3	**24**
Albert Avenue Pools Car Park*	Hull	HCC	5	4	4	2	2	2	5	**24**
Wellington Street	Hull	HCC	5	3	2	3	5	4	1	**23**
History Centre Car Park	Hull	HCC	5	2	3	1	5	3	3	**22**
Blackfriargate	Hull	HCC	4	1	2	3	5	4	1	**20**
North Point Shopping Centre	Hull	HCC	4	5	2	1	2	1	5	**20**
Pearson Park Car Park	Hull	HCC	4	3	2	2	3	1	5	**20**
Kingston Street	Hull	HCC	1	2	2	4	5	2	2	**18**
Tower Street	Hull	HCC	5	2	5	1	3	1	1	**18**

Table 10- 4: Hull City Shortlist

*As part of the extension and refurbishment works to be carried out at Albert Avenue Pools, 10 number EV charging points are planned to be installed in the car park.

10.2.3 Combined Hull and East Riding Rankings

To aid decision making in respect of any sub-region wide considerations, sites are also ranked for Hull and East Riding combined.

Site Name	Location	Local Authority	DNO Supply	Security of Location	Commercial Charging Conflicts	Residential Charging	Destination Charging	On-Route Charging	EV Uptake in Wider Area	Total Score
Cross Hill Car Park	Driffield	ER	5	4	5	5	4	5	5	**33**
Trinity Lane Car Park	Beverley	ER	5	5	2	5	5	4	5	**31**
East Riding Leisure Beverley Car Park	Beverley	ER	5	5	2	5	5	4	5	**31**
Pryme Street Multistorey	Hull	HCC	5	5	3	5	5	3	4	**30**
Beckside Car Park	Driffield	ER	5	3	5	3	4	5	5	**30**

Site Name	Location	Local Authority	DNO Supply	Security of Location	Commercial Charging Conflicts	Residential Charging	Destination Charging	On-Route Charging	EV Uptake in Wider Area	Total Score
Baker Street	Hull	HCC	5	4	3	5	5	3	4	**29**
Lord Roberts Road Car Park	Beverley	ER	4	3	2	5	5	4	5	**28**
Dock Street	Hull	HCC	5	5	3	3	5	4	3	**27**
Saturday Market Car Park	Beverley	ER	4	2	2	5	5	4	5	**27**
Langdales Wharf Car Park	Bridlington	ER	5	5	2	3	4	5	3	**27**
Francis Street Car Park	Hull	HCC	4	3	3	5	5	3	4	**27**
Paragon Street	Hull	HCC	5	5	3	1	5	4	4	**27**
Wesley Square Car Park	Goole	ER	5	3	2	4	4	4	4	**26**
George Street	Hull	HCC	5	4	3	3	5	4	2	**26**
Osborne Street Multistorey	Hull	HCC	5	5	2	4	5	2	3	**26**
Eastgate Car Park	Driffield	ER	1	2	5	4	4	5	5	**26**
Thorn Road Car Park	Hedon	ER	4	4	5	3	4	2	4	**26**
Nelson Street/Pier	Hull	HCC	5	4	4	3	5	4	1	**26**
Estcourt Street Car Park	Goole	ER	4	3	2	4	4	4	4	**25**
Burlington Crescent Car Park	Goole	ER	4	4	2	4	4	4	3	**25**
West Green Car Park	Pocklington	ER	5	2	5	4	4	1	4	**25**
Woodford Leisure Centre Car Park	Hull	HCC	4	4	3	2	3	1	5	**22**
Alfred Gelder Street	Hull	HCC	4	4	3	2	5	4	2	**24**
Lowgate Car Park	Hull	HCC	4	3	3	4	5	3	2	**24**
Osborne Street	Hull	HCC	5	2	3	4	5	2	3	**24**
Albert Avenue Pools Car Park	Hull	HCC	5	4	4	2	2	2	5	**24**
Spa Slipway Car Park	Bridlington	ER	5	2	2	3	4	5	2	**23**
Wellington Street	Hull	HCC	5	3	2	3	5	4	1	**23**
North Street Car Park	Bridlington	ER	1	3	2	4	4	5	3	**22**
History Centre Car Park	Hull	HCC	5	2	3	1	5	3	3	**22**
Newbegin Car Park	Hornsea	ER	5	3	5	2	2	3	2	**22**
Blackfriargate	Hull	HCC	4	1	2	3	5	4	1	**20**
Haven Car Park	Brough	ER	1	1	5	5	3	2	4	**20**
North Point Shopping Centre	Hull	HCC	4	5	2	1	2	1	5	**20**
Pearson Park Car Park	Hull	HCC	4	3	2	2	3	1	5	**20**
Hailgate Car Park	Howden	ER	4	5	1	3	2	2	2	**19**
Lee Avenue Car Park	Withernsea	ER	2	2	5	5	2	1	2	**19**
Kingston Street	Hull	HCC	1	2	2	4	5	2	2	**18**
Tower Street	Hull	HCC	5	2	5	1	3	1	1	**18**
Goodmanham Car Park	Market Weighton	ER	1	2	5	1	3	2	1	**15**

Table 10- 5: Top 40 sites across East Riding and Hull

10.3 Summary

- In East Riding, the sites in Beverley, Driffield, Bridlington and Goole scored highest in the EV uptake scoring.
- Power connections for sites in Driffield, Bridlington, Brough, Market Weighton and Withernsea appear challenging and will need significant network strengthening.
- Sites in Hull with close proximity to the city centre scored highly due to proximity to key attractors, residential areas with relatively higher levels of income and limited off-street parking. Most sites appear to have sufficient power capacity with relatively low cost (approx. 10k or below) connections although Kingston Street is the exception. Sites on the outskirts of the city centre score lower on commercial conflicts due to there being a number of sites already installed offering rapid charging.

What is the key relevance to HEY?

The site assessments detailed in this chapter provide an evidence base to inform future provision of charge points in appropriate locations.

What are the key lessons for HEY?

A number of locations already benefit from good provision of charge points and there is less need to intervene in these locations. Other locations such Driffield and Hull City Centre currently lack rapid charging sites and scored highly in the assessments.

What are the implications for HEY strategy?

The scoring of sites has informed recommendations in the Action Plan chapter.

How should this inform HEY decision making?

Decision making should incorporate these scorings to prioritise certain sites across the region offering potential to meet identified demand for charging and fill gaps in the network.

11. Action Plan

11.1 Key Strategic Recommendations

In many ways the transition to EVs will be influenced by factors outside the control of Hull and Riding partners and in some cases the UK Government. Overcoming challenges regarding the global supply of batteries / vehicles and the interlinked issue of EVs being comparatively more expensive than ICEs, will require a cross sector effort by both public and private sector organisations. Hull and East Riding can however take strategic actions to ensure the local environment is fit for the EV future alongside wider cross sector working. **Table 11 - 1** sets out key strategic recommendations to create this conducive EV environment, the rationale underpinning this, timescales, lead organisations to pursue these priorities, and how these recommendations align to the brief of the study.

Recommendation	Rationale	Timescale	Responsible Organisations	Alignment to Brief
1. Provide a balanced base charging network that gives residents, visitors and fleet operators the confidence to transition to EV. Using the site recommendations detailed in this study, provide a base level of infrastructure to encourage uptake. Provision of charge points by the commercial sector and local authorities combined is considered reasonable across the majority of Hull and East Riding with a mix of slow, fast and rapid charging. However, rapid charging capabilities are currently lacking in some areas within the region limiting the potential for on-route, destination, residential and taxi charging. Recommendations for improving charging provision in Hull and East Riding are made in following sections. Using the model detailed in Appendix A approximately 1 - 4 rapid chargers are recommended in the Hull area and approximately 4 - 11 in the East Riding based on currently registered EVs. Under this model by 2025 approximately 26 - 75 rapid chargers would be required in the Hull area and approximately 55 - 149 in the East Riding. It is recommended that due to a number of uncertainties however, monitoring of utilisation rates is conducted and engagement with the commercial sector conducted on an ongoing basis to determine the optimum time to bring forward further charge points on top of the base network.	Although there is no empirical link at present between the provision of charge points and uptake of EVs, public opinion surveys consistently show the *opportunity* to charge at publicly available charge point is highly valued. As the supply of vehicles increases it will be important to give users confidence that facilities exist to support their journeys. With increasing battery capacities, the ability to charge quickly on rapid chargers (or in time-ultra rapid) will be important. Additionally, residents who do not have access to off-street parking will require public facilities.	Provision of a base network in the short term to 2023. Monitoring of utilisation and engagement with commercial sector to determine further phases of infrastructure to be brought forward over the medium to long term (2025+).	Hull City Council / East Riding of Yorkshire Council	This is aligned to the fundamental ask of the brief, of identifying the right charge point locations, at the right time.

Recommendation	Rationale	Timescale	Responsible Organisations	Alignment to Brief
2. Future proofing technology and the infrastructure operating model deployed in future phases of infrastructure roll out and procurement of commercial partners / contracts.	Although the demand for ultra-rapid charging is currently limited by the low number of models with this capability, and the technological solutions for vehicle to grid and inductive charging are relatively immature, these elements are likely to play a key role in the future.	Integrate requirements for keeping pace with innovations into contracts with commercial partners in the short term. Delivery of ultra-rapid chargepoints in the medium to long term (2025+).	Hull City Council / East Riding of Yorkshire Council	This is aligned to one of the additional areas of scope to understand future technology and how it may influence the main ask of the brief in addition to future proofing potential investments.
3. Monitoring technological development and maturity of solutions to address use cases that are currently problematic such as HGVs.	These use cases although problematic at present are still key to meeting policy aims.	Monitoring over short to long term.	HEY LEP / Hull City Council / East Riding of Yorkshire Council	Whilst not mentioned specifically HGVs would play an important contribution towards decarbonisation.
4. Conduct procurement of strategic commercial partner through developing a bespoke contract to leverage land assets to secure investment. Recommend using the site assessments in this study in combination with market engagement to offer a balanced package of sites which overall will be commercially attractive and meet policy aims of creating a balanced network. Recommend a joint area wide procurement exercise to reduce officer time required and make the commercial opportunity more attractive. It is also recommended that a coordinated approach is taken to setting tariffs for usage of charge points in partnership with the commercial operator.	A coordinated and consolidated procurement exercise maximising the scale of the opportunity is likely to realise best value and leverage investment.	Short term to 2023.	Hull City Council / East Riding of Yorkshire Council	This aligns with the market opportunities aspect of the brief.
5. In tandem with developing a procurement exercise, seeking external funding from government from: On-Street Residential Charging Fund; Charging Infrastructure Investment Fund; Ofgem funding; and forthcoming funding including the £950m Rapid Charging Fund (for the M62 corridor); and the £90 million fund for larger-scale local charging projects.	Securing external funds from government would improve the business case for investment by reducing the funding required from Council budgets.	Short term to 2023.	HEY LEP / Hull City Council / East Riding of Yorkshire Council	This is related to the funding opportunities for charge point installation.

Recommendation	Rationale	Timescale	Responsible Organisations	Alignment to Brief
6. Pursue the integration of EVs within the wider hierarchy of transport by seeking to reduce car use through e-car clubs, ULEV buses, shared and micromobilty, and potentially Mobility as a Service in the longer term.	Electrification of personal cars will play a key role in decarbonisation however this on its own will not achieve CO2 reduction targets or tackle other issues such as congestion on roads, improving health / wellbeing, and placemaking within communities.	Ongoing through short to long term.	HEY LEP / Hull City Council / East Riding of Yorkshire Council	Although not specifically mentioned in the brief, this is a key component of HCC's transport strategy and the DfT's Decarbonising Transport strategy. There is also a risk that inappropriately installed EV charge points may negatively impact other sustainable modes of transport.
7. Further consideration should be given to engaging training and skills providers through a strategic and regional approach coordinated through the HEY LEP. This should include mapping current training and skills providers across the range of skills required across the EV sector, and understanding key content and geographical gaps.	This would assist in both meeting market demands and take advantage of opportunities to foster skilled employment opportunities in this sector.	Short term to 2023.	HEY LEP / Hull City Council / East Riding of Yorkshire Council	This is aligned with the brief on training and reskilling.
8. Continuous engagement and joint working with Northern Power Grid to address key points of weakness in the power network including the sites noted in the site assessment chapter.	Provision of cost-effective power connections will be fundamental to the delivery of charging infrastructure.	Ongoing through short to long term.	Hull City Council / East Riding of Yorkshire Council / NPG	This is aligned with the capacity and constraint of the power network.
9. For coastal (e.g. Bridlington) and Humber estuary (e.g. Wellington Street in Hull) sites it is recommended that particular attention is given to the potential for coastal flooding and salinity of the environment in the specification of chargepoints. Solutions may include the use of galvanised metals and siting charge points on plinths.	This will lead to reduced maintenance costs and better resilience / reliability.	Short term to 2023 and then ongoing.	East Riding of Yorkshire Council / Hull City Council	This is aligned with the future proofing of the network aspect of the brief.

Recommendation	Rationale	Timescale	Responsible Organisations	Alignment to Brief
10. Utilise the Hull Smart City Platform to integrate utilisation data of charge points to provide a feedback loop to inform future phases of deployment. Additionally, the data aspect can also be tied into various regulatory frameworks necessary for the installation and utilisation of charge point infrastructure. This is an overlooked blocker on the path to a truly integrated EV offering with aspects such as Traffic Regulation Orders leading to delays in the installation of EV Infrastructure.	Ensuring the data from charge points is integrated into the Hull Smart City Platform will enable the tracking of usage levels, allowing for dynamic monitoring and reaction, thereby bringing forward further phases of charge points in a timely way.	Short term to 2023.	Hull City Council	This is aligned with the future proofing of the network.

Table 11 - 1: Key strategic recommendations

11.2 Recommendations for Delivery of Charging Infrastructure

Recommendations are provided below to achieve provision of a base network as noted above.

11.2.1 East Riding Infrastructure

Recommendation	Rationale	Timescale	Responsible Organisations
ER1. Delivery of rapid charging points in towns which currently do not benefit from provision as part of commercially provided networks: • Driffield – Cross Hill Car Park (2x 50kWh rapid chargers) • Hedon – Thorn Road Car Park (2x 50kWh rapid chargers) • Pocklington – West Green Car Park (2x 50kWh rapid chargers), although it is noted there is potential for rapid charging to be provided at the nearby Sainsburys or Aldi car parks and this situation should be kept under review • Hornsea – Newbegin Car Park (2x 50kWh rapid chargers)	As noted above the lack of rapid charging sites is likely to limit the potential for on-route, destination, residential and taxi charging.	Short term to 2025 for filling key gaps in the rapid charging network. Short to medium term for considering bringing forward further infrastructure.	East Riding of Yorkshire Council / NPG

Recommendation	Rationale	Timescale	Responsible Organisations
It is recommended the following locations are kept under review and rapid charging points brought forward in the short to medium term in line with demand and through engagement with the commercial sector to understand their appetite for investing in Council owned sites: • Beverley – Trinity Lane Car Park • Bridlington – Langdales Wharf Car Park • Goole – Wesley Square Car Park • Howden – Hailgate Car Park The following sites were found to have likely problematic DNO connections are further feasibility work is recommended to identify appropriate locations in these towns: • Brough – Haven Car Park • Withernsea – Lee Avenue Car Park • Market Weighton – Goodmanham Car Park			
ER2. The coverage of slow and fast charging facilities in East Riding is generally good, especially with an additional phase of sites due to be delivered imminently. It is recommended that utilisation figures are monitored and further chargepoints brought forward for longer stay parking as required.	These facilities will support a range of use cases where longer parking durations occur.	Medium term	East Riding of Yorkshire Council / NPG
ER3. As noted in section 6.2.1 a number of areas of East Riding have higher proportions of households that have limited access to off-street parking and therefore charging opportunities in Bridlington, Beverley, Goole and Hornsea. These areas already have rapid charging facilities, or in the case of Hornsea, rapid charging facilities are recommended in this study that will provide opportunities for residents. Further to this, it is recommended East Riding of Yorkshire Council consider the feasibility of siting community hub charging facilities in the proximity of streets with limited off-street parking.	In the short-term early adopters will require publicly available chargepoints and in the medium term as the supply of vehicles increases there will be requirements for additional facilities.	Short to medium term	East Riding of Yorkshire Council / NPG

Table 11 - 2: Infrastructure recommendations and actions for East Riding

11.2.2 Hull Infrastructure

Recommendation	Rationale	Timescale	Responsible Organisations
H1. Delivery of rapid charging points in Hull City Centre as there are no facilities at present. Recommended sites include: • Dock Street (1 x 50kWh rapid) • Paragon Street (1 x 50kWh rapid) • Lowgate Car Park or Francis Street Car Park (2 x 50kWh rapids) – Lowgate preferred as likely cheaper DNO connection and closer to city centre attractors	As noted above the lack of rapid charging sites is likely to limit the potential for on-route to the port, destination, residential and taxi charging.	Short term to 2025 for filling key gaps in the rapid charging network. Short to medium term (2025) for considering bringing forward further infrastructure in line with utilisation monitoring.	Hull City Council / NPG
H2. The coverage of slow and fast charging facilities in Hull City Centre is generally good at destinations. The utilisation monitoring for the Council's current sites shows low usage and therefore further monitoring is recommended to understand the appropriate timescale to increase provision at the History Centre Car Park and forthcoming chargepoints at Albert Avenue Pools Car Park. Further sites that could be delivered include: • Pryme Street Multistorey • Osborne Street Multistorey • North Point Shopping Centre (recommended to be delivered by owner / operator)	These facilities will support a range of use cases where longer parking durations occur.	Short to medium term (2025) for considering bringing forward further infrastructure in line with utilisation monitoring.	Hull City Council / NPG
H3. As noted in section 6.2.1 Hull has significant numbers of properties with limited off-street parking and therefore charging opportunities. The rapid charging sites already in place around on the outskirts of the city centre, on the A63 corridor, and those recommended above will provide opportunities for these residents. Further to this, it is recommended further technical work is conducted to assess the feasibility of locating consolidated charging hubs of slow chargers at the following locations: • Baker Street • Nelson Street • Wellington Street	In the short-term early adopters will require publicly available chargepoints and in the medium term as the supply of vehicles increases there will be requirements for additional facilities.	Short to medium term	Hull City Council / NPG

Recommendation	Rationale	Timescale	Responsible Organisations
• Pearson Park • Woodford Leisure Centre Car Park (would also be useful for destination use case)			
H4. It is recommended that for on-street locations noted above charge point units do not impact on the level of service for pedestrians and cyclists. Where footways are considered too narrow, units should be placed on buildouts within the carriageway.	EV should be placed within the wider hierarchy of transport with pedestrians and cyclists taking higher priority in urban areas.	Ongoing	Hull City Council
Footnote – a number of sites are not recommended to be moved forward at the present time as noted below: • George Street, Alfred Gelder Street, and Osborne Street are not recommended at this time due to limited highway space available and potential conflicts with placemaking and/or sustainable and integrated transport objectives. • Blackfriargate and Tower Street are not recommended at present time due to lack of perceived safety at these locations. • Kingston Street is not recommended at this time due to a problematic DNO connection.			

Table 11 - 2: Infrastructure recommendations and actions for Hull

11.3 Key Recommended Next Steps

	Timescale		
	Short Term (2021 - 2023)	Medium Term (2023 - 2030)	Long Term (2030+)
Provide a base level of infrastructure to encourage uptake of EVs			
Continuously monitor utilisation of charge points and bring further additional infrastructure in coordination with the commercial sector			
Conduct procurement of strategic commercial partner			
Future proof technology provided in base network and ongoing procurement			
Pursue the integration of EVs within the wider hierarchy of transport			
Consider engagement in training and skills providers through a strategic and regional approach coordinated through the HEY LEP			
Continuously engage and collaborate with Northern Power Grid to future proof the power network			

Appendix A. Rapid Charger Model

As noted in the main body of this report rapid chargers of approximately 50kWh serve a wide range of use cases and across Hull and East Riding are generally the type of charging points that a lacking.

To guide development of a base network in the short term to medium term, a model has been developed to approximate the numbers of rapid chargers required. This model uses the following formula:

Number of required rapid chargers per day = Nv x Pr x Ct/Cw

Nv = number of vehicles expected in a LA area;
Pr = The percentage predicted which may/will use a rapid (20%);
Ct = The average charge time (42mins);
Cw = The charge window the realistic window when people will use rapid chargers (900mins).

Three scenarios are plotted using the model reflecting current uncertainty regarding consumer behaviour:

- Charging every day;
- Charging every second day;
- Charging every third day.

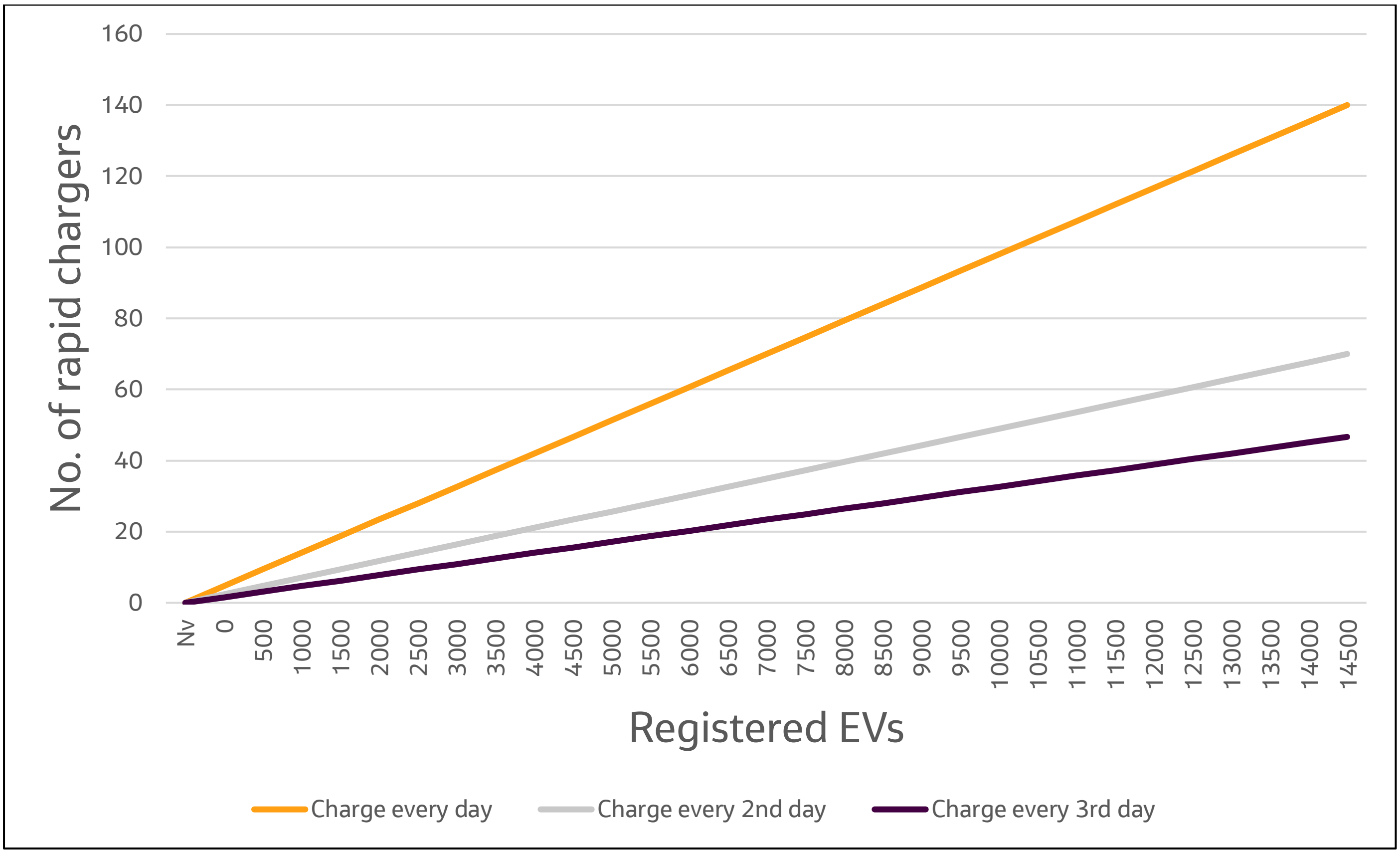


Figure AB1 – Required rapid chargers as determined by model

	Hull	East Riding	Total
2021 Network	1 - 4	4 - 11	5 - 15
2025 Network	26 - 75	55 - 149	81 - 224

Table AB1 - Number of rapid chargers required in Hull and East Riding under the model scenarios ranging from the assumption of EVs charging every day to every 3rd day.