Delivering innovation in transport and energy infrastructure for zero emission mobility

PROJECT

REPORT

Isle of Wight Electric Vehicle Infrastructure Planning

Final Report

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Prepared for:

Natasha Dix
Isle of Wight Council
County Hall, Newport
Isle of Wight
PO30 1UD

natasha.dix@iow.gov.uk
019 8382 3777 (ext. 6623)

Prepared by:

Jacob Roberts
Infrastructure Strategy Specialist

Approved by:

Chris Rimmer
Infrastructure Strategy Lead

Company Details

Cenex
Holywell Building
Holywell Park
Ashby Road
Loughborough
Leicestershire
LE11 3UZ

Registered in England No. 5371158

Tel: 01509 642 500
Email: info@cenex.co.uk
Website: www.cenex.co.uk

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Abbreviations

ANPR	Automatic Number Plate Recognition
CO_2	Carbon dioxide
CSF	Central Southern Framework
DfT	Department for Transport
DNO	Distribution Network Operator
EGR	Exhaust Gas Recirculation
ELV	Emission Limit Value
ETRO	Experimental Traffic Regulation Order
EU	European Union
EV	Electric Vehicle
FFR	Firm Frequency Response
HGV	Heavy Goods Vehicles
IoW	Isle of Wight
IWC	Isle of Wight Council
IoWEVIP	Isle of Wight Electric Vehicle Infrastructure Planning
kW	Kilowatt
kWh	Kilowatt-hours
MW	Megawatt
OLEV	Office for Low Emission Vehicles
OSM	OpenStreetMap
PCN	Penalty Charge Notice
PHEV	Plug-in Hybrid Electric Vehicles
PiV	Plug-in Vehicle
PV	Photovoltaic (solar) panels
SLA	Service Level Agreement
TRO	Traffic Regulation Order
V2G	Vehicle to Grid

1 Introduction

1.1 Introduction to Cenex

Cenex was established in 2005 as the UK's first Centre of Excellence for Low Carbon and Fuel Cell technologies.

Today, Cenex operates as an independent, not-for-profit consultancy specialising in the delivery of projects, supporting innovation and market development, focused on low carbon vehicles and associated energy infrastructure.

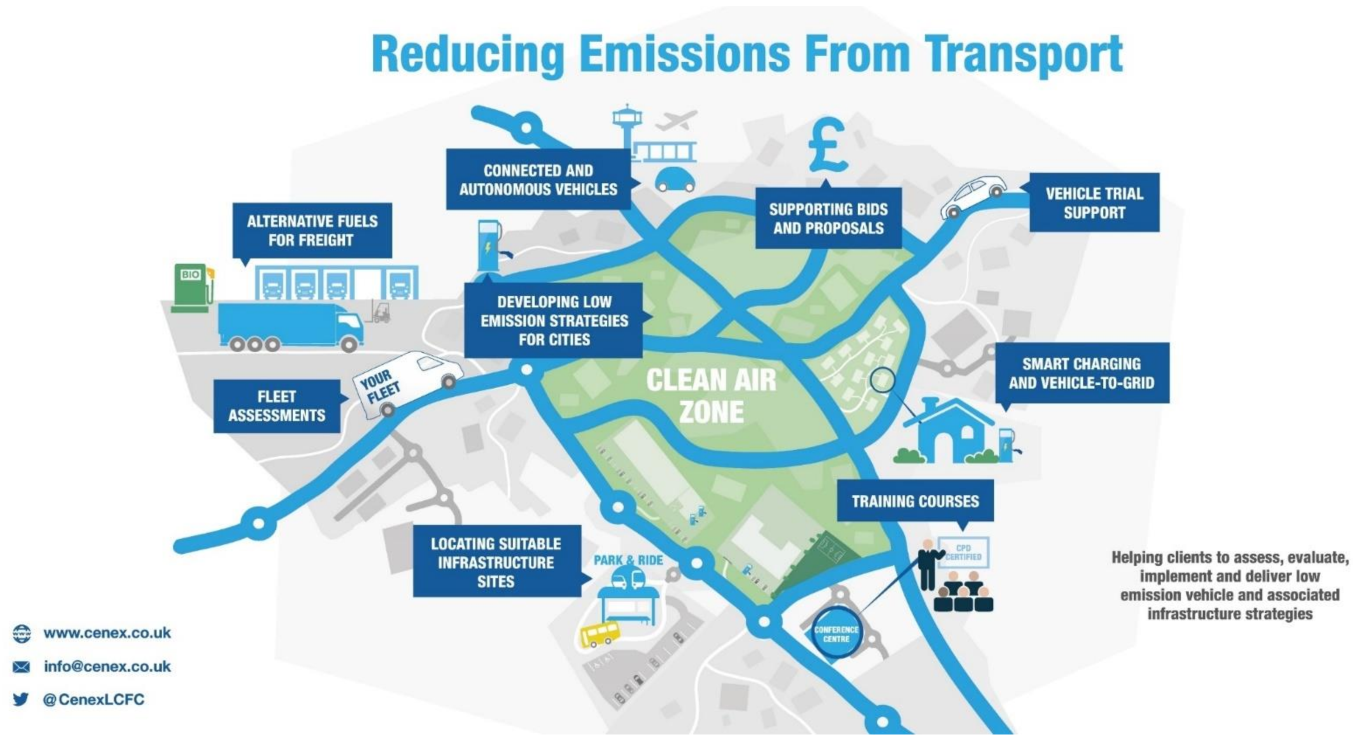
We highly value our independence as it allows us to provide impartial advice and helps us build trust with our customers.

Being a not-for-profit, Cenex isn't driven by doing the work which pays the most or builds our order book, but by what is right for our customers and for the industry. This is reflected in everything we do, from the work we do and the advice we give, even to the prices we charge.

Finally, as consultants our aim is to be trusted advisors with expert knowledge – the go-to source of help and support for public and private sector organisations. We want to be people you can trust to help where and when it is most needed as our customers progress along their journey to a zero-carbon future.

To find out more about us and the work that we do, visit our website:

www.cenex.co.uk



1.2 Introduction to the Project

To aid decarbonisation on the Isle of Wight, Isle of Wight County Council (IWC) have commissioned Cenex to explore options for a network of electric vehicle (EV) chargepoints on the island. This project assesses IWC-owned and privately-owned car parks to determine feasibility for EV charging infrastructure locations, and recommend the ideal quantity and specification of equipment appropriate for each site. An aim of this project is also to identify car parks where a charging hub could be installed and where solar canopies would be feasible.

This project is divided into three work packages, each with specific outputs. These work packages and their outputs are:

Work Package 1: Chargepoint locations

a. Identify sites suitable for EV charge points, noting the ideal charge point specification and sites with potential for installation of solar canopies and charging “hubs”;
b. Identify potential usage of charge points at identified sites, comparing different ownership models; and
c. Review business models, including Central Southern Framework (CSF) with Joju Solar.

Work Package 2: On-street parking assessment

a. Provide a methodology to decide appropriate locations for on-street charge points, for use by IWC;
b. Review infrastructure available for on-street charging; and
c. Propose traffic regulation order (TRO) requirements to accompany on-street chargepoints.

Work Package 3: Desk study for IWC fleet and commercial vehicle users

a. Assess potential for rapid and fast charge hubs or on-street charging suitable for commercial vehicles; and
b. Assess potential for development of public/private partnership for commercial EV charge points.

This report has been divided into three sections, reflecting these work packages. Certain outputs of this project are not suitable for inclusion within a written report and have therefore been provided as appendices to this report. These appendices include:

- Appendix A: Microsoft Excel format document, containing a table of all potential infrastructure sites identified through this project, along with all attributes associated with each site.
- Appendix B: Microsoft Excel format document, containing all business model information and including a dashboard allowing for the business case for all shortlisted EV infrastructure sites to be compared between three different EV uptake scenarios and four different infrastructure ownership models.
- Appendix C: A GIS GeoPackage format document, containing all mappable outputs, including: locations of existing and proposed EV infrastructure locations; points of interest used to inform potential infrastructure site locations and; the results of the on-street residential charging suitability analysis

2 Electric Vehicle Charging Infrastructure Locations

The first work package of the Isle of Wight EV Infrastructure Planning (IoWEVIP) project is Electric Vehicle Charging Infrastructure Locations. This work package is divided into three sub-sections:

1. Charging infrastructure site identification
2. Potential deployment of innovative technologies
3. Business modelling

2.1 Charging Infrastructure Site Identification

2.1.1 Site Identification Process

The methodology for identifying potential sites for EV charging infrastructure installation followed a process beginning with the production of a longlist and ending with a ranked list of the top 25 potential sites. The outline of this process is shown in Figure 1.

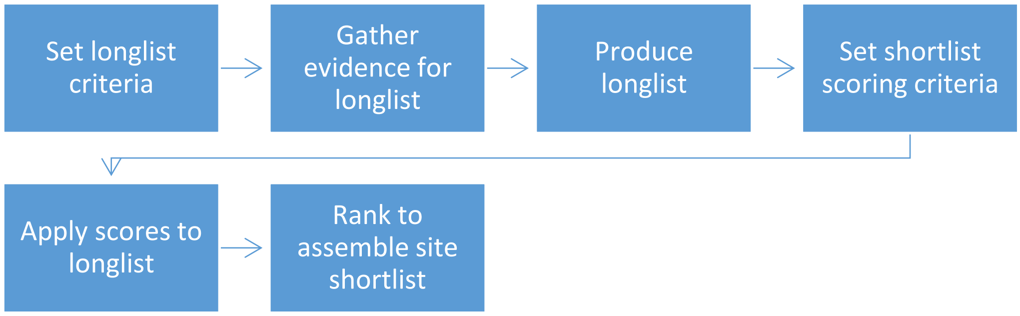


Figure 1; Site identification process

2.1.2 Longlist criteria

Sites were longlisted that conformed to any of the following criteria:

- Car parks owned by Isle of Wight Council
- Car parks owned by other parties including:
  - Private businesses and industrial estates
  - NHS
  - Educational organisations
- Transport hubs, including:
  - Train stations
  - Fuel stations
  - Taxi ranks
  - Ferry terminals
- Leisure destinations and attractions, including:
  - Retail parks and districts
  - Museums
  - Galleries
  - National Trust and English Heritage sites
  - Theme parks
  - Viewpoints
- Locations where EV charging infrastructure has already been installed
- Supermarkets with attached car parks

2.1.3 Longlist evidence

Data on the locations of sites meeting the criteria for longlisting was primarily sourced from OpenStreetMap (OSM)[1]. There were two exceptions to this. Firstly, Isle of Wight Council (IWC) car parks, for which information was provided by IWC. Secondly, current EV infrastructure locations and upcoming installations were gathered from a combination of data from National Chargepoint Registry[2], Zap-Map[3] and IWC.

OSM data is freely available and, in most localities, it contains a large array of accurate datapoints. As an open dataset that can be edited by any individual, it is impossible to entirely guarantee the accuracy of the data it provides. However, within the geographical scope of this project, OSM data was rich and was supported by alternative sources of information including internet search results). The information gathered through OSM has been verified for all sites that have been longlisted for EV charging infrastructure installation.

The combined dataset used to evidence the longlisting process contained 3,189 datapoints.

2.1.4 Longlist production

Based on the evidence gathered from multiple sources, a longlist of 137 sites was produced. Details for these locations can be found in Appendix A. For each location, site ownership was recorded (where possible) and a primary use case and ideal chargepoint specification has been suggested, based on the nature of the location.

The 137 longlisted sites have been broken down by primary use case (Figure 2), suggested chargepoint power (Figure 3) and land ownership (Figure 4).

Primary use case

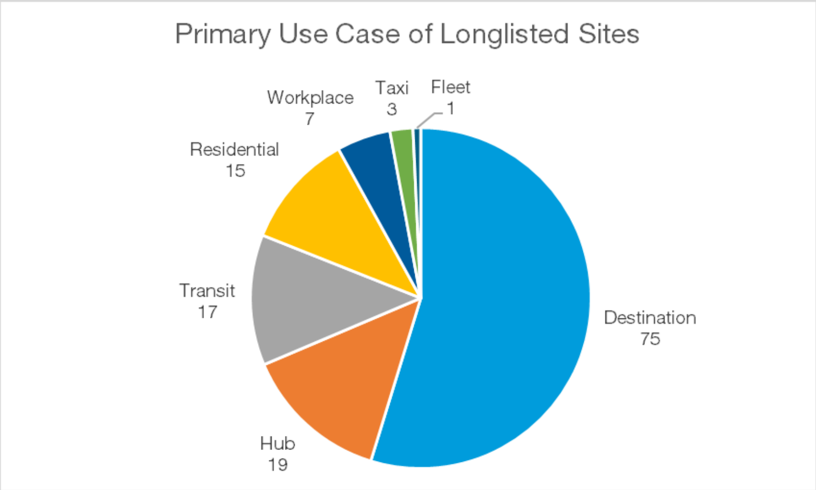


Figure 2; Breakdown of primary use cases for longlisted sites

Definitions for the use cases that describe the longlisted sites can be found in Table 1.

[1] https://www.openstreetmap.org/about

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

[3] https://www.zap-map.com/

Table 1; Definitions of use cases used to describe longlisted sites

Use Case	Location type
Destination	Near to a point of interest, where vehicles are likely to visit regardless of whether EV charging infrastructure is installed
Hub	With size and space enough to install multiple, high-power chargepoints
Transit	Offering an opportunity for EV users to charge on route to another destination that is not near to any other particular point of interest
Residential	Within a residential area, mitigating the need to install charging infrastructure on-street
Workplace	Near to or part of an employment site
Taxi	Near to or on a taxi rank
Fleet	Near to or on a site likely to be frequented by commercial vehicles

Suggested chargepoint power

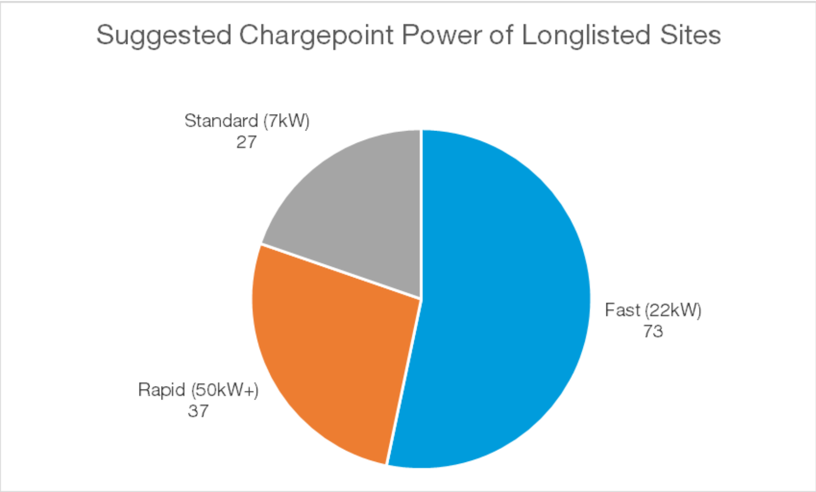


Figure 3; Breakdown of suggested chargepoint power of longlisted sites

Land ownership

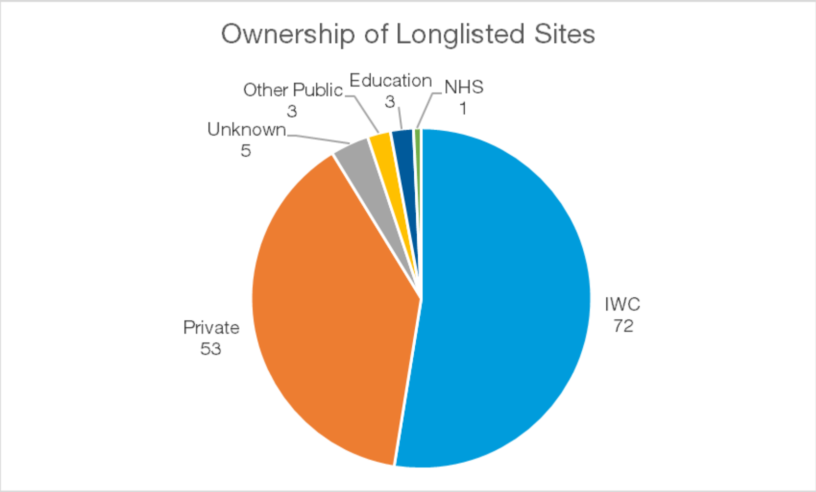


Figure 4; Breakdown of land ownership of longlisted sites

2.1.5 *Shortlist scoring criteria*

The scoring criteria used to assess and rank longlisted sites included two indices, which were combined to provide a single score. Each longlisted site was assessed and given a score between one and ten, relating to the following factors:

- Usage: How ideal the site would be from a user perspective
- Installation: How feasible chargepoint installation is at the site

The criteria used to score each site against these two factors is shown in Table 2.

Table 2; Scoring criteria used for site shortlisting

Score	Usage	Installation
10	Great convenience to most or all common user groups across all use cases. An ideal site for the installation of charging hubs.	Clear evidence of a strong electrical supply on or near the site. Road surfaces are easily excavated (e.g. tarmac, porous surface) without causing significant inconvenience. Land owned by IWC, public body or another pre-engaged stakeholder. Possible evidence that redevelopment or construction work is underway or imminent.
	Moderate convenience to majority of user groups, across several use cases. Alternatively, clear convenience to a select number of user groups, across a smaller number of use cases.	Evidence of proximity to an electrical supply of reasonable strength. Road surfaces easily excavated with limited inconvenience caused. Land owned by IWC, public body or other stakeholders who are already engaged in activities regarding EV charging.
5	Moderate convenience to a select number of user groups, across a smaller number of use cases.	Evidence of electrical supply, but likely not to be particularly strong or in close proximity. Road surfaces more difficult to excavate (e.g. concrete). Some inconvenience likely to be caused during installation process. Land owned by external stakeholders, potentially with some interest in installing EV chargepoints (e.g. fuel station).
	Some convenience to an exclusive user group, with only a single use case likely.	Evidence of a weak electrical supply and/or a supply that is a significant distance from the site. Inconvenience likely to be caused to users of the site. Land owned by external stakeholders with unknown interest in EV charging.
1	Of little practical convenience to any user group. Would require significant behavioural change to make it a useful location.	Low confidence that an electrical supply exists to the site. Major inconvenience likely to be caused as a result of installation process (e.g. through roadworks). Land owned by external stakeholder with unknown interest in EV charging.

2.1.6 Create and rank site shortlist

In order to determine scores for each location, sites were assessed remotely, using spatial information gathered for open sources. This included OpenStreetMap, Google satellite imagery and Google Street View, where available.

The scoring criteria outlined in Table 2 was applied to all 137 longlisted sites. The usage and installation scores were then added together, resulting in a score between one and 20, representing the overall appropriateness of installing EV charging infrastructure at each site.

The longlist was then ranked by overall score and the top 28 sites were selected to form the shortlist, which is shown in Table 3. 28 sites were selected, as opposed to the 25 that were originally planned, because three additional sites were ranked in equal 25th place. A map of these sites is shown in Figure 5

Table 3; List of sites shortlisted for electric vehicle charging infrastructure installation

Name	Ownership	Charge Type	Use Case	Scores		
				Usage	Instl.	Total
Chapel Street Car Park	IWC	Rapid	Hub	10	9	19
St Thomas Street Car Parks (hub)	IWC	Rapid	Hub	10	9	19
County Hall	IWC	Standard	Workplace	9	9	18
St John's Road Car Park	IWC	Fast	Destination	8	9	17
Carisbrooke High Street Car Park	IWC	Standard	Workplace	9	8	17
Lidl Shanklin	Private	Rapid	Destination	9	8	17
Morrisons Lake	Private	Rapid	Destination	9	8	17
Medina Yard Redevelopment	Unknown	Fast	Destination	7	9	16
Cross Street Car Park	IWC	Fast	Destination	8	8	16
New Red Funnel Ferry Terminal	Unknown	Rapid	Transit	8	8	16
Newport Jobcentre Plus	Public	Standard	Workplace	8	8	16
Quay Road Car Park	IWC	Fast	Destination	8	8	16
Spa Car Park	IWC	Fast	Destination	8	8	16
St Mary's Hospital	NHS	Fast	Destination	8	8	16
Church Litten Car Park	IWC	Rapid	Taxi	9	7	16
Orchardleigh Road Car Park	IWC	Fast	Destination	9	7	16
Appley Car Park (hub)	IWC	Rapid	Hub	6	9	15
Cowes Enterprise College	Education	Standard	Workplace	7	8	15
Isle of Wight College	Education	Standard	Workplace	7	8	15
Robin Hill Country Park	Private	Fast	Destination	7	8	15
The Needles	Private	Fast	Destination	7	8	15
Vernon Gardens Car Park	IWC	Fast	Destination	7	8	15
New Road Car Park	IWC	Standard	Residential	8	7	15
Park Road Car Park	Unknown	Standard	Destination	8	7	15
Pound Lane Car Park	IWC	Fast	Destination	8	7	15
The Heights Car Park	IWC	Standard	Workplace	8	7	15
Victoria Street Car Park	IWC	Fast	Destination	8	7	15
Aldi Lake	Private	Rapid	Hub	9	6	15

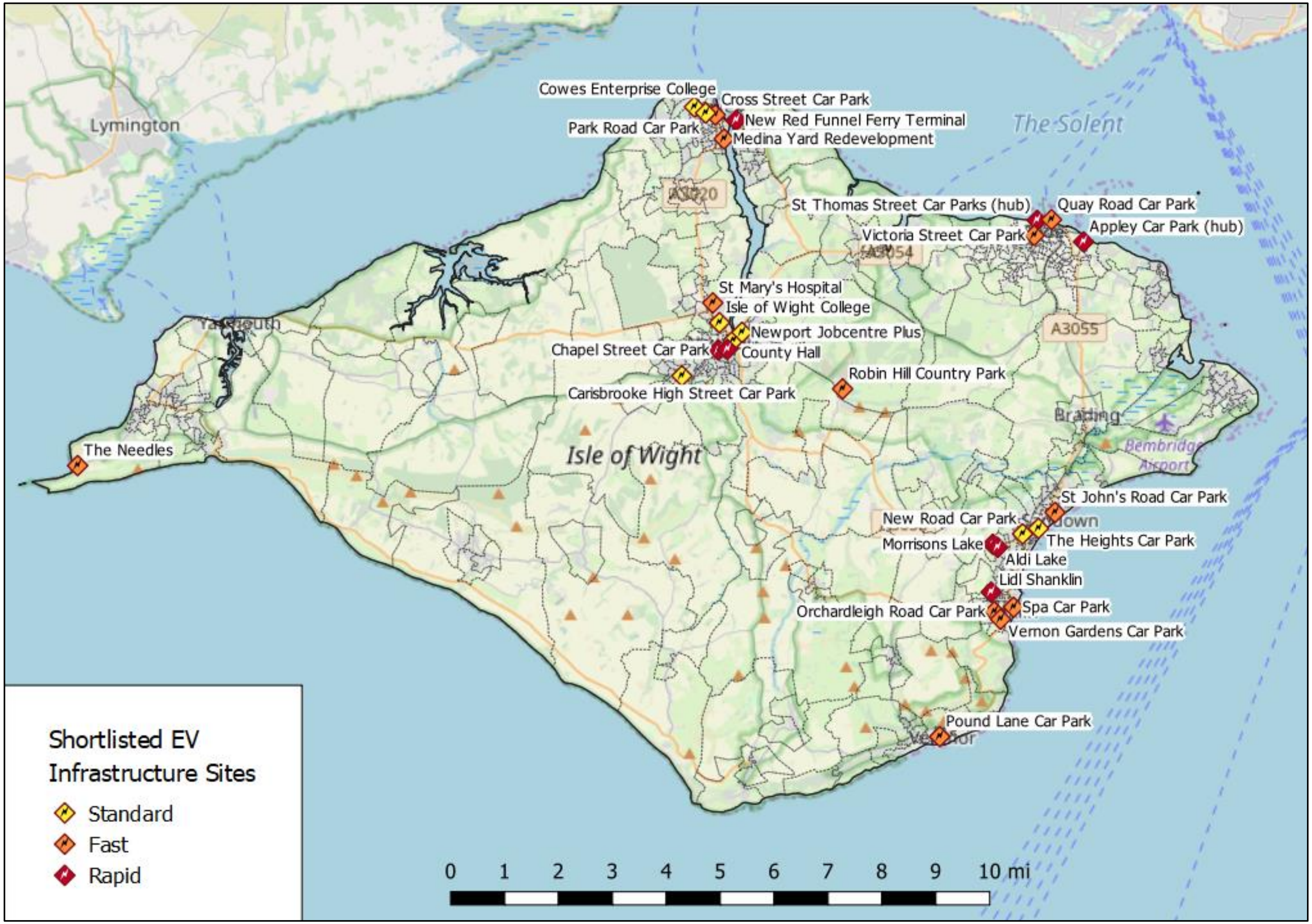


Figure 5; Map of shortlisted EV charging infrastructure locations.

2.2 Opportunities to Deploy Innovative Technologies

During the site assessment process, sites that presented potential opportunities to deploy innovative technologies were noted. These sites were considered to have a user need for innovative technologies and/or were particularly feasible locations to explore certain technologies. The technologies that were considered are described in Table 4.

Table 4; Descriptions of innovative technologies considered in the site assessment

Technology	Description
Solar Photovoltaic (PV) Panels	Panels of photovoltaic cells that convert photons (light energy) to electricity. These panels can be fitted to canopies that cover parking bays, which are currently available from several suppliers.
Inductive (Wireless) Charging	Pads mounted above the road surface or coils installed beneath the road surface that wirelessly provide electricity to compatible electric vehicles by inducing an oscillating magnetic field. Two types of inductive charging exist: • Static wireless charging. Fixed wireless charging pad that a compatible EV must be stationary and correctly positioned above to receive a charge. • Dynamic wireless charging. Coils typically fitted underneath the road surface that will provide a charge to a compatible vehicle positioned correctly above it, whether it is moving or stationary. As of 2019, no production EVs are compatible with wireless charging, but the technology can be retrofitted. Research and development of wireless charging technology is currently being funded by Innovate UK. Cenex has expertise in inductive wireless charging if a more detailed study into this technology is required.
Vehicle-to-Grid (V2G)	Electric vehicle chargepoints that are equipped to accept bi-directional electrical currents. This enables compatible EVs to return electricity back to a building or to the grid in periods of high demand on the electrical distribution network. V2G can also be used to store renewable electricity during periods of high renewable generation, allowing it to be used during periods of high carbon intensity. A small number of production electric and plug-in hybrid vehicles are available that are compatible with V2G chargepoints, including the Nissan Leaf, Nissan eNV-200, Mitsubishi Outlander. This is expected to increase in the future. Research and development of V2G technology is currently being funded by Innovate UK. Cenex has a long history of expertise in V2G modelling and deployment if a more detailed study into this technology is required.

A list of sites that were considered appropriate for the installation of one or more of these technologies is shown in Table 5.

Solar

Sites that were identified as being appropriate for the installation of solar PV canopies were typically larger sites, with evidence of an electrical supply either on or near to the site. The most appropriate sites were also located near to buildings, where electricity generated by the solar PV canopies could be used to supply the buildings, as well as EVs. Whilst smaller car parks could also potentially host solar PV canopies, the installation of the canopies would have a greater impact on parking availability and potentially remove a small number of bays that would have a more significant impact that sites with a greater number of spaces. Sites without an electrical supply could also benefit from solar PV panels, but they would most likely need to be accompanies by battery storage in order to allow EV chargepoints to utilise any electricity generated.

Table 5; List of sites identified as being appropriate for innovative technology deployment

Name	Ownership	Shortlist	Solar	V2G	Wireless
St Mary's Hospital	NHS	Yes	Yes	Yes	Yes
New Red Funnel Ferry Terminal	Unknown	Yes	Yes	No	Yes
Red Funnel Ferry Queue	Private	No	No	No	Yes
County Hall	IWC	Yes	Yes	Yes	No
Cowes Enterprise College	Education	Yes	Yes	Yes	No
Isle of Wight College	Education	Yes	Yes	Yes	No
The Heights Car Park	IWC	Yes	Yes	Yes	No
Tapnell Farm Park	Private	No	Yes	Yes	No
Chapel Street Car Park	IWC	Yes	Yes	No	No
St Thomas Street Car Parks (hub)	IWC	Yes	Yes	No	No
Medina Yard Redevelopment	Unknown	Yes	Yes	No	No
Quay Road Car Park	IWC	Yes	Yes	No	No
Gunville Retail Park	Private	No	Yes	No	No
Carisbrooke College	Education	No	Yes	No	No
Yarmouth Car Park (hub)	IWC	No	Yes	No	No
Appley Car Park (hub)	IWC	Yes	Yes	No	No
Aldi Lake	Private	Yes	Yes	No	No
Albany Road Redevelopment	Unknown	No	Yes	No	No
The Old Smithy & Gardens	Private	No	Yes	No	No
Tesco Westridge	Private	No	Yes	No	No
Yarmouth Car Park	IWC	No	Yes	No	No
Arreton Barns Craft Village	Private	No	Yes	No	No
Aldi Cowes	Private	No	Yes	No	No
The Needles (hub)	Private	No	Yes	No	No
Freshwater Bay Car Park	IWC	No	Yes	No	No
Tesco Express Lake	Private	No	Yes	No	No
Seaclose Park Car Park	IWC	No	Yes	No	No
Osborne Car Park	Private	No	Yes	No	No
Freshwater Bay Car Park (hub)	IWC	No	Yes	No	No

Wireless charging

Sites that were identified as being particularly appropriate for the deployment of wireless charging technology were typically locations where vehicles potentially spend a significant time but are unlikely to be completely stationary or unlikely to be able to access a conventional wired chargepoint under the normal parking behaviours associated with the site. Examples of this that have been identified include queues for ferry terminals, where the usage conventional wired charging would prohibit an EV to join and maintain position in the terminal queue. Other examples include taxi ranks, where hackney carriage vehicles queue whilst plying for hire. In these cases, an EV hackney carriage driver would be prohibited from maintaining their position in the rank if their vehicle was plugged-in to a conventional wired chargepoint.

Vehicle-to-Grid

Sites that were identified as being particularly appropriate for deployment of V2G technology were typically car parks attached to specific properties, where vehicles are likely to be parked for a significant period of time (e.g. workplaces). In these cases, V2G charging infrastructure would allow compatible EVs to supply electricity to the building, as well as to the grid. Research has shown that the business case for V2G is stronger when the technology is utilised primarily to provide electricity to buildings during periods of peak energy pricing, as opposed to being utilised to return electricity to the grid. This is especially the case where EVs have been charged using electricity from local renewable sources. The business case can be further improved by providing grid services such as Firm Frequency Response (FFR). V2G can also be utilised to mitigate costs that may arise from additional power required as part of a supply agreement with the distribution network operator (DNO).

2.3 Business Case Analysis

The business case for installation of EV charging infrastructure for the years 2020-2028[4] was calculated for each of the 28 sites that were shortlisted. The business cases were developed across three EV uptake scenarios and looking at four operational business models. The full business case across all individual sites can be found in Appendix B.

This section will describe the overall business case, representing the consolidated view across the 28 shortlisted sites, displayed on pages 27 to 33.

2.3.1 Electric Vehicle Uptake Projection Scenarios

To determine number of EV users likely to visit each site, EV uptake was forecasted over three scenarios, based on the UK Government Industrial Strategy, as set out in the Road to Zero strategy (2018)[5]. These scenarios are described in Table 6, with the transition shown in Figure 6.

Table 6; Plug-in vehicle adoption by 2028, based on UK Government Industrial Strategy

Scenario	Plug-in vehicle uptake by 2028	
	% of new registrations	% of all vehicles registered
Low	23%	8%
Mid	38%	12%
High	53%	16%

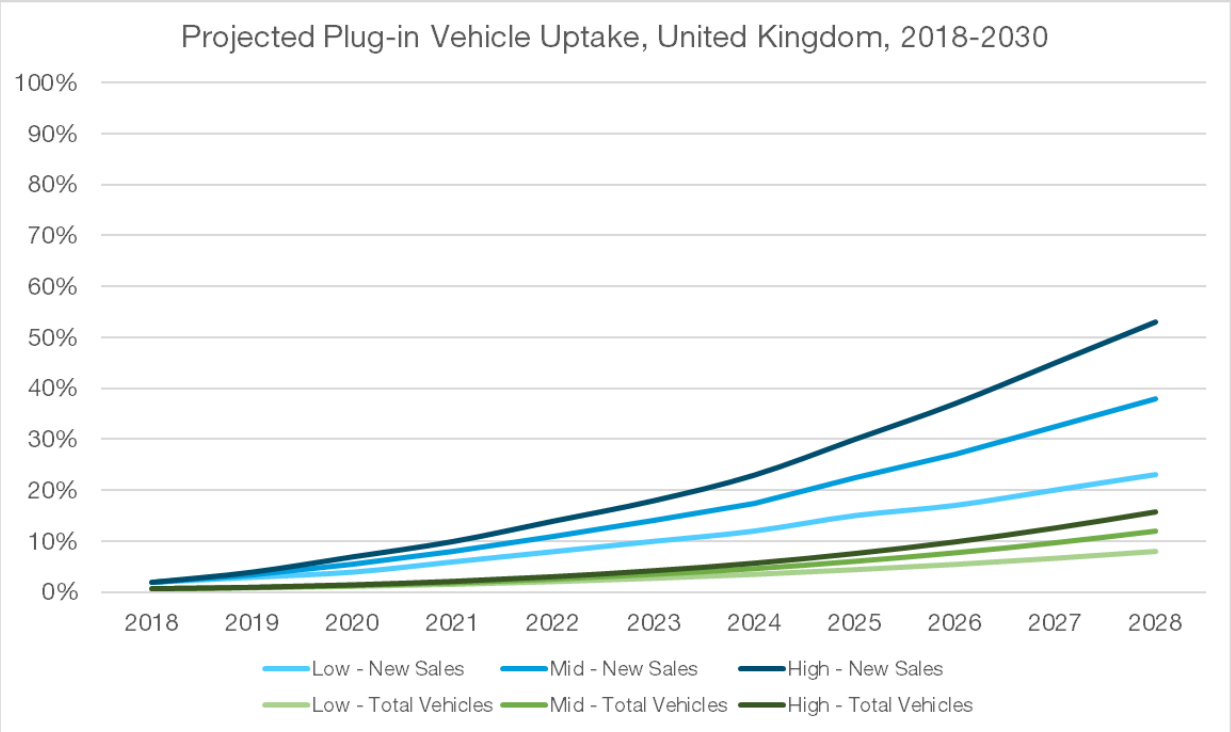


Figure 6; Plug-in vehicle uptake, 2018-2028, based on UK Government Industrial Strategy

[4] 2028 date range chosen to reflect typical eight-year operational life span of public EV charging infrastructure.

[5] UK Government, Road to Zero 2018

2.3.2 Key Modelling Inputs and Assumptions

Key inputs and assumptions made for each site can be found in Appendix B.

Number of Parking Bays

Where information was not available on the exact number of spaces at a particular site, satellite imagery was used to manually count the number of bays. This method is accurate for outdoor parking bays but, where bays are sheltered and therefore not visible on satellite imagery, they will not have been counted. However, to the best of knowledge available through desk research, none of the shortlisted sites feature indoor parking.

Car Park Turnover

For each site, we have assumed an average daily turnover rate, which has the effect of increasing the total number of vehicles using the site each day. For example, a car park with 100 spaces and a turnover rate of 1.5 would be visited by an average of 150 vehicles per day. Without car park usage statistics, there is no direct evidence to base this assumption upon. Therefore, we have estimated the turnover rate based on the nature of the site. For example, destinations where visitors are unlikely to stay more than a small number of hours (e.g. supermarkets, short-stay car parks, etc.) have a higher turnover rate than those where vehicles are more likely to park for long durations (e.g. residential car parks).

Site EV Usage Uplift

It has been assumed that, by providing EV charging infrastructure at a site, a greater proportion of EVs will visit that site than an alternative site without charging infrastructure. This assumption has been applied differently, depending on the nature of the site. For example, sites where charging hubs have been proposed are assumed to have a five-fold increase in proportion of EVs visiting the site, compared to the national average. For sites where the installation of EV charging infrastructure would be beneficial but not necessarily lead to an increase in the proportion of EVs using the site (e.g. workplaces), little or no uplift has been applied. No research is yet available to evidence these assumptions, but it was considered unreasonable to assume that all sites would be visited by an equal proportion of EVs, when considering the different use cases. Details on the uplift assumed for each shortlisted site are found in Appendix B.

Breakdown of EV Chargepoint Types

Based on the potential use cases for each shortlisted site, modes of charging were proposed that are proportional to the different use cases likely to occur at each site. For example, where sites are dedicated short-stay car parks, with limited or no opportunity to install rapid charging equipment, 100% fast charging has been proposed. For long-stay car parks, 100% slow charging was assumed. For charging hubs in areas with attractions, a mix of 80% rapid charging and 20% fast charging was assumed, reflecting that some EV users may wish to park for a longer duration without needing to return to the car park to unplug their vehicle.

Chargepoint Usage Behaviour

The way in which EV charging infrastructure was assumed to be used was based on data collected by the UK Government Office for Low Emission Vehicles (OLEV), looking at usage of public-funded standard[6], fast[6] and rapid[7] chargepoints. The assumed average usage for standard, fast and rapid charging infrastructure is shown in Table 7. The amount of time assumed to elapse between charging events has been assumed, based on the likely use-case of the chargepoint. For example, rapid chargers are more likely to be installed in high-turnover car parks, where EV users unplug their

[6] UK Office for Low Emission Vehicles (OLEV), 2017. *Electric Chargepoint Analysis 2017: Public Sector Fasts*

[7] UK Office for Low Emission Vehicles, 2017. *Electric Chargepoint Analysis 2017: Local Authority Rapids (revised)*

vehicle promptly once they have received a full charge. In comparison, standard and fast chargepoints are more likely to be installed in car parks where EV users may be away from their vehicle and therefore not be able to return as soon as their vehicle is fully charged.

Table 7; Assumed average usage behaviours for standard, fast and rapid chargepoints.

Chargepoint type	Average charge duration (hours)	Time between charges (hours)	Total duration (hours)
Standard (7 kW)	5.12	2.00	7.12
Fast (22 kW)	1.17	1.00	2.17
Rapid (50 kW)	0.64	0.50	1.14

An assumption was also applied to consider how frequently EV users take advantage of public charging infrastructure. This is necessary as it is not reasonable to assume that, for example, every EV user will utilise EV charging infrastructure whenever they visit a site with a chargepoint installed. The Zap-Map Annual Survey 2019[8] was used as a source of evidence to estimate how likely any given user is to utilise EV charging infrastructure upon visiting a site with a chargepoint installed.

The results of the survey were analysed to estimate a percentage likelihood of chargepoint use. The original survey results and the results of Cenex's analysis are shown in Table 8. This analysis indicated that, given the opportunity, 19% of EV users are likely to use public charging infrastructure on a given day. This proportion was applied at the site level, resulting in the key assumption that 19% of EV users visiting a given site will require the use of EV charging infrastructure.

Table 8; Survey responses to question "How often do you use public chargepoints?" from Zap-Map Annual Survey 2019, interpreted and analysed to infer the proportion of EV users using public charging infrastructure every day.

Charging frequency	% of all survey responses	Assumed uses per day	% of responses to question
Few times a day	1%	2	1%
Once per day	4%	1	4%
Few times per week	18%	0.4	19%
Once a week	14%	0.142	15%
Few times a month	21%	0.095	22%
Once a month	16%	0.033	17%
Less than once a month	20%	0.015	21%
Weighted % using public infrastructure per day			19%

Costs and Tariffs

Capital and operating costs have been derived from the average of three quotations received from EV charging infrastructure suppliers. The nature of these quotations is commercially sensitive, so cannot be provided separately. Capital costs include typical electrical connection costs, but do not include costs for extensive grid reinforcement. A wholesale electricity cost of 15p/kWh has been assumed. Usage tariffs have also been proposed, based on typical market costs for each infrastructure type. Average cost per use has been estimated, based on evidence from the UK Government regarding average duration of charging sessions for different types of EV charging infrastructure. Lastly, average net revenue per use has been estimated, which is calculated as the total cost to the user of the chargepoint, less the cost of electricity and VAT, which is charged at 20%

[8] Zap-Map EV Charging Survey 2019. Further information available online.

for public electricity supplies. A summary of costs, tariffs and average net revenue per usage is shown in Table 9.

Table 9; Breakdown of total capital costs, annual operating costs, proposed usage tariffs, average cost per use and average net revenue per use for Standard, Fast and Rapid charging infrastructure.

	Standard (7 kW)	Fast (22 kW)	Rapid (50 kW)
Total capital cost	£8,176	£8,403	£27,553
Total annual operating cost	£751	£751	£501
Wholesale electricity	15p/kWh		
Usage tariff	20p/kWh	25p/kWh	30p/kWh
Connection fee	-	-	£1
Average cost per use	£7.17	£6.45	£9.59
Average net revenue per use	£0.36	£1.29	£3.88

Assumed Electric Vehicle Charging Infrastructure Specification

A summary of the assumed specification of EV charging infrastructure used to model future charging infrastructure requirements in this study is shown in Figure 7 (page 24).

2.3.1 Electric Vehicle Charging Infrastructure Ownership Models

The business case for investment in EV charging infrastructure has been calculated over four different ownership models. In each ownership model, elements of capital cost. operating cost and revenue are shared differently between the landowner and the chargepoint provider. A summary of the proportion of cost incurred and revenue retained by the landowner across different ownerships models is shown in Table 10.

Table 10; Comparison of proportion of costs incurred and revenue retained by landowner across ownership models considered.

Ownership Model	Hardware	Groundworks	Back-office	Electricity	Maintenance	Revenue
Own and Operate	100%	100%	100%	100%	100%	100%
External Operator	100%	100%	0%	100%	100%	90%
Lease	0%	0%	0%	0%	0%	20%
Concession	0%	100%	0%	0%	0%	30%

When making decisions on chargepoint ownership models, it is important to also consider the non-financial implications of each model. Whilst the most obvious distinctions between each ownership model are in how costs and revenue are shared, there is also a variable share in the contractual control over how the chargepoints are operated. In most cases, the greater the investment made by an external supplier(s), the greater the control of the supplier(s). In turn, this means that the landowner will have less control over the quality and type of service(s) provided to EV users on their site which, in a worst-case scenario, could create a negative perception of the landowner that they cannot easily address. Regardless of the ownership model pursued, contractual terms should be sought that ensure both financial and reputational risk are fairly distributed and that the level of service to EV users is maintained to the satisfaction of the landowner.

7 kW Standard Charger

- Alternating Current (AC)
- Twin Type 2 sockets to charge two vehicles simultaneously
- Provides c. 20-25 miles charge in one hour
- Compatible with every consumer PiV currently on sale in UK - adaptors are available for older models
- Assumed use case: Long-stay and overnight charging, up to 12 hours

22 kW Fast Charger

- Alternating Current (AC)
- Twin Type 2 sockets to charge two vehicles simultaneously
- Provides c.70-80 miles charge in one hour
- Compatible with every consumer PiV currently on sale, but not all vehicles will receive full 22 kW power
- Assumed use case: Destination charging, up to two hours

50 kW Rapid Charger

- Direct Current (DC) and Alternating Current (AC)
- Triple connector incl. Type 2, CHAdeMO & CCS connectors
- Charges one vehicle at a time
- Provides c. 70-80 miles charge in 30 minutes
- Compatible with every consumer PiV currently on sale in UK - some older models may not be comptible
- Assumed use case: Transit charging, up to 30 minutes

Figure 7; Summary of assumed specification for electric vehicle charging infrastructure used to model future infrastructure requirements.

Own and Operate

The "Own and Operate" model represents the most involved level of intervention for the landowner, where all costs are covered, and all revenue is retained by the landowner. The landowner prepares the site, including groundworks and electrical connection, procures the EV charging equipment, funds the installation of the equipment and purchases a back-office system to manage the chargepoint. All revenue is hence retained by the landowner. By comparison with other ownerships models, own and operate offers the greatest revenue opportunity but also the greatest risk to the landowner. In this model, the landowner has control over all aspects of how the chargepoint is operated, including tariffs and network compatibility.

External Operator

The "External Operator" model is identical to the "Own and Operate" model in all regards except that the operation of the chargepoint is agreed with an external supplier. The supplier then provides the back-office system at no direct cost, in return for a share of net revenue gathered by the chargepoint.

In our modelling, we have assumed this share to be 10%). This ownership model removes some of the operating expense associated with the chargepoint, therefore reducing an element of risk whilst retaining the majority of the revenue gathered by the chargepoint. The capital investment is still entirely provided by the landowner and, in all regards except for network compatibility, the landowner retains control of how the chargepoint is operated.

Lease

The “Lease” ownership model represents the lowest level of investment from the landowner. In this model, all capital and operating costs are covered by an external supplier, with a small share of revenue retained by the landowner in return for making their land available to the chargepoint supplier. This model involves the least exposure to financial risk, but also the least opportunity for revenue generation.

The “Lease” model is not without risk or challenges, however. The success of this model relies on sourcing an external supplier with the appetite to accept the financial risk, which will be dependent on the type of site being offered and the revenue generating potential that it presents. In less ideal sites, external suppliers may seek additional contractual assurances to mitigate long-term risks, such as having autonomy over usage tariffs; a longer lease period; 24-hour access and/or; favourable contract termination conditions. Another key risk to the landowner is that, as the external supplier has ownership of the electrical connection point, the landowner may incur additional costs associated with asset transfer of the connection point at the end of the contract period.

Concession

The “Concession” model is similar to the “Lease” model, in that much of the risk to the landowner is mitigated in exchange for a lower share of revenue. The key difference between the “Concession” and “Lease” models is that, as part of the concession, the landowner provides the capital investment to establish an electrical connection point for an external supplier to install and operate a chargepoint. The benefit of this model is that, as the landowner retains ownership of the connection point, there is no lasting obligation to the external supplier, beyond the terms of their concession. This increases the contractual leverage of the landowner and may assist in negotiating contractual terms that are more favourable to the landowner, such as tariff controls; mandatory ad hoc access and interoperability; daily operating hours; shorter contract length and/or; stricter Service-Level Agreement (SLA) criteria.

2.3.1 Operational Business Model Comparison

Scenario Comparison

A comparison of the business case for different EV uptake scenarios, totalled across all shortlisted sites, is shown on pages 27 (low scenario), 28 (mid scenario) and 29 (high scenario). These comparisons are all based on the “Own and Operate” chargepoint ownership model, as it includes the full extent of all predicted capital and operating costs, as well as estimated annual net revenue and profit margin.

Ownership Model Comparison

A comparison of the business case for different ownership models, totalled across all shortlisted sites, is shown on pages 30 (own and operate), 31 (external operator), 32 (lease) and 33 (concession). These comparisons are all based on the mid scenario for EV uptake, being the central scenario that has been projected.

Table 11; Business case – Low uptake scenario, Own and Operate model. All costs exclusive of VAT

Site Name	Total
Description	Total infrastructure required across all sites assessed.

Scenario	Low
Ownership Model	Own and Operate

Projected users per day					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	4.82	9.11	15.60	24.69	36.42
Fast	17.29	32.67	55.96	88.57	130.65
Rapid	15.61	29.51	50.54	79.98	117.99
Total	37.71	71.29	122.10	193.24	285.05

Chargepoints required (sockets)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	11	11	12	14	18
Fast	25	25	26	28	31
Rapid	9	9	9	10	13
Total	45	45	47	52	62

Capital Cost (cumulative)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	-£ 49,054	-£ 49,054	-£ 49,054	-£ 57,229	-£ 73,581
Fast	-£ 109,239	-£ 109,239	-£ 109,239	-£ 117,642	-£ 134,448
Rapid	-£ 247,976	-£ 247,976	-£ 247,976	-£ 275,529	-£ 358,188
Total	-£ 406,269	-£ 406,269	-£ 406,269	-£ 450,400	-£ 566,216

Operating Cost (per annum)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	-£ 4,508	-£ 4,508	-£ 4,508	-£ 5,259	-£ 6,762
Fast	-£ 9,767	-£ 9,767	-£ 9,767	-£ 10,519	-£ 12,021
Rapid	-£ 4,512	-£ 4,512	-£ 4,512	-£ 5,013	-£ 6,517
Total	-£ 18,787	-£ 18,787	-£ 18,787	-£ 20,791	-£ 25,301

Net Revenue (per annum)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	£ 630	£ 1,192	£ 2,041	£ 3,230	£ 4,765
Fast	£ 8,141	£ 15,387	£ 26,356	£ 41,710	£ 61,528
Rapid	£ 22,089	£ 41,751	£ 71,514	£ 113,177	£ 166,950
Total	£ 30,860	£ 58,330	£ 99,910	£ 158,117	£ 233,243

Margin (per annum)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	-£ 3,877	-£ 3,316	-£ 2,467	-£ 2,029	-£ 1,997
Fast	-£ 1,627	£ 5,620	£ 16,588	£ 31,191	£ 49,506
Rapid	£ 17,577	£ 37,239	£ 67,002	£ 108,163	£ 160,433
Total	£ 12,073	£ 39,543	£ 81,123	£ 137,326	£ 207,943

Table 12; Business case – Mid uptake scenario, Own and Operate model. All costs exclusive of VAT.

Site Name	Total
Description	Total infrastructure required across all sites assessed.

Scenario	Mid
Ownership Model	Own and Operate

Projected users per day					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	5.47	11.32	20.67	34.83	54.22
Fast	19.62	40.62	74.14	124.94	194.52
Rapid	17.72	36.68	66.96	112.83	175.67
Total	42.82	88.62	161.77	272.60	424.42

Chargepoints required (sockets)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	11	11	12	17	25
Fast	25	26	27	31	39
Rapid	9	9	10	12	16
Total	45	46	49	60	80

Capital Cost (cumulative)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	-£ 49,054	-£ 49,054	-£ 49,054	-£ 73,581	-£ 106,283
Fast	-£ 109,239	-£ 109,239	-£ 117,642	-£ 134,448	-£ 168,060
Rapid	-£ 247,976	-£ 247,976	-£ 275,529	-£ 330,635	-£ 440,847
Total	-£ 406,269	-£ 406,269	-£ 442,225	-£ 538,664	-£ 715,190

Operating Cost (per annum)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	-£ 4,508	-£ 4,508	-£ 4,508	-£ 6,762	-£ 9,767
Fast	-£ 9,767	-£ 9,767	-£ 10,519	-£ 12,021	-£ 15,027
Rapid	-£ 4,512	-£ 4,512	-£ 5,013	-£ 6,016	-£ 8,021
Total	-£ 18,787	-£ 18,787	-£ 20,040	-£ 24,799	-£ 32,815

Net Revenue (per annum)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	£ 716	£ 1,482	£ 2,704	£ 4,557	£ 7,095
Fast	£ 9,242	£ 19,129	£ 34,918	£ 58,840	£ 91,610
Rapid	£ 25,077	£ 51,904	£ 94,748	£ 159,659	£ 248,577
Total	£ 35,035	£ 72,514	£ 132,371	£ 223,056	£ 347,283

Margin (per annum)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	-£ 3,792	-£ 3,026	-£ 1,804	-£ 2,205	-£ 2,672
Fast	-£ 525	£ 9,361	£ 24,400	£ 46,819	£ 76,584
Rapid	£ 20,565	£ 47,392	£ 89,735	£ 153,643	£ 240,556
Total	£ 16,247	£ 53,727	£ 112,331	£ 198,257	£ 314,467

Table 13; Business case – High uptake scenario, Own and Operate model. All costs exclusive of VAT.

Site Name	Total
Description	Total infrastructure required across all sites assessed.

Scenario	High
Ownership Model	Own and Operate

Projected users per day					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	6.12	13.54	25.74	44.97	72.03
Fast	21.96	48.56	92.33	161.31	258.40
Rapid	19.83	43.86	83.38	145.68	233.36
Total	47.92	105.96	201.44	351.96	563.79

Chargepoints required (sockets)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	11	12	14	20	30
Fast	25	26	28	37	46
Rapid	9	9	10	16	19
Total	45	47	52	73	95

Capital Cost (cumulative)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	-£ 49,054	-£ 49,054	-£ 57,229	-£ 81,756	-£ 122,634
Fast	-£ 109,239	-£ 109,239	-£ 117,642	-£ 159,657	-£ 193,269
Rapid	-£ 247,976	-£ 247,976	-£ 275,529	-£ 440,847	-£ 523,506
Total	-£ 406,269	-£ 406,269	-£ 450,400	-£ 682,260	-£ 839,409

Operating Cost (per annum)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	-£ 4,508	-£ 4,508	-£ 5,259	-£ 7,513	-£ 11,270
Fast	-£ 9,767	-£ 9,767	-£ 10,519	-£ 14,275	-£ 17,281
Rapid	-£ 4,512	-£ 4,512	-£ 5,013	-£ 8,021	-£ 9,525
Total	-£ 18,787	-£ 18,787	-£ 20,791	-£ 29,810	-£ 38,076

Net Revenue (per annum)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	£ 801	£ 1,771	£ 3,368	£ 5,884	£ 9,425
Fast	£ 10,343	£ 22,871	£ 43,481	£ 75,971	£ 121,693
Rapid	£ 28,065	£ 62,057	£ 117,983	£ 206,140	£ 330,204
Total	£ 39,209	£ 86,699	£ 164,832	£ 287,995	£ 461,322

Margin (per annum)					
	2020	**2022**	**2024**	**2026**	**2028**
Standard	-£ 3,707	-£ 2,737	-£ 1,892	-£ 1,629	-£ 1,845
Fast	£ 576	£ 13,103	£ 32,963	£ 61,695	£ 104,412
Rapid	£ 23,553	£ 57,545	£ 112,969	£ 198,119	£ 320,678
Total	£ 20,422	£ 67,912	£ 144,040	£ 258,185	£ 423,246

Table 14; Business case – Mid uptake scenario, Own and Operate model. All costs exclusive of VAT.

Site Name	Total
Description	Total infrastructure required across all sites assessed.

Scenario	Mid
Ownership Model	Own and Operate

Projected users per day

	2020	2022	2024	2026	2028
Standard	5.47	11.32	20.67	34.83	54.22
Fast	19.62	40.62	74.14	124.94	194.52
Rapid	17.72	36.68	66.96	112.83	175.67
Total	42.82	88.62	161.77	272.60	424.42

Chargepoints required (sockets)

	2020	2022	2024	2026	2028
Standard	11	11	12	17	25
Fast	25	26	27	31	39
Rapid	9	9	10	12	16
Total	45	46	49	60	80

Capital Cost (cumulative)

	2020	2022	2024	2026	2028
Standard	-£ 49,054	-£ 49,054	-£ 49,054	-£ 73,581	-£ 106,283
Fast	-£ 109,239	-£ 109,239	-£ 117,642	-£ 134,448	-£ 168,060
Rapid	-£ 247,976	-£ 247,976	-£ 275,529	-£ 330,635	-£ 440,847
Total	-£ 406,269	-£ 406,269	-£ 442,225	-£ 538,664	-£ 715,190

Operating Cost (per annum)

	2020	2022	2024	2026	2028
Standard	-£ 4,508	-£ 4,508	-£ 4,508	-£ 6,762	-£ 9,767
Fast	-£ 9,767	-£ 9,767	-£ 10,519	-£ 12,021	-£ 15,027
Rapid	-£ 4,512	-£ 4,512	-£ 5,013	-£ 6,016	-£ 8,021
Total	-£ 18,787	-£ 18,787	-£ 20,040	-£ 24,799	-£ 32,815

Net Revenue (per annum)

	2020	2022	2024	2026	2028
Standard	£ 716	£ 1,482	£ 2,704	£ 4,557	£ 7,095
Fast	£ 9,242	£ 19,129	£ 34,918	£ 58,840	£ 91,610
Rapid	£ 25,077	£ 51,904	£ 94,748	£ 159,659	£ 248,577
Total	£ 35,035	£ 72,514	£ 132,371	£ 223,056	£ 347,283

Margin (per annum)

	2020	2022	2024	2026	2028
Standard	-£ 3,792	-£ 3,026	-£ 1,804	-£ 2,205	-£ 2,672
Fast	-£ 525	£ 9,361	£ 24,400	£ 46,819	£ 76,584
Rapid	£ 20,565	£ 47,392	£ 89,735	£ 153,643	£ 240,556
Total	£ 16,247	£ 53,727	£ 112,331	£ 198,257	£ 314,467

Table 15; Business case – Mid uptake scenario, External Operator model. All costs exclusive of VAT.

Site Name	Total
Description	Total infrastructure required across all sites assessed.

Scenario	Mid
Ownership Model	External Operator

Projected users per day

	2020	2022	2024	2026	2028
Standard	5.47	11.32	20.67	34.83	54.22
Fast	19.62	40.62	74.14	124.94	194.52
Rapid	17.72	36.68	66.96	112.83	175.67
Total	42.82	88.62	161.77	272.60	424.42

Chargepoints required (sockets)

	2020	2022	2024	2026	2028
Standard	11	11	12	17	25
Fast	25	26	27	31	39
Rapid	9	9	10	12	16
Total	45	46	49	60	80

Capital Cost (cumulative)

	2020	2022	2024	2026	2028
Standard	-£ 49,054	-£ 49,054	-£ 49,054	-£ 73,581	-£ 106,283
Fast	-£ 109,239	-£ 109,239	-£ 117,642	-£ 134,448	-£ 168,060
Rapid	-£ 247,976	-£ 247,976	-£ 275,529	-£ 330,635	-£ 440,847
Total	-£ 406,269	-£ 406,269	-£ 442,225	-£ 538,664	-£ 715,190

Operating Cost (per annum)

	2020	2022	2024	2026	2028
Standard	-£ 600	-£ 600	-£ 600	-£ 900	-£ 1,300
Fast	-£ 1,300	-£ 1,300	-£ 1,400	-£ 1,600	-£ 2,000
Rapid	-£ 900	-£ 900	-£ 1,000	-£ 1,200	-£ 1,600
Total	-£ 2,800	-£ 2,800	-£ 3,000	-£ 3,700	-£ 4,900

Net Revenue (per annum)

	2020	2022	2024	2026	2028
Standard	£ 644	£ 1,333	£ 2,434	£ 4,101	£ 6,386
Fast	£ 8,318	£ 17,216	£ 31,427	£ 52,956	£ 82,449
Rapid	£ 22,569	£ 46,714	£ 85,273	£ 143,693	£ 223,719
Total	£ 31,531	£ 65,263	£ 119,134	£ 200,750	£ 312,554

Margin (per annum)

	2020	2022	2024	2026	2028
Standard	£ 44	£ 733	£ 1,834	£ 3,201	£ 5,086
Fast	£ 7,018	£ 15,916	£ 30,027	£ 51,356	£ 80,449
Rapid	£ 21,669	£ 45,814	£ 84,273	£ 142,493	£ 222,119
Total	£ 28,731	£ 62,463	£ 116,134	£ 197,050	£ 307,654

Table 16; Business case – Mid uptake scenario, Lease model. All costs exclusive of VAT.

Site Name	Total
Description	Total infrastructure required across all sites assessed.

Scenario	Mid
Ownership Model	Lease

Projected users per day

	2020	2022	2024	2026	2028
Standard	5.47	11.32	20.67	34.83	54.22
Fast	19.62	40.62	74.14	124.94	194.52
Rapid	17.72	36.68	66.96	112.83	175.67
Total	42.82	88.62	161.77	272.60	424.42

Chargepoints required (sockets)

	2020	2022	2024	2026	2028
Standard	11	11	12	17	25
Fast	25	26	27	31	39
Rapid	9	9	10	12	16
Total	45	46	49	60	80

Capital Cost (cumulative)

	2020	2022	2024	2026	2028
Standard	£ -	£ -	£ -	£ -	£ -
Fast	£ -	£ -	£ -	£ -	£ -
Rapid	£ -	£ -	£ -	£ -	£ -
Total	£ -	£ -	£ -	£ -	£ -

Operating Cost (per annum)

	2020	2022	2024	2026	2028
Standard	£ -	£ -	£ -	£ -	£ -
Fast	£ -	£ -	£ -	£ -	£ -
Rapid	£ -	£ -	£ -	£ -	£ -
Total	£ -	£ -	£ -	£ -	£ -

Net Revenue (per annum)

	2020	2022	2024	2026	2028
Standard	£ 143	£ 296	£ 541	£ 911	£ 1,419
Fast	£ 1,848	£ 3,826	£ 6,984	£ 11,768	£ 18,322
Rapid	£ 5,015	£ 10,381	£ 18,950	£ 31,932	£ 49,715
Total	£ 7,007	£ 14,503	£ 26,474	£ 44,611	£ 69,457

Margin (per annum)

	2020	2022	2024	2026	2028
Standard	£ 143	£ 296	£ 541	£ 911	£ 1,419
Fast	£ 1,848	£ 3,826	£ 6,984	£ 11,768	£ 18,322
Rapid	£ 5,015	£ 10,381	£ 18,950	£ 31,932	£ 49,715
Total	£ 7,007	£ 14,503	£ 26,474	£ 44,611	£ 69,457

Table 17; Business case – Mid uptake scenario, Concession model. All costs exclusive of VAT.

Site Name	Total
Description	Total infrastructure required across all sites assessed.

Scenario	Mid
Ownership Model	Concession

Projected users per day

	2020	2022	2024	2026	2028
Standard	5.47	11.32	20.67	34.83	54.22
Fast	19.62	40.62	74.14	124.94	194.52
Rapid	17.72	36.68	66.96	112.83	175.67
Total	42.82	88.62	161.77	272.60	424.42

Chargepoints required (sockets)

	2020	2022	2024	2026	2028
Standard	11	11	12	17	25
Fast	25	26	27	31	39
Rapid	9	9	10	12	16
Total	45	46	49	60	80

Capital Cost (cumulative)

	2020	2022	2024	2026	2028
Standard	-£ 30,044	-£ 30,044	-£ 30,044	-£ 45,067	-£ 65,096
Fast	-£ 65,096	-£ 65,096	-£ 70,104	-£ 80,118	-£ 100,148
Rapid	-£ 39,082	-£ 39,082	-£ 43,424	-£ 52,109	-£ 69,478
Total	-£ 134,222	-£ 134,222	-£ 143,572	-£ 177,294	-£ 234,722

Operating Cost (per annum)

	2020	2022	2024	2026	2028
Standard	£ -	£ -	£ -	£ -	£ -
Fast	£ -	£ -	£ -	£ -	£ -
Rapid	£ -	£ -	£ -	£ -	£ -
Total	£ -	£ -	£ -	£ -	£ -

Net Revenue (per annum)

	2020	2022	2024	2026	2028
Standard	£ 215	£ 444	£ 811	£ 1,367	£ 2,129
Fast	£ 2,773	£ 5,739	£ 10,476	£ 17,652	£ 27,483
Rapid	£ 7,523	£ 15,571	£ 28,424	£ 47,898	£ 74,573
Total	£ 10,510	£ 21,754	£ 39,711	£ 66,917	£ 104,185

Margin (per annum)

	2020	2022	2024	2026	2028
Standard	£ 215	£ 444	£ 811	£ 1,367	£ 2,129
Fast	£ 2,773	£ 5,739	£ 10,476	£ 17,652	£ 27,483
Rapid	£ 7,523	£ 15,571	£ 28,424	£ 47,898	£ 74,573
Total	£ 10,510	£ 21,754	£ 39,711	£ 66,917	£ 104,185

2.3.2 2028 Business Case Summary

The implications for each business case at the 2028 timescale have been summarised and compared across different uptake scenarios and ownerships models.

EV Users and Infrastructure Requirements

Table 18; Summary of total EV users per day and number of EV chargepoints required, 2028, by EV uptake scenario

	EV Uptake Scenario		
	Low	Mid	High
Projected users per day	285	424	564
Standard chargepoints	18	25	30
Fast chargepoints	31	39	46
Rapid chargepoints	13	16	19
Total chargepoints	62	80	95

2028 Capital Costs (cumulative)

Table 19; Total cumulative capital costs, 2028, by EV uptake scenario and infrastructure ownership model

	EV Uptake Scenario		
Ownership Model	Low	Mid	High
Own and Operate	-£566,216	-£715,190	-£839,409
External Operator	-£566,216	-£715,190	-£839,409
Lease	Null	Null	Null
Concession	-£181,636	-£234,722	-£272,787

2028 Operating Costs (annual)

Table 20; Total annual operating costs, 2028, by EV uptake scenario and infrastructure ownership model

	EV Uptake Scenario		
Ownership Model	Low	Mid	High
Own and Operate	-£25,301	-£32,815	-£38,076
External Operator	-£3,800	-£4,900	-£5,700
Lease	Null	Null	Null
Concession	Null	Null	Null

2028 Net Revenue (annual)

Table 21; Total annual net revenue, 2028, by EV uptake scenario and infrastructure ownership model

	EV Uptake Scenario		
Ownership Model	Low	Mid	High
Own and Operate	£233,243	£347,283	£461,322
External Operator	£209,919	£312,554	£415,190
Lease	£46,649	£69,457	£92,264
Concession	£69,973	£104,185	£138,397

2028 Margin (annual)

Table 22; Total annual profit margin, 2028, by EV uptake scenario and infrastructure ownership model

Ownership Model	EV Uptake Scenario		
	Low	Mid	High
Own and Operate	£207,943	£314,467	£423,246
External Operator	£206,119	£307,654	£409,490
Lease	£46,649	£69,457	£92,264
Concession	£69,973	£104,185	£138,397

Summary

By 2028, here is around ±20% variance in capital costs between the central medium scenario and the low and high scenarios, as a lesser or greater amount of charging infrastructure is required to meet reduced or increased demand, respectively. This is accompanied by variance of ±35% in the total annual profit between the central scenario and the low and high scenarios.

The Own and Operate ownership model requires the greatest initial and ongoing investment but has the potential to return the greatest amount revenue and the greatest amount of profit. This ownership model comes with the risk that, should EV uptake not meet these projections, IWC could be left with loss-making assets.

The External Operator ownership model has identical capital costs as the Own and Operate model, with reduced operating costs as a result of the charging infrastructure being operated by an external supplier in return for a 10% revenue share. This results in a lower annual net revenue than the Own and Operate model.

The Lease ownership model comes with no associated capital or operating costs. A revenue share agreement with the lessor generates the lowest amount of annual net revenue of any ownership model, but this net revenue is effectively all profit, as no costs have been incurred. Even so, annual profit margin in this scenario is the lowest of all ownership models. Should EV uptake not meet projections, net revenue and profit would decline, but IWC would not incur loss as it has no operating expenses to cover.

The Concession ownership model requires a lower initial capital investment than the Own and Operator or External Operator models, as the only capital costs covered are associated with the establishment of a connection point. No operating expense is incurred, as these expenses would be covered by the concessionaire. Through a revenue share of higher proportion, annual net revenue is marginally higher than the Lease model, but still considerably lower than the Own and Operator and External Operator models. All net revenue effectively becomes profit, as no operating expenses are incurred. Should EV uptake not meet projections, there is a risk that IWC will be left with a depreciating asset, in the form of a connection point that no longer represents an attractive concession to external EV charging infrastructure suppliers.

3 On-street Charging

On-street Charging represents the second work package of the IoWEVIP project. This work package is divided into three sections:

1. Residential chargepoint planning methodology
2. Review of on-street charging technologies
3. Proposal of Traffic Regulation Orders (TRO)

3.1 Residential Chargepoint Planning Methodology

3.1.1 Evidence Base

Research commissioned by the UK Office for Low Emission Vehicles (OLEV) indicates that early adopters of EVs are "middle-aged, male, well-educated, affluent, and live in urban areas with households containing two or more cars and with the ability to charge at home"[9]. This is supported by more recent information collected by Zap-Map, who conducted a survey of 1,617 EV and PHEV owners in 2019. Over half of the 1,261 respondents who disclosed their annual household income declared earnings of over £50,000 per year, with roughly a quarter earning over £80,000 per year. An earlier survey of 908 UK adults, conducted by the UK Office for National Statistics in 2016[10], indicated that: those with degrees were more likely to consider buying an EV than those without; those with an annual income of more than £26,000 were 33% more likely to consider buying an EV than those earning less than £26,000 per year; men were more likely to consider buying an EV than women.

Geospatial data is freely available that can be used to map demographics that have been shown to be more favourable to early EV adoption. Using this data, we can identify areas that, according to existing evidence, include a relatively higher proportion of early EV adopters.

Taken in isolation, the demographics favourable to EV adoption do not necessarily reflect the locations where public residential charging infrastructure is likely to be required. This is because EV users with access to off-street parking can install domestic charging equipment, enabling them to charge their EV at home and removing the need for public infrastructure to be located nearby. Therefore, to understand where public residential charging infrastructure is most likely to be required, the proportion of off-street parking availability also needs to be considered.

3.1.2 Data Used

The methodology that has been used to identify locations on the Isle of Wight that are relatively more likely to require or benefit from public residential charging infrastructure has taken into account all of the factors previously described. The factors considered and the datasets used to determine these factors is shown in Table 23.

All datasets used have been obtained from the UK Census 2011 and are valid down to the Output Area level. This means that findings will be mappable into zones with, on average, 131 households each.

[9] UK Government Office for Low Emission Vehicles, 2015. Uptake of Ultra Low Emission Vehicles in the UK. Available online.

[10] UK Government Department for Transport, 2016. Public attitudes towards electric vehicles (revised). Available online.

Table 23; List of factors considered within the residential charging index and the data sources used to determine them.

Factor	Dataset(s) used
Vehicle ownership	Vehicle ownership by household; Total population; Datasets combined to determine vehicles per person as a relative indicator of vehicle ownership
Vehicle usage	Method of commute, specifically number of people commuting either as a car driver or passenger; Distance of commute
Affluence	Number of households deprived on one or more dimension; National Statistics Socio-economic Classification (NS-SEC), specifically the number of people falling within NS-SEC categories 1 to 4, representing more advantaged groups
Off-street parking availability	Households by building type, specifically the number of detached and semi-detached houses (which have been considered to be more likely to have off-street parking)

3.1.3 Scoring

Each output area is scored relatively for each factor, on a scale of -100 to 100, based on how it ranks against other output areas. This means, for example: an output area with the median value will score zero; an output area with the most favourable value will score 100 and; an output area with the least favourable value will score -100.

Each output area is scored against every factor. Scores are then individually weighted and added together to form a total, reflecting the relative suitability of each output area for public residential charging infrastructure.

For a given output area: a score of zero indicates an that the area is neither particularly suited nor unsuited to public residential charging infrastructure. A positive score shows that the area is more suited than average for public residential charging infrastructure and a negative score shows that the area is less suited than average for public residential charging infrastructure installation. The relativistic nature of the scores mean that comparisons can be made between output areas. For example, an output area with a score of 250 is five times better suited to public residential charging infrastructure than an output area with a score of 50.

3.1.4 Weighting

Acknowledging that certain factors listed in Table 23 will have more of an impact on the suitability of a geographical area for public residential charging, a weighting is required to enhance the validity of the analytical results.

As no research has yet been conducted to determine the relativity of different factors impacting EV ownership, Cenex conducted an internal peer review exercise, drawing upon the expertise and experience of nine members of staff, with backgrounds in the transport and energy sectors, as well as local government. Each participant was asked to rank seven different demographic indicators in order of how important they believed those indicators were to identify areas where public residential charging was required. Once these rankings were collected, the scores for each indicator were added up and then attributed a weighting value, proportional to how highly or lowly each factor was ranked. The results are shown in Table 24.

Table 24; Weightings attributed to demographic factors in the development of the residential charging index.

Indicator	Related Factor	Sum of Ranks (lower = higher priority)	Weighting
Method of commute	Vehicle usage	36	88%
Off-street parking availability	Off-street parking availability	11	290%
Annual earnings	Affluence	34	94%
Vehicle ownership rate	Vehicle ownership	23	139%
Daily mileage	Vehicle usage	38	84%
Deprivation	Affluence	37	86%
Population density	Off-street parking availability	44	72%

3.1.5 Results

The weightings shown in Table 24 were applied to the individual scores for each output area to produce a value illustrating the appropriateness of public residential charging in that area. A snapshot of the on-street residential charging map that was created using this index is shown in Figure 8. Further detail can be found in Appendix C.

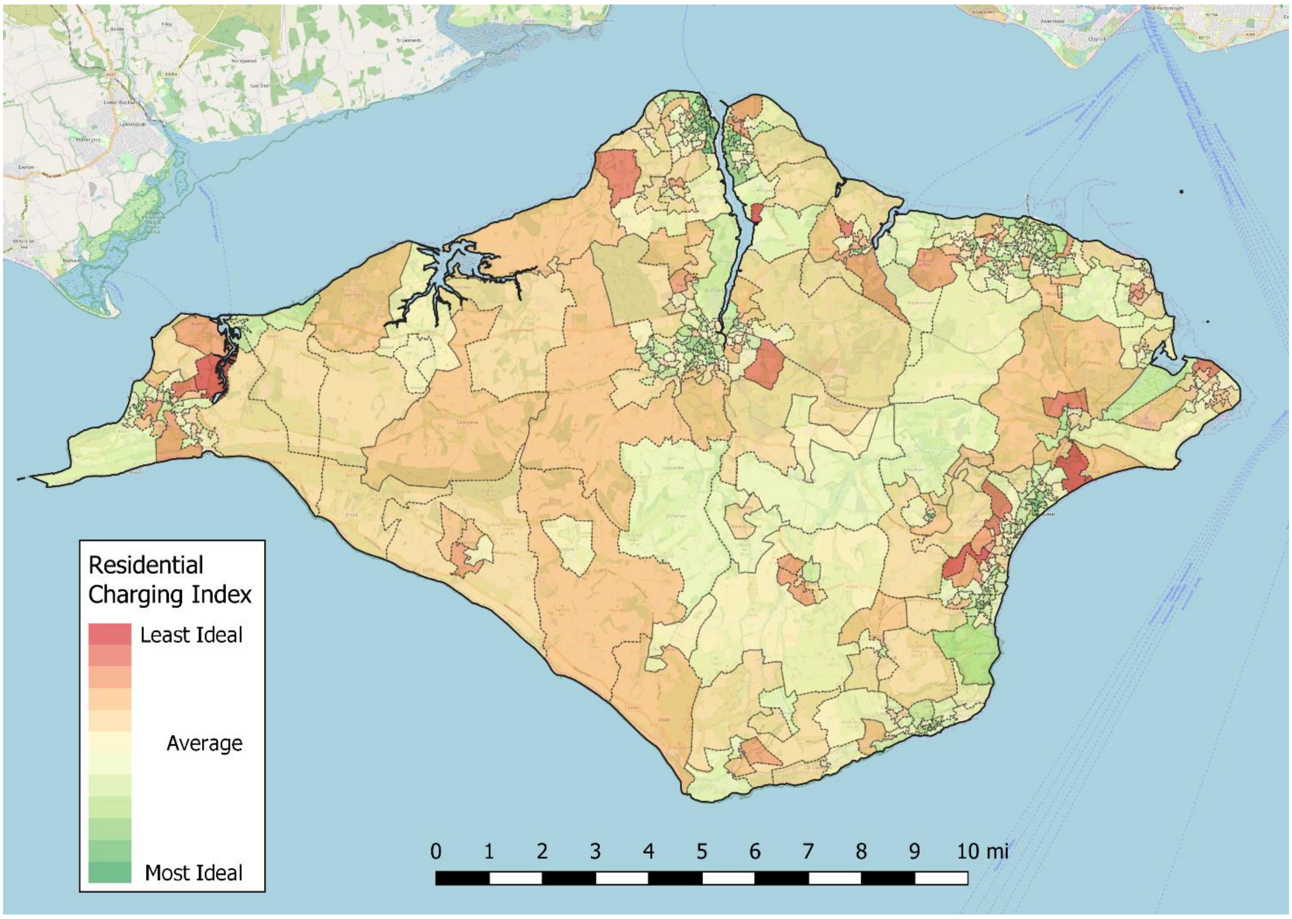


Figure 8; Map showing relative appropriateness for public residential EV charging installation across all Isle of Wight output areas.

3.2 Review of On-street Charging Technologies

This section shall review different solutions to providing EV charging infrastructure on-street. These solutions are most applicable to residential locations, where speed of charge is a lower priority to convenience of location. It should be acknowledged that fast and rapid charging infrastructure can be installed in on-street locations, so this is also included.

For each technology reviewed, a summary of strengths and weaknesses is provided.

3.2.1 Conventional Free-Standing Slow and Standard Chargepoints

Before exploring more novel solutions available, it is important to consider the conventional equipment that, for many years, represented the only option available to provide charging infrastructure for EVs. Free-standing slow or standard chargepoints (3.5-7 kW) have a similar profile to a large bollard and usually feature two sockets outlets compatible with the IEC 62196-1 Type-2 connector standard.

Strengths

- The most well-developed, tried-and-tested charging solution available – many models have been on the market for several years
- Well-developed market with many suppliers available, allowing competitive procurement
- Single unit can be equipped with two sockets, allowing two vehicles to charge at the same time
- Functional design is more easily repaired than novel alternatives that, for example, may have more components fitted underground
- Equipment can be switched without civil works, once electrical connection point is established
- Can be configured to allow ad hoc access
- Cost difference between 7 kW and 22 kW equipment is usually small such that it is feasible to install 22 kW equipment and run it at 7 kW if there is insufficient supply – this adds an element of futureproofing
- Relatively simple component requirements allow for compact designs.

No rectification of the AC power to the vehicle is taking place. AC – DC power conversion takes place using the vehicle’s onboard charger. This aids with the longevity and reliability of the on-street charging equipment.

Weaknesses

- Additional street furniture adding clutter to pavement
- Vulnerable to vandalism
- Vulnerable to accidental damage from vehicle collisions, unless a crash barrier is fitted
- More expensive to purchase and install than some more novel alternatives
- Requires a dedicated electrical supply

Example

- Pod Point

Figure 9: Pod Point Twin chargepoint. Source: pod-point.com

3.2.2 Passive Solutions

In order to allow residents to use their own electrical supply, solutions exist that can either extend domestic cabling to the kerb without presenting a trip hazard or allow vehicles to be parked closer to a property (e.g. on a dedicated driveway). In either case, the property supplying the charge to the EV should ideally be fitted with a dedicated 3-7 kW domestic chargepoint. This will maximise speed of charge, reduce likelihood of electrical faults and add smart functionality that is anticipated to be used in the future to reduce impact on the grid.

Cable channels and guides

Extending domestic electrical supply to the kerb can be achieved using cable channels and guides. These are typically shallow trenches dug into a pavement, before being fitted with a cover that allows a charging cable to run through the channel without presenting a public health and safety risk in the form a trip hazard.

Strengths

- EV user can access domestic supply at domestic electricity rates, providing greater equity between those with off-street parking
- EV user has ownership of charging equipment, increasing confidence in technology
- Mitigates capital and operating costs associated with purchasing, installing and operating public charging infrastructure
- Government is consulting on proposals that would see all domestic chargepoints equipped with smart technology that would minimise impact on the local distribution network, as the number of EVs increases
- Costly and complex elements of traditional chargepoint installation are mitigated, including the need for extensive trenching to install electrical cabling and the need for a feeder pillar.

Weaknesses

- Unless a dedicated bay is provided, there is no assurance to the property owner that their EV will be able to park close enough for the domestic charging cable to reach from their property to their vehicle, which could lead to conflict over parking bays
- No restrictions preventing property owner from running cables through the channel that are not intended for outdoor use, increasing the likelihood of tripping fuses and potentially presenting an electrical hazard to the public

- For solutions with covers that can be removed or opened, this could present a trip hazard across the pavement width should the covering not be replaced or closed, respectively
- Provision of cable ducting to kerb may create perception of dedicated parking bay when this is not the case
- As yet unclear where public liability rests and who is at fault should a member of the public come to injury as a result of a cable being ran from a private property into the public realm
- Capital costs of installing charging equipment and purchasing a lengthy charging cable will rest with the property owner. If the property owner does not purchase this equipment, they forego key smart capabilities and safety features.

Dropped Kerbs

Dropped kerbs can be installed to allow EV owners to park closer to their property and access their domestic electricity supply. This applies where a property has a footprint extending between the edge of the building and the pavement that is large enough for a vehicle to be parked.

Strengths

- EV user can access domestic supply at domestic electricity rates, providing greater equity between those with off-street parking
- EV user has ownership of charging equipment, increasing confidence in technology
- Mitigating capital and operating costs associated with purchasing, installing and operating public charging infrastructure
- Government consulting on proposals that would see all domestic chargepoints equipped with smart technology that would minimise impact on the local distribution network, as the number of EVs increases
- Costly and complex elements of traditional chargepoint installation are mitigated, including the need for extensive trenching to install electrical cabling and the need for a feeder pillar.

Weaknesses

- Only applicable to properties with a footprint large enough for a vehicle to be parked
- In many cases will require property owner to undertake a costly driveway conversion
- If done at scale, revenue from issuing parking permits and PCNs would decline
- If done at scale, significant lengths of kerb in certain neighbourhoods may eventually be dropped, potentially impacting pedestrian safety and integrity of the footway
- Vehicles crossing the pavement presents a hazard to pedestrians and, done at scale, this hazard would be multiplied
- Unless there is willingness to provide this service equitably and indefinitely to all residents, the benefits may be unfairly distributed to early adopters of EVs

3.2.3 Pop-up Chargepoints

Pop-up chargepoints feature a mechanism by which the chargepoint can sit flush to the pavement surface when not in use and, in some cases, while charging is underway. These solutions are, for the most part, at a “close to market” stage of development, with many suppliers currently engaging with local authorities and landowners to deploy units on a trial basis.

Strengths

- Additional street clutter mostly mitigated, reducing hazards to pedestrians and maintaining the integrity of the footway

- Less of a target for vandalism, especially for units that require interaction through an app or RFID card for the chargepoint to emerge
- Less vulnerable to accidental damage from, for example, low speed vehicle collisions

Weaknesses

- Mostly unproven in the public realm
- Depending on the intricacy of the mechanism used to propel the chargepoint into its in-use position, faults may be more frequent and repair costs may be higher when compared against conventional charging infrastructure
- Installation process more complex than some alternative solutions, possibly requiring a greater depth of excavation and therefore greater risk of interrupting underground service lines
- May be vulnerable to water ingress, depending on exact design
- For units that use motorised mechanisms to emerge from the pavement, higher capital costs are likely to occur due to the greater number of components required
- Units that are not propelled to a significant height above the ground require user interaction at very low height, impacting accessibility from users with impaired mobility
- Certain designs do not entirely remove trip hazards when in use, as the charging cable emerges from the ground and into the vehicle – potentially more hazardous than cables running from a free-standing chargepoint

Examples

- Urban Electric

Figure 10; Urban Electric UEOne pop-up EV charger | Source: www.urbanelectric.london

- Street Plug

Figure 11; Street Plug underground charging solution | Source: www.streetplug.nl

3.2.4 Shared Power Supply (including Lamp Column)

EV charging equipment has been on the market for over a year that can be retrofitted to existing street furniture with a pre-existing electrical connection. The most commonly used equipment of this nature is affixed to lampposts, typically replacing the existing faceplate with another faceplate that is fitted with an EV charging socket. Variations of this technology exist where the equipment installed into the lamppost is not fitted with a user interface, with user input, billing and smart communications instead facilitated through specially designed smart cables, that belong to the user. Where existing assets are located away from the kerb, certain suppliers can provide equipment that extends the existing supply to a charging unit at the kerbside (often referred to as “satellite” posts or units).

Strengths

- Can typically be installed quickly – a matter of hours in most cases
- Low profile and, in most cases, no additional street clutter
- No need to dig up pavement, unless additional earthing required
- No need for additional electrical cabling, unless using satellite posts
- Considerably lower equipment and installation cost than most alternatives

Weaknesses

- Where smart cables are required, EV users must purchase them individually (£200-400), creating potential perception that costs are being transferred to residents and making the units less attractive to occasional and opportunistic users
- Spare capacity can be limited, which may restrict the speed of the equipment and/or the number of units that can be fitted in a given area
- Smart cables are proprietary to the chargepoint provider and therefore the chargepoints are not truly interoperable and do not provide “ad hoc” access – this is arguably non-compliant with the requirements of the Automated and Electric Vehicle Act (2018)
- Technology is most appropriately fitted to assets that are close to the kerb and, in many areas, assets such as lampposts have been or are being relocated away from the kerb
- Where satellite posts are required, this adds extra street furniture, potentially forcing pedestrians to squeeze between the existing asset and the satellite post
- When installing charging equipment using shared power suppliers, certain distribution network operators are not satisfied that earthing is strong enough to present no risk to public– in some cases, connection requests have been refused on this basis

Examples

- Ubitricity

Figure 12; Ubitricity on-street charging solutions | Source: www.ubitricity.co.uk

- Rolec

Figure 13; Rolec Streetserve (left) and Streetcharge (right) | Source: www.rolecserv.com

3.2.5 Modular EV Chargers

Modular charging equipment allows for the charging equipment to be removed from the cabling that supplies it with electricity. Users typically operate this equipment by manually inserting a removeable component of the charging equipment into a fixed component. The removable component typically includes the charging socket and user interface, where the fixed component will include the electrical supply and, in some cases, the power electronics. In some solutions, the removable component is owned by the user and can be used at any location with compatible fixed components installed.

Strengths

- Additional street clutter mostly or entirely mitigated, reducing hazards to pedestrians and maintaining the integrity of the footway
- Less of a target for vandalism, especially for units that require interaction through an app or RFID card for the chargepoint to emerge
- Less vulnerable to accidental damage from, for example, low speed vehicle collisions

Weaknesses

- Unproven in the public realm
- Depending on the intricacy of the interface used to connect the modular components of the chargepoint, faults may be more frequent and repair costs may be higher when compared against conventional charging infrastructure
- Installation process more complex than some alternative solutions
- Requires proprietary hardware to be used, which either needs to be purchased by users or needs to be securely stored nearby
- Where proprietary hardware is required to be purchased by the user, the chargepoints are not truly interoperable and do not provide “ad hoc” access – this is arguably non-compliant with the requirements of the Automated and Electric Vehicle Act (2018)
- Where the modular components are owned by the user, any damage done to the modular component (e.g. accidental damage or vandalism) would cause loss to the user
- Some of the current designs of this technology involve user interaction at low heights, impacting accessibility from users will impaired mobility

Examples

- Trojan Lance

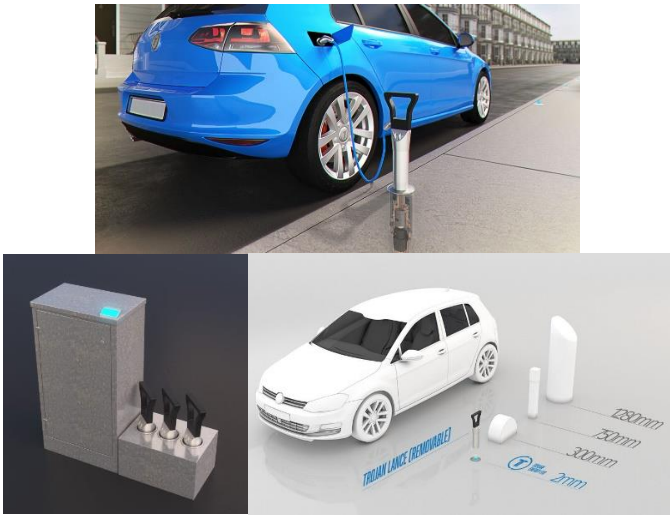


Figure 14; Trojan Lance on-street charging solution | source: www.trojanenergyltd.com

- Parking Energy

Figure 15; ParkingEnergy modular charger | Source: www.parkingenergy.com

3.2.6 Low-lying Fixed Chargers

Compared to traditional free-standing chargepoints, low-lying units are similar in most regards, aside from being significantly lower-profile. This is typically achieved by housing a greater proportion of the chargepoints components under the ground, rather than in an enclosed cabinet above the ground.

Strengths

- At least as robust as conventional free-standing chargepoints, potentially more robust, due to small form factor
- No proprietary equipment or additional user interactions required for use
- Expensive components are typically installed underground and are well protected, leaving less costly components above ground that can be more easily replaced if damaged
- Arguably less interruption to aesthetic of the local environment
- The technology is mostly proven, if not in such a low-profile form factor

Weaknesses

- Arguably present a significant trip hazard, by virtue of having minimal visual impact on the local environment
- More vulnerable to accidental damage caused by vehicle collision, as the units would be obscured by the bonnet and bodywork of a vehicle parked/parking close by
- Vertical height may be less, but the equipment footprint is potentially greater than a conventional charging post
- Certain repairs may require greater time and cost in order to access underground components
- Potential water ingress as vehicles drive through roadside puddles and cause splashes
- Users must interact with the unit at a very low height, potentially restricting use by those with impaired mobility

Examples

- Connected Kerb Armadillo

Figure 16; An illustration of a kerbside charge point | Source: www.connectedkerb.com

3.2.7 Wireless Charging

Wireless charging, also referred to as inductive charging, allows an EV to receive a charge without the need to physically connect the vehicle to a chargepoint. Wireless chargers utilise electrical coils, mounted on or under the road surface, to generate an oscillating magnetic field. This field is then received and converted back to electrical energy by a set of coils fitted to the underside of an EV, before being fed into the battery. This technology is not yet at market but is being developed and demonstrated by several organisations. It is anticipated that, when fully developed, communication between the wireless chargepoint and the user will be managed by the vehicle.

Wireless charging systems are predicted to be available in static and dynamic forms. Static wireless charging has a fixed transmitter pad that an EV must be parked on top of in order to interface and receive a charge. Dynamic wireless charging is fitted along a stretch of road and will interface with and charge any wireless charging enabled EV either parked or moving on top of it.

Strengths

- Added convenience of not needing to physically plug-vehicle in
- Particularly added convenience for users who are not likely to remain stationary for long (e.g. taxi vehicles on a taxi rank)
- Less additional street clutter than wired chargepoints

- Resistant to vandalism and accidental damage from vehicle collisions
- Dynamic wireless charging is a feasible pathway to enabling EVs to charge as they drive

Weaknesses

- Technology not at market – it is anticipated that wireless charging will not be commercially viable until around 2025-2030
- Considerably more expensive to purchase and install than wired charging infrastructure – especially dynamic wireless charging, which requires long stretches of road surface to be removed during installation
- Limited vehicle compatibility – at present, the only vehicles that are compatible have either been purpose-built or retrofitted to demonstrate wireless charging
- Lack of common standards and interoperability, due to the immaturity of the technology
- Connection process still requires significant user input in order to ensure the wireless charging transmitter on the road surface aligns with the receiver on the vehicle
- In an on-street parking scenario, there is no guarantee that the wireless charging pad will be in the correct position to interface with a vehicle – this will depend on how other vehicles are parked and where the wireless charging pad is positioned on the underside of a given vehicle

3.2.8 On-street Rapid Charging

According to Zap-Map, 219 rapid charging units have been installed specifically in on-street environments in the UK as of November 2019. This is therefore proven to be technically feasible, under certain circumstances, and has unique strengths and weaknesses that should be considered alongside alternative on-street charging technologies. Unlike slower charging equipment, rapid chargepoints supply electricity using a direct current (DC), that requires them to be fitted with rectifiers, which convert electricity from alternating current (AC) to DC.

Strengths

- Provides around 180 miles of charge in one hour, compared to around 25 miles of charge in an hour from a 7 kW chargepoint
- Faster charging speed means that a single rapid chargepoint can be used by a greater number of people over a certain amount of time
- Greater number of users increases revenue making potential of each unit
- Even installed in a residential environment, a rapid chargepoint would remain useful during the day, as opposed to 3.5- 7 kW chargers, which are likely to be used mostly overnight when installed in residential environments
- Technology is well developed, with 3,323 units currently installed across the UK as of November 2019, according to Zap-Map

Weaknesses

- Considerably more expensive than 3.5-7 kW charging equipment – in many cases, capital equipment and installation costs are tenfold higher than slower chargepoints
- Larger footprint than conventional 3.5-7 kW charging equipment, considerably larger than many of the novel on-street technologies described in this report
- In some cases, may require a "build-out", where the kerb is moved further into the highway, in order to accommodate the equipment – this would be at the cost of at least one parking space
- Higher operating and maintenance costs per socket, owing to additional power electronics required to produce a direct current

- Less vehicle compatibility than slow charging – while most modern EVs can accept a rapid charge, some older models and many plug-in hybrid electric vehicles (PHEVs) are not compatible
- Require a strong electrical supply – 50 kVA three-phase supply required, as opposed to 3.5-14 kVA single-phase required for slow chargepoints
- With some exceptions, the residential environment does not typically lend itself to rapid chargepoints, which are more ideally located in areas of higher footfall (e.g. town centre car parks, motorway services, etc.)

3.3 Traffic Regulation Order (TRO) Recommendations

Traffic Regulation Orders (TROs) are the legal mechanism by which local authorities determine how public highways and footways are to be used, and the legal basis upon which their usage can be enforced. TROs are required for local authorities to set and enforce parking restrictions that can include maximum permitted parking durations, no return periods, vehicle type, time of day and parking permit requirements.

In the context of EVs, TROs can be implemented that prevent petrol and diesel vehicles from parking in front of a chargepoints – a occurrence commonly referring to as ICE'ing. Ensuring that access to public charging infrastructure cannot be blocked by vehicles that are not using the chargepoint is important in order to ensure that EV users have confidence in the charging network. TROs can be used to implement EV-only bays, which allow local authorities to issue penalty charge notices (PCNs) to non-EV users that park in the bay, thereby acting as a deterrent that prevents this parking behaviour from occurring.

Implementing TROs for EV charging bays requires similar considerations to regular parking bays. Specifically, the TRO should be set with the intended purpose of the bay in mind. As different types of EV charging infrastructure are used in different ways, they require different TRO conditions to ensure they can be used in the most ideal way.

This section will recommend TRO conditions for three locations types, including:

- Long-stay – including residential and workplace charging, typically suitable for slow or standard charging infrastructure (3.5-7 kW)
- Short-stay – locations close to tourist, leisure and/or retail destinations, typically suited to standard or, more often, fast charging infrastructure (7-22 kW)
- Hub – locations mostly or entirely dedicated to refuelling EVs, providing the fastest charge possible and are typically suited to rapid or ultra-rapid charging infrastructure (50 kW+)

This section will also compare conventional (permanent) TROs with experimental TROs (ETROs), and what advantages and disadvantages each method features. This report will not consider temporary TROs, as these are not appropriate to implement EV-only bays for fixed charging infrastructure.

Conventional vs Experimental Traffic Regulation Orders

Experimental TROs (ETROs) can be used to implement the same conditions and restrictions and conventional TROs but are implemented using a different process that allows for greater short-term flexibility, at the expense of long-term certainty. In either case, powers are devolved to local authorities to implement TROs through Part I of the Road Traffic Regulation Act 1984[11]. A summary of the differences between conventional and experimental TROs, as well as their respective advantages and disadvantages, is shown in Table 25.

[11] https://www.legislation.gov.uk/ukpga/1984/27/contents Powers relating to conventional TROs are found in paragraphs 1 through 5. Powers relating to experimental TROs are found in paragraphs 9 through 13.

Table 25; Comparison of regulations orders, adapted from Energy Saving Trust, 2019. [Positioning chargepoints and adapting parking policies for electric vehicles]()

	Permanent Traffic Regulation Order	Experimental Traffic Regulation Order
Duration	Permanent	Maximum 18 months
Minimum public notice required	21 days	7 days
Objections	Objections can be made before the TRO is in approved	Once the ETRO is in place, objections must be made within six months after it came into effect, or within six months of changes being made to the ETRO
Public inquiry	Required if certain objections are made. 42 days' notice required	Not required
Ability to make changes	New TRO needs to be issues, following the same process	Within first six months of ETRO coming into effect or of a change being made
After expiry	N/A	Converted to permanent TRO, removed or extended by up to 18 months by authority of Secretary of State for Transport
Advantages	• Permanent • Opportunity for public to express views • Familiar statutory process	• Quicker and cheaper to implement • Public objections are based on actual effects of order, rather than preconceptions • Can be altered while in force • Can be made permanent easily, providing certain conditions are met
Disadvantages	• Time consuming and costly to gain approval • Potentially subject to public inquiry • Potential to fail	• Temporary – up to 18 months • May need to be revisited to be made permanent • If certain conditions are not met, the process for permanent TROs may not apply on expiry

Alternative TRO Enforcement Options

In some cases, it is desirable to enforce TRO conditions on EV-only bays 24 hours a day, seven days a week. Doing so may be problematic as, in most cases, TROs are only active between certain times of day and/or certain days of the week. It is especially important for rapid charging infrastructure that EV users are prevented from blocking the chargepoint by remaining plugged-in even when their EV has finished charging. Technologies are available that can enforce TRO conditions on EV-only bays, without the need for traditional civil enforcement. These methods include:

- Overstay charges. If a vehicle remains plugged-in longer than a set period of time, that user is charged extra, depending on how long they stay. This is already a common practice for many rapid chargepoint operators.
- Vehicle detection systems. Parking bays can be fitted with vehicle detection systems (typically mounted either under the road surface or on the ceiling of an indoor car park) that gather data on whether a vehicle is parked in a given bay. This data can be used to notify a civil enforcement officer when a vehicle has breached a TRO, prompting attendance at the scene and the issue of a penalty charge notice.
- ANPR systems. Using cameras to read the vehicle registration marks, vehicles that breach a TRO can be identified, enabling penalty charge notices to be issued by post, accompanied by photographic evidence.

With a combination of different approaches, EV-only bays can be enforced without the involvement of a civil enforcement officer, allowing TROs to remain active over long periods of time without the requirement for officers to work unsociable hours or the associated costs of supporting constant enforcement.

3.3.1 Long-stay Parking

Long-stay parking is ideal in locations where motorists are expected to leave their vehicle for a significant length of time. This commonly includes car parks for commuters, park & rides, residential parking permit zones (i.e. controlled parking zones) and visitors to an area. In many cases, vehicles using long-stay car parks may remain parked for the best part of a whole day and/or overnight. In some circumstances, vehicles may remain parked at a long-stay car park for several days – most likely in residential car parks and long-stay car parks attached to transport hubs (e.g. airports, railway stations, etc.).

Permitted Parking Duration

Due to the extended vehicle dwell time at long-stay car parks, they are most appropriately equipped with slow or standard EV charging infrastructure. For EV-only bays in long-stay car parks, TROs are most effectively deployed to prevent EVs from remaining plugged-in to a chargepoint long after the EV has finished charging.

If a long-stay car park is equipped with 7 kW standard charging equipment, EVs will received roughly 25 miles of charge every hour. By this measure, a Tesla Model S – which has the largest battery of any current production EV (100 kWh) – would receive a full charge in around 15 hours. Therefore, this could be considered an upper limit to the length of stay permitted for an EV-only bay in a long-stay car park. There are several additional considerations that should also be made.

Whilst the highest specification of Tesla Model S has a 100 kWh battery, the majority of EVs have considerably smaller batteries. Across all EVs on sale in 2019, the average battery size is 57.5 kWh, which would take around eight hours to fully recharge on a 7 kW standard chargepoint.

It should also be considered that, in most circumstances, EV users will not typically begin a charging session with their batteries at or close to 0% state of charge. A survey by Zap-Map, conducted in 2019 with input from over 1,600 EV and PHEV owners, suggests that the median state of charge that EV users report when they use a public chargepoint is 29%. Taking this into account, the average EV will require 40.825 kWh, taking around six hours on a 7 kW standard chargepoint.

No Return Period

No return periods are not as necessary for long-stay car parks as they are for short-stay car parks but, in the context of EV-only bays, they are required to ensure charging infrastructure is not monopolised by a small number of users. For example, were a no return period not specified, there would be no legal mechanism preventing EV users from repeatedly returning to the site to plug their vehicle in, even if it does not require a meaningful charge. This behaviour is commonly referred to as “blocking”. This would reduce the utilisation of the chargepoint and, in some cases, may cause conflict between EV users.

The balance to be struck with the no return period for EV-only bays in long-stay car parks is that it needs to be long enough to prevent undesirable behaviour, whilst being short enough to ensure that sensible charging behaviour is not prevented. As EV users would be permitted to park and charge for an extended period at a long-stay car park, they would have the time to recharge most or even all of their battery capacity. Therefore, it is reasonable to allow users to return to the chargepoint no sooner than a day after their previous charging session.

In order to achieve this, a no return period of 12 hours could be set, ensuring that EV users could return to the chargepoint within 12 hours of when their previous charge ended. For many users, this would mean that they could use their vehicle during the day and charge once during the evening. Evidence suggests that 80% of EV charging takes place at home and this kind of charging behaviour would be facilitated by implementing a 12 hour no return period.

A longer no return period could be considered but if, for example, a 24 hour no return period were implemented, a commuting user that finished one charging session at 7am one morning would not be able to use the chargepoint again potentially until the evening of the following day. In this example, vehicles undertaking high mileage would be prevented from using the same chargepoint from one day to the next.

Active Hours

Whilst the EV-only bay should remain EV-only at all times, the permitted parking duration and no return period could be specified to be enforced only during specific hours of the day.

For long-stay parking, TROs for EV-only bays could be extended to match the hours of the working day (e.g. 8am-6pm). Consideration should be made that, with the extended parking durations inherent in long-stay car parks, users who begin charging in the early-afternoon could effectively leave their vehicle in the bay until the following morning. It should also be considered that many users would potentially not begin their charging session until they returned from work, for instance, after 6pm.

Alternatively, the TRO could remain active at all times. This would present two issues. Firstly, it would dissuade people from charging their EV overnight, as to avoid needing to unplug and move their vehicle at an unsociable hour. Secondly, it would require civil enforcement officers to patrol the area overnight, which would add significant salary cost.

Imposing the TRO between the hours of 7am and 9pm would prevent EV users remaining plugged-in from the early afternoon through to the next day but would also still allow EV users to charge overnight.

Long-stay TRO Recommendations

Taking the above considerations and evidence into account, Cenex suggests Isle of Wight Council consider the TRO conditions shown in Table 26 for an EV bay in a long-stay car park. A combination of a 6-hour permitted parking time and 7am-9pm active hours ensures that users can park and charge overnight, when required, but equally prevents users from remaining plugged in from the early-afternoon through to the following day. The no return period of 12 hours would encourage users to use the chargepoint less frequently, reducing the likelihood of vehicles returning to charge overly frequently and blocking the chargepoint for other users.

Table 26; Recommended TRO conditions for long-stay parking

	Minimum	Recommended	Maximum
Permitted parking duration	6 hours	6 hours	15 hours
No return period	None	12 hours	24 hours
Active hours	8am-6pm	7am-9pm	At all times
Type of charger	Slow	Standard	Fast
Charge power	3.5kW	7 kW	22 kW

3.3.2 Short-stay Parking

Short-stay parking is appropriate in locations of high vehicle turnover, where parking for extended periods is therefore actively discouraged in order to maintain acceptable parking provision. Short-stay car parks are typically located near to destinations or attractions, where car parks are provided with a specific site in mind, in order to drive footfall towards those sites. In these cases, vehicles are typically permitted to stay for a period of time that is appropriate with the destination that the car park is serving, which would typically be a small number of hours.

Permitted Parking Duration

Short-stay car parks are best equipped with Fast 22 kW charging infrastructure. This would provide a more meaningful amount of charge over a small number of hours than slow or standard charging infrastructure without the additional cost of rapid charging infrastructure, or the need for EV users to unplug and move their vehicle before they have had time to explore the local attractions.

Fast 22 kW charging infrastructure would provide roughly 75 miles of charge in an hour. For the highest spec Tesla Model S, this would provide a full charge in around 4.5 hours and, for an average EV currently on sale, a full charge could be provided in under three hours. When considering that EVs using public charging infrastructure have 29% of charge remaining when deciding to use public charging infrastructure, the average EV on sale would require under two hours to return to full charge on a Fast 22 kW chargepoint.

A further consideration to make, specifically regarding Fast 22 kW charging infrastructure, is that certain EVs are not able to accept the full 22 kW power from the chargepoint. This varies from one vehicle to another and, for some EVs, 22 kW charge capability is specified as an optional extra. For this reason, it may be sensible to provide some extra time to allow vehicles that are not compatible to still receive a meaningful charge.

No Return Period

TROs for short-stay parking bays with high turnover typically include no return periods to prevent vehicles from re-parking their vehicle immediately after they have reached the maximum permitted parking duration. This period is typically a small number of hours.

Provided that EV users are permitted to park and charge in a short-stay parking bay for a long enough duration to receive a meaningful charge, they should not need to return to that bay again within several hours of leaving. Therefore, a no return period of around 4 hours could be set to ensure that the bay remains available for other EV users.

Implementing a no return period of longer than four hours may prevent high mileage users from recharging as frequently as required. For example, commercial fleet vehicles that regularly stop near to a given fast chargepoint may not be able to use it when most convenient and therefore may not be able to complete their shift as intended.

Active Hours

For an EV chargepoint in a short-stay car park, it is important to ensure that the chargepoint remains available and accessible during periods when it is likely to be used. This suggests that the TRO should be enforced over the greatest period of time that is practically feasible for the site. However, data from the UK Office for Low Emission Vehicles (OLEV) shows that very few public charging sessions currently take place on fast chargepoints between the hours of midnight and 5am[12], suggesting that enforcement would not be necessary during this time.

If the period over which the TRO is active is too short – for example, reflecting the common working hours of 9am-5pm – there is a danger that the infrastructure may be blocked out overnight from the early evening onwards. Considering that a Fast 22 kW chargepoint can fully charge many vehicles in under two hours, if the chargepoint is blocked, several users may be inconvenienced.

Short-stay TRO Recommendation

For EV charging infrastructure in short-stay locations, a permitting parking duration of three hours will provide enough time to ensure that the majority of vehicles can receive at least a meaningful charge and, in many cases, a full charge. A no return period of four hours will reduce the likelihood of the bay being blocked out by EV users who do not require a meaningful charge or those who repark to avoid charges. The TRO restrictions need not be in place between the hours of midnight and 6am, as utilisation is likely to be low during these periods. The remaining period of 6am to midnight should be enforced to the maximum extent that is feasible given the location of the chargepoint.

Table 27; Recommended TRO conditions for short-stay parking

	Minimum	Recommended	Maximum
Permitted parking duration	2 hours	3 hours	5 hours
No return period	None	4 hours	8 hours
Active hours	9am-5pm	6am-midnight[13]	At all times
Type of charger	Standard	Fast	Rapid
Charge power	7 kW	22 kW	50 kW

3.3.3 Charging Hubs

The concept of charging hubs is that several rapid – or increasingly ultra-rapid – chargepoints are installed in a single location. This location then has the primary purpose of recharging as many EVs as possible, as quickly as possible. Charging hubs are therefore most commonly found in locations with high traffic flows, making them convenient to EV users seeking to charge in order to continue their journey or EV users looking to recharge before returning home, in a similar manner to refuelling a petrol or diesel vehicle.

Permitted Parking Duration

Charging hubs are best served by Rapid 50 kW chargepoints, that can provide around 90 miles of charge in half an hour. Even so, a Tesla Model S with a 100 kWh battery would still require roughly

[12] UK Office for Low Emission Vehicles (OLEV), 2017. *Electric Chargepoint Analysis 2017: Public Sector Fasts*

[13] As late as feasibly possible, no later than midnight

2.5 hours to receive a full charge. However, for an average EV on sale in 2019, a full charge could be provided in roughly 90 minutes and, when considering likely state of charge of 29%, a full charge would likely take under an hour.

Predicting the exact time required to receive a full charge on rapid and ultra-rapid charging infrastructure is more complex than for standard or fast charging, as different EVs manage how they receive a rapid charge using different methods. When using a rapid or ultra-rapid chargepoint, an EV will typically slow the rate of charge until the battery reaches 20% capacity, before increasing the power to the highest amount available and then reducing the speed of charge once more when battery capacity reaches 80%. As a result of this, the fastest charge can usually be received between 20% and 80% state of charge.

Setting a permitted parking duration of one hour would allow most vehicles to charge from around 29% state of charge (the remaining capacity that Zap-Map survey suggests EV users have when using public chargepoints) to 80%. This charge would allow EV users to continue their onward journey.

Allowing a longer duration of parking would negatively impact the utilisation of a rapid chargepoint, preventing it from recharging as many vehicles a day as would otherwise be possible. If a shorter duration were specified, it would create a risk that EVs with larger batteries may not be able to receive a meaningful charge in the permitted time.

No Return Period

With the speed at which a rapid or ultra-rapid chargepoint delivers a charge, it is unlikely that an EV would require use of a chargepoint more than once in a given day. There may be some exceptions to this, where EVs drive a high daily mileage on a regular basis (e.g. taxi and private hire) but, even in these cases, it is unlikely that an EV could receive a rapid charge and then require another charge soon after. For example, if an EV uses a rapid charger to receive 90 miles of charge in half an hour, it would require roughly four hours driving at typical average A-road speeds[14] before it required another charge.

Additionally, no return periods have less impact on the utilisation of rapid charging infrastructure, as vehicles are parked only briefly. This means that, so long as permitted parking duration is set and enforced appropriately and provided that a meaningful charge is required by the EV user, frequent users will not negatively impact the utilisation of a rapid chargepoint. On the contrary, frequent repeat usage could debatably be in the business interest of the chargepoint operator, as this will provide a regular revenue source.

Active Hours

For a rapid chargepoint in a hub setting, TRO conditions should ideally be in effect 24 hours a day, seven days a week. Data from OLEV suggests that, whilst demand for rapid charging is considerably less during the hours of 1-5am[15], there is still a significant enough demand that inconvenience may be caused were a rapid charger to be inaccessible during these hours. It may also be sensible to assume that EV users charging their vehicle during these hours would not do so if they had a reasonable alternative, and therefore the availability of rapid chargepoints during these hours may be of great importance to a small number of EV users. These users may include, for example, taxi and private hire drivers and commercial fleets.

Charging Hub TRO Recommendation

A permitted parking duration of one hour should allow most EV users to charge their vehicle from 20% to 80% state of charge and, in some cases, will allow a vehicle to fully recharge. A no return period of two hours will prevent EV users from returning to the bay before they require a meaningful

[14] UK Department for Transport, 2019. Average speed, delay and reliability of travel times

[15] UK Office for Low Emission Vehicles, 2017. Electric Chargepoint Analysis 2017: Local Authority Rapids (revised)

charge, without preventing higher mileage EV users to access the chargepoint as often as they require. These conditions should be enforced at all times, as certain user groups may rely on the chargepoints being available, even at unsociable hours.

Table 28; Recommended TRO conditions for charging hubs

	Minimum	Recommended	Maximum
Permitted parking duration	30 minutes	1 hour	3 hours
No return period	None	2 hours	6 hours
Active hours	9am-5pm	At all times	At all times
Type of charger	Fast	Rapid and/or ultra-rapid	Ultra-rapid
Charge power	22 kW	50 kW+	120kW+

3.3.1 TRO Recommendation Summary

A summary of recommended TRO conditions is shown in Table 29. Further detail on the rationale behind these recommendations is provided across subsequent sections of this report.

Table 29; Summary of TRO recommendations for long-stay, short-stay and hub locations.

	Long-stay	Short-stay	Hub
Permitted parking duration	6 hours	3 hours	1 hours
No return period	12 hours	4 hours	2 hours
Active hours	7am-9pm	6am-midnight[16]	At all times
Type of charger	Standard	Fast	Rapid and/or ultra-rapid
Charge power	7 kW	22 kW	50 kW+

In all cases, it is recommended that parking bays adjacent to EV charging infrastructure are only permitted to be used by EVs. This restriction should apply at all times. However, permitted parking duration, no return periods and the hours in which these restrictions apply should vary depending on the type of location that EV charging infrastructure is being installed.

[16] As late as feasibly possible, no later than midnight

4 Fleet and Commercial Vehicle Infrastructure

Fleet and Commercial Vehicle Infrastructure is the third and final work package of the IoWEVIP project. This workpackage is divided into the following sections:

1. Fleet and Commercial Vehicles
2. Public-Private Partnerships

4.1 Fleet and Commercial Vehicles

As part of the identification and assessment of the 137 potential EV charging infrastructure locations that were longlisted in workpackage 1, each site was also assessed regarding its appropriateness for fleet and commercial vehicle users. As a result of this assessment, sites that were appropriate for these users were highlighted within the longlist. A selection of the most feasible of these sites is shown in Table 30.

Table 30; List of potential EV charging infrastructure sites rated 14 or higher, considered appropriate for use by fleet and commercial vehicles

Name	Ownership	Type	Use Case	Rating	S.list
Chapel Street Car Park	IWC	Rapid	Hub	19	Yes
St Thomas Street Car Parks (hub)	IWC	Rapid	Hub	19	Yes
County Hall	IWC	Standard	Workplace	18	Yes
Carisbrooke High Street Car Park	IWC	Standard	Workplace	17	Yes
Medina Yard Redevelopment	Unknown	Fast	Destination	16	Yes
Cross Street Car Park	IWC	Fast	Destination	16	Yes
New Red Funnel Ferry Terminal	Unknown	Rapid	Transit	16	Yes
Quay Road Car Park	IWC	Fast	Destination	16	Yes
St Mary's Hospital	NHS	Fast	Destination	16	Yes
Church Litten Car Park	IWC	Rapid	Taxi	16	Yes
Cowes Enterprise College	Education	Standard	Workplace	15	Yes
Isle of Wight College	Education	Standard	Workplace	15	Yes
Park Road Car Park	Unknown	Standard	Destination	15	Yes
The Heights Car Park	IWC	Standard	Workplace	15	Yes
Blackgang Chine Theme Park	Private	Fast	Destination	14	No
Booker Wholesale Cowes	Private	Rapid	Fleet	14	No
Gunville Retail Park	Private	Fast	Destination	14	No
Park Road Car Park (hub)	Unknown	Rapid	Hub	14	No
Shanklin Station Car Park	Private	Rapid	Taxi	14	No
Waitrose Cowes	Private	Rapid	Hub	14	No
The Parade	Public	Fast	Destination	14	No

4.1.1 Criteria for Fleet and Commercial Vehicle Use

In the site assessment process, there were three criteria that, if one or more was met, the site was indicated as being appropriate for fleet and commercial vehicle usage. These criteria included sites that were considered likely to be:

1. Used by employees of businesses on or near to site
2. Visited as part of daily operation of certain fleets
3. Of broad appeal, attracting fleet users even if not part of existing operations

For the purposes of this assessment, taxi and private hire vehicles were considered as being commercial vehicles and, therefore, sites near to taxi ranks or taxi operators were marked as appropriate for fleet and commercial vehicle use.

Used by employees of businesses on or near to site

Where potential EV charging infrastructure sites were identified that are near to large employment sites, or areas with a high density of smaller employers, it would be possible for employees of those businesses who own EVs could utilise the chargepoints to recharge their vehicle during their working shift. In some cases, the same car park may be used by employees and operational fleet vehicles, potentially allowing for employees to charge their own EV during the day and for fleet managers to charge operational vehicles overnight.

Visited as part of daily operation of certain fleets

Locations were identified that were considered likely to be visited regularly by fleet and commercial vehicles. This included locations such as popular transit routes, including ferry terminals and railways stations, as well as hospitals, taxi ranks and conveniently located urban car parks. A wholesaler in Newport was also considered appropriate for EV charging installation for fleet and commercial vehicles, owing to the site being visited mostly or exclusively by commercial vehicles, which are likely to remain parked for a meaningful period whilst gathering stock. In most cases, sites identified that meet this criterion are also appropriate for other vehicle users.

Of broad appeal, attracting fleet users even if not part of existing operations

It is anticipated that high-power EV charging hubs would attract users from multiple user groups, as the greater quantity and speed of the chargepoints provides EV users with a greater assurance that a chargepoint will be available to recharge their vehicle. This assurance is particularly important to fleet and commercial vehicles, as time spent charging their vehicle or waiting for a chargepoint to become available effectively has a cost attached. Therefore, sites where the installation of charging hub has been proposed have been marked as appropriate for use by fleet and commercial vehicles. This additional use has been considered in the site business cases.

4.2 Opportunities for Public-Private Partnerships

During the site identification and assessment, 53 privately owned sites were longlisted, with a further five of unknown ownership that are also likely to be private ownership. The top 23 privately owned sites that were assessed during the EV infrastructure mapping are shown in Table 31. When reviewing the overall rating of the site, it is important to consider that privately owned sites were typically scored lower for feasibility of installation, as the agreements required with the landowner will invariably complicate and lengthen the installation process. From a user perspective, many of the privately-owned sites listed below are ideal – particularly those at high footfall locations, such as supermarkets.

Table 31; List of privately-owned sites, identified as ideal for EV charging infrastructure installation.

Name	Ownership	Type	Use Case	Rating	S.list
Lidl Shanklin	Private	Rapid	Destination	17	Yes
Morrisons Lake	Private	Rapid	Destination	17	Yes
Medina Yard Redevelopment	Unknown	Fast	Destination	16	Yes
New Red Funnel Ferry Terminal	Unknown	Rapid	Transit	16	Yes
Robin Hill Country Park	Private	Fast	Destination	15	Yes
The Needles	Private	Fast	Destination	15	Yes
Park Road Car Park	Unknown	Standard	Destination	15	Yes
Aldi Lake	Private	Rapid	Hub	15	Yes
Albany Road Redevelopment	Unknown	Standard	Residential	14	No
Blackgang Chine Theme Park	Private	Fast	Destination	14	No
Brading Car Park	Private	Fast	Destination	14	No
Morrisons Newport	Private	Rapid	Hub	14	No
Tapnell Farm Park	Private	Fast	Destination	14	No
The Old Smithy & Gardens	Private	Fast	Destination	14	No
Booker Wholesale Cowes	Private	Rapid	Fleet	14	No
Gunville Retail Park	Private	Fast	Destination	14	No
Park Road Car Park (hub)	Unknown	Rapid	Hub	14	No
Shanklin Station Car Park	Private	Rapid	Taxi	14	No
Waitrose Cowes	Private	Rapid	Hub	14	No
Gulf Lushington Hill	Private	Rapid	Transit	14	No
Northwood Garage	Private	Rapid	Transit	14	No
Tesco Westridge	Private	Rapid	Hub	14	No
Arreton Barns Craft Village	Private	Fast	Destination	14	No

The privately-owned sites identified as being suitable for EV charging infrastructure installation broadly fall into one or more of the following categories:

- Supermarkets
- Retail parks
- Tourist and leisure destinations
- Privately owned car parks
- Privately run transport hubs

- Fuel stations

Supermarkets

Many of the UK's major supermarket chains have already made commitments to install EV charging infrastructure at their sites, and/or they have entered into commercial partnerships with particular EV chargepoint suppliers. A list of supermarkets, their partnerships with EV chargepoint providers and further commitments to install EV charging infrastructure that have been made public are shown in Table 32.

Table 32; List of supermarkets and their partnerships with particular EV chargepoint suppliers and commitments that have been publicly made to install further EV charging infrastructure.

Supermarket	EV Chargepoint Partner	Commitments Made
Lidl	Pod Point	£25m to install rapid chargers at 300 stores[17]
Morrisons	GeniePoint (Engie)	100 rapid chargepoints installed by end-2019[18]
Tesco	Volkswagen	2,500 charging bays at 600 stores by 2020[19]
Aldi	E.on (Hungary)	EV charging at 123 stores in Hungary[20]
Asda	BP Chargemaster	222 chargepoints installed[21], no future commitment
Waitrose	BP Chargemaster	154 chargepoints installed[21], no future commitment
Sainsbury's	Pod Point	112 chargepoints installed[21], no future commitment

Sites for supermarket chains that are known to have made public commitments to install EV charging infrastructure were rated more highly for installation, as there may exist a route for IWC to engage with the supermarket branch managers in order to encourage them to take action with their existing partner.

Supermarkets represent ideal sites to locate EV charging infrastructure, in the same way that they are convenient locations for conventional fuel stations. Supermarkets have also begun offering free EV charging to customers to attract EV users to their stores, much in the same way that they offer cheaper fuel to attract customers. In consideration of this, installing EV charging infrastructure that may later be in direct competition with a nearby supermarket should be avoided.

Engaging with supermarkets that are known to have ambitions or commitments to install EV charging infrastructure – especially rapid charging infrastructure – should be considered and undertaken ideally in the short-term. Doing so will mitigate the risk that public-funded charging infrastructure is exposed to competition, and potentially undercut by privately funded charging infrastructure. It will also allow the supermarket site manager to consider and communicate what steps they plan to take and when.

Retail parks

Similar considerations should be made with retail park operators as are made with supermarkets. The most significant difference is that a retail park could be operated by an organisation that is external to the retailers based on the site. This removes an element of incentive for the landowner

[17]https://www.fleetnews.co.uk/news/environment/2019/10/28/lidl-to-install-rapid-ev-charging-points-at-all-new-stores

[18]https://www.fleetnews.co.uk/news/fleet-industry-news/2019/03/28/morrisons-supports-ev-adoption-with-geniepoint-rapid-chargers

[19]https://www.bbc.co.uk/news/business-46386858

[20] https://bbj.hu/energy-environment/aldi-eon-to-build-ev-charging-stations-at-123-stores_159373

[21] https://www.zap-map.com/zap-analysis-supermarkets

to invest in charging infrastructure, as the effect that it will have on attracting users to the site will be of less direct benefit to them. In these cases, engagement with the retail park operator should be planned to explore whether any public-sector intervention is required for EV charging infrastructure to be provided on the site, and what the terms of this intervention will be. Where the retail park owner intends to invest privately in EV charging infrastructure, it is equally important to gather information about the nature and timing of this investment, to allow for the additional charging infrastructure to be factored into wider plans and avoid the installation of competing infrastructure.

Tourist and leisure destinations

The primary benefit of installing EV charging infrastructure at tourist and leisure destinations is that, in many cases, these may be locations where visitors stay for several hours. This provides an ideal opportunity for EV users to recharge their vehicle without any inconvenience. Where visitors are staying for several hours, a tourist or leisure destination would not need to provide rapid charging in order to offer a useful service to EV users visiting the site, as a fast or even standard chargepoint could provide a meaningful charge in that time period.

Tourist and leisure destinations may also be situated in more rural areas of the island, where few other appropriate sites exist for EV infrastructure to be installed. In these cases, installing chargepoints at a tourist and leisure destination has the benefit of providing EV users with a location to charge in more remote areas, and the additional benefit of providing another method of attracting visitors to the site. Providing infrastructure in remote locations also has the benefit of improving the breadth of the network across the island, therefore improving consumer confidence in EVs.

Tourist and leisure destination owners may be more easily engaged than owners of more overtly commercial sites, making site access and wayleave arrangements more easily agreed. This would be especially the case where the destination is run independently, as individuals with decision-making authority are likely to be more easily contactable. Proactive engagement should be made with tourist and leisure destinations that present an opportunity to strengthen the overall EV charging infrastructure network. Tourist and leisure destinations could also be engaged with reactively, by inviting interested destination owners to contact IWC to discuss and explore the potential to install EV charging infrastructure on their sites.

Cenex engaged with both National Trust and English Heritage, who each own and manage several heritage sites on IoW. Both National Trust and English Heritage have made Cenex aware of intentions to explore provision of EV charging infrastructure at several of their sites across the UK. In the case of National Trust, several of their sites across the UK have already installed EV charging infrastructure. At time of writing, both parties are in an exploratory phase and may welcome engagement from IWC to discuss providing EV charging infrastructure at their sites on IoW.

Privately owned car parks

Whilst installation of EV charging infrastructure is likely to be considerably easier to manage at car parks owned by IWC, well-located privately-owned car parks can present a more convenient site to install chargepoints. Whether or not a particular private car park is being considered as a site for EV charging infrastructure installation, engagement should be made with the operators of larger car parks across IoW to discuss what plans already exist and ensure that these align with the plans of IWC, including interoperability with the wider charging network across IoW.

Where a private car park is being considered as an ideal site for EV charging infrastructure installation, discussions with the operator should focus on how EV charging can increase usage of the car park and generate new sources of revenue. It is important that the type of infrastructure provided reflects the usage of the car park, with short-stay car parks favouring fast and rapid charging and long-stay car parks being more suitable for standard and fast charging. Discussions should also seek to address concerns that providing EV charging and EV-only parking bays will reduce parking revenue, which is a common concern of car park operators. If EV charging infrastructure is installed in proportion to demand, the revenue generated from its use can offset and exceed any revenue lost from reduced parking bay usage. An example of how EV charging can increase revenue for a single parking bay is shown in Table 33.

Privately owned transport hubs

Transport hubs are amongst the most ideal locations to install EV charging infrastructure. In the case of railways stations and ferry terminals, these sites are often owned and operated by private organisations.

For railway stations, the provision of charging infrastructure can be useful to ensure that EV users can leave their vehicles on charge whilst using the railway. There is also additional benefit in that, with IoWs railway stations being in or near to more densely populated area, railway station car parks are potentially convenient for residents and visitors, regardless of whether they are going to use the railway. In engaging with railway station operators, discussions should focus on how EV charging infrastructure can introduce a new revenue stream and also attract EV users to use the railways whilst they charge.

Specific to IoW is the importance of ferry crossings as a means of transporting vehicles to and from the mainland. Ferry terminals represent ideal locations to charge EVs, as vehicles are already likely to be stationary for some time and, by using that time to recharge, EV users can ensure they have enough battery charge to continue their onward journey after disembarking. In the medium-term, providing EV charging facilities could also provide a reliable source of additional revenue for the ferry operator.

Despite the high probability that EV users would be likely to have enough time to receive a meaningful charge whilst waiting for the next ferry, ferry terminals present a logistically challenging location to provide EV charging infrastructure. The queueing systems used at ferry terminals would need to be adapted to allow EV users to charge whilst waiting in the queue by, for example, adding EV charging bays at the front of the queue. Should EV charging be located outside of the queueing area, EV users may be dissuaded from using it for fear that they may miss one or more crossings before being able to join the queue. In engaging with ferry terminals, it is important to emphasise the importance of allowing EV users to charge and queue at the same time to ensure charging infrastructure remains useful.

Table 33; A worked example of how, under maximum utilisation, EV charging infrastructure can increase the revenue generated by a parking bay. This example assumes wholesale electricity cost of 15p/kWh and chargepoint tariffs set at 20p/kWh.

Bay usage	Typical time	Parking revenue (£1.50/hr)	Net charging revenue (5p/kWh)	Max users per 18-hour day	Max potential daily revenue
Parking	3 hours	£4.50	-	6	£27
Rapid charging	30 minutes	£0.75	£1.25	32	£64
Fast charging	2 hours	£3	£2.20	9	£46.80
Standard charging	6 hours	£9	£2.10	3	£33.30

Fuel stations

In the coming years, fuel stations will inevitably need to consider how to repurpose their sites to maintain profitability as petrol and diesel vehicles are phased out. Whilst the transition towards EVs could be perceived as a threat to the conventional business model of a fuel station, it also presents a significant opportunity. Providing EV charging infrastructure can unlock two key benefits:

1. The profit margin for refuelling EVs is greater than for refuelling petrol/diesel vehicles. According to the BBC[22] in 2011, only 31p of every £10 spent at fuel stations goes to the operator of the fuel station, with £7 claimed in taxation and £2.69 going to the fuel supplier. As the tax and supplier contributions for electricity are significantly less, a greater proportion of revenue is retained by the station owner, even if less is charged for a comparable amount of energy.
2. Even the most high-powered infrastructure will typically still take at least 10-30 minutes to provide a meaningful charge. This increases the value of the fuel stations retail offering, as those using EV charging infrastructure have time to stop for refreshments as their vehicle charges. This is especially the case where fuel stations are located in rural areas, where there is little incentive for customers to explore beyond the site.

In engaging with fuel station operators, these benefits should be highlighted in order to inform the site owner. Whether EV infrastructure is then funded and installed by IWC or by the fuel station owner, efforts should be made to ensure that what infrastructure is installed is interoperable with the rest of the EV chargepoint network on IoW or, more ideally, allows ad hoc payment through contactless debit or credit cards. Ensuring this is the case is in the best interest of the fuel station operator, as well as IWC and EV users on IoW.

[22] https://www.bbc.co.uk/news/av/business-12250225/business-basics-where-does-your-petrol-money-go

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Cenex
Holywell Building
Holywell Park
Ashby Road
Loughborough
Leicestershire
LE11 3UZ

Tel: 01509 642 500
Email: info@cenex.co.uk
Website: www.cenex.co.uk