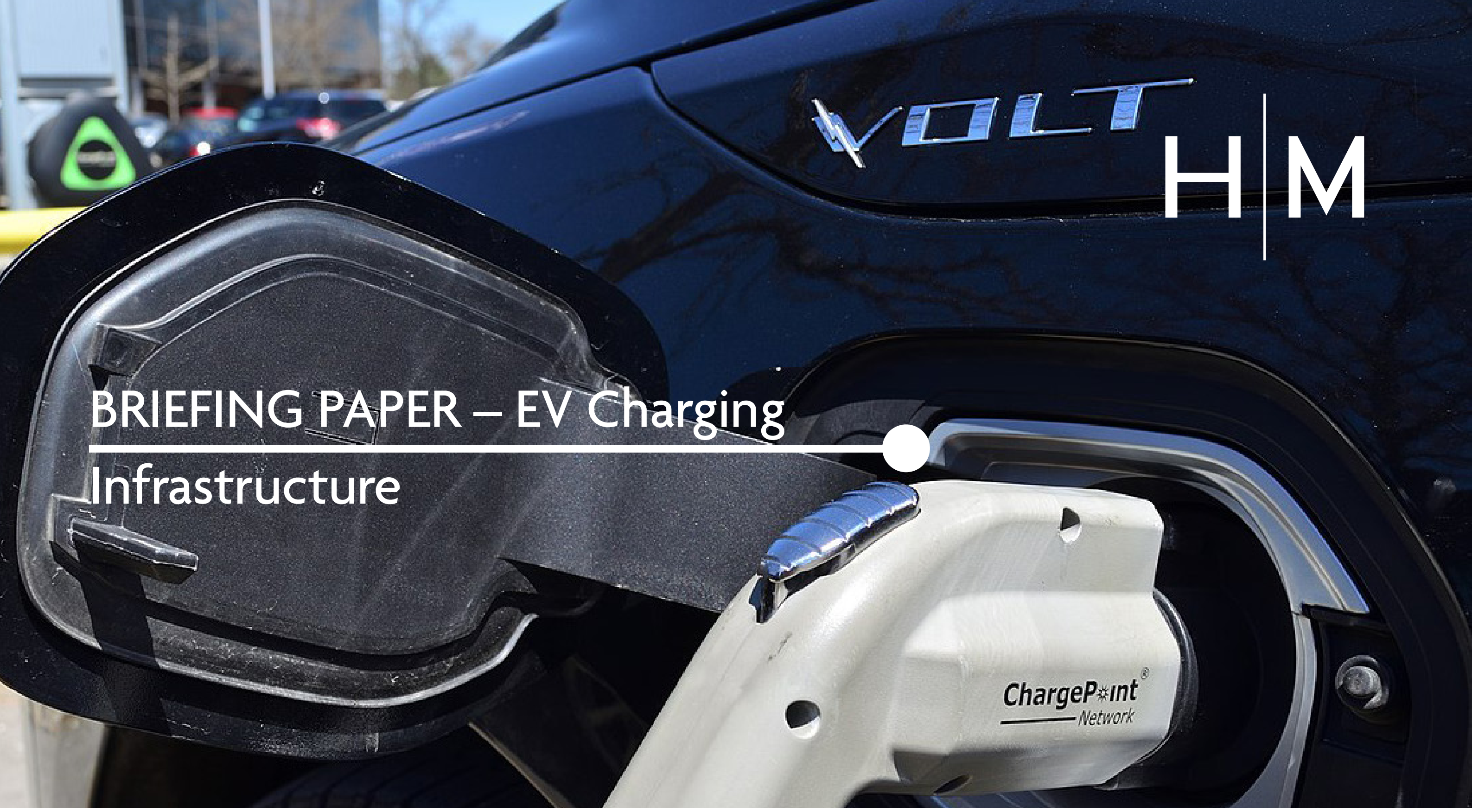


BRIEFING PAPER – EV Charging Infrastructure

Introduction

This Briefing Paper is intended to summarise the procurement and governance options for Electric Vehicle (EV) charging points for new developments within Great Britain. Ultimately this Paper is intended to feed into the design and commercial decision making process to help Developers define the number, location and – crucially – ownership and operation opportunities for new EV charging infrastructure.

Hilson Moran has engaged in detail with a number of suppliers of EV charging infrastructure to find solutions for various development projects – links to some of these suppliers providing technical specifications, and other background information is contained at the end of this note.

This note is intended to cover all new-build development projects but arguably the options for the various tenures of residential development provide the widest range of opportunities, and with anticipated changes to Building Regulations next year these options will be brought into focus sooner.

Context

It is clear now that the demand for electric vehicles, and therefore electric vehicle charging infrastructure is rapidly increasing (c. 50,000 vehicle registrations in 2015 and c. 200,000 registrations in 2018).

The UK Government recently mandated that after 2040 no new petrol or diesel cars will be sold (lobbyists are now pushing for 2030). Various local planning authorities are already imposing their own requirements in advance of this; some going as far as to mandate that a 7.4kW fast charger must be provided for every single parking space that is directly connected to an individual dwelling.

Furthermore and very importantly consultation is about to commence on the update of Building Regulations to mandate that every new dwelling is fitted with a 'smart' [7.4kW] fast charger. See excerpt below from the Government website (Office for Low Emission Vehicles – OLEV).

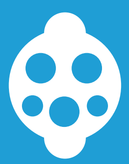
In this paper we summarise the different types of EV charging points, the different connectors available, and importantly, how to manage the electricity demand, as well as options for the procurement and governance of all related charging infrastructure.

There are three recognised categories of charging points that encompass varying power and phase types. Each category also utilises differing types of connector. Connectors are either tethered (a fixed lead that can be plugged into the EV to charge) or untethered (no lead provided, the EV carries a lead which is used to plug into the CP). This is all summarised below, some of which is taken from the Zap Map website.

It should be noted that to charge a car more quickly typically more power is required, and importantly it should be noted that to achieve greater 'range' (distance between charging) then batteries will likely get bigger: bigger batteries take longer to charge from empty.

1. Slow Chargers

3-Pin-3 kW AC



Type 1-3 kW AC

Type 2-3 kW AC

Commando-3 kW AC

- 3kW or 3.7kW slow charging on one of four connector types
- Charging units are either untethered or have tethered cables
- Includes mains charging and from specialist chargers
- Often covers home charging

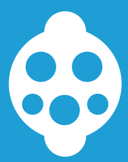
Many slow charging units are rated at up to 3kW which are simply plugged into a 13A fused 3 pin household socket. Larger capacity units are required to be directly wired into a suitably fused outgoing way of the consumer unit (e.g. a 3.7kW charger requires a dedicated 16A fused connection); it should be noted that some lamp-post chargers (although 'slow') are rated at 6 kW.

All plug-in EVs can charge using at least one of the slow connectors pictured above using the appropriate cable. It should be noted that other than the first (household 3-pin 13A plug) shown below, the remaining plugs are actually rated at 3.7kW.

On these slow units, smaller plug-in hybrid vehicles with a 12kWh battery can take around 4 hours to charge but a much larger battery EV (e.g. a 100kWh battery) can take more than 30 hours to fully charge.

2. Fast Chargers

Commando-7-22 kW AC



Type 1-3 kW AC

Type 2-7-22 kW AC

- 7.4kW fast charging (32A single phase) on one of three connector types
- 22kW fast charging (32A three phase) on one of three connector types
- 11kW fast charging on Tesla Destination network
- Units are either untethered or have tethered cables

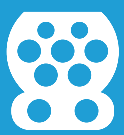
Fast chargers, all of which are AC, are typically rated at either 7.4kW or 22kW. Charging times vary and the table below from UK Power Networks shows examples for typical EVs on common sizes of slow and fast chargers. Fast chargers tend to be found at destinations, such as car parks, super-markets, or leisure centres where you are likely be parked at for an hour or more.

The majority of fast chargers are 7.4kW and untethered units and are therefore more flexible as they can be used by any EV with the correct cable. Charging rates when using a fast charger will depend on the car's on-board charger, with not all models able to accept 7.4kW or more. These models can still be plugged in to the charge point, but will only draw the maximum power accepted by the on-board charger.

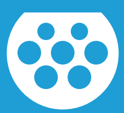
Tesla's 'destination' chargers provide 11 or 22 kW of power but, like the Supercharger network, are intended only for use by Tesla models. Tesla does provide some standard Type 2 chargers at many of its destination locations, and these are compatible with any plug-in model using the correct cable.

3. Rapid Chargers

CHAdeMo-
50 kW DC



CCS-50 kW AC



Type 2-43 kW AC

Tesla Type
2-120 kW DC

- 50kW DC charging on one of two connector types
- 43kW DC charging on one connector type
- 120kW DC charging on Tesla Supercharger network
- All rapid units have tethered cables

Rapid chargers are the fastest way to charge an EV, often found in motorway services or in locations close to main roads. Rapid devices supply high power direct or alternating current – DC or AC – to recharge a car to 80% in 20-40 minutes. In most cases, the charging units power down when the battery is around 80% full to protect the battery (extend its life). All rapid devices have the charging cable tethered to the unit.

Tesla's Supercharger network also provides rapid DC charging to drivers of its cars, but use a Tesla Type 2 connector and charge at up to 120 kW. While all Tesla models are designed for use with Supercharger units, many Tesla owners use adaptors which enable them to use 50 kW rapid units fitted with a CHAdeMO connector. While these provide less power than a Supercharger, they are more common.

Typical charging times for PHEVs and EVs

PHEV and EV models (battery capacity)		Residential charger from empty			Residential charger from half empty		
		3kW Domestic plug (13A)	3.7kW (32A)	7.4kW (32A)	3kW Domestic plug (13A)	3.7kW (32A)	7.4kW (32A)
Mitsubishi Outlander (12k Wh)	3kW On board charger	4hrs	3.5hrs	2hrs	2hrs	1.75hrs	1hr
Tesla S 100D (100k Wh)	10/20kw On board charger	33.3hrs	27hrs	14hrs	17hrs	13.5hrs	7hrs
2018 Nissan leaf (40k Wh)	1kW On board charger	13hrs	10hrs	6hrs	7hrs	5hrs	3hrs

Revenue Recovery Options

There are a number of ways that electric vehicle charging points can be deployed and managed but in simple terms, the two key options are:

1. The Landlord (or a Management Company) owns and maintains the EV charging points; paying for all electricity used and either charging users as they see fit (variable charges based on electricity used, or perhaps fixed charges through a standing charge); or allowing users to charge for free. Typically users are recharged via software provided by the charging point supplier. EV charging points can be purchased outright, or via a lease agreement, or can be rented.

2. The Landlord appoints a 'franchisee' to install and manage the EV charging points. The franchisee will then also take care of the billing. In this option, and dependent on various factors, such as the expected usage frequency, and amount of revenue share desired by the Developer, the upfront supply and installation cost could potentially be off-set by a capital contribution where under some circumstances the capital cost for design and install could be a £nil cost to the Developer.

Option 1 is typically applied where electric vehicles are used as part of the landlord's business, or if they provide this as some kind of perk to their employees. This could also be used in communal residential parking areas. Again, residents could be charged separately for power used, or they could pay a standing charge through their management fee.

For the public areas of the site Option 2 might be the preferred way forward. In short, an operator is appointed to install and manage the charging points. They will take responsibility for the metered electricity supply and be responsible for the subsequent charging of all customers.

Based on previous experience, and subject to detailed negotiation with various EV charging point suppliers, we would expect that commercial offers could vary based on specific requirements, and could therefore potentially be varied to suit the needs of the development.

Some charging points are equipped with LED screens that can be utilised for advertising which generates additional revenue (for which the value can be monetised) in the form of additional capital contributions toward the cost of the design and installation.

Under ideal circumstances the landlord, could receive a modest income from the operator for each EVCP depending on the detail of the commercial agreement between operator and landlord.

It should be noted that there are currently at least 20 providers of EV charging points in the UK at the moment. Some of these are regional and others are specifically for applications not necessarily relevant to every type or location or development (e.g. Ecotricity operate a network of rapid charging stations, predominantly at motorway service stations and may not wish to engage in building, regeneration or masterplanning projects). Each of these providers also has their own unique method of charging for electricity usage, such as:

- Bespoke Smartphone apps
- RFID cards (i.e. Radio Frequency ID Cards aka “Contactless”)

Some are free to the user (e.g. Tesla chargers – but the installer/ landlord pays for electricity used).

The method of revenue charging should also be considered when selecting a provider. For instance, requiring an RFID card in advance to enable vehicle charging may put some people off due to the perceived inconvenience so it may be preferable to select an EV charging points that can be run via an app.

Summary of Technical Options

At this stage, and based on the varying options above, we might tentatively suggest the following are considered for installation across a residential or mixed-use site:

7.4kW Fast Chargers – for residential parking
22kW Fast Chargers – for public use on-street charging

Managing Demand

On the face of it, and depending on the size of the development (in terms of allocated parking spaces), EV charging – especially with the likely advent of new Building Regulations mandating the use of 'smart' fast-chargers on every new dwelling – will add a significant electrical demand to the overall development demand. Currently a standard residential dwelling is estimated to use an average peak demand of approximately 2kW). Adding a 7.4kW fast charger will therefore increase peak demand by >400%, which would clearly have a very significant effect on local LV network design, numbers and locations of distribution substations, and the quantum and capital cost of off-site network reinforcement. However there are certain opportunities to mitigate some of these effects (i.e. to reduce peak demand):

1. UK Power Networks (and other DNO) levels of network diversity. The table below is taken from a slide at a recent UKPN event detailing the levels of diversity they are currently prepared to allow for EV charging points. It is important to note that this is based on each charging point being separately connected to the LV network via an individual revenue meter.

2. Grouping multiple EV charging points through a metered single point of connection. In the case of medium density developments it is assumed that many, if not all, will have communal parking areas (perhaps with allocated bays). It is possible to connect multiple EV charging points up to an array of chargers and feed from a single point of connection to the LV network. Load management software and hardware managing this array (provided by the charge point supplier) can then regulate the output of each individual charge point to ensure the total output across all the connected EV charging points does not exceed the overall capacity of the LV connection. Depending on the capacity allocated to the LV connection, and the number of EV charging points installed, it could be that the first few people connecting, can take the full capacity of a given charge point, but as more EVs connect, the power delivered is lowered and 'averaged' out over all connected users to ensure that the overall capacity of the single LV connection is not exceeded (i.e. it will take longer to charge each EV when multiple vehicles are charging simultaneously).

Furthermore, on street EV charging points could also be connected in groups of 2, via a single LV point of connection, with the overall combined demand of the two EV charging points regulated by software as previously described. This is a similar concept to how bandwidth and download speeds on a broadband network can be restricted at peak times.

Number of EVCPs connecting to the network	Slow (<6.6kW)	Fast (>6.6kW, <22kW)
1 to 14	0.5	0.5
15-19	0.5	0.47
20-29	0.5	0.41
30-39	0.5	0.33
40-49	0.48	0.33
50-69	0.46	0.30
70-99	0.42	0.28
100-139	0.4	0.25
140-274	0.35	0.22
>274	0.31	0.22

Procurement and Governance Recommendations and Next Steps

We recommend that stakeholders review the content of this Briefing Paper and if required, HM and specifically Hilson Moran's dedicated Infrastructure Services team, can discuss what options would best suit an individual development. There will be different solutions for different types/parts of a development. Once this is completed we can better determine likely electrical loads and consult with the local electricity network operator to understand specifically design and cost implications/risks.

Detailed Background Information – FURTHER READING

For further information, we would recommend the following websites/documents:

Zap Map - https://www.zap-map.com/charge-points/

Pod Point - https://pod-point.com/

Polar - https://polar-network.com/

Chargemaster - https://bpchargemaster.com/

Ensto - https://www.ensto.com/products/electric-vehicle-charging/

Ecotricity - https://www.ecotricity.co.uk/for-the-road/our-electric-highway
City EV - https://cityev.net/

HM Government; The Road to Zero - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

Please contact Jason Horner or Steve Ormrod in Hilson Moran's specialist Infrastructure Services group for more information.

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EV CHARGER