Electric Vehicle Charging Points for Freight Vehicles in Central London

Prepared for

Central London FQP

Report on CLFQP Strategy

by

Transport & Travel Research Ltd

In partnership with

TRL

and

Zero Carbon Futures
Innovative Transport Solutions

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EXECUTIVE SUMMARY

The study was commissioned to provide advice for the seven Central London Boroughs on whether, and if so how, they can help with the development of electric vehicle charging for freight transport, with a particular focus on charging point infrastructure.

Whilst charging point (CP) infrastructure is a vital component of running electric vehicles (EV) this study identified very little or no demand at present from current commercial EV users for public/shared charging points located away from their depot. In the two Central London Borough locations where appropriate infrastructure has been installed there is very low demand from commercial vehicle operators. There are circumstances, such as the expected growth in electric van take up, which may stimulate future demand, but no evidence of demand for public charging infrastructure was found by this study at the present time.

This study has highlighted that existing EV CP infrastructure in the Central London Boroughs is suitable for the early models of EV passenger cars but is not compatible with the majority of electric vehicles suitable for freight, servicing and delivery duties. It would need upgrading or replacing to the currently preferred standards for vehicle connection. The study recommends not locating future EV CP infrastructure in off-street car parks if it intended to be accessible by commercial EV users, and that parking/loading bays near desired destinations as more useful locations away from base.

In future, EV passenger cars and vans are likely to use the same charging point standards. However, vans will always have larger batteries and be constrained by operational timescales therefore their requirements for on-street infrastructure will always be for higher powered, faster charging. Given that such infrastructure is costly it is not recommended that an EVCP for freight vehicles strategy should include installation of significant levels of such infrastructure on street at this point.

The recommendation from this study is that CLFQP should work closely together with local business and commercial fleet operators to:

- Provide financial, technical and incentive support for installing 7kW EVCP on business' premises, which can more closely mirror demand for EV. Ideally this would be under some kind of shared access arrangements, where this is practicable.

A further strategy option could be adopted by London Boroughs if they wish to be involved in providing on-street/public charging infrastructure for electric freight vehicles:

- Fast charging (at least 22kW), on-street charging points ideally sited in dedicated loading bays, at specific locations with a clear demand.

These options may be relevant to meeting the London Plan (Greater London Authority, 2011) targets for EVCP provision in London up to 2020-2025.

Other options for incentivising take up of electric vehicles by local business and commercial fleets should also be considered. Investigating these options or their effectiveness was not part of this study but could include on the supply side: reduced (or abolished) parking fees for EVs; longer dwelling times; and priority delivery windows; and on the demand side: the use of procurement to incentivise EV specification for a contract; and grants to support vehicle purchase or CP installation.

1. INTRODUCTION

1.1 Background

This report has been prepared by Transport & Travel Research Ltd (TTR), working with Transport Research Laboratory (TRL) and Zero Carbon Futures (ZCF). It has been prepared on behalf of the Central London Freight Quality Partnership (CLFQP) - including the seven Central London Boroughs.

The seven Central London Boroughs are London Boroughs of Camden, Islington, City of London, Lambeth, Southwark, Westminster, and the Royal Borough of Kensington and Chelsea. Their relative locations in central London are shown in Figure 1.1 below.

Figure 1.1. Map of London including Central London Boroughs

The study brief noted an expectation of expanded Electric Freight Vehicle usage in the seven Central London Boroughs and therefore a need to establish a direction in which each Borough can take in order to help with the development of electric vehicle charging for freight transport. The seven Boroughs were therefore seeking guidance on how to develop a charging point strategy that will help industry adopt greater use of electric vehicles for freight. The study objectives were to focus on the role of Electric Vehicle Charging Points (EVCP), including identifying where the current charging points are within the seven Boroughs, their type of connector, charging mode and rate of charge, and where any future locations should be developed. The study objectives also included identification of the main barriers to the introduction of additional EVCP or their usage. Among the considerations about how best to implement EVCP for Electric Freight Vehicles was the wish to also understand if there was sufficient demand (now and in the future) to justify separate EVCP for freight vehicles.

As context, there are currently a relatively small number of EV in use in commercial applications, but there is a strong wish from local and central government for a greater use of these vehicles to reduce the impact of road transport on the local and global environment. It is acknowledged that there are other technology options for reducing environmental impact of road transport, for example hybridisation or CNG powered vehicles.

TTR, working with our partners TRL and ZCF, has provided advice to the seven Boroughs on what basis they might develop a strategy to help industry adopt greater use of electric vehicles for freight, focussed on charging point infrastructure. As part of the study we were able assess the degree of current demand for charging points from operators of Electric Freight Vehicles. This has influenced the recommendations on what actions might be appropriate at this time. This report represents the main formal deliverable from the study.

1.2 Overview of study

To understand the elements of what might be an effective strategy it was important to investigate three inter-related topics, in order to recommend whether Boroughs can influence uptake and develop a suitable strategy based on Charging Point provision. These were:

- Freight vehicle operational practices (including use of Charging Points);
- Vehicle design and charging requirements; and
- Recharging infrastructure technology and its applicable variations.

It was decided to broaden the study scope somewhat, so that wherever feasible it includes *freight, delivery, collection and servicing* (rather than just freight). With this in mind it was appropriate to consider vans as well as small trucks requiring a heavy goods vehicle (HGV) license to operate. The cut-off for larger vehicles was set at 12.5 tonne gvw as this is the current and anticipated future limit for the majority of electric commercial vehicles. The types of organisation relevant to the study include businesses that operate large fleets of vehicles *and* sole traders or small businesses with only one or two vehicles. The focus of the study is therefore on the demand and requirements of users of commercial electric vehicles (i.e. vans and HGV) for charging point infrastructure, and how this contrasts with the way in which EVCP infrastructure has been planned to date for the anticipated requirements of drivers of electric passenger cars.

1.3 Contents of this report

Following this introduction, this report contains the following sections:

Section 2 sets out a summary of the current situation, beginning with a summary of the interviews carried out with operators of Electric Freight Vehicles in Greater London and a survey of local business in Central London. Next, it presents the key results from a review of electric vehicles on the market that are suitable for commercial operators (small vans, large vans and small trucks). Finally, a comprehensive review was carried out of EVCP infrastructure in Central London which includes the policy context, current EVCP locations/types, the relevance of existing CP infrastructure to commercial EV operators and finally barriers to their use.

Section 3 sets out guidance on the current and future requirements for EV charging relevant to a strategy of supporting commercial users of EVs. This is based on three sub-sections: vehicle requirements; infrastructure options; and what are appropriate vehicle and infrastructure combinations.

Section 4 contains guidance on what options exist to form an outline strategy and action plan, should Central London Boroughs wish to engage in charging point infrastructure provision. It is based on activities arranged in the short, medium and longer term, and contains advice on number and location of EVCP that each option would provide. The content can provide a framework for the Central London Boroughs if they wish to take a common approach to encouraging EVCP suitable for electric commercial vehicles with the aim of stimulating their greater use.

Section 5 provides a summary of the conclusions and recommendations from the study report.

Finally, two Annexes contain the results of the key background reviews undertaken earlier in the study on: currently available EVs suitable for commercial use; and existing and planned EVCP infrastructure (by location and type). A third and final Annex contains information in response to specific questions set out in the study brief;

2. SUMMARY OF CURRENT SITUATION

2.1 Electric Vehicles for commercial use

2.1.1 Background

Electric Vehicles (EVs) are currently being used by a range of logistics, delivery (parcels) and servicing companies in London and elsewhere. Companies using EV in London for commercial use are actively promoted via the Electric Ten and other initiatives[1].

However, EV numbers are currently small compared to standard diesel fuelled Internal Combustion Engine (ICE) based vehicles. There are a number of factors that constrain demand for EV that includes higher initial vehicle purchase cost, reduced payloads, smaller vehicle range (distance between charges) and lower vehicle availability (models by manufacturer). This means that only a proportion of the full range of required vehicle duties are appropriate for conduct by EV in a cost effective manner.

Within this context one of the key aims of this study was to focus on additional barriers that exist to, and opportunities for, the introduction of Charging Points suitable for commercial vehicles and their subsequent usage.

There were two levels of vehicle operator input to the study. Firstly, in-depth interviews were carried out with operators of commercial Electric Vehicles about their current experience and interest in charging point infrastructure. Secondly, a survey was designed and promoted for completion by businesses located in the Central London Boroughs.

2.1.2 In-depth interviews with operators of commercial EV

Ten interviews and structured written feedback were obtained from operators with EVs of various commercial types, the majority with experience of operating EVs in London (as well as elsewhere) and one solely in Newcastle.

There was a spread of vehicles into three basic types that were interviewed for the report:

- Small trucks / large vans (7.5 – 12 tonne gvw) provided by Smith Electric vehicles (e.g. Newton) and Modec;
- Medium sized vans (up to 3.5 tonne gvw), such as the Smith Edison, the Bluebird QEV and Transit 350 e-connect van; and
- Small vans (probably up to 1.3 t gvw), which in this case was the Aixam Mega (which is classed as a quadra-cycle).

[1] http://legacy.london.gov.uk/electricvehicles/commercial/mayor-fleet/

The Smith Newton accounted for the largest number of vehicles by one type/model. The interviews were with a mixture of commercial organisations (both small and very large companies) and one local authority. The commercial organisations included major parcel delivery companies, in-house fleets from major retailers of food/print/clothing, major logistics providers to retailers and an SME delivery company.

All interviewee organisations had depot facilities in which to store their vehicles and had installed relevant charging infrastructure to match their EV requirements. The majority were positive about their experience of EVs and their application to specific duties and delivery / servicing routes. There were some negative experiences: some vehicles had proved less reliable than expected; some required improvements over their early life; or the supplier of that vehicle had gone out of business.

Overall, operators were interested to expand their EV fleets over time, and they anticipated performance improvement and/or cost reductions would gradually make EV cost-effective for larger sections of their fleets and duties.

There was evidence of a strong inclination to deploy EV in London compared to other areas. This was evidenced by two operators having more EV in their London fleet than for other cities, including an example of an EV being moved from another city to London because the payback was better. The congestion charge in London was citied as a contributory factor. A more general factor was diesel fuel costs. For example, one operator stated that when they first purchased their EV 3 to 4 years ago the payback over the diesel equivalent was expected to be 7 years, but with diesel fuel price rises this was now down to 4 years. This operator expected to keep their fleet of EV for 10 years (much longer than standard diesel vehicles) partly due to the investment costs but also on the expectation that the vehicle will be more durable overall (due to extensive use of plastics/polycarbonates and the lower number of moving parts).

From the in-depth interviews it was found that vehicles, current and proposed, are universally selected for their range to be compatible with existing and proposed duties or delivery routes. Recharging EV out of depot does not make cost effective use of driver time and there are concerns about security of cargo and vehicle. One survey participant pointed out that most current on-street ‘slow’ charging points are not suitable for Smith Edison vans, not only because of their low power output but also because the charging points use standard 3-pin plugs (equivalent to UK domestic set-ups).

It was hoped to include a number of companies that used EV for servicing (e.g. carrying a site engineer) in case the usage profile varied considerably and there was a greater need for on-street charging. This was not possible from those agreeing to be interviewed or responding to in-depth questions with feedback. The local authority organisation and those EV operated by TfL contractors are deployed for maintenance so probably come closest to the definition of servicing within the sample. It is known that the daily range of the vehicles is sufficient for the duties required, so on-street (or any form of charging away from depot) is not considered necessary for these vehicles in their current roles.

2.1.3 Survey of local businesses

A subsequent set of surveys took place with local businesses located in central London. The survey was administered on-line and invitations to participate were sent out by three Central London Boroughs initially, with a subsequent round of invitations sent to the Federation of Small Businesses via inclusion of a news item in a regular newsletter. The survey aimed to gather views on EV and attitudes to charging point provision amongst other aspects of EV use. This was a sample of general businesses and not targeted at EV users.

A total of 15 responses were obtained from Borough contacts and 22 responses via the FSB invitation to complete the survey, giving a sample of 37 in total. The response rate is not known as the exact mailing list size was not conveyed to the study team, but it is likely to be low (i.e. under 5%, and possibly as low as 1%). This is not necessarily a problem for understanding respondents views as confidence limits are calculated from the size of the sample rather than the response rate from the total population. In addition, the low response rate should not be taken as a sign that businesses are not interested in EV as there are many other reasons why invitations to complete a survey are not taken up. The sample size is therefore not a reliable indicator of demand for EV charging, rather the responses contained within it are the indicator. The sample was not anticipated to include many or any current EV users. In fact, 1 of the 37 responses was from a participant who had owned or used an EV car.

The survey was designed to understand levels of interest in EV and views on the role of charging points. The results were that around 12% of the local business participants responded positively to the question of whether they would consider owning or using an EV in the future as their main vehicle with 20% responding fairly or very likely to the separate question of whether they would consider an EV as a second vehicle.

When asked to consider the scenario of using an electric vehicle for their business and asked where would be the most attractive location to charge it the most commonly selected locations were at their businesses premises and on-street parking bays (joint favourites). The FSB sample also included a large number of responses for charging at their home (while the Borough contacts had none). Charging in public car parks was not selected by any respondent as a preferred place to charge an EV.

In summary, the sample of local businesses respondents were almost all (bar 1) people who had no direct experience of using EV, which is a very different level of experience to the in-depth interviewees. There were a range of concerns and benefits perceived as being attached to EV use, which can be explored via the source data (supplied to the Boroughs). These seem broadly in line with current views of the general population (e.g. cost of vehicles, range, environmental benefits). Specifically on the level of demand for EV there was some positive interest registered about using EV from a reasonable proportion of respondents either as their main or second vehicle. The results also indicate where the preferred charging location for these vehicle would be, based on the current level of experience.

2.1.4 FTA survey of members

As context to the study the following FTA survey results are included, which quantify the extent of perceptions about a wide range of relevant aspects of EV purchase and operation.

In a survey by FTA of its members undertaken in March 2012 which received 176 responses, already 11.9 per cent are utilising electric vehicles. However, just over 40 per cent are not even considering introducing them to their fleets. To use or consider electric vehicles, 66.7 per cent of respondents would require reduced vehicle costs, 71.9 per cent would want to benefit from operational cost savings, 55 per cent would use electric vehicles for environmental reasons and 22.2 per cent would use electric vehicles due to contractual requirements.

The survey found that 70.3 per cent of respondents said that range issues were a major operating problem. Some operators are also dissuaded from utilising electric vehicles due to the limited capacity (an electric vehicle will typically have a kerbside weight some 500kg higher than its non-electric counterpart). There are also concerns regarding residual values with electric vehicles at the end of their warranty periods due to the high cost of battery replacements.

Source: FTA

2.2 Electric commercial vehicle design and availability

2.2.1 Review of available vehicles

The study has produced a summary of currently available and soon to be released EV (including a review of Plug-in Hybrid EV) commercial vehicles of all size and payload classes. It should be noted that the list deliberately does not include prototypes and planned vehicle models, for which very little public information is available. Vehicles indicated to be available from 2011 are in some cases only available in small volumes, however all vehicles included in the review are in production. The results of the review are presented in Annex A of this report.

The key points from the review are:

- A large variety of payload carrying ability is available, ranging from 350kg to 7,558kg.
- The majority of available electric vans are between 1.3 and 3.5t GVW, with only 2 available with GVW of 1.3t or less.
- However, payloads vary considerably. As an example 5 different vehicles are available that have a payload capacity under 600kg (i.e. same as small 'vans').
- Costs range considerably from around £17,000 for smaller vehicles with battery leasing available, to £90,000 for larger vehicles with no battery leasing option (2011/12 costs)
- In comparison, typical costs for standard diesel vehicles are approximately as follows: small van £11,400; medium van £19,775, large van £28,150, small

truck (3.5 – 7.5 t) £21,800; medium truck (7.5 – 12.5 t) £38,500 (2011/12 costs).
- For EV a typical range is between 60 and 100 miles depending on battery (sometimes battery choice is available to increase range for an added cost).
- A typical top speed is between 50 and 60 mph.

The key market development is the availability in 2012 of more van sized vehicles that bring new opportunities for take up by fleet operators and opens up the possibility of more sole-traders and small business purchasing EVs. This expansion in vehicle design and availability comes at the same time as Government has extended the EV grant to subsidise some of the additional upfront costs of van sized EVs. The development of electric van models and potential market is detailed further in section 2.2.2, below..

2.2.2 Development of electric vans

A range of electric vans has been available to buy in the UK for some years. However, until recently, most available electric vans were electric conversions of ICE models. In contrast, from 2011/12 a number of new electric van models have become available from major OEMs, such as Renault and Mercedes-Benz, as well as smaller OEMs, such as Mia. These are expected to be much more useable than previous models and a number qualify for Government Plugged in Van Grant.

The cost, size and performance of available electric vans to date has varied considerably, mostly due to the majority of models (until recently) being conversions, manufactured in low volumes or versions of vehicles made available for trials. Generally, the majority of available electric vans are between 1.3t and 3.5t gvw, with only 2 vans available with gross vehicle weight of 1.3t or less. Range is typically between 60 and 100 miles (often with different battery configurations possible) with top speeds between 50 and 60mph.

Costs of electric vans vary considerably from around £17,000 for smaller vehicles with battery leasing available, to £90,000 for larger vehicles (effectively small trucks) with no battery leasing option. No Plug-in Hybrid EV or Range Extended EV vans are currently available and it is uncertain when the first models may enter the market. It is unlikely that this will happen prior to 2013.

Cost of EV vans is currently seen as a major barrier to adoption by fleets, with the majority of fleet operators unwilling to purchase electric vans unless cost of ownership can be within 10% of the ownership costs of diesel vans (Element Energy, 2012). The recently announced Plugged in Van grant will help to reduce the initial purchase cost but it is still unlikely to be within 10% of the cost of diesel van ownership. In contrast, the interviews undertaken in this study reported that operators puchasing small EV trucks (in the 7.5 to 12 tonne gvw range) had seen payback duration on additional investment costs drop from an initial 7 years, when the vehicles were first purchased some 3.5 years ago, to just 4-5 years as the price of diesel rose for use in comparable diesel technology vehicles. In addition, use of battery leasing models, such as the one adopted by Renault for their Kangoo Z.E. range, bring the cost of electric van ownership almost on par with diesel vans. It is possible that if more OEMs adopt such models then take up of electric vans can be accelerated.

It is likely that the market for electric vans, if it develops, will include an increasing number of smaller businesses based in and around London. These are companies not providing transport services primarily or seen to be fleet operators, but rather using one or more vehicles to service the primary aims of their business. This has been the subject of a survey as part of this study, and referred to in Section 2.1.

Annex A contains the summary tables of currently available and known EV models.

2.3 Electric Vehicle charging points - policy and provision

2.3.1 Policy context and targets for charging point provision in London

There are several publications and reports, from TfL and the Mayor of London, which describe various targets for the provision and deployment of EV charging infrastructure in London. Two of the most recent publications appear to cover the latest guidance and targets: The London Plan (Greater London Authority, 2011) and Guidance for implementation of electric vehicle charging infrastructure (TfL, 2010).

Guidance for implementation of electric vehicle charging infrastructure (TfL, 2010) describes the following targets for Greater London EVCP network:

- 25,000 charging points by 2015, composed of:
  - 500 on-street;
  - 2,000 off-street; and
  - 22,500 in employers' car parks.

London's Electric Vehicle Infrastructure Strategy (Greater London Authority, 2009) provided a further separation of the target by region's in London. Relevant to this strategy are targets for Central London were as follows:

- 190 on-street (currently: 72)
- 400 off-street (currently: 221)
- 2,600 at workplace (currently: unknown).

The target numbers may have been reduced since the publication of these documents as the publicly available Infrastructure Strategy document is a draft for consultation. We understand from a study stakeholder that current Source London charge points number some 714 (as of August 2012) and that a revised interim target is to have 1300 points installed in London by March 2013.

There do not seem to be any implications for not meeting the stated targets so their importance in encouraging Boroughs to install EVCP should not be overestimated. The targets were part of the Mayoral pledge and are therefore not intended to be followed absolutely. Furthermore, these were set in 2009, before most current EVs were on the market, so their take up and the requirement for EVCP was unknown. It is unlikely that these targets remain relevant in the context of quite low general demand for EVs.

The influence of target setting is, however, further complicated by new targets which have been set by the London Mayor as part of the London Plan for including EVCP in all new buildings. These targets will be expected to be met in order to get planning permission. The London Plan (Greater London Authority, 2011) sets out ambition and provides further targets for EVCP provision in London up to 2020-2025. Targets are described in terms of percentages of all parking spaces that must be equipped with EVCP for different property types. No distinction is made between EVCP required for passenger vehicles and for vans. The London Plan targets are:

- Retail parking: 10% of all spaces must be for electric vehicles with additional 10% passive provision for EVs in the future.
- Employment: 20% of all spaces must be for electric vehicles with additional 10% passive provision for EVs in the future.
- Residential: 20% of all spaces must be for electric vehicles with an additional 20% passive provision for electric vehicles in the future.

It should be noted that targets and recommendations within all of the above documents do not differentiate between charging infrastructure for passenger EVs and charging infrastructure for electric commercial vehicles. However, the focus appears to be firmly on passenger EVs and as a result, recommendations for the number and type of charging infrastructure do not appear to be well developed for electric commercial vehicles. As previously noted, space requirements for electric vans and required power output from charging infrastructure is higher for electric vans than for passenger cars.

Targets for Central London include government co-funded EVCP, through the Plugged-in Places programme, and privately funded EVCP. One of the biggest examples of privately funded EVCP networks is Chargemaster's POLAR network. It is expected that as part of the scheme 4,000 charging points will be installed across the UK by end of 2012. It is not known how many of these charging points will be in Central London and how many in outer areas, but privately funded EVCP has the potential to significantly change the level of provision.

2.3.2 Current and planned charging point numbers and locations

A review was undertaken of existing and planned EV charging infrastructure in the seven Central London boroughs. The review primarily relied on information supplied by individual boroughs and supplemented by publicly available information from websites providing maps of existing charging infrastructure in London[2]:

A summary of the results is presented in tables 2.1 and 2.2, with greater detail to be found in the accompanying Tables in Annex B.

The definitions of CPs used in the study are as follows:

- [2] NewRide London (http://www.newride.org.uk/recharge.php) and Source London (https://www.sourcelondon.net/map). 'Smart' charging infrastructure in NewRide data is assumed to mean fast chargers with either a Mode 3 Type 2 or Type 3 connector.

- Slow charge: 3 pin plug, 3kw max (also used as 'Household').
- Fast charge: Mode 3, type 2 or 3 connector (IEC 61296-2), between 7 and 21 kW (1 to 3 phase).
- Dual: using either a standard 3-pin plug connector (3kw) or the blue commando connector (3 kW typical, but can be up to 11kW in theory [with more phases]).
- Rapid/quick: DC voltage.

It should be noted that various sources of data are available and a full reconciliation could not be made between them all. However, Borough confirmed figures for on-street Charging Point infrastructure locations were as follows:

- Camden - 27 on street charge points plus 2 electric car club points
- Southwark - 10 on street
- Lambeth - 3 on street
- Islington - 6 on street plus 1 electric car club point
- City of Westminster - 33 on street point
- Kensington & Chelsea - 0 on street
- City of London - 0 on street

As noted a review was also conducted by the study team of all available information sources, and Tables 2.1 and 2.2 present this, which are linked to specific locations in the detailed tables presented in Annex B.

Table 2.1: Summary of existing CP infrastructure

Borough	Infrastructure Type								Total
	Car Park		On-street			Unknown			
	Fast	Slow	Dual	Fast	Slow	Dual	Fast	Slow	
Camden	20	17		1	19			6	63
City of London		59							59
Islington		6			5				11
Kensington and Chelsea		18							18
Lambeth		2						3	5
Southwark	2	8		5	5				20
Westminster		89	1		26	2	2		120
Grand Total	22	199	1	6	55	2	2	9	296

Table 2.2: Summary of planned CP infrastructure[3]

Borough	Infrastructure Type					Total
	Car park	On street		Unknown		
	Dual	Dual	Unknown	Dual[4]	Slow	
Camden						
City of London	29					29
Kensington and Chelsea		2				2
Southwark		2				2
Westminster				18		18
Grand Total	29	2	3	18		51

The study team review of existing CP infrastructure and Borough information resulted in records for 296 of EVCPs in Central London (where 1 location may have multiple charge points).

The majority of the charging infrastructure is installed to match the charging requirements of passenger EVs. It is low power output (slow charger) mostly of 3kW, with some 7kW chargers being installed. The majority (around 260) use Type 1 connectors, and around 30 use Type 2 connectors. Such infrastructure is sufficient to provide charging for passenger EV batteries over prolonged time, e.g. night time or all day, but are not be sufficient to provide an adequate level of top-up charge to a larger-sized battery over the relatively short period of time that a commercial vehicle is likely to stop or be parked while in daily use.

The vast majority of existing EVCP points are slow (3kW) and are in public car parks (often multi-storey or underground). All but two of the on-street EVCPs are in car-sized parking bays.

Public car parks are locations not used for stopping or parking by vans. In London such public charging infrastructure does not come with free parking and it seems unlikely that a freight operator would want to reduce margins further by having to pay parking charges whilst charging their vehicle. In addition, most vans and freight vehicles would not be able to use EVCP in car parks, either because of access restrictions, or because it would mean reducing the time that the vehicle can spend on deliveries.

Most EVCP, either on-street or in car parks, are installed in car-sized parking bays. *If* these are at the upper range of parking bay size they could accommodate many of the small and medium sized commercial EV models available. If the bays are at the lower end of the size range they may not accommodate transit sized (3.5t) vehicles and above, so only smaller vans may be able to use. A comparison of EV exterior dimensions with two common sizes of London parking bay was done as part of the EV review, contained in Annex 1 of this report.

[3] Information included in this table summarises estimates provided by Boroughs who have responded to the request for information.
[4] In this case, dual chargers could be either slow/slow or slow/fast. For the purpose if this assessment, based on the information available to TRL, an assumption is made that dual chargers are slow/fast.

2.3.3 Relevance of existing charging points to commercial EV operators

The summary of key findings for existing charging points is that:

- The vast majority of charging points currently installed are slow charge (13A, around 3kW power output, and therefore Type 1 connectors) and these are not suitable for charging larger capacity batteries used by commercial EV over an acceptable duration when these vehicles are away from depot.
- The vast majority of charging points are in public car parks (often multi-storey or underground) and are therefore not well suited for access by freight and delivery vehicles.
- On-street and car-park located CPs are in car-sized parking bays so the largest EV in common use at present will not fit.
- Many medium sized and smaller EV do, however, fit inside the larger standard parking bays, so on-street charging should not prevent access because of vehicle size for these EVs. A greater number of smaller EV are coming onto the market in 2012 (of smaller van size). However, the prevalence of low power CPs will still result in an insufficient charge if the vehicle can only be parked for a relatively short duration.
- Camden and Westminster have installed three phase (fast) charge points for larger vehicles, which provide a quicker charge if the mode of connector matches the vehicle requirements, but the demand/use of these has been low. This is thought to be because the sector of the EV market that can use these CP are in the early stages of development (with a few models in service in London or elsewhere) and secondly that the relatively small number of commercial vehicle fleet operators with EVs working in Central London have specified and planned duties around return to base charging.

Information regarding location or type of future EV charging infrastructure is largely not available because plans are not yet finalised, but from what is known:

- Camden have no plans to install further street charging points in 2012/2013 after going live with Source London installations in April 2012[5].
- City of London have no confirmed plans to install additional EV charging infrastructure, however, there are plans to modernise existing infrastructure.
- Westminster have planned to install an unspecified number of EV charging points over the next 3 years, the majority of which are likely to be on-street.

2.3.4 Current barriers to EVCP use in London by commercial EV fleets

Vehicle manufacturers are producing the same types of vehicle in EV format as for vehicles produced to use diesel fuel. The customers want to operate them as they do

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[5] http://www.camden.gov.uk/ccm/content/transport-and-streets/parking/where-to-park/-parking-electric-vehicles-in-camden.en

conventional, diesel vehicles, and there is an desire to not change current operating practices too much.

Despite customer wishes there is a range of barriers to using existing charging point infrastructure for EV in commercial operations due to vehicle dimensions, their duties and operating environment plus the specification or location of charging point infrastructure. This section of the report does not list the known barriers of cost, availability or range of vehicles, but rather focuses on how vehicle design and driver requirements interact with current and potential charging point infrastructure and other aspects of the vehicle operating environment.

Table 2.3: Current barriers to EVCP use in London by commercial users of EV

Vehicle / driver environment	CP Infrastructure/ Operating environment
Batteries and charging	
Vehicles have battery capacities roughly in the ranges of 24/40/80 and 120kWh. It is likely that most commercial EV using on street charging infrastructure have very limited time in which to use it, mostly limited by the need to minimise idle time and by limited parking duration allowed for kerbside loading in London. As a result maximum charging time for on street charging may be as low as 20-40 minutes.	Current street side charging point (CP) hardware is almost exclusively 3kW or dual posts with 3kW and 7kW. The 3kW posts are of little use even with a 24kWh vehicle as a half charge is circa 4 hrs. The 7kW will deliver a half charge to a 24kWh battery in circa 2hrs, which is still a barrier to 'opportunistic' charging. The 7kW CP is of limited or no use once the battery is over 24kWh (as is the case with larger EV) because only a very small proportion of the battery could be charged with the timeframe of the vehicle being parked.
Driver scheduling and behaviour	
Professional drivers of commercial vehicles typically have to follow a demanding schedule and try to complete all deliveries as efficiently as possible. This includes having to stop / park in locations most convenient to the delivery / pick up location.	The majority of current EV charging infrastructure in central London is placed in car parks (220 out of 291 identified locations). These are not possible for drivers of larger commercial EV to access (height/weight restrictions) or not convenient as they are not near to the desired delivery/pickup location.
Professional drivers of commercial vehicles may not be willing to spend extra time looking for an appropriate parking space where they could also charge their EV. Drivers may look unfavourably at having to spend extra time plugging and unplugging their ECV	The more limited on-street charging infrastructure in London is not often placed in locations that would be suitable for freight vehicles, which would be better suited by charging at loading bays that are especially located in close proximity to major delivery sites (if this is an option, given high demand for

while making deliveries. Sole traders and small businesses (using a vehicle as own transport) tend to have lower utilisation rates of their vehicles and will have more flexibility over parking locations. There behaviour and preferences will be closer to a private car driver.	limited loading bays in many Boroughs). Car park and on-street bay locations may, in contrast, suit sole-traders/tradesman and small businesses using commercial vehicles to move staff and products around Central London if they do not have on-premise parking.
Connectors	
All vehicles are anticipated to be produced in the future with type 2 connectors, but various configurations currently exist.	Many posts in London have blue ‘Commando’ connectors[6] which are not suitable for fleet passenger cars or latest commercial EVs. However, all 3/7 kW charging posts will ultimately move to type 2 connectors (as per Source London decision (OLEV, 2011)), which will match the type 2 connectors likely to become more dominant in the future. Quick or Rapid charging (50kW DC) has a bespoke connector. Not all EV currently on the market, or about to enter the market, can utilise this mode of charging.
Access by vehicle to CP	
Commercial EV are able to access most on-street locations in London but drivers will not want to park or access multi story car parks.	Within London the main population of charging posts are currently in car parks and specifically in multi-story car parks, which rules out many commercial vehicles except the smallest EV van (e.g. Kangoo type). Open car parks can also have entrance width and height restrictions, as well as very limited manoeuvring space. Access by vehicles to on-street parking bays can be a barrier if the EV is larger than a standard bay. This tends to mean largest vans up to 3.5 tonnes gvw and small trucks.
Electricity supply	

[6] Defined as ‘Dual’: using either a standard 3-pin plug connector (3kw) or the blue commando connector. The blue commando connect is typically still 3 kW typical (i.e. Slow) but can be up to 11kw in theory (with more phases).

The fundamental requirement for EV charging is that the equipment rating and charging times should reflect the time constraints and other requirements of the customer. This may mean higher capacity charging equipment is desirable for commercial users of EV, to fit with the needs of the vehicle operating requirements.	Actual appropriate and available electrical power supply may be some distance away from the desired parking/loading location. This will result in cable and connection charges.

Summary

The study team identified around 290 EV charging points in London as of April 2012. The vast majority of these are slow charge types, located in off-street car parks. The majority of these points are not suitable for use by commercial EV either due to location, type of connector or rate of charge. Two charging points more suitable for use by electric minibus and commercial vehicles are currently under utilised.

There are also practical and operational barriers to the use of electric vehicles in the freight, service and delivery industry. Barriers such as electric freight vehicles having long charging times, reduced range and comparatively high initial purchase cost, expensive charging infrastructure (particularly for high powered EVCP) and the lack of understand how EVs may fit into existing scheduling and driver behaviour could mean that take up of electric freight and delivery vehicles could be slower than that of electric cars.

Current users of EV for commercial duties (freight, delivery and servicing) are generally happy with their performance, however cost reductions and performance improvements seem necessary to justify shifting an increasing proportion of a fleets' duties to the EV sub-segment. There is no demand for on-street charging from these existing users with their current EV operations.

The ongoing development of the electric van market may lead to an expanded demand for charging points from businesses located in Central London, but this has yet to take place to the extent that there is firm evidence.

3. COMMERCIAL VEHICLE USERS REQUIREMENTS

3.1 Introduction

There are several important considerations when choosing what electric vehicle charging equipment to install. It could be argued that it is more important for these factors to be considered in a freight environment as the commercial output and success of any such installations or supporting schemes will no doubt be directly related to the amount of usage the infrastructure attracts. Therefore ensuring the charging equipment is of the correct technical specification, sited in the most advantageous position and that relevant users are made fully aware of the existence and availability of such equipment, is paramount to successfully implementing a freight supporting charging infrastructure.

There are three major aspects to be considered in establishing a strategy for freight electric vehicle charging points:

a) What are the current and likely future vehicle requirements?
b) What charging point infrastructure options are currently available, what do vehicles use now and what is required in the future?
c) How do the vehicle requirements and charging point options combine in practical terms (for example range and duration of effective charge)?

There are also other considerations that will influence the way in which a strategy is developed, and by whom. One of these is how much does the infrastructure cost, and another is at what point is it expected to be fully utilised?

Each of these aspects is addressed in section 3.2 to 3.4 below, with costs of a sample of EVCP designs included in section 3.3.

3.2 Vehicle requirements

The key questions that need consideration when designing an electric vehicle charging infrastructure are:

- What are the typical usage profiles of the vehicles that are being served (or for which we wish to encourage take-up)?
- How do these requirements vary by types of user?

3.2.1 Typical requirements of electric vehicle use

A common starting point is to identify the maximum amount of range required for each use cycle, which equals the distance of travel required between charges. This will dictate what battery capacity is required to fit into the vehicle.

The larger the battery capacity, the longer it will take to charge for any given input charge power. Charging time is a factor of battery size and determines power requirement, for example a large battery requiring a short charging time, will require large power input.

The electric vehicle's charging behaviour is also governed by any on board charger technology that interfaces with the charging point. The capacity and type of this on board charger dictates the type of charging solution required. A small on board charger requires more time to charge any given battery than a larger on board charger.

It is also important to consider the duty characteristics for the vehicle as these will affect power usage, and therefore likely range. Long journeys at constant high speed (e.g. motorway driving) require a low proportion of braking and therefore provide minimal regenerative charge back into the battery. Short and interrupted journeys optimise regenerative capability. Duties in London are typically short and interrupted due to nature of the road network and levels of congestion, and this has been one factor reported by participants in the study interviews that makes using commercial EV in London more attractive.

The required percentage of payload usage plus the sequence of payload delivery will also affect range. The commercial users of EV interviewed during this study are exhausting their payload before using all available power in the vehicle batteries, so the natural action is to return to base to reload and meanwhile recharge the vehicle.

The confidence of being able to complete the assigned duties and of being able to charge as planned is of prime importance to commercial vehicle operators. Loss of time clearly equates to loss of revenue.

3.2.2 Requirement of different types of commercial vehicle users

From the above experience, and the consultation exercise completed specifically for this study, it is clear that the dominant preference for current fleet operators with experience of using EV is for charging point installation at their own depots. This guarantees access and availability when they return to base to re-load their vehicles, or store overnight. However, this does require a depot location and the ability/funds to invest in fixed charging infrastructure, which will only be feasible for a proportion of commercial vehicle operators inside and into London.

In contrast, the many sole-traders and small businesses that make use of vehicles as part of their work (as well as small-scale hauliers and delivery companies) are less likely to be able to install and/or justify the cost of investment in their own charging infrastructure. For example, the on-line survey of local and small businesses pointed to on-street and at-home charging being equally desirable as charging at business premises, supporting the view that the opportunity or desire to install charging points at business premises is less for smaller companies over large ones. This is not universally the case; one in-depth interview took place with a specialist delivery company with 3 EVs in operation, their own charge point (at own premises) and a clear wish to continue that model given their duty characteristics.

Serving smaller and local businesses with EV CP might be anticipated to follow the current model for passenger car EV users (of largely car-park based charging). However, for commercial users CP locations will probably be more attractive if aligned with where commercial users of vehicles wish to park: near clusters of business premises where they store their vehicle in-between use in a working day and at loading bays at delivery and servicing destinations.

For existing fleet operators with EV there *may* also be some potential for top-up or emergency charging as more EV models become available, particularly the latest versions of van-sized vehicles that will suit more reactive duties and routes required by servicing and repair personnel.

The wish for guaranteed access to charging bays could require booking mechanisms and enforcement mechanisms.

In summary, the technical specification, location and ease of access to and use of these points needs to be aligned to the needs of those using commercial vehicles.

3.3 Infrastructure options - modes of charging and types of connector

The technical aspects of charging modes and connector types are covered in Section 3.3.1 and 3.3.2 below.

3.3.1 Modes of charging

There are 4 common modes of charging, offering varying levels of interface and control to the charging process. These are described below.

- Mode 1: EV charging with a non dedicated EV charging plug and also with no specific charging control or communications between the charge equipment and the EV. It is limited to 16A charging by compliance with BS EN 61851-1. This is <u>not</u> recommended any more as a charging option in the UK even for passenger cars and should not be used with commercial vehicles.

- Mode 2: EV charging with a non dedicated charging plug and with an integrated control & safety system in the charging cable. This system is limited to 32A by compliance with BS EN 61851-1

- Mode 3: EV charging using a dedicated EV charging plug and incorporating a control and safety system in the charging infrastructure which interfaces directly to the charging equipment in the vehicle. **This is the preferred method for AC charging for any public or commercial EV charging infrastructure.**

- Mode 4: EV charging through a DC specific EV plug incorporating a control and safety system as well as a AC / DC converter in the infrastructure.

Early infrastructure installed in London and other Plugged in Places projects is primarily Mode 1 equipment incorporating a BS1363 (or 3 pin domestic) outlet. This means it is the dominant format in infrastructure installed up to end of 2011. From Jan 2012 Plugged in Places projects, which includes Source London, have been advised to discontinue procurement of charging equipment incorporating domestic BS1363 outlets and should be targeting no further installation of this type of outlet from April 2012. The preferred specification of standard charging is to incorporate a Type 2 connector with mode 3 control which will provide higher capacity and enhanced safety features in comparison to the mode 1 and mode 2 systems.

3.3.2 Types of connector

There are 4 common types of connector which allow an electrical connection to be established from the charging post to the electric vehicle. The type of connector dictates which vehicle can be connected to what type of charging equipment and how much power can be drawn. Vehicles are generally supplied with a charging cable which will have the relevant connector to connect to the vehicle side but it should be specified or checked to ensure that the connector on the charge point side of the cable will match with the specified charge post.

- "Type 1" - single phase vehicle coupler - reflecting the SAE J1772/2009 automotive plug specifications. This is only capable of a single phase connection, but widely used on most EV's sold to date at the vehicle connection.

- "Type 2" - single and three phase vehicle coupler - reflecting the VDE-AR-E 2623-2-2 plug specifications. **This is likely be the preferred connector at the vehicle side for any 3 phase applications as it can be used up to 63A three phase.**

- "Type 3" - single and three phase vehicle coupler equipped with safety shutters - reflecting the EV Plug Alliance proposal. This is <u>not</u> adopted in the UK.

- "JEVS G105-1993" - fast charge coupler - Currently used on DC quick chargers up to 50kW DC.

Type 1 connectors are typically used in slow chargers. Based on the study team review of various information sources there were around 260 slow chargers in the area covered by the Central London Boroughs.

Type 2 and 3 connectors are typically used in fast chargers. In the UK mostly Type 2 is used for new installations and at the time of this study, there were approximately 29 fast or dual (fast/slow) chargers in the area covered by the Central London Boroughs.

Fast charge couplers are used in DC rapid chargers. At the time of writing, only two DC rapid chargers were identified in the area covered by the Central London Boroughs..

Electric vehicle technology is changing at a rapid pace and until recently there were no European standards agreed for charging post connectors. Vehicle developments have not always been in line with infrastructure choices, and this can lead to a justifiable dilemma about charging point investment. However, discussions have been taking place in the industry to agree a common standard for a charging connector. The Plugged in Places Programme has worked with the IET, the SMMT and the main UK infrastructure suppliers to ensure that the infrastructure that is purchased and installed is as far as possible aligned to the developing EV infrastructure standards across the EU. This would use what is called a Type 2 connector. This common standard will be used across countries such as Germany, Holland, Portugal and Ireland, and the UK will therefore adopt this new standard. This means that it is reasonably clear what the options are for installing EV charging infrastructure in the future, and some upgrading of existing infrastructure is taking place in Plugged in Places areas to Type 2 connector standards.

The costs of installing some relevant combinations of EVCP by mode and connector type are included in Section 3.3.3.

3.3.3 Outline costs of EVCP

An indication of equipment and installation costs is provided here to give context to the suggested options for any future Central London EVCP strategy.

Table 3.1 Typical EVCP equipment and installation costs

	Post Costs	Install Costs	Total Costs
7kW twin on-street	£3000	£3000	£6000
22kW twin on Street	£6000	£4000	£10000
DC_50kW	£15000	£15000	£30000

Costs above are based on experience of study team from similar installations in a range of locations. It should be noted that installation costs can vary massively depending upon cable runs and type of excavation required. These costs assume <10m cable trenching and the use of bespoke retention socket so civil engineering and electrical works can be done in separate visits. These are therefore likely to be the minimum installation costs.

The installation costs do not include any land costs for the site of the DC 50kW charging station. The costs provided here are for a single charging points, and we have suggested multiple charging points (4 – 6) at each of the station. Therefore the costs of a full 'station' will rise accordingly. However, there would be some economies of scale on the installation costs for multiple CPs in this case.

The installation cost guidelines assume all equipment is RFID access and floor mounted. 7kW is single and 22kW is three phase. Three phase is supplied with Type B RCD. If single outputs are required rather than twin outputs then it should be assumed 80 - 90% of twin cost. Posts can be specified as single, and upgraded to twin in due course.

3.3.2 The technical requirements for charging equipment

Key information that charge post manufacturers will require when supplying charging equipment will be:

- Power type – AC or DC;
- Power level – 3 up to 22kW, 43kW may be available in the near future;
- Number of outlets – usually single or double outlet;
- Type of outlets – will the outlets be the same connector or will they be different;
- Mounting options – generally floor or wall mounting is available and if any specific mounting base is required e.g. surface mount kit, or retention socket; and
- How much “intelligence” is required in the charging post.

Once it is understood what the charging power requirements are for the vehicle and where the charging points will be situated the next question is whether there needs to be any access limitations to the use of the charge point. If it is decided that a level of control is required to allow a charging session to be started this can be achieved by the use of a Radio Frequency Identification (RFID) system using a card of fob to start a charge session, or by simply “locking off” the power to the station to prevent unauthorised use.

The charge post owner also needs to consider what reporting systems are required for the power distributed from the post, and this will vary based on whether it is a public or 3rd party accessible CP or whether it is only used by one organisation and their EVs:

- For on-street charging then line-by-line reporting is required to show which vehicle used the post, when, and how much power was drawn. This can be incorporated into most charging posts. Reporting can be accessed via the post operating system by authorised users at their desk via the internet. It should be understood that if this system is specified, the data may be collected from the post via a machine to machine (M2M) GPRS modem which will result in some ongoing running costs for data transfer.

- For depot charging we suggest the post owner will only require power reporting capabilities as the equipment can be matched to a particular vehicles' power and connector requirements. As the overall power drawn is the only requirement a meter can be installed at the head of the supply point for the charging post and this could be manually read as and when information is required.

3.4 Appropriate Vehicle and Infrastructure Combinations

As noted, the two key aspects to consider are the duration of charging time that is required and how often the need to charge occurs:

- The required usage profile of the electric vehicle coupled with the on-board charger and battery capacity will indicate how frequently the vehicle will need to be charged.

- To minimise downtime in freight deliveries a short charge time delivering a high amount of power is crucial.

This leads to considerations of the charging power requirements and the useful duties this power capacity provides when the vehicle is ideally charged. As the battery capacity of electric commercial vehicles is generally greater than that of passenger EVs it is sensible to assume that any charging equipment that is installed should be of a higher power output than EVCP for passenger cars to minimise re charging times. This suggests circa 22kW, which requires a three phase supply.

It is currently rare to find public locations with the required spare power capacity to support fast charge times required for commercial electric vehicles. Workplaces and depots often require a new or upgraded supply to enable three-phase charging.

Table 3.2 gives indicative values of range that can be added to a passenger car or NV200/Kangoo van by charging for 30 minutes on charging infrastructure with varying power capacity. The assumptions are shown for a 24kWh battery (LEAF/Renault Kangoo / Nissan NV200) and a 50kWh battery, which may be typical of a larger commercial vehicle. For the purposes of this example it is assumed that all of these vehicles would have a 100 mile range when fully charged.

Table 3.2 Combination of EV CP power and battery pack capacity: distance travelled and time to full-charge.

				30 min charge - distance travelled (miles)		**Full charge - time required (hours)**	
				EV battery capacity		EV battery capacity	
Amps	Mode	AC kW	Phase	24kWh	50kWh	24kWh	50kWh
10A	2	2.3 kW	single	5	2	10.4	21.7
16A	2/3	3.7 kW	single	8	4	6.5	13.5
32A	2/3	7 kW	single	15	7	3.4	7.1
16A	2/3	11 kW	3 phase	23	11	2.2	4.5
32A	2/3	22 kW	3 phase	46	22	1.1	2.3
70A	4	50kW	DC	80	40	0.5*	1*

Notes: * DC charging point time is for 80% charge, then charging slows to cool battery pack.

From Table 3.2 it can be seen that a commercial EV user or freight operator wishing to make use of EVCP either has to:

- Continue to charge for a significant length of time over a number of hours, ideally overnight when using 7 or 11 kW CP; or
- Gain access to the higher power type infrastructure, such as 22kW AC or 50kW DC power.

Therefore, if access to EVCP is to be useful in addition to (or as a substitute for) commercial EV owners using their own charging equipment it is imperative that access to the charge point is guaranteed and that any such charge post was capable of the correct power output and with the correct connector type and access arrangement.

Summary

Electric vehicle technology is changing at a rapid pace and until recently there were no European standards agreed for charging post connectors. Discussions have been taking place in the industry to agree a common standard for a charging connector. This common standard would use what is called a Type 2 connector. In the areas covered by Central London Boroughs Type 2 connectors are in the minority (with only about 30 charging points vs. around 260 Type 1 connectors); however industry agreement means that it is reasonably clear what the options are for installing EV charging infrastructure in the future, and some upgrading of existing infrastructure to Type 2 connector standards is taking place in Plugged in Places areas. This is the recommended standard for all new charging points installed under Source London.

An analysis of EV battery pack capacity vs. derived range has been conducted to illustrate how a commercial EV user or freight operator wishing to make use of EVCP either has to:

- Continue to charge for a significant length of time over a number of hours, ideally over-night when using 7 or 11 kW CP; or
- Gain access to the higher power type infrastructure, such as 22kW AC or 50kW DC power.

Therefore, if access to EVCP is to be useful in addition to (or as a substitute for) commercial EV owners using their own charging equipment it is imperative that access to the charge point is guaranteed and that any such charge post is capable of the correct power output and has the correct connector type and access arrangement.

4. GUIDELINES FOR DEPLOYING CHARGING POINTS

4.1 Introduction and context

This report has previously described how provision of EVCP for electric commercial vehicles should be considered separately from EVCP for passenger EVs because their requirements for use differ greatly. Furthermore, much of the current EVCP infrastructure is not currently suitable for commercial users of EV. Finally, there are no existing targets for the number of EVCPs to be installed in Central London that are specifically meant to serve electric commercial vehicles.

However, a key factor in determining whether there is a need for a CLFQP Strategy for EV CP is the likely level of demand, specifically from freight, delivery or servicing operations. As reported in Chapter 2 the current demand for on-street or public charging points from users of commercial vehicles (for freight, delivery or servicing) is very low. The situation might be similar to the early stages of the demand from passenger car EV where charging point installation has been seen as encouraging take up of future vehicles; however installation of specific infrastructure is a costly step to take and the evidence from the in-depth interviews with current commercial users of EV emphasised that at depot charging is favoured.

This section aims to provide guidance on how best to cater for users of commercial EV based on existing and currently planned charging point infrastructure and investment plans as far as they exist, and how to tailor any future investment to better suit commercial users of EV both now and for the near future.

The guidelines are focussed on the geographical area covered by the participating Central London Boroughs and cover the period of the next 5 years. Suggestions are made on the type and broad number of locations that might form the basis of a strategy (should one be developed), rather than a detailed plan of exact locations, and are organised as three distinct options.

4.2 Recommendations on charging point deployment

Current feedback from the relatively few existing operators of EV for freight, delivery and servicing duties in London is that at-depot charging is suitable and preferred. Parallel feedback from local businesses in Central London is that, if they were to use EV in the future, charging at their place of business and in parking bays were equally desirable (noting that these respondents do not yet have direct experience of EV, so their views may change once they do so).

If the Central London Boroughs wish to continue their valuable role to date in the development of charging point infrastructure then three options are suggested for supporting future EVCP for electric commercial vehicles:

- Option 1 - Supporting installation at business premises and at depots (at least 7kW) in response to demand.

- Option 2 – Installing fast charging (at least 22kW), on-street charging points in dedicated loading bays.
- Option 3 – Development of strategically located rapid charging stations (50kW and above), with capacity for multiple charging points over time, similar to a petrol station for petrol/diesel vehicles.

It should be noted that these options will not suit all vehicles and duties required by commercial users of EV, but they do cover a reasonable spread of needs and represent the study team's views on the best opportunities for providing EVCP to a potentially growing demand for commercial EVs. As the commercial EV market is expected to evolve markedly over the next few years the options are designed to cover short, medium and longer-term activities (1, 3 and 5+ year). It has proved difficult to forecast forward any further than about 5 years.

Option 1 is recommended for initial consideration by CLFQP. It could be rolled out in light of future emand for EV and charging facilities and links the users into a minimum level of commitment.

There does not seem to be sufficient demand for EVCP or a high enough number of electric freight vehicles to justify investing in a major way in Option 2 or 3 at the present time, so they are suggested as future options. Option 2 is based on matching infrastructure to the charging demands of EV vans and small trucks that users *may* wish to charge away from depot. Therefore, if small scale on-street/loading bay or off-street locations convenient to commercial users are being planned at this time then the infrastructure basis for Option 2 also is relevant guidance. To realise Option 3 would require significantly higher costs. In addition, concerns have been raised by study stakeholders about the potential for traffic generation from centralised charging 'hubs'. Therefore, CLFQP should consider option 3 only if and when demand for EVCP has increased beyond on-street provision (Option 2) or in light of a clear requirement for rapid charging away from vehicles' base.

Each of the three options is described in more detail in sections 4.3 and 4.4, starting with the rationale (including benefits and drawbacks) and highlighting key stakeholders that would need to be involved.

4.3 Supporting EVCP installation on business premises

4.3.1 Rationale

This option is likely to be the most cost effective and one that might be implemented relatively quickly, if it is acceptable to the Boroughs and possible within financial rules. Evidence from the fleet operator consultation undertaken as part of this study suggests that most operators of commercial vehicles would purchase electric vehicles which match the vehicle to the requirements of the job, starting with a consideration of vehicle range and payload. These operators would likely not use any recharging infrastructure during the course of the day while the vehicles are in operation but would instead charge them while they are idle back at the depot or business premises car park. Subsiding part of the cost of EVCP infrastructure at depots and business premises could be a cost-effective way to ensure increased infrastructure and use for EV charging. Ideally the business owner would contribute a proportion of the costs. Another way of gaining greater benefit would be to operator some of the installed charging points under shared access arrangements, where this is practicable, so that other businesses can utilise them.

4.3.1.1 Benefits

Low cost and can be quickly implemented, compared with other solutions. As this type of EVCP will be tailored to the needs of each fleet operator, it is likely to be highly utilised. The EVCP will also be easier to install, monitor, control and perform maintenance work on because it will be located on private premises.

Suitable EVCP technology of 7kW and above with Type 2 connectors already exists and is available from a number of major manufacturers.

4.3.1.2 Drawbacks

A possible drawback is the level communication and engagement with fleet operators and business that might be required in order to individually encourage them to adopt electric commercial vehicles.

There could be barriers to funding subsidies for installing the necessary infrastructure on their premises / in car parks.

4.3.2 Estimated timescale of introduction

Introduction could begin immediately, if financial and procedural review of providing grants to commercial businesses is feasible.

4.3.3 Stakeholders to be engaged

It is important for Boroughs / CLFQP to engage with as many as fleet operators and businesses as possible to describe the level of subsidy that would be available and to encourage them to take up electric commercial vehicles.

For large installations of EVCP, DNO should also be engaged in order to ensure that the distribution network could cope with demand for power when large numbers of vehicles are plugged in to charge.

4.4 Supporting on-street and public access charging points

In addition to the recommended option above, two other strategy options are proposed for consideration at a time when and if a focus on public/on-street charging locations is appropriate.

To be suitable for use by electric commercial vehicles, on-street/public EVCP should be:

- Of sufficiently high power output (at least 22kW), if they are to be used for opportunistic charging during the normal working day;
- Located sufficiently close to the required delivery destination;
- Installed in parking / delivery bays large enough to accommodate vans and possibly larger commercial EVs; and.
- Include a process to book in and guarantee access when it is required.

Using the above criteria two options are proposed for possible location of EVCP for electric commercial vehicles:

- Option 2 – Installing fast charging (at least 22kW), on-street charging points in dedicated loading bays.
- Option 3 – Development of strategically located rapid charging stations (50kW and above), with capacity for multiple charging points over time, similar to a petrol station for petrol/diesel vehicles.

As expected, each option has benefits and drawbacks that should be considered. These are presented in more detail below together with the suggested timescales over which they should be pursued and relevant stakeholders to be engaged to assist with planning and delivery.

4.4.1 Option 2 – On-street charging (at loading and parking bays)

4.4.1.1 Rationale

In order to facilitate charging of electric commercial vehicles on-street dedicated, fast-charging infrastructure should be provided exclusively for the use of electric commercial vehicles, located sufficiently close to the premises to which deliveries will be made (i.e. in loading bays). It is expected that most electric commercial vehicles will be able to complete the required daily duty cycle without requiring top-up charging during the day, particularly for vehicles operating exclusively within Central London due to the low mileage covered during the day. However, on-street infrastructure is likely to prove beneficial to electric commercial vehicles originating from outside of Central London and for businesses without extensive depot facilities or the wish/ability to invest in their own CP infrastructure.

Benefits

22kW Fast charging EVCPs are significantly cheaper to procure and install than rapid charging EVCP (50kW DC). Some existing EVCPs are designed to be "22kW ready" and can therefore be upgraded from 7kW single phase to 22kW 3-phase at a relatively low cost (e.g. the POLAR network). This option also provides some flexibility about where on-street infrastructure can be installed to maximise its effectiveness in encouraging electric commercial vehicle take up.

22kW power supply would be sufficient to allow top-up charging for most electric commercial vehicles over short charging periods of between 30min – 1 hour, especially if the vehicle can be charged in this way at a number of stops during the day.

Drawbacks

Demand for on-street parking in Central London is already high; therefore, provision of additional loading bays for electric commercial vehicles could conflict with Boroughs' policies on minimising vehicle use in Central London. In addition, it is likely that initially these bays will be underutilised due to low numbers of electric commercial vehicles, which could result in complaints from the public and/or abuse of the loading bays (i.e. non-compliance with parking rules) in areas of high demand.

Fast charging three-phase infrastructure (22kW) will also be more costly than slow chargers (3kW) or fast charging for cars (7kW) and will require access to 3-phase voltage supply. This will limit the number of possible locations and increase the cost of installation.

There is evidence from current users of electric commercial vehicles that vehicles are selected by freight operators in such a way as to ensure that they are able to complete the daily duty cycle without the need for opportunistic, top-up charging. If this continues to be the case with an expanding market of users the on-street infrastructure will be underused. Therefore a step-by-step approach is recommended.

Furthermore, 22kW charging is not included as standard in most current vehicles although some French manufacturers are pursuing this and it will be included as an option in future models. However some freight vehicle manufacturers already offer 22kW as an option (i.e. Smiths) and it is likely that for electric commercial vehicles this will become the norm for on board charging capability with larger vehicles.

4.4.1.2 Estimated timescale of introduction

Identification and selection of suitable locations and planning approval can be time consuming. This option might therefore be implemented in the medium term (1-3 years).

4.4.1.3 Stakeholders to be engaged

A wider range of commercial vehicle users should be engaged to determine at what locations installation of on-street charging points would be most beneficial. Particularly, consultations with a range of users of commercial vehicles based in Central London will be key.

The requirement for access to 3-phase voltage supply means that the DNO should be engaged to discuss where this is possible or to agree provision of the supply to a new location.

EVCP manufacturers and suppliers should be engaged to determine which suppliers are able to provide 22kW EVCP and if commercial providers are interested to partner with Central London Boroughs.

4.4.2 Option 3 – Strategically located off-street rapid charging stations

4.4.2.1 Rationale

Many commercial vehicles currently operating in Central London travel in from outside Central London and this pattern is expected to be repeated in the future. Therefore, their duty cycle is likely to include driving on motorways and dual carriageways and have higher mileage and include higher speeds than vehicles operating exclusively inside Central London.

If such vehicles were to be replaced with electric commercial vehicles then they would require facilities to recharge the majority of the battery very quickly (in 20 minutes or less) in order to not add delays into their schedule compared to a diesel vehicle. These EV could benefit from a strategically located rapid charging station which they could use to recharge batteries to allow the return trip out of London. In addition, such strategic rapid charging stations might also be used by electric commercial vehicles based in Central London and even by drivers of EV passenger vehicles (potentially as a premium service) if/when they were unable to charge at workplace or at home.

Benefits

Such rapid charging stations will be very visible and could help to promote the use of electric vehicles more effectively than on-street chargers. Most drivers are likely to be able to relate to this setup as it is similar to their experience with petrol stations. Such rapid charging stations may also be integrated with cafés and small shops.

Existence of such rapid charging stations in Central London should to some degree remove aspects of range anxiety and allow fleet operators based outside of Central London to operate electric vehicles into Central London that would not normally have sufficient range to return back to the depot.

The numbers of charging stations installed at each location could be low at the outset and increased as utilisation increased to ensure best value for money. Obviously there would be an upper limit (by initial design) to the amount of energy that could be provided, but due to the fact that a DC charger does not supply a constant amount of power to the battery (it diminishes over time and provides most energy at the beginning of the charge) DC charger equipment manufacturers have already recognised that there is a use for software and hardware that can limit and share load across charge stations to ensure that maximum demand is not exceeded but that more vehicles can be charged at any given time. This will be an important factor in the efficient design of any such multi outlet DC charge stations.

Drawbacks

Such rapid charging stations will have a high cost associated with them and will require substantial planning in terms of selecting the most appropriate location that is strategically located to allow recharging of freight vehicles and also, one that has sufficient high power available.

It will also require considerable amount of space, which is difficult to find in Central London and is very expensive. There will likely be increased congestion around such stations which is something that most London boroughs would try to avoid.

4.4.2.2 Estimated timescale of introduction

This option could be implemented in the long term (5 years plus) in order to allow sufficient install base of electric commercial vehicles and passenger EVs to maximise the utilisation of this type of infrastructure. The necessary time for planning and building will also mean that it is unlikely to be introduced prior to 2015 at the earliest.

4.4.2.3 Stakeholders to be engaged

The DNO has to be engaged early on in the process and work closely with the research institution and the local boroughs to identify suitable locations in terms of power supply and stability.

Retailers could be engaged to seek partnerships for building rapid charging stations with retail outlets on site.

Fleet operators, based outside of Central London but operating in Central London, should be consulted on the likelihood of such long range deployment in the medium term and, if considered appropriate, where they think would be the most suitable locations for rapid charging stations, based on the types of electric vehicles they are/would consider operating.

Equipment suppliers should be consulted to ensure they can maximise available power capacity to serve optimum number of users.

4.5 Number and location of charging points

If the Central London Boroughs wish to develop an EV CP Strategy this section contains guidelines on the size of EV market that could be served by a range of charging point infrastructure (type and number).

The number of required CP sites is challenging to forecast for two reasons:

1. The take up rates and total number of electric commercial vehicles in operation in London is uncertain; and
2. It is not known how much the anticipated usage patterns of future electric vans and larger commercial vehicles will vary from current usage of EV for commercial purposes and their petrol/diesel counterparts.

It is, therefore, difficult to make precise recommendations for the number of required CP sites for electric commercial vehicles. As a guide the London's Electric Vehicle Infrastructure Strategy consultation draft (2009) provides the following targets for Central London EVCP by 2015:

- 190 on-street (currently: 48)
- 400 off-street (currently: 220)

- 2,600 at workplace (Currently: unknown).

It should be noted that the targets do not distinguish between electric cars and electric commercial vehicles. However, some recent research undertaken by TRL suggests that early mass adoption of EVs is likely to come from fleet operators and, therefore, the targets above should be used as an opportunity to encourage fleet operators take up of electric commercial vehicles.

If the Central London boroughs wanted a guiding target for commercial user focused EVCP the year 2015 is suggested as appropriate to both encourage take up and be in line with existing overall 2025 EVCP targets for London. Illustrative targets are shown in Table 4.1 below. The consideration of benefits and drawbacks for each EVCP option has influenced the scale of the target number.

The size of the potential fleet that can be served by a target number of EVCP is calculated, based on maximum utilisation over a 24 hour period. This section of the table builds on the estimation of typical charge times / miles travelled for full charge/30 minute durations presented in Chapter 3. This is provided as an illustration of the scales of the potential impact. In reality the pattern of demand for using the EVPC will not cover the full 24 hours so the practicable supportable fleet of EV will be somewhere less that the theoretical maximum. Also note that if some EV are using the CP for a full charge (over a full hour or more) then the same CP is not also available for a 30 minute top-up charge at the same time.

Table 4.1 Illustrative targets for commercial vehicle EV CP by type in Central London and potential number of EV served (by duration of required charge)

Type of use / EVCP	**2015 London target**	**Recommended type of freight EVCP**	**Illustrative 2015 target EVCP (freight)**	**Size of commercial EV fleet that can be serviced (max. limit)**			
Charge duration				Number of EV benefit from **30 min 'top-up'** (and miles extra range)		Number of EV that can be **fully charged** (and duration)	
EV Battery Capacity				24kWh van	50kWh truck	24kWh van	50kWh truck
1.Workplace	2,600	On business premises and at depot AC charging (at least 7kW)	400-500 EVCP	N.A. (15mile)	N.A. (7mile)	3500 (3.4hr)	1680 (7.1hr)
2.On-street	190	Fast (at least 22kW), on-street AC charging points in dedicated loading bays	20 – 30 EVCP	1440 (46mile)	1440 (22 mile)	660 (1.1hr)	N.A. (2.2hr)
3.Off-street	400	Dedicated, strategically located rapid charging DC stations (50kW and above).	1-2 EVCP 'stations' (each containing between 4 and 6 rapid CPs)	576 (80mile)	576 (40mile)	576 (0.5hr)	288 (1hr)

In some cases the number of EV that can be serviced is marked as Not Applicable (N.A.). In the case of on-street charging the length of time required for fully charging a vehicle with a 50 kWh battery pack of 2.2 hours is not desirable from what is known about the vehicles duties of larger EVs used for commercial delivery and logistics work. Similarly not applicable is the use of relatively low power (7kW) CP at workplaces for 30 minute top-ups, as they are only suitable for overnight charging.

4.6 Action Planning

A list of actions has been compiled for the CLFQP to consider as the basis for an Action Plan, should they wish to take one or more of the suggested options forward. This might be in response to higher number of EV operating in London or demand for charging point access by local businesses thinking of buying the next generation of electric vans. Actions are organised into short, medium and longer-term activities.

Table 4.3 Draft action plan

Action	Lead	Timescale	Notes
Short term and preparation activities			
Reach agreement between relevant Source London partners about the design and deployment of CP to encourage commercial EV use.	CL Boroughs	Short	With the recommended strategy options as basis: - Can support for commercial EV be made explicit? - are partners agreed on strategy options; and is there stronger support for one or more of the options? - what is the preferred option or options; - what are next steps and roles?
Further investigation of Camden York Way CP, including promotion in hand with developing EV van market.	CL Boroughs	Short	The current CP set-up cannot be used by the most common Smith Newton vehicles (120kW) and are not as attractive for delivery duties (where re-charge at base is preferred): - How could the take up of the CP be encouraged with new EV coming to market in 2012? - What is the detailed feedback from a range of stakeholders to scenarios for use? - Is the CP connector of the correct type for upcoming commercial EV?
Identify funding for EVCP relevant to current and future commercial electric vehicles.	CL Borough	Short	Investigation of funding options for CP installation, including among existing commitments. In particular, there would need to be further work done on feasibility and conditions attached to grant/subsidies for businesses installing CP at premises.
Engage with DNO to understand impact of increased number of higher power EVCP.	CL Boroughs	Short	Discuss impact of 22 kW CP and 50 kW stations on network and start to identify potentially suitable location locations Understand what/whether investment on their side is possible and under what

			circumstances.
Plan and agree roles and responsibilities across the CL Boroughs, including team make-up and tasks.	CL Boroughs	Short	Essential if a co-ordinated approach is to be taken, including standardisation on technology, shared marketing and maximising the potential of any funding sources.
Further investigation with commercial vehicle users on potential take up and specific locations.	CL Boroughs	Short	Consultation on the strategy and draft plans in light of new vehicles and an appreciation of demand for latest van sized vehicles.
Installation and roll-out phase			
Install EVCP at business premises and depots (7kW, Mode 3, Type 2)	Central London Boroughs/TfL /Commercial Charge Post Company	Short (commence in 1 year)	This should be done via discussion with businesses looking to install EVCP and increase their EV fleets.
Install and upgrade on-street EVCP 22kW (3-phase Mode 3, Type 2)	Central London Boroughs/TfL /Commercial Charge Post Company	Medium (may commence in 1 to 3 years).	This is not seen as a priority due to low demand for EVCP. However, most electric freight vehicles will not be able to use existing EVCP effectively. Electric freight vehicle take up should be monitored and if significant increase is foreseen then this action should be taken.
Install rapid charging DC stations (50kW and above).	Central London Boroughs/TfL /Commercial Charge Post Company	Longer term (may commence in 3 to 5+ years).	This action will have associated costs and should really only be implemented if other options are unable to satisfy the demand for on street charging, or if speed of on-street charging becomes a significant barrier to the adoption of electric freight vehicles.
Review and adjustment of strategy			
Review the early take up of the new EVCP for commercial vehicle users.	Central London Boroughs/TfL /Commercial Charge Post Company	Matched to timescale of option(s) deployed and also the vehicles and operation types that are seen in the marketplace	- How much have EVCP been used and by whom? - What feedback from users and non-users? - What adjustments to equipment, access and conditions of use are sensible to make? - What elements work and what future investments should be made in the scheme?

Summary

If the Central London Boroughs wish to continue their valuable role to date in the development of charging point infrastructure then three options are suggested for supporting future EVCP for electric commercial vehicles:

- Option 1 - Supporting installation at business premises and at depots (at least 7kW) in response to demand.
- Option 2 – Installing fast charging (at least 22kW), on-street charging points in dedicated loading bays.
- Option 3 – Development of strategically located rapid charging stations (50kW and above), with capacity for multiple charging points over time, similar to a petrol station for petrol/diesel vehicles.

Option 1 is recommended for initial consideration by CLFQP. It could be rolled out in light of demand for EV and charging facilities and links the users into a minimum level of commitment. Option 2 includes advice on how to deploy on-street/loading bay charging infrastructure if the Boroughs perceive specific demand, but more widespread deployment is not recommended until a demand is apparent. Option 3 is looking towards a future where rapid charging away from base is in demand from EV users.

The size of the potential fleet that can be served by a target number of EVCP has been calculated for each of the options, based on maximum utilisation over a 24 hour period. This is provided as an illustration of the scale of the potential impact.

A list of actions has been compiled for the CLFQP to consider as the basis for an Action Plan, should they wish to take forward one or more of the suggested options.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Relevance of existing EVCP to commercial vehicle operators

As presented in section 2 of this study report there are currently around 290 EVCPs in Central London. This is a significant number, realised through the efforts of both public and private sector, and to date has focussed on encouraging take-up of EVs by passenger car users.

There is a range of barriers to using existing CP infrastructure by EVs in commercial operations due to vehicle dimensions, its duties and operating environment plus the specification or location of charging point infrastructure.

The majority of charging infrastructure is installed to match the charging requirements of passenger EVs. It is low power output (slow charger) of mostly 3kW, with some 7kW chargers being installed. The majority are Type 1 connectors, rather than the preferred standard going forward of Type 2. Such infrastructure is sufficient to provide charging for car-sized batteries over prolonged time, e.g. night time or all day but would not be sufficient to provide an adequate level of top-up charge to a larger, van-sized battery over a period of time the driver of a freight vehicle is able to stop and park.

The vast majority of these points are located in public car parks (often multi-storey or underground); most are in car-sized parking bays. Most vans and freight vehicles would not be able to use EVCP in car parks, either because of access restrictions, or because it would mean reducing the time that the vehicle can spend on deliveries. In addition, if the parking bays with EVCP are at the lower end of the size range (as most currently are) they will not accommodate transit sized (3.5t) vehicles and above, so only smaller vans will be able to use these spaces.

5.2 Requirements of commercial EV users

From the above, and the consultation exercise, it is clear that the dominant preference for current fleet operators with experience of using EV is for CP installations at their own depots.

In contrast, the many sole-traders and small businesses that make use of vehicles as part of their work (as well as small-scale delivery companies) may be less likely to properly site and/or justify the cost of investment in their own charging infrastructure. For example, the on-line survey of local and small businesses pointed to on-street and at-home charging being equally desirable as at business premises, supporting the view that the opportunity or desire to install charging points at business premises is less for smaller companies over large ones.

Serving smaller and local businesses with EV CP might be anticipated to follow the current model for passenger car EV users (of largely car-park based charging). However, for these commercial users CP locations will probably be more attractive if aligned with where commercial users of vehicles wish to park: near clusters of business premises where they store their vehicle in-between use in a working day and at loading bays at delivery and servicing destinations.

For larger fleet operators with EV among their fleet there *may* also be some potential for top-up or emergency charging as more EV models become available, particularly the latest versions of van-sized vehicles which will suit more reactive duties and routes required by servicing and repair personnel.

The wish for guaranteed access to charging bays could require booking mechanisms and enforcement mechanisms.

In summary, the technical specification, location and ease of access to charging points needs to be aligned to the requirements of those using commercial vehicles (which are set out in this document).

5.3 Relevant EV CP technology

The modes and type (connector) most relevant to commercial electric vehicles are:

- Mode 3: EV charging using a dedicated EV charging plug and incorporating a control and safety system in the charging infrastructure which interfaces directly to the charging equipment in the vehicle. **This is the preferred methodology for AC charging for any public or commercial EV charging infrastructure.**

- Type 2 - single and three phase vehicle coupler - reflecting the VDE-AR-E 2623-2-2 plug specifications. **This is likely be the preferred connector at the vehicle side for any 3 phase applications as it can be used up to 63A three phase.**

Therefore any investment in EVCP should be made with this in mind, focusing on introducing charging technology which is able to serve the highest number of relevant vehicles and do so within the operational constraints of those vehicles.

5.4 A charging point strategy to support commercial users of EV

Whilst CP infrastructure is important, this study showed that there is no demand at present from current commercial EV users for 'public/shared' EVCP. There are circumstances, such as the expected growth in electric van take up, which may stimulate demand, but at present this is not proven.

This study has highlighted that existing EVCP infrastructure is not suitable for the vast majority of electric freight vehicles. In addition, the study identified that there is strong evidence to avoid certain locations, such as car parks, if EV CP infrastructure is put in that is intended to be used for freight.

In future, EV passenger cars and vans are likely to use the same CP standards but vans will have larger batteries and be constrained by operational timescales, therefore their requirements for on-street infrastructure will always be for higher powered, faster charging compared with passenger cars. However, given that such infrastructure is costly and has additional considerations that should be taken into account, such as impact on the grid, it is not recommended that an EVCP for freight vehicles strategy should focus on the installation of such infrastructure.

The recommendation from this study is that CLFQP should work closely together with local business and commercial fleet operators to:

- Provide financial, technical and incentive support for installing 7kW EVCP on business' premises.

Two further strategy options are provided which could be adopted by London Boroughs if they wish to be involved in providing on-street/public charging infrastructure for electric freight vehicles. These are:

- Fast charging (at least 22kW), on-street charging points ideally in dedicated loading bays.
- Dedicated, strategically located rapid charging stations (50kW and above), with capacity to expand to multiple posts (equivalent of a small petrol station).

These two options may be relevant to meeting the London Plan (Greater London Authority, 2011) targets for EVCP provision in London up to 2020-2025. Targets are described in terms of percentages of all parking spaces that must be equipped with EVCP for different property types. If EVCP is to be provided throught the planning mechanism it could be helpful, for future electric van users, for some of this infrastructure to be commerical vehicle friendly.

Other options for incentivising take up of electric vehicles by local business and commercial fleets should also be considered. Investigating these options or their effectiveness was not part of this study but could include on the supply side: reduced (or abolished) parking fees for EVs; longer dwelling times; and priority delivery windows; and on the demand side: the use of procurement to incentivise EV specification for a contract; grants to support vehicle purchase or CP installation.

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ANNEX 1 – ELECTRIC VEHICLE TECHNOLOGY REVIEW

A1.1 Introduction

The task is to produce a summary of currently available and soon to be released PEV and PHEV commercial vehicles. It should be noted that the list is not exhaustive as there are other prototypes and vehicle models planned for which very little public information is available. The table below is a summary of the latest publicly available information, at the time of writing.

A1.2 Overview

Points to note when refereeing to the table:

- Vehicles sorted by GVW (lowest first), where a vehicle is available in different configurations it is positioned in the table according to the lowest GVW configuration. GVW categories in the table are as follows:
    - Yellow: less than 1.3t
    - Green: between 1.3 and 3.5t
    - Blue: above 3.5t
- Majority of available electric vans are between 1.3 and 3.5t GVW, with only 2 available with GVW of 1.3t or less 5 different vehicles are available with payload capacity under 600kg
- Vehicles indicated to be available from 2011 in some cases are only available in small volumes, however, all vehicles are in production
- Costs range considerably from around £17,000 for smaller vehicles with battery leasing available, to £90,000 for larger vehicles with no battery leasing option
- In comparison, typical costs for standard diesel vehicles are approximately as follows: small van £11400; medium van £19,775, large van £28150, small truck (3.5 – 7.5 t) £21800; medium truck (7.5 – 12.5 t) £38,500.
- For EV, typical range is between 60 and 100 miles depending on battery (sometimes battery choice is available to increase range for an added cost)
- Typical top speed is between 50 and 60 mph
- A complete list of vans eligible for the plugged-in van grant and the criteria which they must meet, is available at: http://www.dft.gov.uk/topics/sustainable/olev/plug-in-van-grant/
- Summary of key plug-in van grant vehicle eligibility criteria:
    - Only new vans up to 3.5 tonnes are eligible (N1 category)
    - Emissions less than 75gCO_2/km
    - Fully electric range must be at least 60 miles, electric-only range for PHEV must be at least 10 miles
    - Must come with at least a 3-year vehicle and battery warranty.

- No Plug-in Hybrid EV (PHEV) are currently available or expected to be available until late 2012. More PHEV are expected to be realised after 2012 with information being made available throughout 2012.
- Images of vehicles were provided where available from TRL library of images or provided by manufacturers.

The following table of EV suitable for commercial users has been arranged into small van (under 1.3 t gvw), medium and large van (1.3 to 3.5 t gvw and 3.5 to 7.5 t gvw) and small truck (7.5 – 12.5 t gvw). In addition, vehicle dimensions have been added where known. Together these information are a useful guide to vehicle size and the accessibility of car parks or on-street parking bays, although with changing specifications this is not possible to be a definitive guide.

Table 1 – EV developments and CP requirements

Make	Model	payload capacity (kg)	GVW	Dimensions (m) &	Fit in parking bay (Y, y, N[7])	Drivetrain type	Cost	Cost minus plug-in van grant (20% of price, up to £8,000)[8]	Battery Lease or Vehicle lease	Availability	Range (miles)	Charge modes / specific requirements	Top speed (mph)
Megavan Electric range (Mega Van, 2011)	various	435	1.12t	L: 3.33 W: 1.5	Y	PEV	£12300	Not currently eligible	N/A	2011	60 - 100	No information available but likely to be 240V, 13A.	30
Mia-electric (mia electric, 2012)	Mia U	350	1.3t	L: 3.19 W: 1.64	Y	PEV	£26124[9]	£20899	N/A	2011	80	230V5 hours	65
Peugeot (Allied Electric)	e-bipper	350	1.7t	L: 3.87 W: 2.02	y	PEV	£40950	Not currently eligible	N/A	2011	60	Full re-charge time: 3 hours on 3-phase or 8.5 hours on single phase.	62

[7] A standard parking bay can be anywhere between 1.8 wide and 4.5m long and 2.7m wide and 6.6m long, therefore: Y = if the vehicle is smaller than 1.8m x 4.5m; y = if vehicle is smaller than 2.7m x 6.6m; and N = if vehicle is wider than 2.7m or longer than 6.6m

[8] This column indicates only those vehicles which have been already announced as being eligible for the scheme; in future years it is likely that more vehicles will become eligible.

[9] https://www.sourcelondon.net/electric-vans

Make	Model	payload capacity (kg)	GVW	Dimensions (m) &	Fit in parking bay (Y, y, N[7])	Drivetrain type	Cost	Cost minus plug-in van grant (20% of price, up to £8,000)[8]	Battery Lease or Vehicle lease	Availability	Range (miles)	Charge modes / specific requirements	Top speed (mph)
Renault (Renault, 2011)	Kangoo Z.E.	595	2.15t	L: 4.21 W: 1.83	y	PEV	£16,990	£13,592	£60 per month battery rental (6000 miles per year) Other options are available depending on annual mileage.	2012	106	13A, 16A or 32A. (Typical charge between 6 to 8 hours). Fast charge (80% in 10 min) is also possible. All Z.E. models are also compatible with Better Place[10] battery quick drop schemes	80

[10] http://www.renault-ze.com/en-gb/electric-motoring/renault-z.e.-in-detail/electric-cars-charging-renault-z.e.-1967.html&t=4&coe_i_id=1967

Make	Model	payload capacity (kg)	GVW	Dimensions (m) &	Fit in parking bay (Y, y, N[7])	Drivetrain type	Cost	Cost minus plug-in van grant (20% of price, up to £8,000)[8]	Battery Lease or Vehicle lease	Availability	Range (miles)	Charge modes / specific requirements	Top speed (mph)
												Quick charger available in near future	
Renault (Renault, 2011)	Kangoo Z.E. maxi	650	2.18t	L: 4.60 W: 1.83	y	PEV	£17,990	£14,392	£60 per month battery rental (6000 miles per year) Other options are available depending on	2012	106	13A, 16A or 32A. (Typical charge between 6 to 8 hours). Fast charge (80% in 10 min) is also possible. All Z.E. models are also compatible	80

Make	Model	payload capacity (kg)	GVW	Dimensions (m) &	Fit in parking bay (Y, y, N[7])	Drivetrain type	Cost	Cost minus plug-in van grant (20% of price, up to £8,000)[8]	Battery Lease or Vehicle lease	Availability	Range (miles)	Charge modes / specific requirements	Top speed (mph)
									annual mileage.			with Better Place[11] battery quick drop schemes Quick charger available in near future	
Peugeot (Allied Electric)	e-Partner	681	2.19t	L: 4.38 W: 2.11	y	PEV	£47950	Not currently eligible	N/A	2011	60	Full re-charge time: 5.2 hours on 3-phase or 9 hours on single phase (13A, 240V).	62
Faam (Faam, 2012)	Ecomile	935	2.2t	L: 4.03 W: 1.56	Y	PEV	£35100[12]	£28080	N/A	2011	50	380V charger: 6	50

[11] http://www.renault-ze.com/en-gb/electric-motoring/renault-z.e.-in-detail/electric-cars-charging-renault-z.e.-1967.html&t=4&coe_i_id=1967
[12] https://www.sourcelondon.net/electric-vans

Make	Model	payload capacity (kg)	GVW	Dimensions (m) &	Fit in parking bay (Y, y, N[7])	Drivetrain type	Cost	Cost minus plug-in van grant (20% of price, up to £8,000)[8]	Battery Lease or Vehicle lease	Availability	Range (miles)	Charge modes / specific requirements	Top speed (mph)
												hours Fast charger: 2 hours	
Ford (Motor Torque, 2011) 	Transit e-connect[13]	500	2.27t	L: 4.59 W: 2.11	y	PEV	£40,000 Or rental at £600 per month	£32,000	£600 per month initially	2011	80	Standard 3-pin plug (240V, 13A, single phase). Full charge in 8-10 hours	75
Peugeot (Allied Electric)	e-Expert	660	2.93t	L: 5.14 W: 2.19	y	PEV	£54000	Not currently eligible	N/A	2011	95	Full re-charge time: 8.5 hours on 3-phase or 14.3 hours on single phase (13A, 240V).	65

[13] At the time of writing Azure Dynamics was filling for financial protection and the company was at risk of filing for bankruptcy.

Make	Model	payload capacity (kg)	GVW	Dimensions (m) &	Fit in parking bay (Y, y, N[7])	Drivetrain type	Cost	Cost minus plug-in van grant (20% of price, up to £8,000)[8]	Battery Lease or Vehicle lease	Availability	Range (miles)	Charge modes / specific requirements	Top speed (mph)
Mercedes-Benz (Daimler, 2012)	Vito E-CELL	850	3.05t	L: 5.01 W: 1.90	y	PEV	£17420[14]	£13936	N/A[15]	2011	80	380/400V charging in 6 hours, Standard charge (240V): up to 12 hours.	55
Peugeot (Allied Electric)	e-Boxer	800 or 895 (depending on configuration)	3.5t	L: 5.41 W: 2.70	y	PEV	£64500	£Not available	N/A	2011	95	Full re-charge time: 10.5 hours only on 3-phase.	62
Iveco (The Green Car website, 2010)	ECO Daily Electric	N/A	3.5t 5.2t	Not available	N/A	PEV	£40000	Not currently eligible	£23000 (5 years)	N/A	55-80 (based on trials data)	Full re-charge time: 8 hours only on 3-phase.	45

[14] http://www.greenwisebusiness.co.uk/news/seven-electric-vans-to-benefit-from-8000-green-grant-3086.aspx
[15] The relatively low price of this vehicle would suggest that a battery lease option is available, however, no information was available on this at the time of writing.

Make	Model	payload capacity (kg)	GVW	Dimensions (m) &	Fit in parking bay (Y, y, N[7])	Drivetrain type	Cost	Cost minus plug-in van grant (20% of price, up to £8 000)[8]	Battery Lease or Vehicle lease	Availability	Range (miles)	Charge modes / specific requirements	Top speed (mph)
Bluebird 	BE-1	1700	3.5t	Not available		PEV	£24995	Not applicable	N/A	2012	Up to 75	Standard charge from 13 amp socket - 8 hours Battery swap - 3-4 minutes	40 (56 from April 2012)
Faam (Faam, 2012)	Jolly 2000	1900	3.5t	L: 4.77 W: 2.2	y	PEV	£49950	£41950	N/A	2011	75	380V charger: 6 hours Fast charger: 2 hours	62
Smith (Smith Electric Vehicles, 2012) 	Edison	Up to 3220	3.5t 4.6t	L: 5.23 W: 2.37 L: 6.43 W: 2.49	y	PEV	£47000-£55000 (depending on configuration and number of	£41000 - £47000	N/A	2011	55-110 (depends on size of battery)	Standard (32A, 1 or 3 phase) charger: 6-8 hours Fast charger: 3-4 hours	50

Make	Model	payload capacity (kg)	GVW	Dimensions (m) &	Fit in parking bay (Y, y, N[7])	Drivetrain type	Cost	Cost minus plug-in van grant (20% of price, up to £8,000)[8]	Battery Lease or Vehicle lease	Availability	Range (miles)	Charge modes / specific requirements	Top speed (mph)
							vehicles)						
Smith (Smith Electric Vehicles, 2012) 	Newton	Up to 7558	7.5t 10t 12t	L: 6.80 W: 2.15 L: 7.80 W: 2.15 L: 8.80 W: 2.15	N N N	PEV	£70000 - £90000	Not currently eligible	N/A	2011	30-150 (depends on size of battery)	Standard (32 or 63A, 3 phase): 8 hours	50
Ford[16]	Transit e-connect (PHEV)	N/A	2.27t	L: 4.59 W: 2.11	N/A	PHEV	£N/A	£N/A	£N/A	2012	N/A	N/A	N/A

[16] The PHEV model is also being built by a Ford / Azure partnership, same as the PEV version released in 2011. At the time of writing Azure Dynamics was filling for financial protection and the company was at risk of filing for bankruptcy.

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ANNEX 2 – CHARGING POINT INFRASTRUCTURE REVIEW

A2.1 Introduction and summary - existing and planned EV CP

TRL undertook a review of existing and planned EV charging infrastructure in participating boroughs. The study combined information supplied by individual boroughs and information by publicly available information from websites that provide locations/ maps of existing charging infrastructure in London:

- NewRide London (http://www.newride.org.uk/recharge.php)
- Source London (https://www.sourcelondon.net/map).

Captured information is displayed in the following pages with summarised results shown in following 2 tables, with detail in subsequent tables.

The definition of CP used in the study is as follows:

- Slow charge: 3 pin plug, 3kw max (also used as 'Household').
- Fast charge: Mode 3, type 2 or 3 connector (IEC 61296-2), between 7 and 21 kw (1 to 3 phase).
- Dual: using either a standard 3-pin plug connector (3kw) or the blue commando connector (3 kw typical, but can be up to 11kw in theory [with more phases]
- Rapid/quick: DC voltage.

Summary of key findings, existing CPs:

- Vast majority of charging points currently installed are slow (13A, around 3kW power output)
- Vast majority of charging points are placed in car-sized parking bays, therefore, unlikely to be suitable for larger vans (>3.5t)
- Camden and Westminster have installed three phase charge points for larger vehicles and the demand/use of these has been low.
- Vast majority of charging points are in public car parks (often multi-storey or underground), therefore, are not well suited for freight vehicles (see barriers and design requirements sections of working papers)
- 'Smart' charging infrastructure in NewRide data is assumed to mean fast chargers with either a Mode 3 Type 2 or Type 3 connector.

Table A2.1 : Summary of existing CP infrastructure

Borough	Infrastructure Type								Total
	Car Park		On-street			Unknown			
	Fast	Slow	Dual	Fast	Slow	Dual	Fast	Slow	
Camden	20	17		1	19			6	63
City of London		59							59
Islington		6			5				11
Kensington and Chelsea		18							18
Lambeth		2						3	5
Southwark	2	8		5	5				20
Westminster		89	1		26	2	2		120
Grand Total	22	199	1	6	55	2	2	9	296

Table A2.2: Summary of planned CP infrastructure[17]

Borough	Infrastructure Type					Total
	Car park	On street		Unknown		
	Dual	Dual	Unknown	Dual[18]	Slow	
Camden						
City of London	29					29
Kensington and Chelsea		2				2
Southwark		2				2
Westminster				18		18
Grand Total	29	2	3	18		51

Summary of key findings, planned CPs:

- Information regarding location or type of planned EV charging infrastructure is largely not available because the plans are not finalised
- Camden have no plans to install on street charge points in 2012/2013 as they would like to see what the take up on the charge points will be once going live with Source London on 1st April 2012[19].
- City of London have no plans of installing additional EV charging infrastructure, however, there are plans to modernise existing infrastructure
- Westminster have planned to install a number of EV charging points over the next 3 years, majority of which are likely to be on-street.

A detailed breakdown of CPs (existing and planned) now follow.

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17 Information included in this table summarises estimates provided by Boroughs who have responded to the request for information.

18 In this case, dual chargers could be either slow/slow or slow/fast. For the purpose if this assessment, based on the information available to TRL an assumption is made that dual chargers are slow/fast.

19 http://www.camden.gov.uk/ccm/content/transport-and-streets/parking/where-to-park/-parking-electric-vehicles-in-camden.en

A2.3 Detailed review of existing and planned EV CP

Table A2.3: Existing EV charging infrastructure (full breakdown)

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
Camden	Bloomsbury Sq Car Park, Bloomsbury Sq, Camden, WC1A 2RJ	9	Slow	3kW	3-pin plug	Need to pay at the car park	Yes	Car Park
Camden	NCP Drury Lane, Parker Street, Camden, WC2B 5NT	10	Slow	3kW	3 pin plug	Need to register with park and charge scheme. Only for electric motor bikes scooters.	Yes	Car Park
Camden	NCP Saffron Hill, St Cross Street, Camden, EC1N 8XA	5.	Slow.	3kw	3 pin plug	Can only charge bikes and scooters – register with car park as Park and Charge no longer involved	Yes	Car Park
Camden	c/o Electrip, 152 College Street, Camden, NW1 0TA. Outside a scooter shop	5	Slow	3kw	3 pin plug	Register with dealer – only charge bikes and scooters	Yes	Car Park
Camden	8-14 Store Street, Camden, Camden,	1	Slow	3kW	3-pin plug	Source	No	Unknown

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
	WC1E 7DE							
Camden	26 Red Lion Square, Camden, Camden, WC1R	1	Slow	3kW	3-pin plug	Source	No	Car Park
Camden	Malet Street, Camden, Camden, WC1E 7HY	1	Slow	3kW	3-pin plug	Source	No	On Street
Camden	Sardinia Street, Camden, Camden, WC2B 6JX	1	Slow	3kW	3-pin plug	Source	No	Car Park
Camden	40 Charlotte Street, Camden, Camden, W1T 2NW	1	Slow	3kW	3-pin plug	Source	No	Unknown
Camden	21 Bernard Street, Camden, Camden, WC1N 1LN	1	Slow	3kW	3-pin plug	Source	No	Unknown
Camden	11 Warren Street, Camden, Camden, W1T 5NH	1	Slow	3kW	3-pin plug	Source	No	Unknown
Camden	29 Doughty Street, Camden, Camden, WC1N 2AA	1	Slow	3kW	3-pin plug	Source	No	Unknown
Camden	Acton Street, Camden, Camden, WC1X 9NB	1	Slow	3kW	3-pin plug	Source	No	Unknown
Camden	Regents Park Road, Camden, Camden, NW1 8UG	1	Slow	3kW	3-pin plug	Source	No	On Street
Camden	Bisham Gardens,	1	Slow	3kW	3-pin plug	Source	No	On

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
	Camden, Camden, N6 6DD							Street
Camden	102 Fleet Road, Camden, Camden, NW3 2QT	1	Slow	3kW	3-pin plug	Source	No	On Street
Camden	Greencroft Gardens, Camden Town, Camden, NW6 3LR	1	Slow	3kW	3-pin plug	Source	No	On Street
Camden	South End Road, Camden, Camden, NW3 2RL	1	Slow	3kW	3-pin plug	Source	No	On Street
Camden	Rosslyn Hill, Camden, Camden, NW3 1PH	1	Slow	3kW	3-pin plug	Source	No	On Street
Camden	Haverstock Hill, Camden, Camden, NW3 2AT	1	Slow	3kW	3-pin plug	Source	No	On Street
Camden	John Street, Camden, Camden, WC1X 8PF	1	Slow	3kW	3-pin plug	Source	No	On Street
Camden	NCP Museum Street, Holborn, Camden, London, WC1A 1JP	4	Slow	3Kw –	3-pin plug	Register with park and charge	No	Car Park
Camden	17-21 Camden Road , Camden, Camden, London, NW1 9LJ	2	Slow	3kW	3-pin plug	Sainsbury's underground car park	No	Car Park
Camden	7 York Way, King's Cross, London N1C 4BE	2	Fast	unknown	Mode 3 (Type 2 / Type 3)	Charging point specifically for electric freight vehicles	Yes	On Street

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
City of London	London Wall Car Park, 23 London Wall, City of London, EC2V 5DY	10	Slow	3kW	3-pin plug	London Wall Car Park	Yes	Car Park
City of London	Minories Car Park, Mansell St, City of London, E1 8LP	10	Slow	3kW	3-pin plug	Car park	Yes	Car Park
City of London	Tower Hill Car Park, Lower Thames St, City of London, EC3R 6DP	11	Slow	3kW	3-pin plug	Car Park	Yes	Car Park
City of London	Queen Victoria Street , London, City of London, EC4V 4BY	10	Slow	3kW	3-pin plug	Baynard House Car Park	Yes	Car Park
City of London	West Smithfield Car Park, West Smithfield, City of London, EC1A 9DY	6	Slow	3kW	3-pin plug	Car Park	Yes	Car Park
City of London	White's Row car park, 15 White's Row, E1 7NF	10	Slow	3kW	3-pin plug	Car park	Yes	Car Park
City of London	158-170 Aldersgate Street, City of London, City of London, London, EC1A 4HY	2	Slow	3kW	3-pin plug	Car Park	No	Car Park
Islington	Highbury Crescent, , Islington, N5 1RN	2	Slow	3kW	3-pin plug	Resident only	No	On Street
Islington	2-4 Tufnell Park Road, , Islington, N7 0QA	1	Slow	3kW	3-pin plug	Resident only	No	On Street
Islington	Tolpuddle Street,	2	Slow	3kW	3-pin plug	Resident only	No	On

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
	Islington, Islington, N1 0XT							Street
Islington	Liverpool Road, Islington, Islington, N1 0RW	2	Slow	3kW	3-pin plug	Sainsbury's car park	No	Car Park
Islington	1 Bowling Green Lane, Clerkenwell, Islington, London, EC1R 0BD	4	Slow	3kW	3-pin plug	NCP Farringtion	No	Car Park
Kensington and Chelsea	Town Hall Car Park, Horton Street, Kensington and Chelsea, W8 7NX	6	Slow	3kW	3-pin plug	Town Hall car park	Yes	Car Park
Kensington and Chelsea	100A West Cromwell Road, Kensington, Kensington and Chelsea, W14 8PB	2	Slow	3kW	3-pin plug	Tesco car park	No	Car Park
Kensington and Chelsea	19-27 Young Street, Kensington, Kensington and Chelsea, London, W8 5EH	4	Slow	3kW	3-pin plug	NCP Young Street	No	Car Park
Kensington and Chelsea	158a Cromwell Road, Kensington and Chelsea, Kensington and Chelsea, London, SW7 4EJ	2	Slow	3kW	3-pin plug	Sainsbury's	No	Car Park
Kensington and Chelsea	28 Pavillion Road, Knightsbridge, Kensington and Chelsea, London, SW1X 0HH	2	Slow	3kW	3-pin plug	NCP Pavillion Road	No	Car Park

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
Kensington and Chelsea	Cadogan Place, Knightsbridge, Kensington and Chelsea, London, SW1X 9SA	2	Slow	3kW	3-pin plug	NCP Pavillion Road	No	Car Park
Lambeth	Concert Hall Approach, , Lambeth, SE1 8XU	1	Slow	3kW	3-pin plug		No	Unknown
Lambeth	Pulross Road, , Lambeth, SW9 8AA	1	Slow	3kW	3-pin plug		No	Unknown
Lambeth	Upper Ground, , Lambeth, SE1 9PP	1	Slow	3kW	3-pin plug		No	Unknown
Lambeth	281 Kennington Lane, Lambeth, Lambeth, SE11 5QY	2	Slow	3kW	3-pin plug	Tesco car park	No	Car Park
Southwark	80 Dog Kennel Hill, Southwark, Southwark, SE22 8BB	2	Slow	3kW	3-pin plug	Sainsbury's car park	No	Car Park
Southwark	Magdalen Street, Southwark, Southwark, London, SE1 2TU	1	Slow	3kW	3-pin plug		Yes	On Street
Southwark	Magdalen Street, Southwark, Southwark, London, SE1 2TU	1	Fast	7kW	Mode 3 (Type 2 / Type 3)		Yes	On Street
Southwark	Kipling Street, Southwark, Southwark, London, SE1 3RU	4	Slow	3kW	3-pin plug	NCP Snowsfield	No	Car Park
Southwark	The Cut, Southwark, Southwark, London, SE1	1	Slow	3kW	3-pin plug		Yes	On Street

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
	8DF							
Southwark	The Cut, Southwark, Southwark, London, SE1 8DF	1	Fast	7kW	Mode 3 (Type 2 / Type 3)		Yes	On Street
Southwark	2 East Dulwich Grove, Southwark, Southwark, London, SE22 8EW	1	Slow	3kW	3-pin plug		Yes	On Street
Southwark	2 East Dulwich Grove, Southwark, Southwark, London, SE22 8EW	1	Fast	7kW	Mode 3 (Type 2 / Type 3)		Yes	On Street
Southwark	Horsleydown Lane, SE1	1	1 Fast	7kW 3kW	Unknown		Yes	On street
Southwark	Horsleydown Lane, SE1	1	1 Slow	7kW 3kW	Unknown		Yes	On street
Southwark	Danby Street, SE15	1	1 Fast	7kW	Unknown		Yes	On street
Southwark	Danby Street, SE15	1	1 Slow	3kW	Unknown		Yes	On street
Southwark	QPark, Butlers Wharf, SE1	2	2 Fast	7kW	Unknown		Yes	Car Park
Southwark	QPark, Butlers Wharf, SE1	2	2 Slow	7kW	Unknown		Yes	Car Park
Westminster	Abingdon Car Park, Great College St, Westminster, SW1P 3RX	3	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	Broadwick Car Park, Dufours Place,	3	Slow	unspecified	Blue commando	Car park	No	Car Park

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
	Westminster, W1F 7SJ							
Westminster	Chiltern Car Park, Chiltern St, Westminster, W1U 5AA	3	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	China Town Car Park, Newport Place, Westminster, WC2H 7PU	4	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	Clipstone Car Park, Clipstone Mews, Westminster, W1P 7DL	3	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	Harley St Car Park, Queen Anne Mews, Westminster, W1G 9HF	12	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	Knightsbridge Car Park, Kinnerton St, Westminster, SW1X 8JU	2	Slow	unspecified	Blue commando	Car Park	No	Car Park
Westminster	Leicester Sq Car Park, Whitcomb St, Westminster, WC2H 7DT	7	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	Park Lane Car Park, Park Lane, Westminster, W1K 7TY	6	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	Pimlico Car Park, Cumberland St, Westminster, SW1V 4LR	1	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	Queensway Car Park,	1	Slow	unspecifi	Blue	Car park	No	Car

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
	Queensway, Westminster, W2 3RX			ed	commando			Park
Westminster	St John's Wood Car Park, Kingsmill Terrace, Westminster, NW8 6AA	2	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	Trafalgar Car Park, Spring Garden, Westminster, SW1A 2BN	1	Slow	unspecified	Blue commando	Car park	No	Car Park
Westminster	Wellington St, Covent Garden, Westminster, WC2E 7DA	1	Slow	3kW	3-pin plug	Car park	No	Car Park
Westminster	Sutherland Avenue, Warwick Avenue, Westminster, W9 1BE	1	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	Manchester Square, Marylebone, Westminster, W1U 3BJ	2	Slow	3kW	3-pin plug	Car park	No	Car Park
Westminster	Berkeley Square, West End, Westminster, W1J 6EG	3	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	Wellington Street, Near Covent Garden, Westminster, WC2E 7DA	1	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	Southampton Street, Near Covent Garden Westminster, WC2E 7HE	1	Slow	3kW	3-pin plug	kerbside	Yes	On Street

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
Westminster	Spencer Street (behind City Hall), Victoria, Westminster, SW1E 6AA	2	Slow	3kW	3-pin plug		No	On Street
Westminster	Wilton Street, Belgravia, Westminster, SW1X 7AF	2	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	Hinde Street (Off Manchester Square), Westminter, Westminster, W1U 3BJ	2	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	Albemarle Street, Westminster, Westminster, W1S 4BS	2	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	Btw 73,66a & 62 Eaton Square, London, SW1W 9AW, SW1W 9BQ, SW1W 9BG	2	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	23 Clifton Villas, London, W9 2PH	2	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	9 Montagu mansions, W1U 6LB	2	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	10-19 Biddulph Mansions, Elgin Avenue, W9 1JB	2	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	Opp Greencoat House, 15 Francis Street, SW1P 1DH	3	Slow	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	19 Carlisle Street, W1V	1	Slow	3kW	3-pin plug	kerbside	Yes	On

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
	5RJ							Street
Westminster	Old Cavendish Street, W1A 1EX	2	Fast	7kW	Mode 3 (Type 2 / Type 3)	For use by electric mini-bus		Unknown
Westminster	44 Lincoln's Inn Fields, WC2A 3PF	1	Dual	3kW	3-pin plug		Yes	Unknown
Westminster	opp Nash House, Lupus Street, SW1V 3HQ	1	Dual	3kW	3-pin plug	kerbside	Yes	On Street
Westminster	20 Circus Road, NW8 9SG	1	Dual	3kW	3-pin plug		Yes	Unknown
Westminster	22 Park Lane, Mayfair, Westminster, London, W1K 1BE	2	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	Carrington Street, Mayfair, Westminster, London, W1J 7AF	2	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	21 Grosvenor Hill, Mayfair, Westminster, London, W1K 3QQ	2	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	2 Lexington Street, Soho, Westminster, London, W1F 0LA	4	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	45-47 Berners Street, Westminster, Westminster, London, W1T 3NE	2	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	34-42 Cleveland Street,	2	Slow	3kW	3-pin plug	NCP car park	No	Car

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
	Westminster, Westminster, London, W1T 4JY							Park
Westminster	Great Cumberland Place, Marble Arch, Westminster, London, W1H 7LB	2	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	Gloucester Place, Marble Arch, Westminster, London, W1H 7BG	4	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	Shouldham Street, Corner of Bryanston Place, Westminster, London, W1H 5FE	2	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	Burwood Place, Westminster, Westminster, London, W2 2HN	4	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	43A Crawford Street, Westminster, Westminster, London, W1H 1JR	2	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	170 Marylebone Road, Westminster, Westminster, London, NW1 5AR	4	Slow	3kW	3-pin plug	NCP car park	No	Car Park
Westminster	Semley Place, Victoria,	4	Slow	3kW	3-pin plug	NCP Victoria	No	Car

Borough	Location	No.	Type	Power output (approx.)	Connector Type	Notes	Borough info	On-street or Car park
	Westminster, London, SW1W 9QL							Park
Westminster	Queensway, Bayswater, Westminster, London, W2 5HL	2	Slow	3kW	3-pin plug	NCP car park	No	Car Park

Table A2.4: Planned EV infrastructure (full breakdown)

LA	Location	Number	Type	Power output	Notes	on-street or car park	replacement / New
Camden	N/A	0	N/A	N/A	N/A	Unknown	N/A
City of London	London Wall Car Park, 23 London Wall, City of London, EC2V 5DY	5	Dual	3kW / 7kW	London Wall Car Park	Car park	Replacement
City of London	Minories Car Park, Mansell St, City of London, E1 8LP	5	Dual	3kW / 7kW		Car park	Replacement
City of London	Tower Hill Car Park, Lower Thames St, City of London, EC3R 6DP	6	Dual	3kW / 7kW	1 extra outlet compared with current set-up	Car park	Replacement
City of London	Queen Victoria Street , London, City of London, EC4V 4BY	5	Dual	3kW / 7kW	Baynard House Car Park	Car park	Replacement
City of London	West Smithfield Car Park, West Smithfield, City of London, EC1A 9DY	3	Dual	3kW / 7kW	Car Park	Car park	Replacement

City of London	White's Row car park, 15 White's Row, E1 7NF	5	Dual	3kW / 7kW	Car Park	Car park	Replacement
Kensington and Chelsea	unknown	2	Dual	3kW / 7kW	on-street	On street	New
Southwark	Nunhead	2	Dual	unknown	on-street	On street	New
Westminster	unknown	18	Dual	3kW / 7kW	unknown	Unknown	New

ANNEX 3 - FURTHER CONSIDERATIONS

The following information is provided in answer to detailed elements of the study specification.

A3.1 Detailed / other considerations

Once the technical specification is agreed upon there are still other considerations to agree when deciding upon the holistic approach to charging infrastructure.

Installation: once the technical specification has been agreed upon, an installer needs to be nominated. There is now specific guidance (in the form of the IET Code of Practice for Electric Vehicle Charging Equipment Installation) to would-be installers, but careful consideration should be given to ensure that any would-be installer will provide value for money and a professional and reliable service. It is likely that the charge point equipment manufacturers will be able to nominate their approved installers, which may help to simplify this process.

Ownership: there would be an obligation for the owner to ensure the units were maintained in a safe and working order. This needs some form of commercial commitment with a maintenance provider to ensure charging equipment is both reliable and safe.

Limitations of use: depending upon the chosen location for EVCP for commercial users it may still be possible to allow public use by EV passenger car drivers. However any infrastructure installed specifically for freight use may be required to be "not open to the general public" in order to ensure commercial users gain confidence and guaranteed access. This could be achieved easily by ensuring these requirements are understood at the beginning of the process and are considered when any access tools are specified for use of the charging equipment (e.g. RFID cards, keys etc.).

Ability to ensure access, via enforcement of the EVCP bays: experience shows a high level of abuse of loading bays by drivers and a CP is of limited use by an EV operator if someone is illegitimately parked in their space.

Grid capacity / reliability: installing EVCP of higher power (AC 3 phase/ 22kW or DC 50kW) will place additional demands on the electricity grid and require new cabling and links to be put in place.

Funding: who will fund the infrastructure and are there any available grants or incentives available? The Office for Low Emission Vehicles (OLEV) Plugged in Places (PIP) programme is in operation until 31st March 2013 in eight regions and London is covered in this respect by the TfL PiP project operated under the Source London scheme. It may be that funding could be made available under these for CP specific to commercial users of EV, but this would be dependant on the type and timing of the charging infrastructure to be installed.

Renewable Energy can be provided to EVCP: there are various suppliers who can supply electricity produced from renewable sources if this is required. For example Ecotricity, Good Energy Ltd, Eon "Go Green", NPOWER "Juice", Scottish Power "Green Energy H2O", British Gas "Zero Carbon".

A3.2 Key players relevant to developing an EVCP strategy

Some of the key players that should be considered for contact during the further development of an EV CP strategy for freight vehicles in London are set out in Table 3.2.

Table A3.1 Key contacts for freight EV CP strategy development

Stakeholder Type	Organisation	Notes
DNO	UK Power Networks - Low Carbon London project	As the Distribution Network Operator (DNO) UK Power Networks are responsible for ensuring electricity supply to all customers in London (regardless of the energy provider) remains uninterrupted and is sufficient to meet demand.
Energy Provider	EDF Energy	EDF Energy are taking part in a number of EV related projects in the UK and in London specifically.
Energy Provider	British Gas	As well being an Energy Provider, British Gas is the preferred supplier and installer of charging infrastructure for Nissan and Renault and has installed a large number of domestic and commercial charging points across the UK. British Gas also offer EV electricity tariff for EV owners.
Energy Provider	E.ON E.ON EV Miles	As well being an Energy Provider, E.ON are installing rapid chargers (50kW DC) in Germany. E.ON have recently launched a special tariff for electricity, for EV users, called E.ON EV Miles.
Charging point supplier	ChargeMaster	ChargeMaster are a supplier of slow and fast charging infrastructure. They have also launched a privately funded nationwide EV charging network – POLAR.
Charging point supplier	Pod-Point	Pod Point supply slow and fast charging infrastructure
Charging point supplier	Elektromotive	Elektromotive supply slow charging infrastructure - Elektrobay