London’s Electric Vehicle Infrastructure Strategy

Draft for Consultation

Turning London electric
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Executive summary

Chapter one – Executive summary

While improvements to the internal combustion engine will continue to reduce vehicular emissions of carbon dioxide and air pollutants over the next few decades, it is generally agreed that the adoption of new vehicle technologies will be required to achieve emission targets. Of the potential candidates, there is growing consensus that electric vehicles (EVs) are the best near-to-market low-emission vehicular technology. With no emissions at point of use and “well-to-wheel” carbon dioxide emissions 30-40 per cent lower than comparable petrol or diesel-fuelled vehicles, EVs will play an important role in tackling both local and global environmental challenges in the future.

Recognising these benefits and the inherent suitability of EVs to urban environments such as London, the Mayor launched his Electric Vehicle Delivery Plan in May 2009. The plan highlights the requirement for extensive charging infrastructure to facilitate the uptake and usage of electric scooters, motorcycles, cars, vans and light trucks by Londoners and London’s businesses. This draft strategy sets out the proposed approach to the deployment of charging infrastructure for privately-owned EVs up to 2015.

Initially at least, it is envisaged that the majority of private EV owners will mostly charge their vehicles at home and overnight. This is the cheapest, greenest and most convenient means of charging when off-street parking is available.

Despite this, it is vitally important to make rapid progress with the provision of publicly accessible charging infrastructure over the next few years. Visibility of charging infrastructure during the period preceding the likely mass market launch of EVs in early 2011 will generate consumer interest and bolster the confidence of those contemplating the purchase of an electric vehicle. Practically, it is inevitable that EV owners will occasionally be unable to charge their vehicles at home and will need to top-up their vehicle’s battery elsewhere. Public charging points will also be required for rare instances when daily vehicle mileage in London exceeds the battery’s range. Evidence suggests that accessible charging infrastructure also helps to alleviate “range anxiety”, which can otherwise limit the utility of EVs.

Looking beyond early adopters, public infrastructure will be the only practical means of charging for London-based owners of EVs without access to off-street parking at home. With two-thirds of London’s households unable to park off-street, publicly accessible charging points are a prerequisite for the widespread adoption of EVs.

The Electric Vehicle Delivery Plan sets out a challenging, but attainable target of installing 25,000 charging points in London by 2015. The majority of these points (approximately 22,500) will be installed in workplace car parks. As the most predictable destination for many vehicle owners, utilisation of charging points installed in workplaces is likely to be high. Further, with vehicles typically parked for seven or more hours in a relatively secure location, low-specification cheaper charging points are entirely adequate and represent good value for money.
Executive summary

These workplace points will be complemented by approximately 2,000 charging points in publicly accessible car parks and a further 500 points on-street. Car parks associated with supermarkets and other retailers, near town centres, or attached to train and London Underground stations are promising locations for charging facilities. Collaboration with the boroughs and commercial sector partners will also be a vital part of the deployment process. Installation of charging infrastructure will be further encouraged by London Plan proposals requiring that new developments equip 20 per cent of their parking spaces with charging points.

The type of charging point installed in a specific location will be determined predominantly by the likely duration of parking. Standard (3kW) points, which are capable of topping up a battery in a couple of hours and charging a battery from empty in six to eight hours, will be employed in parking locations typically used by commuters, for example train and London Underground stations and car parks near workplaces. Fast points (7-43kW), capable of topping up batteries in 30 minutes and charging from empty in a few hours, are well suited to retail car parks and on-street locations. In both these cases, it is unlikely that the user will remain with the vehicle during the charging process.

These charging points will be linked to form a pan-London charging network, enabling EV owners to use all publicly accessible charging points in London. Common technical standards are a prerequisite to create the network and Transport for London will work with charging point manufacturers to establish these over coming months.

Rapid points (50-250kW) will most likely be utilised by drivers with a near-empty battery. Charging will take 10-20 minutes, during which time the driver will probably remain near their vehicle. These units are likely to be installed in dedicated off-street charging facilities or concessions within retail car parks. Users may have to pay a premium to use this type of service.

The distribution of charging points across London over the next few years will be critical to maximise early uptake of electric vehicles. A number of equitably dispersed charging points will form the foundation of the charging network and will be positioned with the aim of ensuring no Londoner is more than one mile from a publicly accessible point by 2015.

However, beyond this basic network, charging infrastructure will be targeted at areas where uptake of electric vehicles is anticipated to be highest. Analysis suggests that Londoners living in a band running from the north, through central London and out towards the south-west are likely to be the first to consider purchasing electric vehicles. Focussing infrastructure deployment within this region and in destinations frequented by people living in this area will not only deliver the greatest environmental benefit in the short term, but will maximise sales, drive down vehicle costs and help to make EVs accessible to a greater number of Londoners.
This strategy reflects the best current view of the developing electric vehicle sector. However, the technology associated with electric vehicles and charging infrastructure will advance rapidly over the next decade. Similarly, EV owner behaviours will evolve as familiarity with this new type of vehicle grows. Consequently, the strategy will need to be reviewed on an ongoing basis.

Comments on this initial draft strategy are invited from stakeholders before Friday 26 February 2010.

However, in order that any responses can be incorporated into London’s bid for the UK government funding initiative “Plugged-in Places”, we would welcome comments before Friday 15 January 2010 where possible. Responses should be sent to ev@london.gov.uk with “Electric Vehicle Infrastructure Strategy” entered as the subject of the email.

Figure 1: Charging an electric vehicle in London; typical locations
Chapter two – Introduction

2.1 What is an electric vehicle?

An electric vehicle is a vehicle that is propelled by an electric motor. Electric vehicles may be powered entirely by a battery that is charged by connecting to the electricity supply network (known as battery-electric vehicles or BEVs), or a battery working in tandem with an internal combustion engine (known as a plug-in hybrid or PHEV). Emerging BEV models will have a range of at least 80 miles. The overall range of a PHEV is extended by its internal combustion engine to distances similar to comparable petrol and diesel powered vehicles; however, electric-only range is currently limited to tens of miles.

While offering less environmental benefit compared to BEVs, PHEVs may be an important bridging technology between internal combustion engine vehicles and BEVs. When used throughout the remainder of this document, the term “electric vehicle” refers to both BEVs and PHEVs.

Charging infrastructure outlined in this strategy is intended to support electric cars, vans and powered two-wheelers. However, much of the analysis presented relates specifically to private cars, as these may represent the greatest opportunity to decarbonise London’s transport. Electric two-wheelers are dealt with in appendix 2, while the charging of commercial vehicles is addressed in appendix 3. Specific-use vehicles, such as waste collection vehicles, are likely to require dedicated charging facilities. Electrically assisted bicycles are not explicitly covered by this plan, though they are potentially an attractive cycling opportunity, especially in Outer London, in the future.

2.2 Why promote electric vehicles?

2.2.1 Environmental benefits

Electric vehicles offer a number of environmental benefits and are the closest near-market clean technology. Widespread adoption of EVs will:

- **Reduce carbon emissions**: Cars are responsible for 16 per cent of London’s total CO2 emissions. With electric vehicles, CO2 reductions are dependent on the source of electricity used for charging. Using current UK grid mix, electric vehicles emit around 30 to 40 per cent less CO2 than comparable internal combustion engine vehicles. In the longer term, increasing generation of electricity from renewables offers a pathway to carbon-free motoring.

- **Improve air quality**: London’s air quality is the worst in the UK and breaches EU and national targets. 46 per cent of Greater London’s emissions of NOx and 83 per cent of Central London PM10 emissions come from road transport. Electric cars have zero emissions at the point of use and could help improve air quality, and hence Londoners’ health. While there are emissions at power plants, these are generally easier to manage because they are concentrated at fewer point sources.

- **Reduce noise**: Traffic noise is a major problem, especially for those living or working close to major roads. Electric vehicle motors are near-silent, meaning at low speeds typical of...
urban diving noise pollution is minimal. More research is required on the potential impact of EVs travelling at low speeds on disabled and visually-impaired people.

2.2.2 UK economic benefits

Increased use of electric vehicles will also help to address a variety of energy related issues confronting the UK. Widespread adoption will:

- **Protect consumers from volatile petrol prices:** Increased global demand for oil and declining reserves currently subject motorists to volatile (and generally rising) fuel costs. While electricity costs are currently linked to fossil fuel prices, increasing renewable energy generation will help to break this link. Over time, this will stabilise electricity prices and the costs of running an electric vehicle.

- **Enable better use of the UK grid:** Charging at off-peak times will result in better utilisation of electricity generating infrastructure. Research commissioned by the UK government has examined the impact on the national grid of a significant growth of electric vehicles. It concluded that there is sufficient generating capacity to cope with the increased electricity demand, assuming that demand for charging is managed and targeted at off-peak periods. It also found that the existing national transmission network will be sufficient to cope with the demand from vehicles though there may be local distribution issues to overcome.

- **Vehicle batteries could also be used to store energy at times of low demand and then feed this back to the grid at peak times, reducing the need for peaking plants and maximising the utility of renewable assets.** The impact of vehicle charging on local networks and infrastructure will be researched by the Energy Technologies Institute (ETI), which is commissioning further research to highlight issues.

2.2.3 Financial benefits for Londoners

Electric vehicles have lower running costs compared to internal combustion engine vehicles. Fuel costs for EVs are typically around 3p/km compared to around 10p/km for an equivalent petrol vehicle. Electric vehicles are also exempt from road tax, receive a 100 per cent discount on the central London Congestion Charge, and often incur lower insurance premiums.

Recognising these significant benefits, automotive manufacturers plan to commence mass production of electric vehicles in the next three years. London must work with manufacturers, boroughs and the commercial sector to ensure adequate infrastructure is in place to support these vehicles.

Promotion of EVs is only one element of the Mayor’s plans to reduce transport emissions. Continued investment in walking, cycling and public transport is vitally important. Londoners not immediately interested in the purchase of an electric vehicle must also be encouraged to buy more efficient petrol or diesel models.

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6. Arup (for Department for Business Enterprise and Regulatory Reform & Department for Transport), October 2008, Investigation into the Scope for the Transport Sector to Switch to Electric Vehicles and Plug-in Hybrid Vehicles, Arup (for Department for Business Enterprise and Regulatory Reform & Department for Transport).

7. Assumes domestic electricity cost of 14p/kWh (average London domestic electricity price in 2009, Department for Energy and Climate Change), vehicle energy demand of 0.2 kWh/km, and energy efficiency of 85 per cent (Element Energy Limited, 2009, Strategies for the Uptake of Electric Vehicles and Associated Infrastructure Implications).

8. Assumes fuel economy of 30 miles per gallon and fuel price of £1.10 per litre.
2.3 Mayor’s EV Delivery Plan

The Mayor’s EV Delivery Plan was launched in May 2009 and sets out a comprehensive strategy to encourage electric vehicles in London. The Plan is grouped around three key themes:

- **Infrastructure**: The Plan sets a target of 25,000 charging points across London by 2015. This will be delivered through working with the boroughs, the commercial sector and other partners.

- **Vehicles**: The Plan also sets out the target of 1,000 electric vehicles in the Greater London Authority (GLA) fleet by 2015, with the intention that this will stimulate the wider EV market. As well as delivering this, the GLA will seek to support increasing the number of EVs in other public sector fleets (e.g. boroughs) and will work with businesses to expand the use of EVs in their fleets.

- **Incentives, marketing and communications**: In addition to guaranteeing the Congestion Charge discount for electric vehicles (which is currently worth up to £2,000 a year), the Plan commits to working with the boroughs to develop a simplified range of parking incentives, encourage the uptake of electric vehicles by car clubs and develop a London-wide membership scheme for EV users, giving easy access to a charging point network.

2.4 The Purpose of this strategy

Provision of electric vehicle charging infrastructure is critical to the adoption of vehicles. This document sets out an overarching strategy for charging infrastructure, and provides targets and processes for its roll-out across London. It includes information on the types of locations where infrastructure will be installed, the attributes of a pan-London charging network, and a preliminary view of the funding and procurement processes. While the charging infrastructure described is expected to be used by various kinds of vehicle, the focus of our analysis is on private electric cars. Electric two-wheelers and commercial vehicles are dealt with in appendices 2 and 3 respectively.

This document explains the rationale for the roll-out of charging points across London, seeking to ensure that:

- There is a basic level of charging point coverage across London. Proximity to infrastructure is a practical requirement for charging purposes, but will also address the issue of “range anxiety”. Access to fast charging points at certain locations across London will be essential in the near term (2–3 years).

- There is a holistic approach to charging infrastructure, making it easier for people to find charging infrastructure where they live, work and drive.
• Local concerns regarding on-street charging points, both in terms of health and safety, and controlled parking zones are adequately addressed

This draft strategy has been developed in cooperation with London Councils and boroughs. While the strategy provides a practical starting point, the rapid pace of technology development and as yet unknown consumer response to EVs will necessitate evolution of the strategy over the coming months and years. Further refinement to address specific issues at a local level will also be required.
Chapter three – Electric vehicle charging infrastructure: now and in 2015

3.1 Current infrastructure in London

There are currently around 1,700 electric vehicles in London, representing 0.06 per cent of the total number of vehicles registered. Over 250 electric vehicle charging points are currently in operation in London, with the greatest concentration in central areas (see figure 2). They are primarily located in publicly accessible car parks, with only 32 charging points on-street. Previous experiences of boroughs and Transport for London in delivering these facilities will be drawn upon to expedite further installation over the coming years.

3.2 Charging infrastructure in 2015

3.2.1 Factors affecting the future development of electric vehicle infrastructure

A number of factors will influence the type and location of EV charging infrastructure across London:

- Infrastructure must be compatible with vehicles produced by various manufacturers
- There must be sufficient infrastructure to deliver the targeted take-up rate. In the early years, it is important to ensure that the ratio of charging points to the number of EVs remains high, as it will help create confidence among potential EV buyers. As the number of EVs increases, this ratio will gradually reach an optimal level, after which any future increases in charging infrastructure will be based on demand
- The desire to promote early adoption of EVs must be balanced with the fast evolving nature of the technology. In order to select the best infrastructure options, it will be necessary to assess available technologies in terms of cost, charging time, safety, practicality and other factors, and to compare these with products on the near horizon
- Charging must be encouraged during off-peak hours. The grid already operates close to capacity at peak times, making it a priority to encourage overnight charging, primarily at home. Smart meters and variable tariffs should be employed to promote favourable charging behaviours
- The desire to provide pan-London coverage must be balanced with borough and local concerns over losing regular parking spaces to EV charging spaces
- Efforts will be made to position on-street charging points in a way that is sensitive to the urban environment and does not adversely contribute to “street clutter”

3.2.2 Placement of new charging infrastructure

It is expected that most EV owners will charge their vehicle at home, overnight. Another promising opportunity for charging is workplace parking, since users regularly leave their vehicle for seven or more hours at a time. Correspondingly, 22,500 charging points will be installed in workplace car parks. Together, home and workplace charging constitute “private charging” and are dealt with in section 4.
The publicly accessible charging network will consist of around 2,000 points in public car parks (e.g. car parks owned by the boroughs, Transport for London, Network Rail, retailers and private operators like NCP). A further 500 will be located on-street. Details of the publicly accessible charging network are provided in section 5.

The time taken for an EV battery to charge depends on the initial state of charge and the power capability of the charging point utilised. Points also come equipped with different levels of technical sophistication and communications capability. For these reasons, the distribution of different types of charging point will be determined by local needs.
Chapter four – Private charging

It is envisaged that most EVs will be charged using privately-owned infrastructure located at home or in workplaces.

4.1 Homes

Initially, most private EV owners will charge their vehicles overnight at home. This is the cheapest, greenest and most convenient means of charging when off-street parking is available. Vehicles can be charged using low-cost standard domestic electrical outlets. Using these domestic sockets, it currently takes six to eight hours to fully charge a BEV, with a much shorter length of time to top-up a battery in a car which typically travels less than 20 miles per day.

While not a problem in the immediate future, as vehicle numbers increase, smart metering and variable tariffs may be required to encourage off-peak charging. It is likely that utilities will start to subsidise the installation of smart metering in homes to protect the local electricity distribution from overloading at peak times. This will ease the strain on the local distribution network as well as utilise greener electricity (as “peaking plants” rely heavily on fossil fuels). Preliminary discussions have commenced with utility companies on these and other matters.

Advice on home vehicle charging will be provided through the Mayor’s Home Energy Efficiency Programme and other agencies providing information on reducing residential carbon emissions and cutting energy bills, as well as on the London EV website.

Access to off-street parking varies significantly across London. Approximately a third of households across London have off-street parking. However, access is far more prevalent in outer London boroughs (see figure 4) and around half of privately-owned vehicles are garaged off-street.

Policy 6.13 in the consultation draft of the London Plan (October 2009) proposes that 20 per cent of parking bays in new developments be equipped with charging infrastructure. Over time, this requirement will deliver several thousand charging points each year, at minimal additional cost (see figure 5).

The London Plan is currently undergoing public consultation and it is anticipated that a revised Plan will be adopted in 2011. However, even with changes to planning policy, not all Londoners will be able to charge an EV at home. Residential charging must therefore be supplemented by charging infrastructure in other locations.

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11 GLA, 2009, The London Plan. Note that the policy is not limited to residential developments
Figure 4: Households with off-street parking across London (the labels show the percentage of households in each borough with off-street parking)

Figure 5: Proposed new developments in London, 2011-2021
4.2 Workplaces

Of the 25,000 charging points to be installed in London over the period to 2015, approximately 22,500 (90 per cent) of the points will be provided in workplace car parks. Workplaces across London currently have over 700,000 parking spaces, so this target requires the installation of charging points in approximately 3 per cent of spaces. These charging points will be primarily used by employees, but could also be used to charge fleet vehicles overnight.

To avoid modal shift away from public transport, workplace charging points must be targeted at places where Londoners already commute by car (see figure 6).

Transport for London is looking at proposals to support businesses to install charging points in their car parks. An initiative similar to the “Take a Stand” scheme, where businesses can apply for free cycle stands, is under consideration.

Initially inexpensive three-pin plug sockets will account for the majority of workplace charging points. As the number of EV owners increases, businesses may require more sophisticated infrastructure to enable recouping of electricity costs. While points designed for on-street use have this functionality, they may be over-specified and too expensive for this purpose. Charging point manufacturers are developing simpler charging points incorporating metering capabilities and controlled access features. These

Figure 6: Car commuter destinations across London (the labels show the percentage of commuting trips into each borough made by car)
are likely to have much lower installation costs than on-street points, and could be installed by in-house electricians. Figure 7 shows the proposed number of workplace charging points to be installed over the period to 2015.

Engagement with businesses will start in 2010. Delivery of workplace charging points will start slowly and accelerate as EVs become more widely available over the next few years. Large businesses with employee car-parks will be targeted in the first instance, though all organisations with car-parks will be encouraged to install charging points.

**Figure 7:** Anticipated delivery of 22,500 workplace charging points up to 2015
Chapter four

Figure 8 shows the targeted number of workplace charging points in each borough in 2015. Distribution has been determined by both the overall number of existing workplace car parks in the borough and the number of workers commuting by car to the borough.
Chapter five – Publicly accessible charging infrastructure

A pan-London publicly accessible charging network will be provided to support EV owners without off-street parking, as well as those driving longer distances who may need to “top-up” their battery. While being vitally important, the publicly accessible charging network will be small in size compared to the number of points provided in workplaces.

About 2,500 points will be publicly accessible in London. Of these, approximately 500 will be on-street and 2,000 in off-street car parks.

**A core network of fast charging points**

Points installed initially will charge at standard speeds; however, it is likely that points capable of faster charging will be used (and existing points upgraded) at most locations in the future. Depending on the location and the average duration of parking, standard, fast or even rapid charging points may be most appropriate (See appendix 1 for definitions of different charging speeds).

At least 250 fast points will be publicly accessible by 2015 (50 by 2012), forming a core fast charging network. These charging points will be provided as part of basic coverage in key town centres, as well as at strategic points on the road network and at motorway services.

Partner organisations will play an important role in the roll-out of fast, and ultimately rapid, charging infrastructure. Supermarkets and other retail outlets with large car parks are attractive potential locations as they are well known to Londoners, tend to be easily accessible from the road network, and often have on-site electrical substations, enabling fast charging without the need to strengthen the supply network. Rapid charging will be attractive for drivers undertaking longer trips, and for specific market segments (e.g. taxis, commercial vehicles). Locating rapid charging points in outer London and at motorway services will support national infrastructure integration and facilitate inter-city EV journeys.

**Figure 9:** Likely evolution of fast charging points across London

- **2012:** 32A standard (some 3-phase & DC)
- **2015:** 3-phase standard (some DC)
- **2020:** DC charging or equivalent standard
5.1 Principles guiding distribution of charging points

The delivery of the publicly-accessible EV charging network for London will be led by two guiding principles:

1. Provide equitable base coverage
   - Any Londoner wishing to buy an EV should have reasonable access to charging facilities

2. Target infrastructure in key locations
   - Substantial EV uptake will ensure environmental benefits are maximised
   - Well-utilised charging point will deliver value-for-money
   - Accelerated adoption will result in cheaper vehicles for all

As a minimum, the pan-London EV network will aim to ensure no Londoner is more than one mile from a public charging point by 2015. With 2,500 public charging points to be delivered by 2015, a focus on early adopter areas, especially in early years, is important. After 2015, mass market uptake of EVs will drive demand for additional infrastructure across London.
**Figure 10:** Delivering the 2,500 publicly-accessible points

2,500 publicly-accessible points

- Pan-London coverage
  - Start building good base coverage via points in:
    - Town centres
    - Private partner car-parks with good pan-London coverage

- Targeting likely early adopter “hotspots”
  - Target infrastructure in areas with a high proportion of likely early adopters
  - Provide additional infrastructure in hotspots
  - Expand hotspots as EV numbers grow pan-London

**Figure 11:** Pan-London coverage and early adopter “hotspots” (conceptual)
Equitable pan-London coverage

A number of the on-street and off-street charging points will be distributed across London’s town centres, as well as in appropriately-situated private and borough-owned car parks, with the intention of ensuring equity and addressing range anxiety.

While local considerations will need to be taken into account, it is envisaged that key town centres will each have several charging points (see figure 12).

Efforts to provide truly pan-London coverage will aim to ensure that every Londoner will be no more than one mile from the nearest electric vehicle charging point by 2015.

Targeting potential EV “hotspots”

With funding for EV infrastructure limited, it is important to target the installation of supplementary charging points at locations where utilisation is likely to be highest. Faced with a new product, customers can generally be classified into five categories: innovators, early adopters, early majority, late majority and laggards (see figure 13). The uptake of new products tends to be characterised by a relatively small group of “innovators” and “early adopters” leading the way for subsequent mass-market adoption. Assuming the growth of EV ownership follows this pattern, targeting innovators and early adopters alone will go a long way towards realising London’s EV targets. But who will be the EV innovators and early adopters?

It has been hypothesised that current hybrid and EV owners and people with similar traits to these owners will form the bulk of the innovator and early adopter groups. These people have previously demonstrated a willingness to pay a premium for new technologies, which in some circumstances have functionality limitations. In order to get the highest possible uptake of EVs across London and maximise value for money, additional infrastructure will be targeted at hotspots that have the greatest number of early adopters.

This raises two further questions:
- Where do likely EV-owners live?
- Where do likely EV-owners drive to?

London-wide socio-economic analysis has been undertaken to help answer these questions, and to decide where charging infrastructure investments should be prioritised.

Locating “likely” innovators and early adopters using segmentation analysis

Where do current EV and hybrid owners live?

Looking at current ownership of EVs in London, they are primarily registered in the City, Westminster, Camden and more central parts of Brent, Barnet and Haringey (see figure 14). Hybrid cars are currently registered in similar locations (see figure 15).

12 International, metropolitan and major town centres are designations of the 2009 GLA London Plan.
Figure 12: International, metropolitan and major centres in London

Figure 13: Technology adoption lifecycle

Figure 14: EVs registered for alternative fuel discount

There is a band across London, from the north to the south west, where electric vehicles are more popular.

This can in part be explained by current policies. Camden and Westminster, for example, have implemented free or discounted parking schemes and installed a large number of charging points already. However, the attitude of people living in these areas is of equal importance.

Figure 15: Hybrids registered for alternative fuel discount

The take up of hybrids is more widespread, reflecting greater product maturity.

However, hybrid ownership is highest in similar areas to EVs. This concentration can be explained by similar factors.
Who are the likely innovators and early adopters?

The group of likely EV innovators and early adopters is only partly comprised of current EV and hybrid owners. The remainder of the target group consists of Londoners with similar characteristics to these existing vehicle owners. The Mosaic Public Sector data analysis tool was used to determine the socio-economic features of these two groups. The tool draws on 400 nationwide data variables to characterise every UK postcode as one of 61 household types.

Analysis showed that most current EV and hybrid car owners come from a limited number of Mosaic household types (figure 16). Five of the Mosaic types make up nearly three quarters of current electric vehicle owners. Hybrid car owners are more diverse; however, the same five Mosaic types make up 60 per cent of current hybrid car owners.

Identifying the characteristics of these groups will enable a better understanding of what motivates potential early adopters and more effective communication of EV benefits.

Table 1: Mosaic types who currently own electric or hybrid cars

<table>
<thead>
<tr>
<th>Mosaic type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global connections</td>
<td>Affluent middle-aged singles living in central London</td>
</tr>
<tr>
<td>Cultural leadership</td>
<td>Professionals living in middle ring suburbs and working in central London</td>
</tr>
<tr>
<td>New urban colonist</td>
<td>Ambitious singles or couples living in high density suburbs</td>
</tr>
<tr>
<td>City adventurers</td>
<td>Young and single skilled workers living in inner suburbs</td>
</tr>
<tr>
<td>Corporate chieftains</td>
<td>Business managers living in detached houses in outer suburbs</td>
</tr>
</tbody>
</table>

Mapping these five key Mosaic types across London provides an understanding of where future EV owners are likely to live (figure 17). The largest representations are found in central, north-west and south-west parts of the city, with pockets in the southern and eastern suburbs.
Targeting likely early adopters using location-specific features

In order to maximise the uptake of electric vehicles in London, it is also important to look at likely EV uptake based on several location-specific features. These include:

- Availability of off-street residential parking, as this facilitates regular charging at home
- Locations where vehicle owners drive substantial distances, as this helps maximise the environmental benefit of EV usage and its cost-effectiveness
- Multi-car ownership households, as the likelihood of switching second cars to EVs is high

Figures depicting this information are contained in appendix 4. These location-specific factors, together with the segmentation analysis have been used to guide our understanding of the distribution of likely EV owners over the coming years.

“Hotspot” analysis will be used alongside borough knowledge of local issues to plan the distribution of charging infrastructure in the future. A preliminary hotspot analysis for Camden is shown in figure 18, suggesting three potential hotspots for targeting EV promotional efforts and charging points. Possibly even more important is identifying the principal destinations of Londoners living in hotspot areas. Charging points must be deployed in these locations as well. Specific location-based plans will be developed in conjunction with boroughs over coming months.
5.2 Potential locations for publicly accessible charging points

A variety of locations are well suited to the installation of charging points. Delivery will require effective working between Transport for London, the GLA, boroughs and other organisations.

5.2.1 Transport hubs

London Underground car parks

The EV Delivery Plan commits to installing charging points in London Underground car parks. There are presently 63 London Underground car parks (figure 19) with approximately 10,000 spaces. They are primarily distributed in the outer boroughs with the majority being in North London. Management of these car parks is outsourced to National Car Parks (NCP).
Phase I: The first phase of installation in London Underground car parks will be completed by March 2010, with 12 charging points installed in six car parks.

Table 2: London Underground charging point Phase I locations

<table>
<thead>
<tr>
<th>Car Park</th>
<th>Number of spaces</th>
<th>Proposed charging points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodside Park</td>
<td>141</td>
<td>2</td>
</tr>
<tr>
<td>High Barnet</td>
<td>207</td>
<td>2</td>
</tr>
<tr>
<td>Highgate</td>
<td>41</td>
<td>2</td>
</tr>
<tr>
<td>East Finchley</td>
<td>267</td>
<td>2</td>
</tr>
<tr>
<td>Arnos Grove</td>
<td>306</td>
<td>2</td>
</tr>
<tr>
<td>North Greenwich</td>
<td>506</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>506</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

These car parks have been chosen based upon where current EV owners and potential early adopters live and work.

EV charging points will be installed in visible locations within these car parks, close to station main entrances and exits where practical. Once installed, the EV charging points will be monitored to understand usage and maintenance requirements.

Phase II: Transport for London and London Underground will continue to work to install charging points in suitable London Underground car park locations. Further details of Phase II will be worked up over the next few months.
National Rail car parks
Initial discussions have taken place with the Train Operating Companies, who are keen to support delivery of the Mayor’s aspirations for EVs in London. Transport for London is working with the Association of Train Operating Companies to develop a detailed plan to install charging points in appropriate locations.

5.2.2 Publicly accessible car parks

Borough Car Parks
A number of boroughs have been working to provide charging points in their car parks using Transport for London funding. Existing plans and funding will result in the installation of a further 80 points over the next few months. Beyond this, Transport for London will continue to work with boroughs to install charging points in suitable car park locations.

Privately owned publicly accessible car parks (including retail/leisure)

Privately owned, publicly accessible car parks
Initial discussions have taken place with private car park operators, who are keen to support delivery of the Mayor’s aspirations for EVs in London. Further discussions will be undertaken over the next six months to work up detailed plans.

Retail and leisure car parks
Retail and leisure car parks are important locations for charging points as they provide good coverage across London, are well-known destinations for drivers and the usual length of stay ranges from 20 minutes to a few hours. Many of these car parks are also located close to residential areas, and with agreement from the owners could be opened up
overnight to allow local residents to use charging facilities.

Eleven Sainsbury’s car parks are already equipped with two charging points each\(^{13}\). Tesco has installed points in three of its London car parks\(^{14}\). Both these chains and others have indicated a desire to install more points in the future. Elsewhere, 30 charging points have been installed at Westfield Shopping Centre in West London. Retail car parks may also be ideal locations for faster charging points in the near future.

5.2.3 On-street parking

Transport for London and the boroughs have been working together to install on-street charging points across London for several years. There are currently 32 on-street charging points in London. A further 12 will be delivered on borough roads in the next few months. Transport for London will be working with the boroughs to expand current efforts and deliver the Mayor’s aspirations for 500 on-street points by 2015.

In addition, Transport for London is looking at opportunities to install charging points on appropriate Transport for London Road Network (TLRN) side-roads to supplement current and planned points. An initial short-list of more than 50 potential locations has been identified.

5.2.4 Car club bays

There are almost 2,000 car club vehicles and more than 70,000 car club members in London. Most members are motivated to join by cost savings in comparison to owning and running their own vehicle\(^{15}\). Car club bays are primarily based in inner and central London (see figure 22).

To date, trials of PHEVs and BEVs have been limited to a handful of car club vehicles, primarily due to the high cost of vehicles, but also due to worries about vehicle performance and customer response. However, looking forward, EVs are ideally suited to usage as car club vehicles for a number of reasons. Usage patterns of car club vehicles make EVs a practical option, with the availability of dedicated bays making it easier to provide EV infrastructure. With a high proportion of car club vehicles used in central London, the Congestion Charging discount is an additional argument in favour of EVs. Transport for London will work with the four authorised car clubs to identify opportunities to introduce EVs in their fleets, in particular by providing financial support for charging infrastructure.

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\(^{13}\) The first phase of Sainsbury’s charging points are at their stores in Beckton, Camden, Chiswick, Cromwell Road, East Dulwich, Greenwich Peninsula, Islington, North Cheam, Sydenham, Wandsworth and Whitechapel.

\(^{14}\) 2 points at both Kensington and Vauxhall Kennington, and one point at Bromley-by-Bow (part-funded by the borough of Tower Hamlets).

\(^{15}\) Transport for London Car Clubs Research (2007)
Chapter five

Figure 21: Locations of large supermarkets and NCP car parks in London

Figure 22: Locations of car club bays in London
5.3 Dedicated non-networked charging facilities

Several commercial operators have proposed the development of dedicated charging facilities for EVs. These could be organised along a number of models, but would all include the ability to charge BEVs in a short period of time, typically under 30 minutes. This could be achieved through the provision of rapid DC charging facilities, or via battery-swapping (allowing a driver to exchange the car’s depleted battery for a fully charged one).

These types of facilities could be capable of capturing and storing electricity from the grid at off-peak times, allowing charging to occur at peak times with minimal grid impact. It is likely that users of rapid charging facilities will need to pay a premium to use this type of service. London will endeavour to foster an environment where these types of innovative business models can develop.

5.4 Timelines for delivery

The charts below show the proposed number of publicly accessible charging points to be installed over the period to 2015. Delivery will start relatively slowly and subsequently grow at a faster rate to reach the 2015 targets.

**Figure 23:** Anticipated delivery of 500 on-street publicly accessible charging points up to 2015
Figure 24: Anticipated delivery of 2,000 off-street publicly-accessible charging points up to 2015
Chapter six – Overview of charging infrastructure

6.1 Charging point distribution

Figures 25 and 26 show the estimated number of electric vehicle charging points to be installed on-street, off-street in public locations and in workplace car parks across inner and outer London and London’s sub-regions by 2015. This distribution is only indicative, but will be a useful aid in focusing efforts to deploy charging points across London.

6.2 Targeted rate of installation

Figure 27 depicts the anticipated installation timelines for all charging points. It is anticipated that the rate of installation will accelerate as engagement with relevant stakeholders develops and procurement processes are established.

Figure 25: Proposed distribution of charging infrastructure across inner and outer London by 2015
Figure 26: Proposed distribution of charging infrastructure across London’s sub-regions by 2015

Figure 27: Anticipated delivery of charging points to 2015
7.1 Network integration

Home and workplace charging points will be privately controlled by individuals and organisations, with the sophistication of charging points determined by local necessity.

However, it is vitally important that publicly accessible points form part of a London-wide network. Currently there are separate membership schemes for each of the London boroughs operating charging points. As charging infrastructure expands and EV prevalence increases, it is critical to develop a pan-London network accessible for all EV users. The network must also meet the requirements of other stakeholders involved in the provision of publicly accessible EV charging. These include utilities, boroughs, infrastructure providers and car park owners.

As EV usage becomes more widespread, businesses will be encouraged to take a larger part in infrastructure development and identify new commercial interests and business models.

It is envisioned that the pan-London scheme will have:

- Interoperable tags or cards accepted by all scheme charging points
- Common branding for all scheme charging points, with their location and availability viewable from one website
- Standard charging point connectors
- A call centre for help and advice and to report any issues.

**Figure 28:** Charging infrastructure relationships

- Electricity Supply
- Charging infrastructure
- Network Operator
- Electric Vehicle Users

Network must facilitate flow of:
- Electricity
- Money
- Information
The scheme will initially operate as a flat fee membership scheme, whereby electric vehicle owners will:

- Pay an annual membership fee to access any of the 2,500 publicly accessible charging points
- Be able to access electricity free at the point of use: they will not be billed for electricity usage but will only pay the annual membership fee.

The aspiration is that the scheme could move to a “pay as you go” model when there is a sufficient number of EVs in London to make it viable. Under this type of scheme, users would be charged according to usage rather than a flat annual fee. Operation of the scheme would be reviewed annually with scheme partners.

Transport for London is currently working with London Councils and other partners to specify the detailed requirements of the system.

### 7.2 Funding and procurement processes

Transport for London has allocated £20 million to promote the accelerated adoption of EVs in London. Transport for London is also working with several public and commercial sector organisations to apply for funding through the Government’s “Plugged-in Places” Electric Vehicle Infrastructure Framework. The level of financial support received from this initiative, together with an application for European Commission funding associated with a large scale electro-mobility demonstration project, will determine the exact nature of delivery mechanisms for charging points. However, it is envisaged that joint procurement frameworks will play a key role in minimising both infrastructure and installation costs. Figure 29 outlines the potential funding mechanism for London.

### 7.3 Monitoring

The rate of EV adoption will be monitored via registrations for the Congestion Charge discount and membership to the pan-London scheme. Once a base level of charging infrastructure has been deployed, utilisation of points and the level of membership of the pan-London scheme will be monitored to inform both the rate and location of infrastructure roll-out in the future. Market research will also be undertaken to ensure the needs of early EV adopters are being adequately addressed. The appropriateness of the overall infrastructure strategy will be reviewed periodically.
**Figure 29**: Potential funding mechanism

- **TfL**
  - GLA charging points
    - Blue Commandos (adapted 240V sockets)
    - Stand-alone standard/fast/rapid points
  - Public charging points fund
    - On-street, in particular key town centres
    - Publicly accessible car-parks
  - Workplace car park fund
    - Employee car-parks
    - TfL will contribute to the cost of the infrastructure and/or its installation
    - Set up fund with call-off deadlines

- **Plugged-in Places**
  - GlA fleet garages
  - GLA car parks (e.g. Police stations)
  - Part of TfL/GLA bulk procurement

- **Other funding sources**
  - European Funding
    - On-street and borough car parks – TfL funded
    - Publicly accessible car-parks – part funded
    - Set up fund for boroughs and other organisations to bid into quarterly
    - Enter partnership with private organisation with suitable sites

- **EV London Fund**
  - ~250 standard points for the GLA fleet
  - 500 on-street + 2000 in public car-parks; mix of standard and fast/rapid
  - 22,500 standard points in workplaces
Chapter eight – Benefits of the strategy

8.1 Reduced carbon emissions

Over the period to 2020, if targets to improve the efficiency of internal combustion engine vehicles are achieved, emissions of CO₂ for cars will decrease by approximately 40 per cent (from the current EU average of 153.5g/km for new vehicles to 95g/km). This is vitally important as ICE vehicles will continue to form the bulk of London’s car fleet for the next decade at least.

Nevertheless, EVs can play a significant role in reducing CO₂ emissions over this period as well. Achieving targeted rates of EV adoption may save up to 80,000 tonnes of CO₂ annually by 2020, and a total of up to 400,000 tonnes up until that date. Post 2020, EVs will play a growing role in tackling climate change as vehicle numbers continue to increase and efforts to decarbonise the UK electricity supply come to fruition.

8.2 Improvements to air quality

By 2020, electric vehicles may reduce annual NOx emissions by up to 100 tonnes across London and lower the emission of PM₁₀ by several tonnes per year. As the market share of electric vehicles increases further, major improvements to local air quality will be felt. Moreover, the uptake of electric cars is expected to be particularly high in some of the most polluted parts of Greater London, such as Westminster and the area around Heathrow Airport in the borough of Hillingdon. This will have valuable health benefits for Londoners.

8.3 Reduced noise

Electric vehicle motors are near-silent, meaning at low speeds typical of urban driving noise pollution is minimal. Concern has been expressed regarding the danger quiet vehicles could present to pedestrians, especially blind or partially-sighted people. We will continue to monitor this possibility and work with all relevant parties to ensure compliance with regulations to alleviate this danger.

8.4 Financial benefits for Londoners

A major financial benefit of EVs is the lower fuel costs. The average vehicle mileage in London is around 7,200 miles per year. Assuming a petrol or diesel cost of £1.10 per litre and fuel economy of 30 miles per gallon, annual fuel costs associated with a conventional car may be around £1,150 per year. Electricity is several times less expensive than petrol or diesel, so savings of around £800 per year may be realised. Electric cars are also exempt from road tax and receive a 100 per cent discount from the Central London Congestion Charge. Combined, these factors may benefit London EV drivers by up to £3,000 per year. From 2011, EVs will also receive a government subsidy of £2,000 to £5,000 per vehicle, offsetting to a large extent the up-front premium commanded by EVs at present.
This strategy represents only the beginning of efforts to deploy EV charging infrastructure in London. Detailed working with boroughs, businesses and other stakeholders will take place over the coming months. Figure 30 outlines the anticipated delivery dates of key components of the strategy. These dates are contingent upon securing Government and European funding, and the efforts of the various stakeholders working together to provide this vital transport infrastructure for London.

Details of the strategy will evolve as charging technology develops and early adopters of EVs become familiar with its use. Comments on this initial draft strategy are invited from interested stakeholders before 26 February 2010. However, in order that any responses can be incorporated into London’s bid for the UK government funding initiative “Plugged-in Places”, we would welcome comments before Friday 15 January 2010 where possible. Responses should be sent to ev@london.gov.uk with “Electric Vehicle Infrastructure Strategy” entered as the subject of the email.
**Figure 30:** Indicative timescales

1. Timings depict best estimates for delivery and will be reviewed on an ongoing basis.
Appendix 1 – Glossary

**Air Quality Strategy**
The Mayor of London’s plan for improving air quality in London. Includes measures to reduce NOx and PM10 emissions through the uptake of electric vehicles. Published as a draft in October 2009.

**Battery**
Batteries store energy to be used by an electric vehicle’s motor. Various battery chemistries are available, including lead-acid, nickel-metal-hydride and lithium-ion. Lithium-ion batteries have progressed rapidly as mobile phone and laptop computer battery technology has developed, and this is now the most common electric vehicle battery type.

**Battery electric vehicle (BEV)**
Electric vehicle propelled by an electric motor and powered entirely by a battery which is charged by plugging it into an electrical supply.

**Battery swap**
An electric vehicle re-charging model which allows depleted batteries to be replaced by fully-charged ones at special battery swap stations. This option is being pursued by the electric vehicle venture Better Place in Israel. Battery swapping will require a degree of battery standardisation amongst vehicle manufacturers. Battery swapping stations do not form part of this strategy, but the appropriateness of such facilities will be reconsidered, should battery standardisation emerge.

**Carbon Dioxide (CO₂)**
A naturally-occurring greenhouse gas comprising around 0.04 per cent of the atmosphere. CO₂ is the most important greenhouse gas contributing to global warming. It is emitted when fossil fuels including petrol and diesel are burned. The UK government has set a target of lowering CO₂ emissions to one third below 1990 levels by 2020, while the Mayor of London wishes to reduce emissions by 60 per cent by 2025.

**Charging point**
Facility for charging an electric vehicle battery. Charging points include regular household sockets and more specialist designs. Many different types are available, but three main categories are referred to in this document (see table 3 below).

**Congestion Charge 100% discount for electric vehicles**
Registered electric vehicles receive a 100 per cent discount from the central London Congestion Charge.

**Consumer Incentive**
The UK government plans to provide £230 million between 2011 and 2014 to offset the cost of electric vehicles by £2,000–£5,000 per vehicle. Details of the programme will be announced by the Office for Low Emission Vehicles in early 2010.

**Early Adopters**
Consumers who are quick to adopt a new product. High-tech products are often bought first by innovators and early adopters, with mass-market consumers following once a product is established and perceived as less risky.

**Electric two-wheeler (E2W)**
Battery-powered two-wheeled vehicle, including electric motorbikes, scooters and trikes. Electrically-assisted bicycles are not considered as part of this strategy.
**Electric Vehicle (EV)**
Road vehicle driven by an electric motor. Includes electric cars, vans, motorcycles, scooters and other vehicles. Full electric vehicles (BEVs) are powered entirely by battery; plug-in hybrid electric vehicles (PHEVs) combine this with an internal combustion engine. Hydrogen fuel cell vehicles are electric vehicles, but these are not considered in this document.

**Hybrid vehicle**
Fuel-efficient vehicle with an electric motor in combination with an internal combustion engine. This type of hybrid cannot be plugged in to an electrical supply; instead the battery is charged by the internal combustion engine or other technologies like regenerative braking.

**London Plan**
The Mayor of London’s spatial development strategy for Greater London, published as a consultation draft in October 2009.

**Mosaic Public Sector tool**
A citizen classification tool developed by Experian which uses around 400 geographical data variables related to the social, demographic, economic and residential characteristics of UK households to assign each UK postcode one of 61 household types. Identification of the Mosaic types of current EV and hybrid car owners was used to understand where future EV owners may live.

**Nitrogen Oxides (NOx)**
A generic term for different nitrogen oxides. Emitted when fossil fuels including petrol and diesel are burned, NOx can cause acid rain and is also associated with respiratory problems in humans.

**Plugged-in Places**
A £30 million UK government funding initiative to develop electric vehicle charging infrastructure, available for successful bids from 3-6 cities or regions.

**Plug-in hybrid electric vehicle (PHEV)**
Vehicle combining a battery-powered electric motor and an internal combustion engine, and which can be charged by plugging it into an electrical supply. When a vehicle’s battery is depleted, the drive-train is switched to the internal combustion engine. Pollutants are emitted in situ only when a vehicle is running in internal combustion engine mode.

**Particulate Matter (PM)_{10}**
Particulate matter with a diameter of less than ten microns. PM_{10} is emitted at the tailpipe of internal combustion engine vehicles, but may also result from brake and tyre wear and the re-suspension of ambient road dust. PM_{10} is associated respiratory tract and cardiovascular problems.

**Road tax exemption**
Electric vehicles are exempt from UK Vehicle Excise Duty (“road tax”).

**Transport for London Road Network (TLRN)**
Also known as “red routes”, the TLRN is the network of major through roads managed by Transport for London.
### Table 3: Types of charging point infrastructure

<table>
<thead>
<tr>
<th></th>
<th>Standard Charging</th>
<th>Fast Charging</th>
<th>Rapid Charging</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power</strong></td>
<td>3kW</td>
<td>7kW-43kW</td>
<td>50-250kW</td>
</tr>
<tr>
<td><strong>Approximate time to fully charge an EV</strong></td>
<td>6-8 hours</td>
<td>30 minutes – 3 hours</td>
<td>15-20 minutes</td>
</tr>
<tr>
<td><strong>Approximate unit cost</strong></td>
<td>£0 – £3,500</td>
<td>£3,500 – £5,000</td>
<td>£25,000-£50,000</td>
</tr>
<tr>
<td><strong>Typical locations</strong></td>
<td>Homes, workplaces, train stations</td>
<td>Supermarkets, town centres, entertainment venues</td>
<td>Motorway service stations, supermarket car parks</td>
</tr>
<tr>
<td><strong>Driver behaviour</strong></td>
<td>Leave vehicle and return after several hours</td>
<td>Leave vehicle and return after short time</td>
<td>Remain with vehicle; charging point may be supervised by operator</td>
</tr>
</tbody>
</table>
Electric two wheelers (E2Ws) include electrically-powered motorbikes and scooters (three-wheeled motorcycles are also included). A large and increasing number of E2W models are available in the UK, although by the start of 2009 there were only around 50 E2Ws registered in London. As the quality of vehicles improves and costs fall, E2Ws may play an important role in fulfilling the Mayor’s ambition to make London the electric vehicle capital of Europe.

Petrol-fuelled scooters and motorcycles are especially harmful to local air quality, with NOx emissions around twice as high as those of petrol cars, and PM10 emissions up to four times higher. E2Ws do not emit these pollutants (except for plug-in hybrid models while using their petrol motor), so they offer significant potential to improve London’s air quality.

E2W batteries are small compared with electric car batteries and take less time to charge. The low weight of E2Ws also favours their economy, meaning a shorter charge time for a given range compared with an electric car. A range of 75 miles may be achieved in 2-4 hours of charging using 3kW mains supply. Some E2W batteries are removable so they can be taken indoors to charge.

**E2W users**

The range and performance of most currently available and near-horizon E2Ws make them good substitutes for petrol scooters and light motorbikes, but less favourable as an alternative to high-performance petrol motorbikes\(^\text{17}\). On this

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\(^{16}\) Based on data provided by Department for Transport, 2009.

\(^{17}\) Some high-performance electric motorbikes are available, but smaller scooter substitutes are likely to be more common in London.
understanding we have mapped the location of existing petrol scooter and moped users in London to help understand where future E2W users may live (figure 31). The greatest concentration of potential E2W owners is in central London, with large numbers also found in south-west and north-west London.

Commuting constitutes 65 per cent of motorcycle and scooter trips in London. Moreover, motorcycle and scooter owners in London are three times as likely to use their bike primarily for commuting as the average UK user. Shopping and entertainment are the next most common purposes (see figure 32). The destinations of motorcycle and scooter trips are concentrated in central London, with fewer trips to outer and eastern parts of the city (see figure 33).

**Charging infrastructure**

As with electric cars, it is expected that most E2W users will charge at home overnight. This is especially practical for E2Ws for two reasons. First, off-street parking availability is less important for E2Ws than for electric cars as front gardens, porches or hallways may also be suitable places for charging. Second, some E2W batteries are removable, so they can be charged indoors while the vehicle itself remains outside.

The major purpose of E2W trips is expected to be commuting. The average length of a one-way commute by motorcycle or scooter in London is 7 miles, and over 95 per cent of commuting trips are less than 20 miles\(^{18}\). This suggests many E2W users will be able to undertake their daily return trip

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**Figure 32**: Purpose of sampled motorcycle and scooter trips in London\(^{19}\)

\(^{18}\) London Travel Demand Survey (LTDS), various years, Transport for London

\(^{19}\) Based on London Travel Demand Survey (LTDS), various years, Transport for London
on a single charge. However, charging facilities in workplaces would provide increased flexibility and reassurance to E2W users. Our plan for 22,500 workplace charging points by 2015 therefore supports the requirements of E2W users as well as electric car users.

Some publicly accessible charging points may also be suitable for motorcycle charging. We will work with the boroughs to encourage on-street charging points to be made accessible to E2Ws as well as electric cars. The issue of revenue loss associated with dedicating parking bays to electric cars is less problematic for E2Ws as most motorcycle parking in London is already free to use. E2W charging points may also be provided in off-street parking locations given the importance of shopping and entertainment as likely E2W trip purposes. Publicly accessible E2W charging facilities should be concentrated in central London as this is the main destination for motorcycle and scooter trips.

The greater economy of E2Ws compared with larger EVs suggests a standard 3kW power supply is appropriate for most situations. A power supply of around 7kW may be suitable for some E2W models, but “rapid charging” is unlikely to be compatible.

![Figure 33: Destination and purpose of sampled motorcycle and scooter trips in London](image)

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20 Based on London Travel Demand Survey (LTDS), various years, Transport for London
Appendix 3 – Commercial electric vehicle charging

A wide range of electric commercial vehicles is already available, including car-derived vans, transit-type vans, minibuses and even some heavy goods vehicles. The Mayor wishes to work with businesses in London to expand the use of electric vehicles in commercial fleets. Over 200,000 commercial vehicles operate in central London, representing a significant market for conversion.

Commercial EVs

Current electric commercial vehicles have payload capabilities of between 800kg and 7,200kg and maximum speeds ranging from 50mph and 70mph. Depending on the battery, their range on a full load can exceed 100 miles. They include the same comfort and safety features as equivalent diesel models, and their turning circles range between 10.8m and 14.1m, making them ideal for the urban environment.

While electric commercial vehicles remain more expensive to purchase outright (up to twice the price of a diesel equivalent), this premium is offset by running cost savings: in addition to substantial fuel cost and congestion charging savings, significant maintenance savings have been reported by current users. Compared with an average vehicle, the motors of electric vans and lorries have very few moving parts, keeping servicing costs to a minimum. Other reported benefits include less driver fatigue (through avoiding gear changes, lower vibration, and smoother and faster acceleration) and less noise (particularly useful for delivery vans operating in the early hours in residential areas). Vehicle manufacturers are also exploring leasing models to overcome the potential barrier of high upfront cost.

Charging infrastructure

Typically, fully charging an electric van or lorry would take six to eight hours. This will usually be done overnight, using a dedicated charging point in the company’s depot or car park. Some of these charging points could be made available to employees during the day to charge their personal car. Three phase chargers are commonly used, and in some vehicles are fitted on board. The vehicles can also be “topped up” throughout the day if needed. For vehicles operating in shifts, battery swapping permits the instant replacement of depleted batteries with fully loaded batteries.

Lessons from the “Electric 10”

Ten companies (Amey, Go Ahead, Royal Mail, Speedy, TNT, DHL, Marks & Spencer, Sainsbury’s, Tesco, UPS) currently using commercial EVs have agreed to work with the Mayor to share their experience and encourage the adoption of EVs by other businesses in London. Referred to as the “Electric 10”, they will play an active role in the Mayor’s engagement with London businesses.
Appendix 4 – Identifying potential electric vehicle hotspots

In addition to locating high potential areas of London using consumer segmentation analysis, several other factors have been considered when identifying EV “hotspots”\(^{21}\):

- The number of households with off-street residential parking, to reflect the fact that most early EV adopters will want to have the ability to charge their vehicle at home overnight. As confidence in electric batteries grows and publicly accessible infrastructure becomes more visible on London’s streets, it is expected that households without off-street parking will consider purchasing EVs as well. Across London, a third of households currently have access to off-street parking.

- The number of residents in each borough regularly commuting to and from work by car and driving over distances between 10 and 50 miles return. Converting such regular drivers to EVs will have the greatest environmental impact. Further, financial savings from switching to an EV also increase with the mileage driven. Although most EVs will have a range of at least 100 miles, we have chosen to concentrate on car owners driving up to 50 miles return daily to factor in range anxiety amongst early EV adopters. Across London, an average of nine per cent of commuters regularly travel 10 to 50 miles return to work by car.

- The number of households with more than one car – such households are more likely to switch one of their cars to an EV knowing that they still have a petrol or diesel car to drive long distances, for example for weekend travel. This is especially relevant over the next few years prior to the deployment of a network of rapid charging points along motorways. Across London, an average of 12 per cent of households have more than one car.

An overlay of this information and the locations of high potential consumer segments was used to identify EV hotspots throughout London. Charging infrastructure will be installed in these and surrounding areas as a priority.

\(^{21}\) Source: London Area Travel Survey (LATS) 2001 and London Travel Demand Survey (LTDS), various years, Transport for London.
**Figure 34:** Number of households with off-street parking, by London borough (the labels show the percentage of households in each borough with more than one car)

**Figure 35:** Number of car commuters travelling 10-50 miles return, by originating (home) borough (the labels show the percentage of commuters resident in each borough that regularly drive 10-50 miles return to work)
Figure 36: Number of households with more than one car, per London borough (the labels show the percentage of households in each borough with more than one car)
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Chinese
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Vietnamese
Nếu bạn muốn có bản in tài liệu này bằng ngôn ngữ của mình, hãy liên hệ theo số điện thoại hoặc địa chỉ dưới đây.

Greek
Αν θέλετε να αποκτήσετε αντίγραφο του παρόντος εγγράφου στη δική σας γλώσσα, παρακαλείστε να επικοινωνήσετε τηλεφωνικά στον αριθμό αυτό ή ταχυδρομικά στην παρακάτω διεύθυνση.

Hindi
यदि आप इस दस्तावेज की प्रति अपनी भाषा में चाहते हैं, तो कृपया निम्नलिखित संख्या पर फोन करें अथवा नीचे दिए गए खोल करें.

Bengali
আপনি যদি আপনার ভাষায় এই দলিলের প্রতিলিপি (কপি) চান, তাহলে নিচের ফোন নম্বর বা ঠিকানার অনুরূপ ফোন করুন যে সাথে কোঁশ করুন।

Urdu
اگر آپ اس دستاویز کی نقل این دریا کیند مین جاہتے ہیں تو بھری کیم نیچے گینے گئے نامبر پر فون کرس با دینی گینے پن کریٹ پر رابطہ کریں.

Arabic
إذا أردت نسخة من هذه الوثيقة بلغتك، يرجى الاتصال برقمه الهاتف أو مراسلة العنوان أدناه.

Punjabi
ਨੇ ਉਰਦੁ ਦਰਮਿਅਨ ਲਿਖਣ ਵਾਲੀ ਇੱਕ ਪ੍ਰਤੀ ਉਰਦੁ ਦਰਮਿਆਨ ਲਿਖਣ ਲਈ ਜਾਣਿਤੀ ਹੈ। ਇਹ ਟੇਲੀ ਪ੍ਰਤੀ ਪ੍ਰਤੀ ਦਾ ਟੇਲ ਪ੍ਰਤੀ ਦਾ ਟੇਲ ਹੈ।

Gujarati
જો તમે આ દસ્તાવેજની ઉર્ડુ વિભાગે જોડાણ કરો તો માત્ર અહીંથી પથરા બદલી જ શું કરી શકી શકી શકી શકી. 

Alternative formats