IET Standards

IET Standards Technical Briefing

Electric Vehicles Infrastructure for Fleet Operations

CONTENTS

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The Institution of Engineering and Technology
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Herts, SG1 2AY, United Kingdom
www.theiet.org

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SECTION 1

Introduction

The UK electric vehicle (EV) charging landscape is evolving; the requirements of public infrastructure are beginning to be understood and, in particular, there is an increasing recognition of the importance of rapid charging. Means for financing charging infrastructure are being created as are operating systems and services to underpin business models. In parallel, public and private sector fleet operators are seriously evaluating how EVs can be included in their fleets and this in turn is leading to fleet-specific infrastructure solutions.

At the time of writing this Technical Briefing, EV sales and charging infrastructure development are accelerating, with infrastructure decisions ranging from simple to complex and short term through to future-proofing.

This Technical Briefing sets out the crucial considerations to be taken into account when deciding which EV fleet infrastructure route to take. It will be of use to fleet/transport managers, technical/project managers, and low carbon transport, air quality and sustainability managers.

SECTION 2

Electric vehicle technology is evolving quickly

2.1 EV availability and range

The range and availability of EVs are increasing dramatically, with most major manufacturers having either launched or indicated their intention to launch EVs in coming years.

With some exceptions, most fully electric EVs have a relatively similar range of around 100 miles, while the range of plug-in hybrid EVs (PHEVs) and extended-range EVs (EREVs) varies from around 10 miles to 40 miles, after which point alternative fuels are used for further range.

Ranges are expected to increase because, as new battery chemistries are developed and better battery pack construction methods are introduced, EVs become more energy efficient. By 2020, the average EV range could be approximately double what it is today.

The markets for electric bicycles and electric mopeds are also growing rapidly, while larger vans remain a difficult segment to make commercially successful. Pure electric and hybrid buses are becoming more common with an increasing number of cities, including York and Nottingham, introducing them as key components of inner-city public transport. London is due to have over 50 electric buses operating by late 2016 with a target of 300 by the time the London Ultra Low Emission Zone (ULEZ) goes live in 2020.

2.2 Technological and business innovations

The control of EV charging in order to manage grid load (demand side management), including the use of energy storage, is becoming increasingly common. Other significant innovations include induction charging and vehicle-to-grid (V2G) functionality. Whilst induction chargers can work with compatible EVs as alternatives to plug-in systems, V2G functionality requires adapted infrastructure and operating systems to create a viable business case. Standards in these areas are still emerging and interoperability is still an issue.

Several EV manufacturers are developing energy technology packages to be sold alongside EVs. These include home energy management systems, solar panels, home energy storage devices and apps to remotely view and control EV charging and charge point availability.

The cost of charging systems is reducing, reliability is improving and diverse options of systems are becoming available – all at the same time. These developments have largely displaced the older 3 kW, 3-pin plug charge points, and replaced them with dedicated charging equipment and connectors, in line with latest European standards and regulations. The future of battery swapping remains unclear.

Making sense of EV infrastructure charging solutions

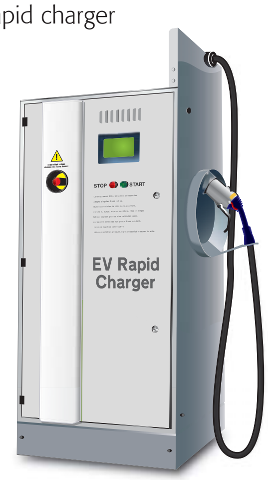
3.1 Charging infrastructure functionality and interoperability

▼ **Table 3.1** Charging types and power

Charging type	Power
Standard charging	3 kW a.c.
Fast charging	circa 7 kW a.c.
Rapid charging	43 kW d.c. or a.c.

EV manufacturers are favouring a range of plug types and communication protocols. At the time of writing this Technical Briefing, rapid chargers use alternating current (a.c.) with type 2 connectors, or direct current (d.c.) Chademo connectors (favoured by Japanese EV manufacturers), or combo plugs (favoured by European and US EV manufacturers). Tesla has its own communication protocols but also has adaptors for non-Tesla chargers. Future-proofing of charging infrastructure needs to include either the use of chargers that are compatible with a wide range of EVs or, alternatively, charging hubs with a range of technology-specific units.

▼ **Figure 1** Rapid charger



The industry is beginning to see trends in EV driving behaviour and is developing complementary technology. The cost of charging technology is closely related to its power output, which in turn is related to charging time and number of outlets. There are many situations when people park for an hour or two, a duration that is too long for a rapid charger and potentially too short for a fast charger. In response, charging equipment manufacturers are developing units with various charge rates to fit specific applications and budgets.

An important consideration is interoperability between the back office operating systems and hardware (see Section 3.2), which enables a fleet manager to gradually build up a network of accessible 'best fit' units. An important starting point is Open Charge Point Protocol (OCPP), which enables any compliant hardware and software to communicate irrespective of manufacturer. Ensuring that hardware and software are OCPP compatible can remove many longer term development and procurement issues.

It should be noted that in many cases fleet operators may be able to introduce EVs with the use of standard or fast chargers alone.

3.2 Back office systems

The back office is the part of the overall operating system that enables fee collection, system monitoring and customer service provision for drivers and fleet operators alike, and as such is critical to the end-user experience.

The service experienced by the customer includes several components that can be provided by integrated service providers or by several organisations working together. The core value chain includes the charging equipment supplier, the back office operator, the site owner and the service provider; however, other parties may provide aggregated smart charging linked to the energy suppliers or parking identification and reservation services.

From an infrastructure developer's perspective the key objective is to ensure that the back office:

(a) provides the latest 'state-of-the-art' functionality;
(b) is responsive to site owners' needs;
(c) provides good customer service; and
(d) is able to support future developments.

There are a number of functions that can be provided by the charging infrastructure provider/back office operator that some fleet operators may find useful. Depending on the provider, some of these may be provided at an additional cost, so fleet operators should understand the arrangements with their providers. Examples of useful functions are:

(a) metering of electricity consumed through each charger and by each EV/user; and
(b) remote monitoring, diagnostics and reporting of faults and important usage data.

3.3 Charging infrastructure service provider

Depending on the initial level of ambition for an EV fleet, outsourcing to a service provider might not be necessary at the outset. But as needs develop in the longer run, it will become increasingly important to ensure that fleet management and asset optimisation are at the core of EV fleet operations and outsourcing may become an attractive option.

As the industry develops and customer requirements emerge and become greater, fleet operators may prefer to place a contract with a turnkey charging service provider rather than seek out separate hardware, software and other services providers. A turnkey charging service provider should be able to guarantee the functionality and coverage of the geographical network required by the fleet.

Operating efficiency can be improved through data provision from back office systems, so the choice of back office provider is important. Tracking costs derived from on-site, home-based and various publicly available chargers are complex and additional complication may be introduced if EVs have more than one driver or are PHEVs or EREVs. The choice of back office provider will be influenced not only by their cost and their technical and service capabilities but also by the estate of assets they will be required to manage. So, for example, the key requirements of three fleets might be fundamentally different:

(a) Fleet A might be based around home charging;
(b) Fleet B might prioritise low capital investment and might use existing public charge points – i.e. low cost interoperable use of charging networks around the UK; and
(c) Fleet C might invest in charging equipment for its exclusive use at its own operational sites.

Many fleet operations are likely to require some combination of all three scenarios.

3.4 Specifying service provision

As a minimum a turnkey charging service provider should provide the following:

(a) a seamless process for setting up a usable infrastructure, including supply and installation on commercial and domestic sites with minimum customer contact and interruption.
(b) account management, including the automatic issuing of cards/PAYG accounts with pre-agreed functionality and user accounts set up as specified.
(c) as a matter of course, fleet information, including electricity consumption (and alternative fuel consumption for PHEVs/EREVs) per mile and performance data for drivers and EVs.
(d) cost management that can reimburse drivers for home charging of company EVs, the use of public infrastructure, etc. Automatic settlement in accordance with pre-agreed payment terms should also be available.
(e) a 24-hour help desk with real time visibility showing the status of all charging infrastructure and the ability for the help desk to remotely start and stop charging.
(f) ongoing, automated upgrade and maintenance of the EV infrastructure operating system.
(g) the facility by which drivers not only use the company network, including home charge points, but also have access to any required public infrastructure.

Matching your vehicles and infrastructure to your needs

4.1 Determining acceptability

In general terms, to determine the acceptability of an EV (whether pure electric, PHEV or EREV), key questions must be considered:

(a) *Is there an overriding requirement to use EVs, such as compliance with ULEZs or a corporate social responsibility (CSR) to use this type of technology?*

(b) *Has the duty cycle of the task been evaluated to check whether an EV is suitable?*

The duty cycle is the profile of energy that will be consumed to do the task. It will depend on factors such as daily mileage, payload, style of driving and terrain. This kind of evaluation can often be undertaken in partnership with a lease provider.

(c) *What if the duty cycle is higher than is reasonable for any specific EV or if it is extremely varied (such as a pool car or management car)?*

Either an EREV or a PHEV may be a viable option (rather than pure EVs), or alternatively, additional charging infrastructure could be used to facilitate the EV's needs.

(d) *Are there predictable 'milk round' type duty cycles?*

Some fleet vehicles have predictable 'milk round' type duty cycles which, when planned, can be achieved with a combination of EV choice and charging infrastructure.

(e) *Have real-world conditions been factored into the expected EV range?*

EV range varies according to real-world conditions so it is often safest to evaluate a duty cycle using a maximum of 80 % of the advertised range.

(f) *Have operational requirements been assessed against the nominal EV 'sweet spot' range?*

The nominal 'sweet spot' range for pure EVs, from a small car through to a small van, is between 40 miles and 80 miles per day (the lower range is because an EV is not economical unless a minimum distance is covered each day). It is always possible to find viable uses for EVs outside this range, but these tend to be specialist in nature, generally involving committed infrastructure, for example, a Park and Ride pure EV bus with rapid charging dedicated to the scheduled route.

(g) *Have hybrid-fuel requirements been assessed for travel beyond the nominal EV 'sweet spot' range?*

For travel beyond the EV 'sweet spots', other fuel types might be considered, such as gaseous hydrogen or biogas (medium energy density) and then high-blend biofuel or liquefied gas (high energy density).

(h) *Has the total cost of ownership (TCO) been addressed for EV fleet operation?*

The TCO structure of an EV means that they must be used heavily (to benefit from the very low running cost) in order to mitigate the higher than conventional purchase price (with residual value remaining uncertain).

4.2 Informed infrastructure requirements

Infrastructure requirements will depend on the duty cycles of the EVs, for example, back-to-home operators will have completely different needs compared with back-to-depot operators:

(a) back-to-home operators require a home charge point with cost management and control functionality.
(b) back-to-depot operators may require the management of a range of rapid or fast chargers to ensure that all EVs are charged to meet operational requirements while minimising the use of peak period/tariff electricity where possible and not exceeding site load capacity.
(c) if on-site solar or wind generation are used, then the charging regime could be very different.

One of the key considerations with charging infrastructure is ensuring that sufficient power capacity is available from the distribution network operator (DNO) to support the connection of the desired charging infrastructure. For most fleet operators, installing small numbers (<10) of standard or fast chargers at their premises should not cause issues. However, installing more than this or more than one rapid charger can sometimes require an upgrade of the DNO connection. As every site is different it is highly recommended that a potential installer speaks to the relevant DNO as early as possible to understand the spare capacity, the requirement for any potential upgrades and any associated costs. Doing this early in the charger selection process can help with deciding what combination of chargers and EVs are best suited to a given fleet operator. If rapid chargers are required, their physical placement may need to be closer to the DNO connection point than other charger types in order to minimise cabling and civil works costs.

It is likely that only a portion of fleet vehicles will be replaced with EVs initially and so the evaluation of replacement opportunities should follow two routes:

(a) consider the viability at a vehicle or user level; and
(b) assess the impact of EVs on the operation of the overall fleet.

There will be instances when EVs simply replace existing vehicles on a like-for-like basis. However, the inclusion of EVs may enable/cause the operating model of an entire fleet to be revised with a consequential reduction in fleet TCO. Taking this to an extreme, it may be attractive to replace a corporate grey fleet with an e-car club or a delivery fleet with a range of EVs.

4.3 Scheduling EVs

Increasingly sophisticated approaches to evaluating the viability of EVs are leading to their increased adoption and also to a review of the structure and operation of fleets in general. Scheduling of EV use is therefore becoming more important and can dramatically improve EV use in terms of range and/or duty cycle through the use of dedicated software.

If a preliminary scheduling exercise reveals that the range of EVs makes them unviable for fleet operations, then infrastructure provision should be reviewed. Away-from-base charging infrastructure – likely in most cases to be rapid charging – may change the viability assessment. Public charging infrastructure may also meet requirements, however, distribution and availability of charge points are likely to be critical and so a purpose-built charging network may be necessary for fleet operations where depot charging is not satisfactory.

Many fleet EVs will be used in a way that makes detailed scheduling impractical, for example, those used as pool cars or by individuals with varied travel requirements. In these cases charge point distribution will be a critical enabler for extending EV fleet operations, as well as helping to reduce drivers' anxieties about range.

The important point is that a rigorous evaluation of the viability of EVs should be undertaken, identifying those constraints that may affect their inclusion in a fleet, as well as how any such constraints can be overcome.

4.4 Solutions for individuals and grey fleet

Outside the realm of corporate fleet use (where evaluation and decision making can be relatively rigorous), individual employees may also have a need to evaluate the viability of using EVs, for instance, in assessing the suitability of an EV as part of a range of company car options. Often the most effective way to aid decision making is to simply evaluate travel requirements and any constraints, such as needing to access ULEV zones, then to follow up with an EV trial.

Organisations and individuals should also include new mobility models and e-car clubs within this evaluation. e-car clubs are becoming increasingly attractive as they add flexibility to their business models and provide new options in the spectrum between private and public transport.

e-car clubs can replace grey fleet use during the day and make EVs available to employees or the public during evenings and weekends, as well as reducing organisational costs, reducing the number of vehicles on the roads and reducing the amount of personal investment tied up in cars.

Analysis of EV use data provided by e-car clubs clearly shows that the vast majority of journeys could be achieved using EVs.

e-car clubs have another important role to play in the EV ecosystem, in that they provide semi-guaranteed use of EV charging infrastructure either at a parking bay or at a local rapid charger. This means that they can help underpin the business case for rapid charging and, through collaboration, could potentially help the business case for infrastructure to support other corporate EV use.

Infrastructure location, geography and transport planning considerations

5.1 Home charging and work charging

In addition to fleet adoption, EVs are also becoming a required option for many company car schemes. In light of this, a number of questions may need to be addressed, including: what, if any, charging infrastructure should be provided at home and at work? What should employees be expected to pay for recharging their EVs at work? What are the tax implications?

Whatever infrastructure model is ultimately adopted there are several types of location that may form part of the overall picture:

(a) private infrastructure locations – i.e. installed specifically by the fleet operator either at base, at the driver's home or potentially at strategic locations owned by the employer (or combinations thereof).
(b) public infrastructure locations – already installed or requested.
(c) shared infrastructure locations – developed with a third party to enable a viable business model.

The location, type and availability of EV charging infrastructure will affect fleet operating costs as well as the ability to meet travel requirements. Publicly available rapid charging will always be more expensive than charging at base or at home, and availability may not be guaranteed. Infrastructure requirements may therefore need to be mapped out to provide the best value. If the fleet EV is also used by the driver for private trips then they should be encouraged and potentially supported to install home charging. In almost all cases and across all fleets, work-based or depot-based charging improves EV practicality. Consequently, wherever possible, EV fleets should be supported by work-based charger points.

Although home charging for back-to-home fleet operation might be the best option, this may be difficult for staff who do not have their own off-street parking. One solution may be to ensure access to fast or rapid charging facilities. Local authorities can sometimes apply for grant funding to provide fast on-street chargers – check with the local Highway Authority. Public rapid charger networks are also an option as they are expected to play an important part in providing charging for city centre users. However, fleet operators may prefer to strategically place rapid charging units at other sites owned by the company or on appropriate third party sites to avoid inconveniencing drivers.

5.2 Managing EV charging

Charge points installed on company sites need to take into account the implications of an increasing EV fleet, i.e.

(a) space and grid capacity may have a major influence on site layout and the equipment chosen.
(b) catering for a large number of EVs parked-up all night (or all day) may require extensive infrastructure and committed parking bays.
(c) unless managed, non-critical charging may take up grid capacity required for providing charge for those EVs needed for essential journeys.

A combination of duty cycles may require a range of charging technologies that are used in accordance with a site charging policy and a managed charging system.

Rapid chargers that are fundamental to the fleet operation and are installed on site may need to be managed to ensure that chargers are not tied up for longer than necessary and that maximum utility charging is being achieved. As the simultaneous use of multiple rapid chargers can place a significant load on the site grid connection, some form of upgrade or increase to cover peak loads may be required, potentially increasing the cost of the site connection. Alternative sites may be preferred to avoid expensive upgrades, while other solutions include charging equipment capable of managing grid load and energy storage.

The key requirement for the effective charging of multiple EVs is information. If the requirements of drivers are understood (particularly, the state of charge and when charging is needed), then charging management systems and user policies can be developed to effectively address these needs.

5.3 Availability of off-site infrastructure

In terms of critical off-site chargers, lack of availability of public infrastructure could compromise operations. The solution here could be to work with an infrastructure developer/operator to arrange for a charger to be financed and installed at a suitable site. Such a developer would assess viability based on a projected return on investment, so understanding the predicted use of the EV is important.

The attractiveness and cost effectiveness of an off-site location could be enhanced if it could be used by several fleets. Locations that provide additional parking and refreshments may also encourage use by drivers, so if routes are regular, linking up charging locations to points at which drivers might stop at break times should be explored.

Many local authorities are now creating and implementing planning policy in support of EV charging infrastructure so consultation with the local Highways Authority or Planning Authority could also be worthwhile. This makes sense given that some local authorities are:

(a) enforcing the installation of charge points on new-build domestic and commercial property developments;
(b) including charging infrastructure as a proportion of car parking; and
(c) working on the development of charging infrastructure suitable for all types of EV within their areas (elements of work may be in response to available public funding, but many local authorities are also now being contacted by private developers to this end).

In any case, having an understanding of the requirements, wishes and plans of local authorities/organisations can only be beneficial to the strategic development of charging infrastructure. Indeed, the support of a local authority could affect the approach taken to EV adoption and investment in infrastructure (for example, by avoiding unnecessary installations in particular locations).

How much will it cost and when will it pay back?

6.1 Assessing costs and value

There are several factors driving fleet operators to consider the inclusion of EVs in their fleets – the priority is usually cost. There are, however, several parameters to evaluate:

(a) TCO needs to be considered at both the EV and the fleet level.
(b) a key factor in TCO calculation is the electricity cost – to achieve best value, control systems or policing of EV charging should be introduced to promote using electricity at cheaper rates (where available).
(c) compliance with environmental requirements such as Low Emissions Zones or noise restrictions may provide valuable business or customer benefits. The company CSR policy may also require the operation of certain types of EV.

If significant numbers of EVs are included in a fleet and TCO is assumed to be critical, then it is likely that new control processes, strategies or protocols will need to be implemented. These need to cover six areas:

(a) *EV utilisation*

Policies, procedures or cultural changes needed to ensure EVs are heavily utilised.

(b) *Infrastructure availability*

If the availability of charging infrastructure is job critical there needs to be a system to predict when it will be required and ensure that it is available when needed.

(c) *Charging management*

A charging management system may be needed to control when EVs are charged and therefore the cost of energy.

(d) *Operation and maintenance*

Infrastructure will have an operating and maintenance cost in addition to the electricity.

(e) *Cost management*

EV, infrastructure, electricity and alternative fuel costs need to be accurately tracked and managed.

(f) *Driving style*

Driving style has a major impact on EV range and cost, so data showing energy consumption per mile (potentially made available via the charging infrastructure service provider) will be invaluable in reducing costs and targeting training.

Deriving best value from an EV involves ensuring that:

(a) its utility is maximised;
(b) its payload per mile is minimised;

(c) its requirement to carry heavy loads up hills is minimised; and critically
(d) its drivers are well trained.

6.2 Developing the business case

For a fleet operator, the business case for charging infrastructure is likely to be inextricably linked to the success of the entire fleet. However, the optimum use of the infrastructure is still critical to ensuring best value. Best value for infrastructure can be achieved through accurate analysis, planning and the appropriate provision of charging infrastructure services.

There are several strands to the business case that can be managed to good effect:

(a) charging hardware is falling in cost, becoming more sophisticated and more diverse. On this basis there is little point in developing excess capacity when it may not meet future requirements.
(b) public charging infrastructure is low cost or free of charge at the time of writing, but this will change. An increasingly large cost differential will develop between EV fleets that are effectively cost-managed and those that only charge their EVs on an opportunistic basis.
(c) reducing the use of higher cost charging/infrastructure can improve the business case, for instance, public rapid charging is likely to be more expensive than charging at base.
(d) third-party financing schemes could allow for operational use of third-party charging infrastructure. If a third party is motivated to secure additional use of the infrastructure then the cost of use is likely to be more attractive to all concerned.
(e) service, maintenance and upgrade costs should be expected and should not be overlooked. Charging infrastructure will have some associated service and maintenance expenditure required to minimise downtime.
(f) many compatibility issues are due to EV and charger software being out of step. Software is regularly updated by EV manufacturers. EVs and chargers exchange information to initiate a charging session and if the software becomes out of step, then problems can arise and the charging session will fail to commence.

The project plan to your chosen solution and commissioned infrastructure

7.1 Planning and integrating EVs

Introducing EVs into a fleet in a meaningful way results in new considerations for those involved in the process, such as:

(a) fleet management now includes on-site charging or home charging;
(b) fleet costs now include electricity bills;
(c) operating restrictions now include grid connection capacity and parking space provision; and
(d) the EVs will have different functional characteristics and maintenance requirements to internal combustion engine vehicles (ICEs).

Cross-organisational teamwork is needed for an effective process. A plan needs to be developed and stakeholders need to be engaged with it to make it happen.

7.2 Post commission – what do I need to know?

Planning and installing charging infrastructure is not the end of the journey. Several ongoing responsibilities need to be kept in mind when thinking about costs and resource.

(a) *Infrastructure costs*

Infrastructure will have operating and maintenance costs in addition to electricity costs. Ongoing innovation in EVs, charging technology and operating systems is making regular system updates essential. It is important to ensure that this operating cost is factored into the business model of any required infrastructure – whether it be in-house or (more importantly) third party. Any back office will need an asset management system to ensure that all charge points are operational and upgraded as required.

(b) *EV costs*

Costs need to be accurately tracked and managed. Tracking is important for accounting reasons, employee benefits being one key measure. However, if operating costs are to be controlled, systems will need to be put in place to minimise the use of higher cost charging. Employees will require accurate tracking and repayment of any costs associated with charging a company EV at home. Cost per mile becomes an even more complex calculation with a mixture of home and public charging and PHEVs and EREVs, which use both electricity and alternative fuels.

(c) *Infrastructure use*

The non-essential use of rapid chargers should be reduced since in the longer term these are likely to be more expensive than other locations. Rapid charging could also have a greater impact on battery life than lower power chargers.

(d) *EV use*

Overall the efficient use of EVs is important in maximising range and minimising battery degradation. A proven way of significantly improving efficiency is driver training; it is often quoted that approximately 25 % improvement in range can be achieved by improving drivers' behaviour. EVs are also easier to maintain than conventional vehicles due to their much simpler architecture and fewer moving parts; however, they are still required to be kept in good operating condition so basic maintenance is important to ensure efficient and safe performance.

What might the future look like and should I be concerned?

The considerations discussed in this Technical Briefing are relevant to EV infrastructure at the point of writing. Looking to the future there are a few points to keep in mind:

(a) *Battery technologies are improving*

Battery technologies with increasing energy densities are in development; these will enable longer journey distances. There are also claims that some emerging technologies can absorb charge more rapidly. There is a view held by at least some manufacturers that as batteries develop, higher current charging will be enabled so chargers and the associated grid infrastructure may need to support 100 kW+ charging in contrast to the current 50 kW units. Some EV manufacturers such as Tesla already make use of 'superchargers' to provide rapid charging for their cars with larger batteries than most other car brands. These chargers operate at 120 kW.

(b) *New functionality is under development*

It seems likely that EVs will become intrinsic parts of the electrical energy infrastructure with charge points facilitating the switch from a vehicle as a mobility asset to an energy asset. Whether the control is via the EV or the charge point, the functionality of the charge point will be critical. Charge point procurement should consider the extent to which suppliers are developing units to support greater remote control. Key considerations are the ability to stop and start the charging of the EV remotely based on some criteria (demand-side management), provide V2G or vehicle-to-building discharging, and for the unit to communicate accurate event information.

(c) *Charge point access and availability*

A logistical challenge arises from the need to accommodate several EVs charging at the same time with possibly one or more waiting to charge. This challenge is compounded by EVs with sockets in different places. A common problem is that access or traffic flow around the unit is restricted by EVs parked at unexpected angles to enable them to access the charger. This situation needs to be considered when planning the layout of charging bays.

Additionally, it is becoming increasingly common for charging infrastructure operators to receive calls from drivers who are unable to charge because a driver has parked up at a charger and failed to move on when charging is complete. How this is policed in real time will vary according to the location but, in the future, back office or service provider functionality might enable drivers to be alerted to this situation. If the desired fleet operation will depend on the use of public charge points then these issues should be understood to minimise the risk of not being able to charge or delays to operations.

In conclusion

EV charging infrastructure is continuing to evolve but is also gaining a degree of consistency in the context of a broadening base of knowledge and experience.

There are some key considerations but within the context of a fleet an initial project is likely to be scalable and adaptable to meet future requirements. If a watchful eye is kept on the market then ongoing expansion should be able to adopt more up-to-date technologies and services as they emerge.

Introducing EVs to a fleet does however contrast in several ways with the approach that might be taken to traditional fossil fuel vehicles and so to achieve best value a review of EVs and infrastructure in parallel is likely to provide the best results.

Nigel Hutton is the Transport Policy Manager at the Borough of Poole.

Here at the Borough of Poole, we were an early adopter of EVs. The Borough acquired three Citroen Czeros in 2012; these second generation EVs have been in daily use, mostly on short and medium length journeys as they had to return to base for charging due to the extremely limited availability of public charge points at that time.

The Borough Council has obtained seed corn funding to establish an e-car club. The e-car club has become viable following the installation of EV rapid chargers as a joint project between Poole, Bournemouth and Dorset Councils. Cars will normally be charged at the e-car club parking bays, which will be provided with 7 kW fast chargers – range can be extended by using the 16 rapid chargers around the region.

▼ **Figure 2** Civic charging equipment

e-car clubs are suited to EV operation. The latest generation of EVs have a range of around 100 miles to 130 miles, which make them fine for almost all e-car club trips, where the cars are mostly used for short to medium length journeys. In the Dorset region we see e-car clubs plugging the gaps in the bus and train networks, giving residents and visitors all the benefits of car use, without having to own one.

With conventional car club cars, users are asked to fill up with fuel when the tank falls to ¼ full. With EVs, they will be charged each time they are returned to their home parking space. If there is a gap between hires, the EV can start the journey with full range. The next hirer will need to check the range of the EV and may need to use a rapid charger to get full charge. There is currently limited experience of user reaction and time will tell if this is a limiting factor in membership and use.

London Metropolitan University are working on a project, initially being developed for the private hire (mini-cab) market, to better predict the range of EVs based on real time monitoring. This information could be relayed to the next user giving confidence or warning them that they need to allow a little extra time for a rapid charge. Users could also be offered an alternative EV if necessary.

Solar charging

In parallel with the e-car club developments, the Borough has invested in large solar arrays on public buildings. One of the first installations was on the roof of the staff multi-storey car park and provides 115 kW peak output (more than enough to power all the on-site EV chargers!). When the chargers aren't using the energy, it offsets some of the Civic Centre base load.

▼ **Figure 3** Solar arrays on the roof of the multi-storey car park

Further solar panel array sites are being developed and it is hoped that they can also be linked to rapid chargers. Everyone knows that the sun (nearly) always shines in Poole and now we can also say that our EVs run on sunshine too!

Nigel Hutton

Transport Policy Manager

Borough of Poole

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Electric Vehicles Infrastructure for Fleet Operations

The UK electric vehicle (EV) charging landscape is evolving fast. The requirements of public infrastructure are beginning to be understood and in particular there is an increasing recognition of the importance of rapid charging.

Public and private sector fleet operators are seriously evaluating how EVs can be included in their fleets and this in turn is leading to fleet specific infrastructure solutions. EV sales and charging infrastructure developments are accelerating, and so infrastructure decisions range from simple to complex and short term through to future proofing.

This Technical Briefing sets out the crucial considerations to be taken into account when deciding which EV fleet infrastructure route to take. It will be of particular value to fleet/transport managers, technical/project managers and sustainability managers.

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IET Standards
Michael Faraday House
Six Hills Way
Stevenage
Hertfordshire
SG1 2AY