



Rapid Charge Network

Station Canopy Feasibility Study



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1 Executive Summary

1.1 Introduction

This feasibility study is concerned with identifying the main factors which could influence a decision on whether to install canopies at rapid charge points for electric vehicles on the rapid charger network, and with identifying factors which could influence their design if a decision were taken to install them. Rapid charging points are to be installed on two corridors across the UK and Ireland which connect to five major seaports and five international airports. They are to be located at service areas on trunk roads and motorways, ports, airports and IKEA stores. The charging points are designed to charge a typical EV to 80% SOC within 30 minutes¹. This Rapid Charge Network is being implemented as part of a European project in the TEN-T Programme which will see rapid charging networks deployed across Europe. This report is intended to be used as an initial model for use in other countries within the Rapid Charge Network programme.

There is currently little experience of installing canopies at EV charging points: charging points are a relatively new feature of the road network, and in the UK those which do exist tend to be installed without a canopy. Moreover the question of whether or not to install a canopy is not one that canopy suppliers are usually expected to answer – from the perspective of the canopy suppliers, decisions on whether or not to install canopies in other contexts appear to be made on the basis that they improve the customer experience (e.g. sheltering people while they re-fuel their vehicle or wait for public transport, or to keep parked supermarket trollies dry), without the need for a detailed evaluation of the requirement for canopies.

The feasibility study includes a review of the limited amount of information that is available on canopies and EV charging, and a small scale enquiry in which information was obtained from eight canopy suppliers. These suppliers were invited to provide outline designs and indicative costs for canopies to be installed at pairs of EV charging points of the size and layout currently being installed on the RCN network in the UK and Ireland.

1.2 Design considerations

The design factors to be considered in writing a specification for canopies at EV charging points include the basic design of the structure and materials used, the risks, life expectancy, maintenance, and options for additional features. These considerations are each discussed below.

Design

The suppliers which responded **to the project's enquiry** said that they were able to adapt existing designs for other settings to meet the requirements of electric vehicle charging points, although none are currently designing canopies specifically for electric vehicle charging points.

¹ SOC - State of Charge, i.e. up to 80% of full battery charge. Actual charging times will vary depending on the capacity of the EV battery so may vary from vehicle to vehicle.

Some suppliers suggested a full canopy over the vehicle and the charging point, and others suggested a **'partial' canopy** above the charging point and part of the vehicle parking area. In the review of information available on canopies for electric charging points, two European examples of canopies at charging points were identified: of these, **one was a 'partial' canopy and the other was a full canopy**. There is not enough information available to indicate definitively which of these two alternatives is most appropriate.

Some suppliers suggested a cantilever design. This is recommended because it reduces the risk of vehicles hitting the structure as the supporting pillars can be positioned at one side of the bay or behind the charging point, minimising the effect of the pillars on the amount of space available for manoeuvring vehicles in and out of charging bays.

It is recommended that designs should be scalable and modular, so that they can readily be adapted to meet the requirements of different sites or expanded to suit larger scale installations in future to meet higher levels of demand for rapid charging. The designs submitted by suppliers were all scalable and modular.

At the point when installations are expanded from pairs of charging points to larger clusters, it is likely that it would be necessary to equip the charging points with some form of renewable energy to meet the demand for electricity.

Canopy materials should be transparent or semi-opaque. This provides users with natural lighting during daylight hours. In the case of canopies with side panels, transparent panels also give users visibility of the movements of vehicles and people in the vicinity, both while manoeuvring in and out of the charging bay and while using the charging point. Most suppliers suggested designs using either polycarbonate or PET; one suggested tough fabric. There are some site-specific considerations which need to be borne in mind in selecting canopy materials. At airports, the risk of reflections from the canopy roof may mean that anti-glare materials are required.

The materials favoured for the structure were steel, galvanised steel and aluminium. At ports, marine grade paint is recommended to improve corrosion-resistance and life expectancy of the canopy structure.

The suppliers recommended only minor design variations to suit different types of site, with minimal additional costs, and on the whole the basic designs were considered to be suitable for motorway service stations, service stations on main roads, ports, airports and retail outlets in the UK and for sites in other parts of Europe with different weather conditions. This question should however be considered further in the case of canopy installations in northern and mountainous regions of Europe and in southern Europe: significant snowfall, significant sunshine and significant hail storms all create additional requirements.

Risks

Two main types of risk were identified. Impact with vehicles can be reduced in the case of cantilever structures as described above, and by positioning bollards to protect the supporting pillars. Impact with high vehicles if drivers misjudge the height of the vehicle in relation to the height of the canopy might be reduced in the case of partial canopies and by positioning bollards near the structure.

The risk of vandalism and graffiti was mentioned by suppliers in the context of retail parks and service stations on main roads, but not motorways, ports and airports (which

are perceived as being less accessible to vandals). Lighting reduces the risk of vandalism. Graffiti-resistant paint mitigates the risk of this form of vandalism to the supporting structure. Use of polycarbonate sheeting of the strength required to resist wind and snow loadings ensures that the sheeting is also strong enough to be vandal-resistant.

Life expectancy

The life expectancy of the canopy designs provided by suppliers ranged from five to 25 years, with the average around 16 years. It is possible that in the longer term, vehicle charging technologies may have evolved to the point where charging points are no longer required on the TEN-T network (for example inductive charging while vehicles are in motion may in future replace static charging). Thus in specifying canopy designs it may not be necessary to specify a life expectancy as great as 25 years.

Maintenance

Some suppliers stated that the basic design would require no maintenance while others quoted nominal sums for cleaning and touching up paintwork. One supplier recommended more comprehensive maintenance: replacing worn fixings and re-tensioning ground bolts. This indicates that maintenance requirements will need to be considered, and will vary with the canopy design and materials used. It may also vary with the type of site – for example more frequent maintenance may be required at ports or other marine sites and at sites with extreme weather conditions.

Options for additional features

It appears that some of the suppliers which responded would not normally include additional features such as solar panels and lighting in their canopy structures because this is not a requirement for the types of canopy they usually supply. However some did have experience of doing so. These additional features have implications for cost, frequency and nature of maintenance and life expectancy. They require more comprehensive checking and maintenance regimes. For example in some car park locations (such as close to main roads or trees), solar panels may require regular cleaning to maximise their performance.

Solar panels are stated by the solar panel manufacturers to have a shorter life expectancy (5 – 10 years) than the canopy structures. If solar panels are considered for powering lighting in canopies for EV charging points, this will require further investigation because this is not consistent with information from other sources which suggests that solar panels can probably continue to be effective for between 20 and 30 years, in line with the life expectancy of the more durable canopy designs suggested by suppliers.

1.3 Costs and revenues

Overall costs

The cost data provided by suppliers indicated a wide range of initial costs from around £2,100 to £15,000 for materials, equipment and installation at the scale of low volume

production (1-10 units), and around £1,400 to around £13,000 for wide scale deployment.

Lifetime costs were estimated on the basis of information from suppliers for five designs where information was available on capital, installation, maintenance and decommissioning costs, taking account of the life expectancy stated by those suppliers. These simple estimates indicate costs ranging from around £5,300 to £27,000 for up to 10 units, £5,800 to just over £30,000 for between 10 and 25 units and reducing to £4,600 to just over £21,000 for wider scale deployment. Costs per year of life were estimated from these simple estimates of total costs; these ranged from minimum values of around £500 - £600 to maximum values around £1,000 - £1,500, with average values around £700 - £800 per year. Three suppliers identified canopy designs which appear to be cost-effective and these should be considered in the first instance if a decision is taken to investigate canopy options further for the Rapid Charge Network.

Average unit costs at different levels of deployment

Using the figures provided by the suppliers, the average cost per unit for supplying canopies at motorway service stations in the UK was calculated for different levels of deployment.

1 – 10 units:

- Materials and equipment: £6,120
- Installation: £2,520
- Annual maintenance: £226
- Decommissioning: £1,650.

25 – 50 units:

- Materials and equipment: £5,430
- Installation: £2,390
- Annual maintenance: £231
- Decommissioning: £2,930.

Wide scale deployment:

- Materials and equipment: £4,030
- Installation: £2,010
- Annual maintenance: £194
- Decommissioning: £1,340.

Some variations were noted in the installation costs applicable to other types of site, with lower installation costs at service stations on main roads and at ports.

Higher installation and decommissioning costs were indicated for installations in other parts of Europe, which are likely to be associated with additional transport and subcontracting costs for several of these suppliers. (Canopies from at least one supplier are manufactured in Europe.)

Higher maintenance costs were indicated for Scandinavia and mountainous regions associated with the harsher weather conditions experienced.

Additional features

A small number of companies provided information on the costs of solar panels for supplying electricity to the canopy, such as for lighting. The lowest capital cost was £595 for a 28w solar panel with charge control, two 12v batteries, a 12v movement sensor and three 12v LED lamps.

The average cost per unit for supplying solar panels with battery storage and lighting (usually LED) were:

- Materials and equipment: £1,712
- Installation: £414
- Annual maintenance: £475
- Decommissioning: £268.

These figures indicate that at low volumes of canopy production, the capital costs of solar panels with battery storage and lighting represent about 25 – 30% of the capital cost of canopies and 20% of the installation cost. At locations where regular cleaning of the panels is required to maintain the generating capacity of the panels, maintenance costs of the solar panels could be more than twice the maintenance costs of the canopies themselves.

Revenue streams

Only one supplier provided information on revenues. This indicated that advertising could be expected to yield £10,000 to £16,000 per year. This level of revenue could offset the costs of buying and installing even the most expensive of the designs within two years.

Advertising would normally be led by advertisers rather than canopy suppliers. Bus shelters in many urban areas are entirely funded by advertising (the advertisers cover the cost of materials, installation and maintenance); it may be possible to make similar arrangements for rapid charging points.

Given the limited information from this group of suppliers, an investigation among advertising companies of the scope for covering the costs through advertising revenue and how this may vary for various designs of canopy in different types of location, would be required before starting to commission canopies for the Rapid Charge Network.

1.4 Advantages and disadvantages of canopies at EV charging points

The evidence available from recent studies which is relevant to electric vehicle charging behaviour and the use of canopies is limited, so any conclusions about their impact can only be tentative.

The information reviewed in this study indicates the following potential advantages of canopies for EV charging points:

- Protects equipment so that it will be possible to charge even during heavy rain or snow conditions (a number of vehicle manufacturers advise against charging when the vehicle is exposed to inclement weather)
- Will make connecting a charger a more pleasant experience for the user in poor weather
- Provides shelter for charging equipment, thus prolonging its appearance and life

- Will make the charge point easier to see, both by potential users and potential EV purchasers
- Will provide a location for advertising to bring in additional revenue or provide space for further information on the scheme
- Can provide fixing points for additional lighting and CCTV for user convenience and safety at night and to deter vandals
- Can provide the space for solar panels to provide power to the canopy (e.g. for lighting, to make charging easier at night).

The potential disadvantages include:

- Cost of construction and installation
- Cost of maintenance i.e. cleaning or minor repair
- Cost of repair (due to accidents or vandalism)
- The shelter offered by the canopy may make the charging bay more desirable than neighbouring parking bays for non-electric vehicle users or EV users who do not need to charge their vehicle; however it could also be argued that a canopy will help to clarify the purpose of the charging point and reduce occupancy by vehicles which do not need to use the charging point
- The shelters will need to be replaced when they become un-repairable or reach a level of wear which is visually unacceptable to the host organisation.

1.5 Potential for further work

A conclusion from the lack of concrete evidence about the impact of canopies at charging points on charging behaviour and take up of EVs, is that further research in this area would be beneficial. If further evidence is required on the impact of canopies on charging behaviour and whether the cost of adding canopies to charging points is justified, it is recommended that a small scale trial is carried out to assess user behaviour (of early adopters), and provide more detailed information on costs and revenues than it has been possible to gather during this small scale enquiry. The trial could be designed to enable the influence of a range of factors to be assessed, including canopy design (including a partial or full canopy), location and type of site, weather and seasonal variations. A more complex trial could also assess the impact of additional features such as solar-powered lighting.

2 Introduction

2.1 Background and objectives

This feasibility study is concerned with identifying the main factors which could influence a decision on whether to install canopies at rapid charge points for electric vehicles on the rapid charger network, and with identifying possible canopy designs to complement the installation of electric vehicle (EV) rapid charging points. These rapid charging points are to be installed on two corridors across the UK and Ireland which connect to five major seaports and five international airports, and are located at service areas on trunk roads and motorways, ports, airports and IKEA stores. The charging points are designed to charge a typical EV to 80% SOC within 30 minutes². This Rapid Charge Network is being implemented as part of a European project in the TEN-T Programme which will see rapid charging networks deployed across Europe. This report is intended to serve as an initial model for use in other countries within the Rapid Charge Network programme.

There is currently little experience of installing canopies at EV charging points: charging points are a relatively new feature, and in the UK those which are installed at public sites tend to be installed without a canopy. The question of whether or not to install a canopy is not one that canopy suppliers are usually expected to answer – decisions on whether or not to install canopies appear to be made on the basis that they improve the customer experience (e.g. sheltering people while they re-fuel their vehicle or wait for public transport, or to keep parked supermarket trollies dry), without carrying out a detailed evaluation.

The feasibility study includes a review of available information and a small scale enquiry in which information was obtained from eight canopy suppliers (out of a total of 22 companies approached, of which 13 agreed to respond).

2.2 Methodology

The review of available information covered research literature, technical reports, internet sources and **suppliers'** web sites. It was based largely on literature since 2010, which is relevant to the current generation of electric vehicle technology. The results were used to frame enquiries among suppliers about the factors which influence the specification and design of a canopy, including costs and revenue streams.

Using internet searches, a list of 44 potential canopy suppliers was identified based in the UK, including companies specialising in canopies for walkways, car ports, bus shelters, other shelters, shade sails, charging points and solar car parking. Due to cost constraints and greater difficulty in contacting international organisations, the focus was on UK based manufacturers. The suppliers were categorised into the types of materials used, whether or not they offered solar charge roofs, and their area of operation. Suppliers were categorised into three groups to prioritise the companies prior to approaching them:

² SOC – State of Charge, i.e. up to 80% of full battery charge. Actual charging times will vary depending on the capacity of the EV battery so may vary from vehicle to vehicle.

1. Large canopy manufacturing companies, of a range of sizes, some of which offer computer-aided design
2. Smaller companies or with manufacturing closely linked to one type of construction
3. Companies with specific limitations, which would reduce the value of their responses, such as operating in limited geographical area within the UK.

Initially, the 17 suppliers in Group 1 were approached by telephone, and asked if they were willing to consider providing information. The 16 which agreed were sent background information about the project (similar to that shown in Appendix A); of these, 11 agreed to provide information and were sent an electronic copy of the questionnaire to complete. After a week, those which had not responded were contacted by telephone to ascertain whether they had any queries, and to find out when they expected to be able to return their response.

At this stage it was clear that to achieve enough responses (the aim of the study was to gather up to 10 responses) it would be necessary to contact further companies. The four companies in Group 2 and one further company which had not previously been identified were then contacted using the same process, and one agreed to look at the information about the project to see if they could assist. This brought the total number of companies approached to 20. The total number of companies which were sent the questionnaire on the basis that they had agreed to complete it was 15 and one company agreed to look at it to see if they would be able to assist. Three of these companies subsequently responded to state that they did not wish to participate; reasons given were pressure of work and being short-staffed (early winter is a busy time for canopy manufacturers) and being unwilling to commit resources to what was seen as having limited potential to lead to new business.

In total, written responses were received from seven companies in Group 1 (plus one over the phone) and none in Group 2. One company provided information on two designs, so information on a total of nine designs is available in this report. A further company provided estimates of costs per m² but did not complete the questionnaire and is not included in the analysis.

The one company which provided responses over the phone gave a general idea of costs and materials, but did not have the time to complete the full questionnaire.

Responses were rated using a rough indicator of reliability based on the total number of designs for which information was available. Thus where information was available for eight or **nine designs, it was given a reliability rating of 'high'**, five or six replies were given a **'medium rating'** and four replies or fewer were given a **'low' reliability rating**.

2.3 This report

The review of information is reported in Section 3. This summarises the results of the review, the influencing factors and considerations which suppliers were asked to comment on when providing information to the project on elements of canopy specification, estimated costs and potential revenue streams.

The information provided by suppliers on the design and specification of canopies is summarised in Section 4. **Suppliers' responses to questions on costs and revenue are summarised in Section 5.**

The summary and recommendations are presented in Section 6.

Appendix A contains a copy of the background information about the project which was sent to suppliers, including photographs of typical charging points and diagrams of the layout of the charging points.

Appendix B contains a copy of the questionnaire sent to suppliers. The questionnaire **included three 'repeats' of the questions covering three potential canopy designs in case suppliers wished to offer alternative designs**; Appendix B contains questions for one design – **i.e. the first 'repeat' of the questions.**

3 Review of available information

3.1 Introduction

The review of available information covered aspects of electric vehicle charging and use of canopies. It was based on recent literature and information on web sites. It covered:

- electric vehicle charging and the advantages and disadvantages of canopies
- examples of the use of canopies in other contexts which may inform their design at rapid charging points
- factors influencing the potential use of canopies at electric vehicle charging points.

3.2 Electric vehicle charging and the advantages and disadvantages of canopies

3.2.1 Introduction

This section summarises information on experiences of using existing installations of electric vehicle charging points which are relevant to the decision on whether or not to install canopies at EV charging points. Charging of EVs is predominantly carried out at home and at charge points located at local authority car parks, airports, retail outlets and motorway service stations. As of 16/10/2014 there were 2,778 charge points identified on the UK Government National Charge Point Registry; however not all of these are fully accessible to the public, for example at car service centres or in local authority office locations. As more charge points and in particular rapid charge points become available, this is likely to trigger changes in the way they are used. For example, it could be that fewer people will charge at home when they can use rapid chargers elsewhere, or they may use their EVs for longer journeys requiring one or more recharges along the route. Because of this, much of the existing research into current charging behaviours may become less relevant due to the rapidly expanding infrastructure.

The evidence available from recent studies which is relevant to electric vehicle charging behaviour and the use of canopies is limited, reflecting the fact that EV charging points are a relatively new feature. Thus this section draws largely on a small number of studies. The main source of information on user behaviour is a TRL survey among EV purchasers: 192 individuals and 329 organisations. The evidence which is available is summarised in the form of bullet points illustrating the key points.

3.2.2 Advantages of canopies at EV charging points

An advantage of including a canopy in the design of public charge points is that canopies are expected to make the charging network more visible than open charging points and thus easier for users to find because they provide a position for installing signs indicating the presence of EV charging points which can be seen above vehicles parked nearby. Users in one study found it difficult to locate open charge points:

- A survey of EV purchasers in the UK found that some mentioned the difficulty of locating charging points even within the immediate vicinity, particularly in car parks (Hutchins et al, 2013).

Making EV charging points more visible could produce further benefits. It could increase levels of awareness of the existence of public charging points, which in turn could improve confidence in using them and reduce range anxiety, thus helping to promote the take-up of electric vehicles, with benefits for the industry as well as for users. Evidence on these aspects was found in one study of drivers, in two guidance documents on installation of charging points and a survey of US airports:

- A survey of EV purchasers in the UK found that those who had used public charging points reported that difficulty in identifying the location of charging points affected their confidence in using them again in future (Hutchins et al, 2013)
- A survey of non-EV purchasers in the UK identified range anxiety as a significant concern and one of the factors leading them to think that current EVs are not a viable option (Hutchins et al, 2013)
- Guidelines on EV charger installation in an area of Vermont in the US note that canopies offer large visible areas on which to raise awareness of electric vehicle charging (Chittenden County Regional Planning Commission, 2014)
- A local authority in central London notes maximising the visibility of signs for re-charging points and selecting busy locations to provide maximum exposure as two of the considerations in decisions on the location of EV charging points (City of Westminster, 2009)
- A survey at US airports with EV charging points noted that visibility of EV charging points improves awareness and can encourage adoption of EVs (Richard, 2014).

An important advantage of overhead canopies which cover the vehicle and the charging point is the protection they provide from adverse weather for both users and charging equipment, although partial canopies covering the charging equipment and part of the vehicle clearly provide less protection. Protection from adverse weather is clearly a more significant issue in northern and mountainous regions of Europe than in southern Europe. Manufacturers advise against charging in adverse weather conditions and indeed charging systems are designed so that they will not succeed in conditions which jeopardise a safe connection:

- **A North American review of several EV owners' manuals found that most advise against charging "when the vehicle is exposed to inclement weather" (AAA, no date).** The AAA also note that EV charging systems have sophisticated safety features to minimise injury or damage and that if a safe and secure connection to the vehicle cannot be established, the system will not allow charging until a good connection is possible. This suggests that having canopies at charging bays could help to reduce exposure to weather (e.g. rain) and potentially minimise occurrences when charging was either not deemed to be safe by the user or prevented by the safety systems in the vehicle and charger.

Guidelines on installing rapid charging points developed in Sweden state that it is important to provide protection from wind and rain while charging:

- “Charger users (EV owners) should be able to shield themselves from wind and rain when using / contacting the charger or machine interface” (Vattenfall, 2011).

Although no evidence has been found on the perceived safety of charging arrangements, for any users who have concerns about the safety of charging, protection from the weather is likely to be particularly important for improving the experience:

- A field trial involving 79 EV users in Berlin revealed that “most users (87%) agreed (dichotomization of 6-point Likert scale) that charging was easy. However, several users (57%) reported that handling the charging cable was cumbersome” (Franke and Krems, 2013). Canopies could make the experience of using EV charging points easier especially if they were lit at night.

A further advantage of canopies at EV charging stations is that they provide a point for installing advertising materials, which can be used to recoup some of the costs of installation and maintenance:

- Volta Industries, based in Honolulu, provides free charging to the public through sponsors who use advertising space at the EV charging stations (Richard, 2014).

3.2.3 Disadvantages of installing canopies at charging points

No information was found on behavioural aspects of EV charging which indicated that there are disadvantages for users in having a canopy installed at public charging points.

Canopies are not necessarily available at the point where people habitually charge their EV and for some at least, charging at home is seen as more convenient than charging elsewhere. However the prevalence of home charging may reduce in future as rapid charge networks expand and EVs are increasingly used for longer journeys, which the Rapid Charge Network is designed to serve. The recent evidence that is available does show that charging most commonly take place at home and that this is seen as being most convenient, although a public infrastructure is also seen as important when charging at home is not possible:

- A survey of electric vehicle purchasers in the UK found that the vast majority of the 192 private owners reported that they charged their vehicle at home (Hutchins et al, 2013). Only 35% had ever charged their vehicle at an off-street charging point which was not at work or at home, and this tended to be a relatively infrequent occurrence (less than weekly or less than monthly). Around half charged their battery routinely, regardless of the battery level and this generally took place in the evening or overnight. However availability of public charging infrastructure was also considered to be important even though many tended not to use it, and it became more important once people had experience of using electric vehicles. It should be noted that most EV chargers in the UK are not rapid chargers which is likely to change charging behaviour if charging can be undertaken by the user in minutes instead of hours.
- Charging a vehicle at home was described as more convenient than filling a conventional vehicle at a petrol station in a survey of electric vehicle purchasers in the UK (Hutchins et al, 2013); such convenience was typically mentioned by elderly purchasers in the UK survey. In this survey it appeared that many people were charging their vehicle using a standard 13 amp socket and had not installed a dedicated charging point. The survey did not identify whether charging at home took place under cover or not.

The most obvious disadvantage of installing EV canopies is the additional costs over and above the cost of installing the charge point. The basic costs include: purchase of the canopy; installation of the canopy; optionally adding additional fittings for user convenience such as hand towels and disposable gloves; lighting; planned and unplanned maintenance of canopies i.e. regular cleaning, removal of graffiti or repairing damage; end of life removal and disposal of canopy (and replacing canopy). The overall benefits of having a canopy should be at least as large as these costs.

A further potential disadvantage of including a full canopy in the design of rapid charge points is that occupancy or demand for charging points may be influenced by the availability of canopies. It could be argued that full canopies will make charging points more attractive as a parking space and encourage use by those who do not need to use **the charging point (known in the US as "icing"³)**. There is little evidence about this at present, which is one reason why further research could be needed using installed canopies; if the bays are located in premium locations i.e. close to car park exits or site facilities this may be more of a factor. This becomes a disadvantage if enforcement is not put in place to ensure EV charging bays are not used by non-EV users or by EV users who are not intending to use the charger. An alternative solution has been adopted in some airports in the US where the EV charging points in the valet parking area, so that attendants can enforce the use of charging points and move EVs after charging is complete (Richard, 2014). Such disadvantages are less likely to occur if the canopy is partial, covering the charging point and part of the vehicle.

There is some evidence available from EV users about charging spaces being used for parking not charging:

- A survey of electric vehicle purchasers in the UK found that public charging points are attractive to some EV users as a means of obtaining free parking and that they used them even when they did not need to charge their vehicle (Hutchins, 2013). Depending on the arrangements for parking fees, this may not be an issue at some locations where rapid chargers are planned to be installed, for example, the first two hours parking at motorway service stations are typically free of charge, but it may be more of an issue if this approach is taken at other types of car parks.
- The UK survey also found that some EV purchasers had experienced difficulties when public charge points were either in use by another EV, or which were being used as a parking space by other vehicles (Hutchins, 2013).

It could also be argued however, that canopies will make it clearer to non-EV users that charging points are not intended to be used for parking any vehicle, thus reducing occupancy of charging points by non-EV users.

3.3 Examples of the use of canopies in other contexts

This section summarises relevant information about the use of canopies which may inform the design and specification for canopies at rapid charging points for electric vehicles. Canopy systems are used in many ways in the UK and Europe. The following is a set of examples of canopy structures used in other circumstances; the manufacturers

³ Richard, 2013

of these canopy systems have the technology and skill to develop canopies for car charging points.

3.3.1 Canopies in petrol stations

Petrol station canopies are of more substantial construction than those which would be required for charging electric vehicles. They need to be high enough to accommodate vans and possibly large goods vehicles, and to cover a large area. The fuel forecourt experience for many is that the pumps are usually sheltered and there is reasonable protection from the weather. Such protection may be what users expect when electric car charging becomes more of a mainstream activity and petrol and diesel car users change their vehicles for electric vehicles.



Figure 1 A petrol station canopy in Ireland

3.3.2 Canopies in schools

Canopies in schools fulfil a number of different roles; these include:

- Outdoor classrooms - to allow learning outside in many weathers; these tend to be large structures which either lean to existing buildings or can be designed to stand alone.
- Parent Waiting Shelters - to protect parents from weather when picking up children; these tend to be smaller structures but like the example below, are similar to the size needed for a car canopy.
- Walkways – to protect children from the weather when moving between classes. The width of these structures can vary widely.
- Solar shades to protect children from sunlight and other weather when playing outside; a solar shade type of structure may be more useful in locations with many hours of sunshine and high temperatures during the summer.



Figure 2 Canopies at schools

The technology and materials used for many of these types of shelter could be used to make canopies for EV charging points. These systems are designed to meet requirements for snow loading and wind loads.

3.3.3 *Canopies in retail environments*

Shelters are often used for trolley parking areas, to protect trolleys from rain or other weather. Often paper towels are provided to help shoppers to dry excess moisture from the trolleys.

Some supermarket and retail car parks have covered walkways which provide shelter for customers, especially near parking spaces for disabled people and parents with children.

The technology used for trolley shelters could be adapted for use in canopies over EV charge points but trolley shelters tend to be of lighter construction than walkways or canopy systems developed for schools or car ports specifically. This would imply lower cost construction; however, the structural integrity required would need to be assessed, based on the exact dimensions and materials proposed.



Figure 3 A trolley canopy in a supermarket car park

3.3.4 *Bus Shelter Canopies*

Bus shelters are a common sight in the UK, protecting bus travellers from the elements whilst they wait for the bus to arrive. The manufacturers of bus shelters also have the capability for manufacturing shelters for EV vehicle charge points.



Figure 4 A typical recent bus shelter design by Bailey Street Scene

It is also important to note that in many urban areas of the UK, bus shelters are entirely funded by advertising. Often this is a package contract where advertisers take responsibility for providing and maintaining the shelter in return for being able to sell advertising. Examples are available at the links below⁴. It may be possible to make similar arrangements for EV charging points on the Rapid Charge Network.

⁴ <http://www.jcdecaux-oneworld.com/jcdecaux-products/street-furniture/>

<http://www.telegraph.co.uk/finance/newsbysector/mediatechnologyandtelecoms/11323483/Bus-shelters-the-future-for-digital-advertising-says-Clear-Channel-boss.html>

http://www.luton.gov.uk/transport_and_streets/public_transport/buses/pages/bus%20shelters.aspx

3.4 Factors influencing potential use of canopies at EV charging points

This section uses the outputs from the review of available information on user behaviour and canopy provision in other contexts to identify factors for consideration in deciding on the installation of canopies at EV charging points.

3.4.1 Advantages and disadvantages of overhead canopies at EV charging points

The following potential advantages of canopies have been identified for EV charging points:

- Protects equipment so that it will be possible to charge even during heavy rain or snow conditions (a number of vehicle manufacturers advise against charging when the vehicle is exposed to inclement weather)
- Will make connecting a charger a more pleasant experience for the user in poor weather
- Provides shelter for charging equipment, thus prolonging its appearance and life
- Will make the charge point easier to see, both by potential users and potential EV purchasers
- Will provide a location for advertising to bring in additional revenue or provide space for further information on the scheme
- Can provide fixing points for additional lighting and CCTV for user convenience and safety at night and to prevent vandalism
- Can provide the space for solar panels to provide power to the canopy (e.g. for lighting, to make charging easier at night).

The potential disadvantages include:

- Cost of construction and installation
- Cost of maintenance i.e. cleaning or minor repair
- Cost of repair (due to accidents or vandalism)
- The shelter may make the parking spots desirable for non-electric vehicle users or EV users who do not need to charge their vehicle
- The shelter will need to be replaced when it becomes un-repairable or reaches a level of wear which is visually unacceptable to the host organisation.

3.4.2 Features of canopy design

Fast charging stations and installation guidelines (Vattenfall AB)

Figure 5 shows a full canopy at an EV charge point by Vattenfall AB, a charger manufacturer in Sweden.



Figure 5 A Vattenfall fast charging station in Tyresö (Sweden) with a canopy and lighting. Photo: Elisabeth Redlig

Another example of a Vattenfall AB design is a fast charging station near a shopping area in northern Sweden, as shown in Figure 6. It illustrates a partial canopy over the charging point but not the entire vehicle. This protects the equipment but not the user, but is sufficiently prominent to help users locate the charging point and to promote electric vehicle use; it also provides limited protection from rain and snow when plugging in the vehicle.



Figure 6 A canopy over rapid charging equipment in northern Sweden. Source: Vattenfall (2011)

3.4.3 Canopy systems

The examples in Sweden illustrated above indicate that canopies could either be large enough to protect the charging equipment, the vehicle and the user, or could be much smaller, partial canopies covering the charging equipment and possibly the point where the vehicle is plugged in. In either case, a canopy will have a number of features, some of which will be standard and some of which are considered to be optional.

Standard features of canopy systems

- Roof cover and roof structure - this could be transparent to let in light during the day or solid or translucent to shade sunlight, or it could use photovoltaic (PV)

material to generate electricity for secondary uses such as lighting. The roof structure could just cover the equipment or be larger and cover part or all of the vehicle and the user.

- Roof supporting structure - usually metal construction, this could also manage wiring for lighting or advertising and or drainage installations.

Optional features of canopy systems

- Drainage - this would prevent the roof from dripping water from the edges, which can soak users and passers-by.
- Lighting - this could be solar powered or from existing power supplies, to help night time users with connecting/ disconnecting the charger and paying or reading instructions for use.
- Advertising space (lit or unlit) to provide additional income. Some of this space could be used for information purposes such as the locations of the next charging points and promoting the take-up of electric vehicles.
- Structure protection - it may be necessary to add bollards etc. to protect canopy structures from being damaged; this is particularly important for light weight canopy structures.
- Energy storage - if a PV roof is used and the shelter is not connected to the energy grid then a battery storage system will be required to store energy for lighting systems etc.
- A voice / video information system letting user know what the space is for and any enforcement practices in place to help discourage incorrect parking (this feature is beyond the scope of features considered for canopies on the Rapid Charge Network).
- Security monitoring such as CCTV to provide security for users, identify vandalism or to gain evidence of potential fraudulent use (another feature which is beyond the scope of features considered for the Rapid Charge Network).

3.4.4 Factors relevant to specific types of site

Airports

A safety critical issue at airports is the prevention of glare; this can affect pilots, air traffic control centres, and other critical airside operators such as drivers and could be extremely hazardous to the safe operation of an airport. In the UK so far there are no documented concerns but in the USA in at least one airport, glare from PV panels on car charging point roofs has caused glare problems for air traffic control at certain times of day which has required remedial action (Hayward, 2012). The Federal Aviation Administration (FAA) has required the use of a map based tool developed by DOE Sandia Laboratory to identify the potential for glare at critical locations around an airport. The FAA require airport operators to use the tool to ensure that glare is not present at key airport locations or runway operations when planning installations of PV arrays in car parks or in other locations around the airport. The **current US Regulation is the "Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports - 78 FR 63276."** (Federal Aviation Administration, 2013).

The diagram below shows an image from the Solar Glare Hazard Analysis Tool (SGHAT) by Sandia Laboratories in New Mexico USA⁵ There is a comprehensive manual for the tool⁶.

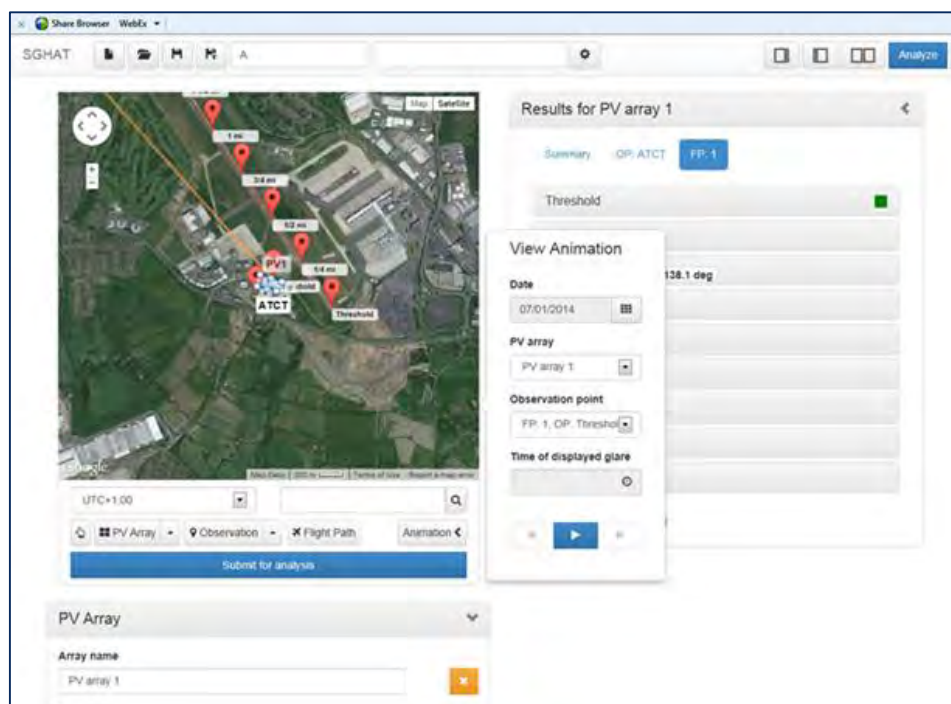


Figure 7 Solar Glare Hazard Analysis Tool

Sea ports

Sea ports are extremely corrosive environments for metals due to the presence of salt spray so there is a need to protect any metal work in canopies from the salt environment.

ISO has a set of standards: ISO 12944 'Paints & Varnishes - Corrosion Protection of Steel Structures by protective paint systems for metal protection in Marine Environments'⁷ which should be considered when placing canopies in these locations. The protection level to consider is C5M for marine, estuaries, coastal areas with high salinity.

Motorway and trunk road service (Strategic Road Network) stations in the UK

The UK government still owns a number of service stations across the country which it leases to third parties; the Government (via the Highways Agency or other regional governments) requires the leased or privately owned service stations to have a minimum set of standards of service, car parking and other requirements, including the placement and design of wind turbines on site; at present there are no specific requirements for low

⁵ <https://share.sandia.gov/phlux>

⁶ https://share.sandia.gov/phlux/static/references/glint-glare/SGHAT_Users_Manual_v2-F.pdf

⁷ <http://www.iso.org/iso/home/search.htm?qt=12944&sort=rel&type=simple&published=on>

carbon vehicles other than a general encouragement to facilitate the users of low carbon vehicles.

Note that the situation may be different in other countries, although no specific details have been obtained in this limited review.

3.4.5 Considerations relevant to specific countries or regions

Generally there should be little need for significant variations in canopy design apart from potentially the scenarios identified below:

Countries and locations with significant snowfall

Whilst all canopies should be designed to manage snow loading, in those regions where snow is frequent, consideration should be given to ensuring that the design facilitates clearing drifting snow from the parking area and the charging point. If the canopy is to incorporate PV, consideration should also be made for removing snow from the PV roof.

Guidance on EV charger installation in an area of Vermont in the US includes provision for snow as follows (Chittenden County Regional Planning Commission, 2014):

“In order to provide accessible operation of EVSE (Charging Equipment), a 3’ by 3’ (minimum) handicapped accessible operating area must be kept clear of vehicles and snow between the nose of the vehicle and the EVSE. Strategic placement of bollards, curbing, or wheel stops may be required to protect EVSE from vehicular impacts, while still providing accessibility and reasonably convenient snow removal. Many EVSE plans utilize wheel stops to prevent vehicle contact with the EVSE, but these can be problematic for snow removal, so bollard poles are often a better option in areas where snow may accumulate. Covering the operating area with a roof structure or canopy would keep the operating area clear of snow, and reduce weather-related pavement damage”.

The locations in which such considerations are relevant are: many parts of northern Europe including Norway, Sweden, Finland, Denmark, Northern England, Scotland, Wales, Latvia, Lithuania, Estonia, Poland, parts of Germany, Austria and Slovakia and the mountainous regions of countries such as Austria, Switzerland, Italy and Spain.

Countries and locations with significant sunshine

For parts of Europe with significant sunshine and high temperatures, the canopy should be designed to provide shade for vehicles, their occupants and the equipment. This would prevent excessive temperatures from overheating vehicles and their occupants while the vehicle is charging or from making the charging equipment too hot to handle.

The locations in which such considerations are relevant are: many parts of southern Europe during summer months including Spain, Portugal, southern France, Greece, Cyprus, Malta and Italy.

Countries and locations with significant hail storms with large hail stones

For parts of Europe with weather that has a risk of significant amounts of larger potentially damaging hail stones, the canopies should be designed to prevent or limit damage from hailstones and to help protect the charging equipment, users and their cars at the charging points.

The locations in which such considerations are more relevant are: southern and western Germany, northern and eastern France and southern and eastern Benelux. Croatia and Serbia also experience frequent occurrences of hail.

4 Information from suppliers: canopy design and specification

4.1 Introduction

This section takes as its starting point the information provided by suppliers in response to the questions about the design and specification of canopies for rapid charging points at motorway service stations. It reviews the designs suggested, materials, and adaptability for different parking bay configurations, maintenance requirements, life expectancy, and risks. Information from suppliers which were able to offer additional features (solar panels e.g. to power lighting, solar panels with battery storage and lighting) is also included. Variations and differences noted by suppliers for different types of site and different locations in Europe are also summarised.

Details of the charging bay layout and other information which was provided to suppliers to inform their designs are available in Appendix A. The questions which suppliers were asked to address are included in Appendix B (the version here includes the questions asked for one canopy design but does not include the repeat questions for suppliers who wished offer additional canopy designs).

4.2 Description of designs and their implications

4.2.1 *Supplier 1*

The type of structure that Supplier 1 would use for the EV canopy cover is shown in Figure 8.



Figure 8 Canopy from Supplier 1

The structure would be created using steel of dimensions 75mm x 50mm x 3mm. The cladding made from Polyethylene Terephthalate (PET).

The estimated lifetime of the structure is ten years.

The design is scalable and modular, so can accommodate different size and shape of parking bay.

The only stated foreseeable risks were noted to be vandalism of the structure.

The maintenance would involve cleaning approximately once a month.

No variations were mentioned for the alternate locations of service stations, ports, airports and retail outlets.

No design changes or costs were given for the alternative European installations in Southern Europe, Scandinavia, Northern Europe or mountainous regions.

The supplier noted that installation costs vary depending upon the location of the installation. It is not certain if this mean geographic location or specific site location. No further response was gained when clarification was requested.

4.2.2 Supplier 2

The design suggested by Supplier 2 is shown in Figure 9.



Figure 9 Canopy design from Supplier 2

The structure would be made using aluminium for the framework and polycarbonate roofing panels. The roof panels would be designed specifically for each site to meet the requirements of the relevant Eurocodes (formerly BS6399) for wind and snow loading.

The design is scalable and modular, so can accommodate different size and shape of parking bay.

The estimated lifetime of the structure is 25 years

No risks were stated to be foreseen by the supplier. The strength of the roof panels required for wind and snow loading ensures that it is also strong enough to be vandal-resistant. The cantilevered design reduces the risk of cars hitting the posts because there are posts on only one side of the parking bay, making it easier to manoeuvre a vehicle in and out without hitting the posts.

No maintenance is thought to be required.

The supplier stated that there would not be any design changes or only very small amendments for implementation at the alternate locations.

The supplier stated that they do not currently have any experience of installations in Europe, they do not see this as a barrier and they have European partners who could potentially assist them, though they do not know if there would be additional installation costs. Once again, they did not think there would be any design changes for European installations.

This company are in the process of evaluating the incorporation of solar panels into the canopy design, but this is in the early stages and they cannot currently give any cost estimates for these additions.

4.2.3 Supplier 3

Supplier three gave their responses in a telephone conversation, and did not supply any images.

The structure would be created with high strength steel for the framework. The panelling would be either polycarbonate or a tough fabric material. Additionally the structure is supplied with guttering around the edge, which is also made from polycarbonate. If specifying guttering, the feasibility of linking this with drains at the site also needs to be considered.

The structure was stated to be of a flexible modular design.

No information was given by the supplier relating to expected lifetime or to installations at alternate locations or in Europe.

4.2.4 Supplier 4

This supplier provided images of typical installations (Figure 10) and a design graphic for an EV charging point canopy (Figure 11).



Figure 10 Canopies from Supplier 4

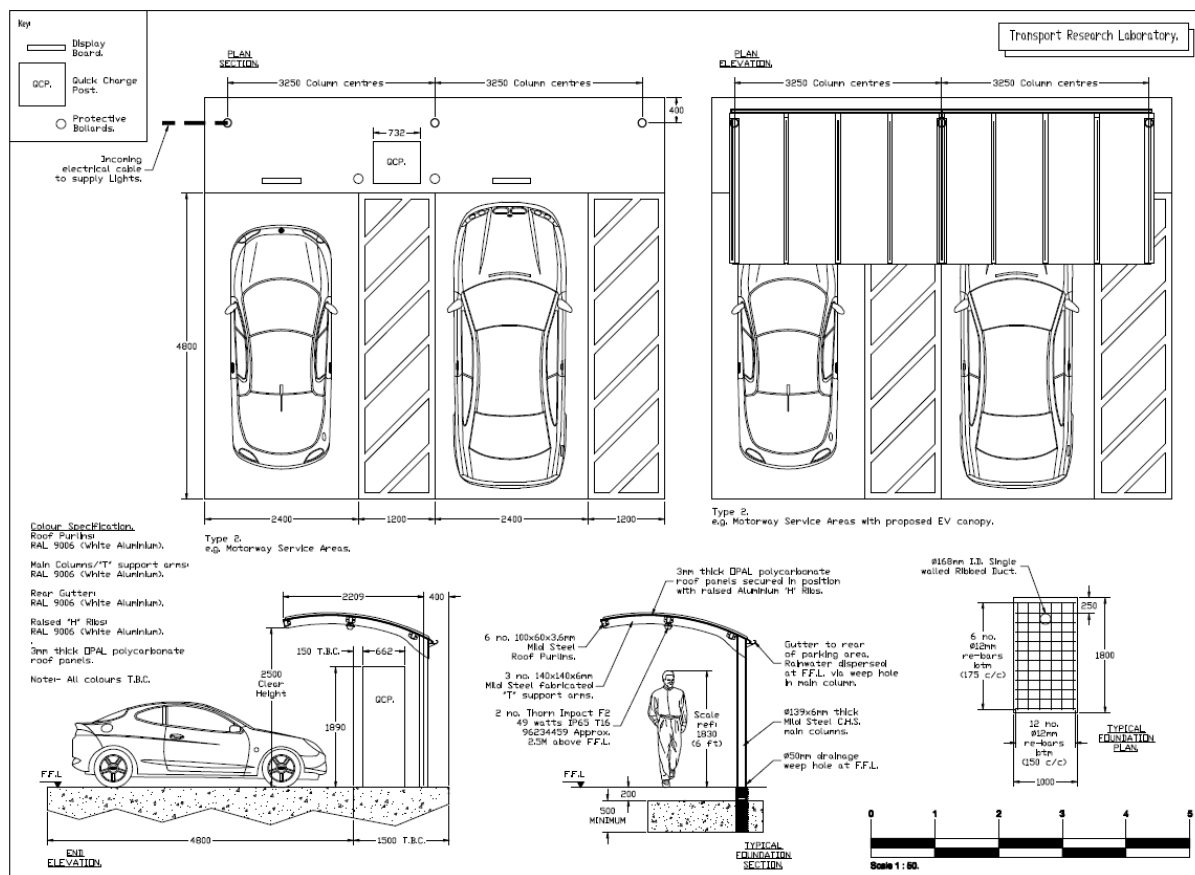


Figure 11 Technical drawing for design from Supplier 4

The structure would be made from the following materials:

- Structural framework - Mild Steel hot dipped galvanised & polyester powder coated.
- Roof structure – Aluminium extrusions and polyester powder coated.
- Canopy glazing – Opal polycarbonate.

The design is stated to be modular and can incorporate different roof sizes.

The company would expect that the canopy would require quarterly cleaning with an annual maintenance inspection.

With this regular maintenance and cleaning, the lifetime can be expected to be 25 years.

The supplier did not foresee any risks relating to this solution.

No additional information was supplied relating to design at service stations, ports, airports and retail outlets. They only additional information is that they have suggested that maintenance and cleaning are carried out by local contractors.

No other designs were supplied for European locations. As above, the supplier has suggested that local contractors could be used for installation and decommissioning after initial training and instruction.

4.2.5 Supplier 5

The graphic provided by Supplier 5 to illustrate the proposed canopy design is shown in Figure 12.



Figure 12 Design from Supplier 5

The canopy structure would be manufactured from 168mm circular hollow section for the frame with 75 x 50mm rolled hollow section for the canopy roof cladding supports, hot dipped galvanized and powder coated to any standard RAL colour. The canopy would be twin wall opaque polycarbonate sheets with aluminium sealing strips.

Maintenance is suggested to be an annual cleaning of the steel structure and polycarbonate canopy with touching up of paintwork and re-tensioning of ground bolts. An inspection and replacement of any worn polycarbonate fixings is also recommended. The polycarbonate roofing sheets are UV stabilized and have a 10 year guarantee against discolouring.

The likely lifetime of the product is in the range of 15 to 25 years. This is expected to depend largely upon proximity to the sea and salt spray. Although not stated, it is presumed that a shorter lifetime of 15 years would be experienced by canopies near the sea or at ports.

If the supplier were to install solar panels on to the structure, then they have stated that these should be cleaned every two months in winter, in order to maintain performance.

The supplier stated that the design is modular and has estimated costs for the required dimensions, including height clearance of 2.3m. The design can be extended for multiple units.

The only foreseeable risk identified by this supplier was potential collisions with high sided vehicles if drivers misjudge the height of their vehicle in relation to the canopy. They have specified installation of bollards near the structure to mitigate this risk. If the structure was installed at service stations on main roads or at retail outlets, the supplier suggested that vandalism may become an additional risk.

The supplier stated the proposed design is suitable for the alternate installation locations and being modular, can use the most suitable dimensions for each installation location.

For installation in Europe the supplier has stated, as above, that the design would remain the same, but that costs may vary. The changes in cost can be seen in the costs and revenue section (Section 5.1.2).

4.2.6 Supplier 6

This supplier provided a series of images showing a range of styles of canopy. These include cantilever designs and structures with four supporting posts. Some include solar panels.



Figure 13 Designs from Supplier 6

The supplier offered costed solutions for two types of canopy, but there is minimal difference between each of the structures. The supplier stated that the canopy structure would be made from galvanised steel or aluminium.

For a service station construction, the canopy would be recommended to be installed with a powder coating over a galvanised steel framework.

Maintenance for the structure was stated to be a requirement for cleaning and possible touching up of paintwork every 4-6 months.

The lifetime of the structure is between 10 and 15 years.

With the additional of solar panels, the frequency of maintenance increases to four times per year. If solar panels are installed, the lifetime of the panels and the battery supply are specified by the panel manufacturer to be 5 years, which is less than the lifetime of the canopy, so would likely require replacing in due course.

No additional risks other than the usual risks could be foreseen by the supplier. It is assumed that this is likely to mean vandalism, graffiti or possible vehicle impact with the structure.

4.2.7 Supplier 7

The supplier provided a series of images as examples of the type of structure they would install, as shown in Figure 14.



Figure 14 Examples of canopies from Supplier 7

The canopy structure would be made from aluminium alloy sections, with polycarbonate sheets for the panels.

The design was stated to be scalable and modular.

The only maintenance required would be annual or biannual cleaning of the structure.

The structure is estimated to have a lifetime of 5 to 10 years, but a rolling refurbishment programme could keep the structure in good condition for longer. This would likely involve replacing the polycarbonate panels and repainting the framework.

The only additional impact on life expectancy is specifically related to the battery lifetime if solar powered lighting were to be installed on the canopy.

The only foreseen risk by the supplier is graffiti at some locations.

The only amendments to design would be for canopies at ports and at retail outlets. At ports, the supplier suggests using marine grade paint for the framework.

For installation in European locations, the supplier does not recommend any design changes but would incur additional delivery charges and could be installed by local contractors.

4.2.8 Supplier 8

Supplier 8 provided images of two examples of canopies installed for other purposes, see Figure 15.



Figure 15 Examples of canopies from Supplier 8

The supplier stated that their canopy would be constructed from galvanised steel box section framework, with Polyethylene terephthalate copolymer (PET-g) [galvanised and powder coated] UV2 for the roof sheeting. A cost saving could be made if the structure was only galvanised steel.

A further cost saving could be made if the roof of the canopy had a flat profile instead of being curved.

The only maintenance required for this structure would be for cleaning and for damage inspection. The supplier suggests cleaning the canopy every 8-12 weeks, with regular visual inspections for any damage. Additional maintenance would be required for a canopy with lighting, as this would require checking for any damaged or non-functioning lights.

The canopy unit is stated to be modular and scalable.

The lifetime is expected to be 20 years.

The only risk foreseen by this supplier is damage to the canopy, but no particular source was specified.

The image on the left in Figure 15 shows what the supplier describes as a solar lighting retrofit option for their canopies. The costs for this option are detailed in the cost and revenue section below (Section 5.2.1).

The supplier states that there would not be any design changes for European installations. They currently have no prior experience, but would be happy to carry out a supply-only operation, with installation carried out by local contractors.

4.3 Summary of canopy design factors

Section 4.2 shows that the suppliers consulted have provided a range of designs, although some provided more detailed information than others. Although none of the suppliers which responded are currently designing canopies for electric vehicle charging points, they were able to adapt existing designs for other applications to meet the requirements of electric vehicle charging points.

All suppliers suggested transparent or semi-opaque canopies using either polycarbonate, PET or in one case tough fabric. The materials favoured for the structure were steel, galvanised steel and aluminium. Some suppliers suggested a cantilever design to reduce the risk of vehicles hitting the structure. Another suggested using bollards to protect the structure from vehicle collisions. One specifically mentioned guttering to capture run-off from the roof.

Some suggested curved roof panels; one indicated that flat roof panels would cost less than curved panels.

All of the designs are scalable and modular, and thus could readily be expanded to suit larger scale installations in future to meet higher levels of demand for rapid charging. At this point it is likely that it would be necessary to equip the charging points with some form of renewable energy to meet the demand for electricity.

From the information provided, it appears that most of the suppliers would not normally include additional features such as solar panels and lighting in their canopy structures, but some did have experience of doing so. These have implications for cost, frequency and nature of maintenance and life expectancy, as discussed further in Section 4.4 and Section 5.2.

The suppliers recommended only minor variations to suit different types of site, and on the whole the basic designs were considered to be suitable for motorways, service stations, ports, airports and retail outlets in the UK and for sites in other parts of Europe with different weather conditions.

The variations suggested were marine quality paint in coastal areas. The additional costs involved in each case were small (£300 and £500 respectively). None suggested anti-glare roofing at airports, a feature required in some US airport locations.

4.4 Implications of canopy design and specification

The information provided by suppliers which was presented in Section 4.2 that is relevant to factors to be considered in decisions on installing canopies at charging points on the Rapid Charge Network is summarised here. This brings together the information from suppliers on risks, maintenance requirements and life expectancy.

4.4.1 Risks

Three suppliers did not anticipate any risks to the structure.

None of those suppliers that mentioned risks had design-specific risks.

Three identified vandalism or graffiti as a risk to the canopy. One stated that meeting the requirements for wind and snow loading on the polycarbonate sheeting would make it strong enough to resist attacks by vandals. Graffiti-resistant paint was suggested as a way of reducing the impact of vandalism on the painted elements of the canopy structure.

Vehicle impact was the other main risk identified – impacts from both cars and high vehicles were identified as potential hazards if drivers misjudge the space available for manoeuvring or the height of the canopy. To mitigate this risk, bollards were suggested. Another supplier pointed out that their cantilever design reduces the risks of vehicles hitting the posts. The supporting pillars can be positioned at one side of the bay or behind the charging point (depending on the design), minimising the effect of the pillars on the amount of space available for manoeuvring vehicles.

In general, suppliers did not expect the risks to be very different from one type of location to another. One supplier noted that vandalism would be a greater risk in some areas than others. Another company identified vandalism to be a risk at service stations on main roads and at retail outlets but not at motorway service stations or at ports or airports; presumably this is associated with accessibility on foot from built up areas to main roads and retail parks.

4.4.2 Maintenance

Seven of the eight suppliers provided information on maintenance requirements for the canopies.

Overall, little maintenance is suggested by the suppliers. One supplier specifically stated that no maintenance is required.

Six suppliers suggested that the canopy should be cleaned. The frequency of cleaning that was suggested varied between the suppliers. The most frequent suggestion was once per month. The least frequent was once per year.

Two companies noted that if solar panels were to be installed, their suggested cleaning frequency would increase. One suggested this would increase from two to three times a year to four times a year, and the other from once per year, to six times per year. It is expected that this would depend on the location of the charging point, which would

affect the extent to which the surface collects dirt and debris, reducing the electricity generating capacity.

Aside from cleaning, little other maintenance was mentioned. One company suggested an annual inspection for wear and tear or damage.

The remaining suppliers would only require possible replacement of worn or damaged fixings, touching up of paintwork or damage inspection in addition to cleaning.

For those suppliers that could provide additional equipment such as solar panels, additional maintenance and inspection for these components would be required.

The maintenance requirements are expected to vary with canopy design and materials. The type of site is also expected to affect the frequency of maintenance of some structures, with canopies at ports and areas with extreme weather conditions having more frequent maintenance requirements than other types of site.

4.4.3 Life expectancy

This section of the survey was completed by seven of the eight suppliers. Life expectancy figures quoted ranged from 5 years as a minimum to 25 years at the maximum. The average of the figures provided was calculated (using the mid-point where a range was given). This resulted in a figure for the average life expectancy among all of the designs of approximately 16.6 years.

Possible limitations on the lifespan of a canopy were suggested by some suppliers. One company suggested that proximity to the sea and salt spray would be likely to have an impact on the life expectancy. Another company suggested that replacing the polycarbonate panels would give additional life to the canopy.

Further life expectancy limitations can be applied to the additional features. One company stated that it would be likely that the solar panels and the associated battery would need to be replaced every five years (based on information from the manufacturer). This is not consistent with information from the Centre for Alternative Technology (Centre for Alternative Technology, no date) which indicates that solar panels can be expected to have a life expectancy in the range of 20 – 30 years. This is in line with the life expectancy of the more durable of the panel designs.

5 Information from suppliers: costs and revenues

5.1 Capital and operational costs

In this section, the responses are presented first for deployment at motorway service stations in the UK, then differences for other types of site and location in Europe are discussed. The figures presented are the averages per modular canopy covering two charging bays, excluding VAT.

5.1.1 Installation at Motorway service stations in the UK

Companies were asked to provide estimates of capital and operational costs for three different levels of deployment: 1 – 10 units in the UK, 25 – 50 units in the UK and Ireland, and costs for a wider scale deployment at the point where costs would reduce significantly. This was on average indicated to be around 150 canopies, but ranged from 30 to 500 canopies. The results are summarised in Table 1. The figures in the table do not include VAT.

All of the suppliers provided figures for materials and equipment, ranging from around £1,100 to £14,500 with a mean of £6,100 at the scale of low volume production (1-10 units). Economies of scale are evident, with materials and equipment costs reducing to an average of about £4,000 in the case of wide scale deployment.

Economies of scale are less apparent for installation, maintenance and decommissioning costs. Note that one supplier stated that there would be no maintenance costs, hence the minimum value for maintenance shown in Table 1 is £0. The supplier with the highest cost for materials and equipment included the installation cost with the cost of materials and equipment; this company has been excluded from the installation costs in Table 1.

In addition to considering the separate capital and operational costs, a decision on installing canopies for the Rapid Charge Network would be expected to take account of the costs of the canopies through their life. Two measures have been calculated from the figures provided by suppliers: a simple estimate of the lifetime cost (capital, installation, and decommissioning costs plus annual maintenance costs over the lifetime specified by the supplier) and the average cost per year of life (the lifetime cost divided by the life expectancy stated by the supplier).

Table 1 shows the lifetime cost estimated derived from the data given by the five suppliers that provided information on all cost elements. This indicates lifetime costs ranging from around £5,300 to £27,000 for low volume production (1-10 units), £5,800 to £30,000 for 10-25 units, reducing to £4,600 to just over £21,000 in the case of wide scale deployment. However given that this is based on information from fewer suppliers, it is less reliable than the data on costs of materials and equipment.

Costs per year of life are also included in Table 1 for this group of five suppliers. It indicates costs per year of life ranging from around minimum values of £500 - £600 to maximum values around £1,000 - £1,500, with average values around £700 - £800 per year.

Note that one supplier quoted higher costs for deployment of 25 – 50 canopies “in the UK and Ireland” than for 1-10 units “in the UK”, which results in rather higher costs at this intermediate scale than at the scale of 1-10 units.

Table 1 Capital and operational costs at motorway service stations in the UK

Cost item	Deployment scale	Min £	Max £	Range £	Mean £	Number of responses	Reliability rating
Materials and equipment	1 - 10	1,086	14,500	13,414	6,122	9	High
	25 - 50	815	12,500	11,685	5,426	9	High
	Wide	750	7,824	7,074	4,025	8	High
Installation	1 - 10	600	6,750	6,150	2,521	9	High
	25 - 50	626	6,400	5,774	2,393	9	High
	Wide	585	5,500	4,915	2,010	7	High
Annual maintenance	1 - 10	0*	405	405	226	5	Medium
	25 - 50	0*	372	372	231	5	Medium
	Wide	0*	400	400	194	5	Medium
Decommissioning	1 - 10	600	4,233	3,633	1,654	6	Medium
	25 - 50	600	9,305	8,705	2,931	5	Medium
	Wide	600	3,405	2,805	1,339	5	Medium
Cost for stated lifetime (where all data provided) ⁸	1 - 10	5,300	26,876	21,576	14,535	5	Medium
	25 - 50	5,800	29,679	23,879	14,826	5	Medium
	Wide	4,600	21,243	16,643	11,830	5	Medium
Cost per year of lifetime (where all data provided) ⁹	1 - 10	610	1,344	734	830	5	Medium
	25 - 50	517	1,484	967	858	5	Medium
	Wide	510	1,062	552	682	5	Medium

*One company stated that there would be no maintenance costs

5.1.2 Installation at other sites

From the companies which provided information on cost variations at other types of site in the UK, the following points are noted:

- One company indicated slightly different costs for UK sites on main roads, ports and airports compared with motorway service stations
 - Installation £900 - £1,800, compared with £650 - £1,000 at motorway service stations
 - Annual maintenance £200 - £350 compared with £250 - £350 at motorway service stations

⁸ Sum of equipment, installation and decommissioning cost plus maintenance over the stated lifetime

⁹ Cost over the stated lifetime divided by the stated lifetime

- Decommissioning £600 - £800 compared with £750 at motorway service stations
- Another company indicated that installation costs would vary between different types of UK site: £600 at motorway service stations, airports and retail outlets, compared with £300 at service stations on main roads and ports.

For installations in other parts of Europe, three companies provided information, which indicated higher costs:

- All three indicated that the cost of materials and equipment would be the same as for the UK
- One indicated higher installation and decommissioning costs: by 25% in Northern Europe, 25 - 30% in Southern Europe, 30% - 40% in Scandinavia and mountainous regions
- This company also indicated that maintenance costs would be higher in some areas: by 15% in Scandinavia and mountainous regions
- Another company noted that there would be additional delivery charges and the costs of hiring local contractors to install the canopies, but did not estimate the scale of these additional costs.

5.2 Additional features

5.2.1 Solar panels

Suppliers were asked to provide costs for solar panels (e.g. to supply electricity for lighting). Not all of the canopy suppliers had experience of incorporating solar panels in their designs. Responses were received from three suppliers, one of which provided costs for two different designs, as shown in Table 2.

The lowest capital cost (£400) was for a 250w panel (1640mm x 990mm) suitable for powering LED strip lighting. A similar cost (£450) was quoted by another supplier for a 28w panel with charge control designed to supply a movement sensor, batteries and three 12v LED lamps. The highest cost (£1,120) was for panels designed to generate 1,000w.

The figures indicate that adding the cheaper solar panels represents a relatively small additional cost per module when compared with the figures shown in Table 1.

Table 2 Cost of adding solar panels to canopies at motorway service stations in the UK

Cost item	Min £	Max £	Range £	Mean £	Number of responses	Reliability rating
Materials and equipment	400	1,120	720	690	4	Medium
Installation	75	286	211	179	4	Medium
Annual maintenance	85	150	65	118	4	Medium
Decommissioning	55	160	105	105	4	Medium

5.2.2 Solar panels and battery storage

Five suppliers provided costs for solar panels with battery storage, as shown in Table 3.

The lowest capital cost (£595) was for a 28w panel with two 12v 12 AH deep cycle batteries, designed to power a movement sensor and three 12v LED lamps. The second lowest capital cost (£800) was for a 250w panel with two 100amp batteries and LED strip lights. The highest capital cost (£2,348) was for the 1000w panel (battery details were not provided by this supplier).

At the lowest level, the costs are about 50% higher than the cost involved in equipping the canopies with solar panels without battery storage, but the more expensive installations are approximately twice the cost of panels without battery storage (in Table 2).

Table 3 Cost of adding solar panels and battery storage to canopies at motorway service stations in the UK

Cost item	Min £	Max £	Range £	Mean £	Number of responses	Reliability rating
Materials and equipment	595	2,348	1,753	1,229	5	Medium
Installation	75	448	373	326	5	Medium
Annual maintenance	95	807	712	351	3	Low
Decommissioning	55	320	265	158	3	Low

5.2.3 Lighting

One supplier included LED lighting (three 12v LED lamps, powered by battery and triggered by a movement sensor) within a solar lighting kit supplied for cycle shelters. Another supplier included LED strip lighting within the costs of solar panels with battery storage. These costs are included within Table 3 above.

Additional costs of lighting were provided by three further suppliers, one of which also provided costs for maintenance and decommissioning, as shown in Table 4. This indicates that lighting is a relatively small additional cost, although without a source of renewable energy, connection to the electricity grid would be required to power the lighting; one supplier estimated the cost of connection to the electricity grid would be £1,250. However connection of the canopies to the electricity grid is not envisaged for the Rapid Charge Network.

Table 4 Cost of adding lighting to canopies at motorway service stations in the UK

Cost item	Min £	Max £	Range £	Mean £	Number of responses	Reliability rating
Materials and equipment	154	1,100	946	501	3	Low
Installation	50	380	330	218	3	Low
Annual maintenance	48	48	0	48	1	Low
Decommissioning	160	160	0	160	1	Low

5.2.4 Solar panels with battery storage and lighting

The information from suppliers which provided costs for solar panels with battery storage and lighting was used to calculate the cost of adding this set of options to the standard canopies. The figures for materials, equipment and installation are shown in Table 5, based on information from five companies: three of which provided data on costs of solar panels with batteries as well as the costs of lighting, and two of which provided costs for a solar panel, battery and lighting package.

The lowest capital cost (£595) was for a 28w solar panel with charge control, two 12v 12 AH deep cycle batteries, with a 12v movement sensor and three 12v LED lamps. The second lowest capital cost (£800) was for a 250w panel with two 100amp batteries and LED strip lights. The highest capital cost (£2,502) was for the 1000w panel option (lighting and battery details were not provided by this supplier).

The cheapest of these systems represents slightly more than half of the capital cost of the cheapest canopy and a tenth of the average capital cost of the canopies (shown in Table 1).

Table 5 Cost of adding solar panels with batteries and lighting to canopies at motorway service stations in the UK

Cost item	Min £	Max £	Range £	Mean £	Number of responses	Reliability rating
Materials and equipment	595	2,502	1,907	1,529	5	Medium
Installation	75	760	685	366	5	Medium
Annual maintenance	95	855	760	367	3	Low
Decommissioning	55	480	425	212	3	Low

5.2.5 Fittings for consumables

Suppliers were asked to provide costs for fittings for consumables such as disposable gloves and paper towels. These would enable users to protect their hands and remove any surface moisture from the vehicle and equipment, providing a level of service equivalent to that at fuel filling stations.

Four suppliers provided information, as shown in Table 6, indicating minimal costs for such fittings. Two stated that the cost of installation would be £0 (included in the cost of materials) and one stated that the cost of decommissioning would be £0, hence the minimum values of £0.

Table 6 Cost of adding fittings for consumables to canopies at motorway service stations in the UK

Cost item	Min £	Max £	Range £	Mean £	Number of responses	Reliability rating
Materials and equipment	100	150	50	127	4	Low
Installation	0	56	56	27	4	Low
Annual maintenance	25	252	227	139	2	Low
Decommissioning	0	128	128	64	2	Low

5.3 Revenue

Suppliers were asked about the types of revenue stream which could be used to offset the costs of installing the canopies. Three suppliers indicated that advertising boards **could be fitted to the canopies. One suggested "sponsored shelters"**. Bus shelters in many urban areas are entirely funded by advertising (the advertisers cover the cost of materials, installation and maintenance); it may be possible to make similar arrangements for rapid charging points.

One supplier noted that advertising would normally be the responsibility of advertising companies rather than canopy suppliers. This may explain why only one supplier was in a position to provide figures for advertising revenue.

This supplier indicated that revenue of £10,000 to £16,000 per canopy per year could be expected. This was not expected to vary between sites at motorway service stations, main roads, ports, airports or retail outlets in the UK. This supplier did not have experience of other parts of Europe, but assumed that similar revenues could be achieved in other countries.

If it were possible to achieve advertising revenue at this level, this would offset even the highest capital and installation costs shown in Table 1 within the first two years of operation. However further information among advertising companies on the potential for covering the costs through advertising revenue for various designs of canopy in different types of location would be required, before starting to commission canopies for the Rapid Charge Network.

6 Summary and recommendations

6.1 Factors to be considered for installing canopies at EV rapid charging points

The information from the suppliers and the review of information is combined here to summarise the factors influencing decisions and design considerations for canopies at EV rapid charging points.

6.1.1 Canopy specification

Canopy coverage

Canopies may either cover the vehicle and the charging point, or cover the charging point and part of the vehicle. Both full and partial canopies were included in the designs suggested by suppliers and examples of both were identified at EV charging points in Sweden. There is not enough information available to indicate definitively which of these is most appropriate.

Materials

Canopy materials should be transparent or semi-opaque, giving users natural light during daylight hours. If the canopy includes side panels, transparent panels enable users to see the movements of people and vehicles, both while using the charging point and manoeuvring their vehicle. Suppliers tended to suggest either polycarbonate or PET for the canopy.

The suppliers specified steel, galvanised steel or aluminium for the canopy structure.

Site specific considerations are important for the materials in the canopy and the supporting structure; these are discussed below.

Scalability and modular design

It is anticipated that the demand for EV rapid charging points will grow over time. It is therefore beneficial for canopy designs to be scalable and modular so that they can readily be extended to suit larger scale installations in future. The designs submitted by suppliers for this study were all scalable and modular, which also provides flexibility for adjusting designs to meet the specific requirements of different sites.

Expected life of EV charging points

The canopy designs supplied had a wide range of expected life from 5 to 25 years. At present it is not clear whether there will still be a requirement for a rapid charging points on the TEN-T network in 25 years, or whether new technologies such as inductive charging while vehicles are in motion, will have superseded them. The anticipated future life of the rapid charge points should be considered in specifying the life of canopies.

Risk of vehicles hitting the structure

Suppliers noted that canopies are at risk from impact with vehicles manoeuvring in and around the charging point and from high vehicles if drivers misjudge the height of the

canopy in relation to their vehicle. Bollards should be considered to protect the supporting structure from vehicle impacts. A cantilever structure is recommended as the supporting pillars can be positioned at one side or behind the charging points, minimising the impact of the supports on the amount of space available for vehicles to manoeuvre, thus reducing the risk of vehicles hitting the structure.

Risk of vandalism

Vandalism is likely to be a risk in some locations, and at some types of site. Sites which are more accessible on foot from urban areas, for example retail parks and service stations on main roads may also be more prone to vandalism. Measures identified by suppliers to reduce vandalism were lighting and graffiti-resistant paint for the supports and strong polycarbonate materials for the canopy. One supplier noted that polycarbonate sheeting which meets requirements for wind and snow loading should be strong enough to resist attack by vandals.

Services to improve the user experience

A canopy can improve the user's experience at the charging point by providing some protection from weather and by making the charging point more visible above vehicles in the vicinity. Additional services may also be considered to further improve this experience.

Lighting (powered from batteries charged by solar panels with batteries) will help users when charging their vehicle at night, particularly in poorly lit areas where security may be an additional concern. Some of the suppliers provided details of packs which they incorporate in their shelters to provide solar-powered lighting. The costs are an important consideration however, with the cheapest of the systems identified being about half of the capital cost of the cheapest canopy and a tenth of the capital cost of the 'average-priced' canopy.

Disposable gloves and paper towels provide a service comparable to that available when conventional vehicles are refuelled, enabling users to protect their hands and remove any surface moisture. Suppliers indicate the cost of such fittings to be minimal.

Glare from the canopy

At airport sites, reflection from the canopy roof is an important safety consideration. No concerns have been identified in the UK but the issue has been documented in the US. A map based tool has been developed to help with planning the location of PV installations near US airports. Glare will need to be considered when selecting canopy roofing materials and positioning charging points in the vicinity of airports.

Exposure to salt

If charging points are located at ports or other locations close to the sea, corrosion caused by salt needs to be considered when specifying canopy structures. ISO standards are available for protective paint systems to protect the metal of canopy structures. Suppliers indicated additional costs of £300 - £500. More frequent maintenance should also be anticipated as a requirement at these locations than at inland sites.

Exposure to heavy snowfall

In areas which are prone to heavy snowfall, the canopy materials should be selected with snow-loading in mind. Consideration should also be given in designing and locating the charging point to the requirement to clear drifting snow from the parking area and the charging point, and from PV panels if fitted.

Maintenance costs are expected to be higher in areas with severe frosts and heavy snowfall; one supplier indicated a 15% increase for Scandinavia and mountainous regions compared with other parts of Europe.

Exposure to hailstorms

In parts of Europe where there is a risk of significant amounts of larger potentially damaging hail stones, canopies should be designed to prevent or limit damage from hailstones, which may affect the canopy itself, the charging point, the users and their vehicles.

Service stations, ports, airports and retail parks

The considerations relating to marine environments and the effect of glare from the canopy on safety in the vicinity of airports mentioned above affect canopy design and specification at these types of site.

The only other consideration identified for different types of site was the risk of vandalism. As mentioned above, this appears to be a greater risk at locations which are more accessible on foot from surrounding built up areas, such as retail parks and service stations on main roads, but less of a risk at motorway service stations, ports and airports. Measures to reduce the risk of vandalism are discussed above.

6.1.2 Costs and revenues

Costs

The costs of canopies appear to vary widely. The capital and installation costs quoted by suppliers ranged from around £2,100 to £15,000 at the scale of low volume production (1-10 units), and around £1,400 to around £13,000 for wide scale deployment.

Lifetime costs or average costs per year of life will also need to be considered because the cost of canopies through their life is as important as the initial costs.

Life time costs were estimated on the basis of information on five designs with complete information. These indicate costs ranging from around £5,300 to £27,000 for up to 10 units, from £5,800 to just over £30,000 for between 10 and 25 units and reducing to £4,600 to just over £21,000 for wider scale deployment.

Average costs per year of life ranged from minimum values of around £500 - £600 to maximum values around £1,000 - £1,500, with average values around £700 - £800 per year.

Thus if low cost canopies are required for the Rapid Charge Network, it appears that canopies could be obtained for around £500 - £600 per year of life, depending on the scale of deployment.

Cost-effective solutions appear to be available from Suppliers 6, 7 and 8 (see Sections 4.2.6 to 4.2.8); it is recommended that these are considered in the first instance if a decision is taken to further investigate companies with a view to procuring canopies for the Rapid Charge Network.

The costs of adding solar panels with battery storage and lighting represent about 25 – 30% of the capital cost of canopies and 20% of the installation cost at low volumes of canopy production and a larger proportion of costs in large scale deployments. At locations where regular cleaning of the panels is required to maintain their generating capacity, adding this package of features could be more than twice the maintenance costs of the canopies.

Installation and decommissioning costs may be expected to vary between different types of site, and in different parts of Europe. Maintenance costs can be expected to be higher in Scandinavia and mountainous regions than elsewhere in Europe.

Revenue generation to offset costs

It is important to consider the opportunities for generating revenue to offset the costs of the canopies. Advertising is the most obvious way of doing this.

Advertising on shelters is normally the responsibility of advertising companies rather than canopy suppliers. However many bus shelter suppliers provide the shelter as part of a package where they sell the advertising, with the advertising covering the costs of the shelter and its maintenance.

Only one supplier provided information on revenues. This indicated that advertising could be expected to yield £10,000 to £16,000 per year. This level of revenue could offset the costs of buying and installing even the most expensive of the designs within two years.

An investigation among advertising companies to ascertain the facilities required on the canopy, the potential for covering costs with advertising revenue and how this varies at different types of location should be considered before commissioning canopies for the Rapid Charge Network.

6.1.3 Advantages and disadvantages

There is little experience of installing canopies at EV charging points and canopy suppliers are not usually expected to answer the question of whether or not a canopy should be installed. Available research on EV charging behaviour has not addressed the question. There is not enough information available therefore to assess whether the benefits are sufficient to justify the costs of installing and maintaining canopies.

The information reviewed in this study indicates the following potential advantages of canopies for EV charging points:

- Protects equipment so that it will be possible to charge even during heavy rain or snow conditions (a number of vehicle manufacturers advise against charging when the vehicle is exposed to inclement weather)
- Will make connecting a charger a more pleasant experience for the user in poor weather
- Provides shelter for charging equipment, thus prolonging its appearance and life

- Will make the charge point easier to see, both by potential users and potential EV purchasers
- Will provide a location for advertising to bring in additional revenue or provide space for further information on the scheme
- Can provide fixing points for additional lighting and CCTV for user convenience and safety at night and to prevent vandalism
- Can provide the space for solar panels to provide power to the canopy (e.g. for lighting, to make charging easier at night).

The potential disadvantages include:

- Cost of construction and installation
- Cost of maintenance i.e. cleaning or minor repair
- Cost of repair (due to accidents or vandalism)
- The shelter offered by the canopy may make the charging bay more desirable than neighbouring parking bays for non-electric vehicle users or EV users who do not need to charge their vehicle; however it could also be argued that a canopy will help to clarify the purpose of the charging point and reduce occupancy by vehicles which do not need to use the charging point
- The shelter will need to be replaced when they become un-repairable or reach a level of wear which is visually unacceptable to the host organisation.

6.2 Potential for further work

There is little research into the use of canopies with EV equipment. Therefore, it is difficult to quantify whether any possible positive impact on utilisation of the charging points due to canopies is enough to justify the additional costs. Moreover it is not clear from the information available whether canopies should cover the vehicle and the charging point, or the charging point and part of the vehicle, or indeed whether this aspect of the design could vary depending on conditions at the charging point site.

It would appear therefore to be beneficial to consider undertaking further work to design and implement a controlled trial. In such a trial canopies could be erected at a small number of sites and data on their use could be monitored and compared with similar sites without canopies or with partial canopies. For example there could be a charging bay with a canopy and one without at the same site, while other sites could have one full and one partial canopy, this giving the user a clear choice. This would help to establish whether canopies make a positive contribution to electric vehicle charging points, or if the choice is random with no clear preference, and whether full or partial canopies are most effective.

Ideally this practical research would be undertaken over a one year period to understand the impacts of weather conditions such as rain, sunshine and snow.

This small trial could help to more fully understand a number of factors relevant to use of canopies and the business case such as:

- Actual installation costs of canopies and time required for installation and connection of any services; this is important for existing EV facilities as disruption of service may be an issue for users

- Utilisation of canopied EV points compared to EV points without canopies
- The potential for income streams such as advertising
- An indication of annual costs such as any maintenance requirements
- Patterns of use vs weather and time of day i.e. use during the wet, snow (if applicable) bright sunny days and at night
- Whether other car park users use the facilities, thus blocking them, and the percentage of times this occurs.

A more complex trial could also assess the impact of additional features such as solar-powered lighting.

It should be noted that EV vehicles are not yet mainstream, so the results would show findings from early EV adopters and other users of the car parks where the canopies are located.

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Appendix A Background information for suppliers

Electric Vehicle Rapid Charger Canopy Feasibility Study: background information for suppliers

The Transport Research Laboratory (TRL Ltd) is working with a client on a project which is developing strategic electric vehicle charging points in the UK. TRL has been asked to examine whether it is feasible to install a canopy to cover either the electric vehicle charging equipment or the vehicle charging equipment and the vehicle.

We are looking for support from ten canopy suppliers to help us understand the basic requirements and options for a canopy system and also to develop a basic specification and indicative costs for installing canopies at EV charging points.

If this enquiry indicates that it would be feasible to install canopies at electric vehicle charging points, it is possible that a small number of canopies could be commissioned for **the client's electric vehicle charge points.**

Any recommendations for canopy installations in the UK will be made available to the European Commission as part of the programme for rapid charger installation across key road corridors it is therefore, worth pointing out that if canopies are shown to be beneficial, there is likely to be a domestic, European and international market for electric vehicle charging canopies in the future. The canopies in this project could be installed in a number of locations including ports, airports, service stations (main road and motorway) and retail car parks in the UK and Ireland.

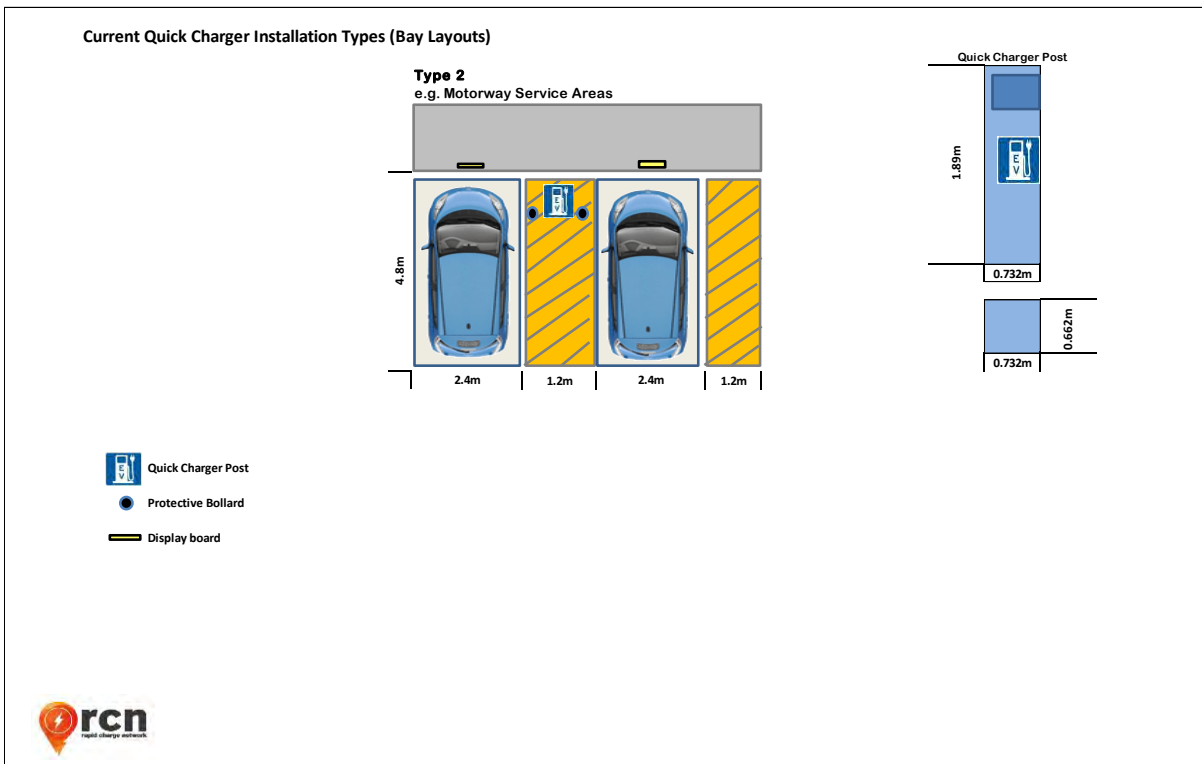
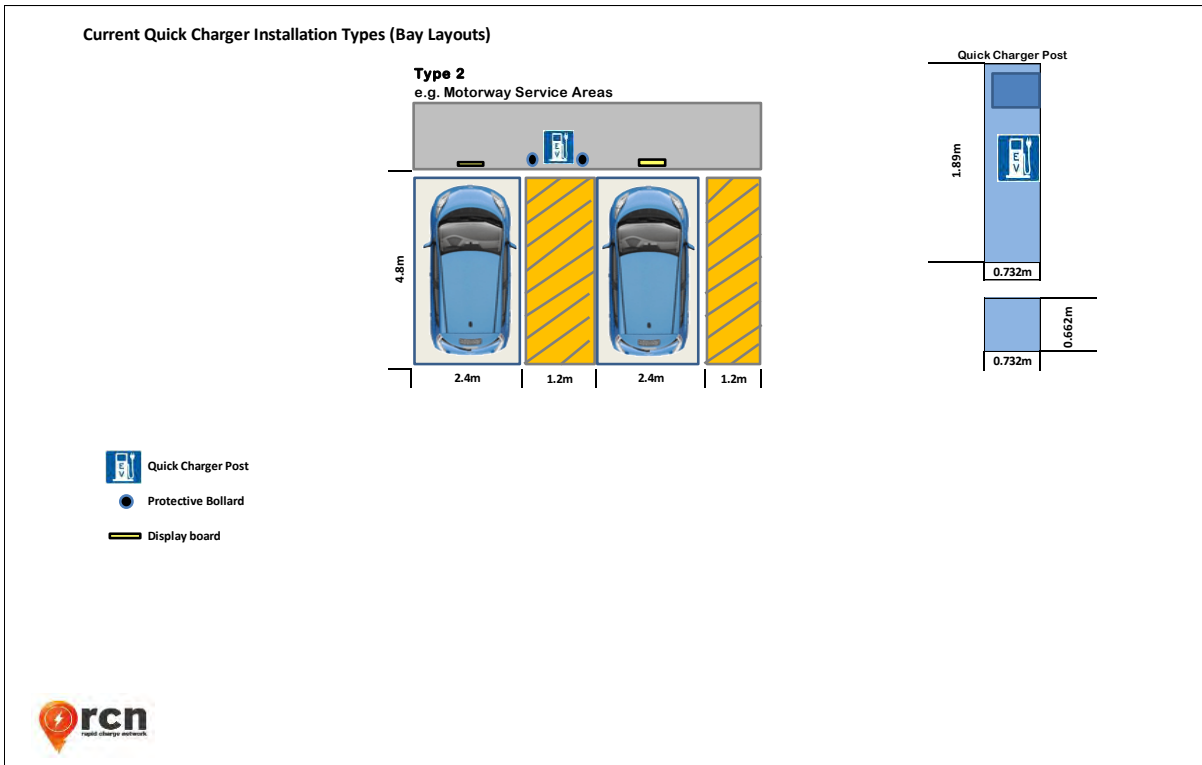
Taking part in the research will involve your company in providing information, sketches, and other material to inform the key factors to be considered in this feasibility study by completing the attached document. There may also be a need for a member of TRL staff to contact you to request clarifications by email and phone.

We cannot guarantee that any work will come out of the research programme as one of **the key questions for the project is "Is it beneficial for electric vehicle charge points to have a canopy"?** However, contributing to this initial investigation will help to determine **whether canopies are specified as a feature of our client's electric vehicle charging points.**

Examples of typical electric vehicle twin charge point layouts are shown below.



The most likely layout of the charging points where canopies would be installed is shown in the diagrams below. In one variant the charging point is positioned at the end of the parking bays and in the other, it is located between the two parking bays.



Further information about the Rapid Charge Network project is available on the project web site: <http://rapidchargenetwork.com/>

If you have any questions about this request, please contact Chris Torkington, TRL Limited: 01344 770490, ctorkington@trl.co.uk

Appendix B Supplier Questionnaire

Rapid Charge Network Station Canopy Feasibility Study – Information from Canopy Suppliers

Introduction

Thank you for agreeing to provide information for this feasibility study. Please note that the information you provide will be treated as indicative, simply for the purpose of assessing whether it would be feasible to install canopies at any of the stations on the Rapid Charge Network. All information you provide will be treated as confidential and not disseminated outside the project team.

For background information about the study, please see the accompanying document: 'EV Canopy Study: Background Information for Suppliers'. Please insert your answers to the questions in the sections below and return the document as an email attachment, including attachments for diagrams, photos etc. where relevant. Please email your reply to Chris Torkington at TRL: ctorkington@trl.co.uk, if possible by **21 November 2014**. If you have any queries, please speak to Chris on 01344 770490.

About your company

1. Company name:
2. Company address:
3. Name and position of the person completing this form:
4. Phone number:
5. Email address:

Design 1

Please outline the design you would propose for a canopy suitable for car parks at **motorway service stations in the UK and Ireland**. The canopy itself would not be connected to the electricity supply grid. (*If you have alternative options to propose, please fill in details in later sections for Design 2, Design 3.*)

6. What materials would you propose to use for constructing the canopy?
7. Please attach a sketch, diagram or photograph to indicate the design

8. What do you estimate the costs would be to supply canopies for two different levels of demand? (*Please complete the table below, filling in one column for each different level of demand.*)

Cost item	Cost (£) per canopy	
	1. Between 1 and 10 demo units in the UK	2. Between 25 and 50 units in the UK and Ireland
a) Capital cost: materials and equipment		
b) Cost of installation		
c) Annual cost of maintenance		
d) Cost of decommissioning		

9. Thinking about the longer term when the demand grows, please indicate the number of canopies that would make up an order large enough for these costs to reduce significantly

Number of canopies:	
---------------------	--

10. For this number of units, please provide an approximate cost per canopy of by filling in the table below

Cost item	Cost (£) per canopy
a) Capital cost: materials and equipment	
b) Cost of installation	
c) Annual cost of maintenance	
d) Cost of decommissioning	

11. What maintenance would be required, and how often?

12. Is it possible to scale this design to different sizes and layouts of parking bay?

13. Is this design suitable for adding further modules if more charging stations are added to meet further demand for charging future? (If not, what would be the cost implications of making it modular?)

14. What is the estimated life expectancy of this design before it would need to be replaced?

15. What risks do you anticipate with installing this design at motorway service stations in the UK?

16. In your experience, what types of revenue stream do you think could be used to offset the costs of installing these canopies, and approximately how much could be expected per year? (*For each type of revenue fill in a row in the table below.*)

Type of revenue	Estimated annual revenue (£) per canopy
a)	
b)	
c)	
d)	

17. Please indicate the impact on costs of including the following additional features to the design, if they are not already part of the design, by filling in the table below.

Cost item	Cost (£) per canopy				
	(i) Solar panels	(ii) Solar panels & battery storage	(iii) Lighting	(iv) Connection of canopy to electricity grid	(v) Fittings for consumables (e.g. disposable gloves, paper towels)
a) Capital cost of materials and equipment					
b) Cost of installation					
c) Annual maintenance cost					
d) Cost of decommissioning					

18. Please indicate the impact on maintenance and life expectancy (i.e. not cost related) of including these features in the design by filling in the table below. (*Insert N/A - 'not applicable' - for any features which your company would not be able to supply.*)

	a) Impact on frequency of maintenance	b) Impact on life expectancy
(i) Solar panels		
(ii) Solar panels and battery storage		
(iii) Lighting		
(iv) Connection of canopy to electricity supply grid (to benefit from the feed-in tariff)		

Variants on Design 1

19. For canopies at other types of site in the UK and Ireland (main roads, ports etc.), please indicate any differences in the design, the costs or revenue streams compared with those in Design 1 for motorway service stations:

Variants Design 1	1. Service stations on main roads	2. Ports	3. Airports	4. Retail outlets
a) Materials				
b) Design				
c) Capital cost materials and equipment				
d) Cost of installation				
e) Annual maintenance cost				
f) Cost of decommissioning				
g) Type and frequency of maintenance				
h) Life expectancy				
i) Risks				

Variants Design 1	1. Service stations on main roads	2. Ports	3. Airports	4. Retail outlets
j) Annual income from revenue stream a (<i>please state here:</i>)				
k) Annual income from revenue stream b (<i>please state here:</i>)				
l) Annual income from revenue stream c (<i>please state here:</i>)				
m) Annual income from revenue stream d (<i>please state here:</i>)				

20. For canopies in other regions of Europe, please indicate whether there would be any differences in the design, costs or revenue streams compared with those in Design 1 for motorway service stations. *(Fill in one column for each of the other types of area where the European rapid charge network will be installed.)*

Differences Design 1	1. Southern Europe	2. Scandinavia	3. Northern Europe	4. Mountain regions
a) Materials				
b) Design				
c) Capital cost materials and equipment				
d) Cost of installation				
e) Annual maintenance cost				
f) Cost of decommissioning				
g) Type and frequency of maintenance				
h) Life expectancy				
i) Risks				

Differences Design 1	1. Southern Europe	2. Scandinavia	3. Northern Europe	4. Mountain regions
j) Annual income from revenue stream a (<i>please state here:</i>)				
k) Annual income from revenue stream b (<i>please state here:</i>)				
l) Annual income from revenue stream c (<i>please state here:</i>)				
m) Annual income from revenue stream d (<i>please state here:</i>)				

Thank you very much for taking the time to provide the information for this study.

If you have any comments or further information relevant to this feasibility study, please provide it here: