Green eMotion

Development of an
European Framework for Electromobility

Specification for Minimum Requirements
for Charging Spots

Deliverable 4.1

Prepared by: **Gerard Buckley, ESB ecars**
ger.buckley@esb.ie
Philip LeGoy, ESB ecars
Philip.legoy@esbi.ie

Date: April 2012
Version: 6.1

Document Information

Authors

	Name	Company
Key author	Gerard Buckley	ESB ecars
Further authors	Philip LeGoy	ESB ecars
	Thomas Wiedemann	RWE Deutschland AG

Distribution

Dissemination level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Revision history

Version	Date	Author	Description
1.0	December 12 2011	Gerard Buckley & Philip LeGoy	Draft for Partners Comments & Rev
2.0	January 05 2012	Gerard Buckley & Philip LeGoy	Draft for Partners Comments& Rev
3.0	February 02 2012	Gerard Buckley & Philip LeGoy	Draft for Partners Comments & Rev
4.0	February 22 2012	Gerard Buckley & Philip LeGoy	Draft for Independent Reviewer
5.0	March 19 2012	Gerard Buckley & Philip LeGoy	Final Draft for Review
5.1	April 10 2012	Thomas Wiedemann	Revision Executive Summary
6.0	April 18 2012	Thomas Wiedemann	Approval
6.1	May 21 2012	Carmen Calpe	Final revision

Status	
For Information	
Draft Version	
Final Version (Internal document)	
Submission for Approval (deliverable)	x
Final Version (deliverable, approved on)	

Table of Contents **Page Number**

1 Executive Summary 7

2 General Introduction 10

2.1 Background 10
2.2 MERGE 10
2.3 European Commission Mandate M/468 10
2.4 Grid for Vehicles (G4V) 11
2.5 EU Green eMotion Project 11

3 Work Package 4 and Task 4.1 Deliverables 13

3.1 Work Package 4 13
3.2 Tasks in Work package 4 13
3.3 Task 4.1 Key Objectives 14
3.4 Data Compilation and Survey Design 14
3.5 Statistical Sample and Interpretation of Findings 14

4 Assessment of Existing Charging Infrastructure/Functionalities 16

4.1 Types of Plugs and Sockets and Modes of Use 16
4.2 AC Street Side and Public unit Typical Arrangements 19
4.3 Fast Public Charge Systems 22
4.3.1 DC Charge Posts 22
4.3.2 DC AC Combination Charge Posts 23
4.3.3 Battery Swap Station 23
4.4 Induction Charging 24
4.4.1 EV Induction Charging System 24
4.4.2 Demonstration Induction Charging 25
4.5 Home Charge Point Arrangements 26

5 Development of Common Functional Requirements 27

5.1 Introduction 27
5.2 Charging Point Capability 27
5.3 Achieving Common Functional requirements 27
5.4 Foundation Design 28
5.5 Enclosure and Charge Post Body 28
5.6 Socket and Socket Enclosure 29
5.7 External Socket Doors 29
5.8 Modularity and Upgradeability 29
5.9 Regulatory and Metering 30
5.10 A Note on DC Chargers 30

6 Electric Utility Interface Connection and Protection Requirements Including Earthing 31

6.1 Electrical Connections 31
6.2 Interface Protection 33
6.3 Earthing 33
6.4 Charge Post Electrical Safety Functionality 35
6.5 Home Earthing Arrangements for Charge Points 35

7 Cost Assessment of Recharging Infrastructure and drivers of Lifetime Costs 36

7.1 Cost Assessment 36
7.2 Charge Post Electronics 38
7.3 Central Legislators, Local Councils and Planning Authorities 38

8 Summary, Discussion and Further Work 39

8.1 General 39
8.2 IEC, ISO and SAE and EU Focus Group on ElectroMobility 39
8.3 Further Work 39
8.4 Recommendations 39

9 References: 44

10 Technical Survey Questions for Minimum Specification 46

Appendix 1: Technical Survey Responses 48

Street [and Public] Charge Post Questions: 49
Home Charge Point Questions: 82
DC Charge Point Questions: 101

Appendix 2: Technical Cost/Price Survey Responses 126

Street [and Public] Charge Post Questions: 129
Home Charge Point Questions: 143
DC Charge Point Questions: 157

List of Figures Page No.

Figure 1: Typical Electrical Installation Layout 19
Figure 2: Typical Electrical Installation Configuration with an Interface Pillar 20
Figure 3: Typical Electrical Installation with an Underground Grid Interface 20
Figure 4: Typical Electrical Installation Configuration with a Direct Underground Grid Connection 20
Figure 5: Shuttered Mode 3, Type 2 Street Charge Post 21
Figure 6: DC Mode 4 CHAdeMO Charging Station 22
Figure 7: DC and AC Combination Charging Station 23
Figure 8: Battery Swap Station 23
Figure 9: Induction or Non-contact Charging System 24
Figure 10: EV Induction Charging System Schematic 25
Figure 11: Mode 3 Type 2 Home Charge Point Socket with Sealed Door 26
Figure 12: Mode 3 Type 2 Home Charge Point Cable Attached 26
Figure 13: Mode 3 Type 2 Combined with Mode 1 Type 1 26
Figure 14: Home Installation Guide 26
Figure 15: Street Charge Point Interface Pillar 31
Figure 16: Charge Posts Connected Through an Interface Pillar 32
Figure 17: Charge Posts Connected Directly Underground 32
Figure 18: Charge Posts Connected Through an Underground Vault 32
Figure 19: TN-C-S system 34
Figure 20: TN-S system 34
Figure 21: TN-C system 34
Figure 22: TT system 34
Figure 23: Costs vs. Time Curve Based Upon Demand 36

List of Tables Page No.

Table 1: Type Definitions of Plugs and Sockets 17
Table 2: Mode Definitions of Plugs and Sockets 18
Table 3: Generalised Summary of Answers to Technical Survey ..... 41 & 42
Table 4: Generalised Summary of Answers to Cost/Price Survey 43

Acronym Definitions **Page No.**

EPRI	**Electric Power Research Institute**
CHAdeMO	**Japanese Standard for DC charging also called Mode 4**
MCB	**Miniature Circuit Breaker**
RCD	**Residual Current Device**
IEC	**International Electrotechnical Commission**
RCBO	**Combined RCD and MCB**
EU	**European Union**
EV	**Electric Vehicles**
MERGE	**Mobile Energy Resources in Grids of Electricity – EC funded project**
ETSI	**European Telecommunications Standardisation Institute**
CEN	**European Committee for Standardisation**
CENELEC	**European Committee for Electrotechnical Standardisation**
ICT	**Information and Communications Technology**
GPRS	**General Packet Radio Service**
PLC	**Power Line Carrier**
GO	**Grid Operator**
IP	**Ingress Protection**
MID	**Meter Instrument Directive**
IEC	**International Electrotechnical Commission**
WP	**Work Package**
G4V	**Grid for Vehicles – EC funded project**

1 Executive Summary

The Pan-European requirements for recharging infrastructure including design, infrastructure installation, and associated costs have been surveyed and data has been collected, analysed and presented in this report by ESB ecars. The report is based mainly on the survey results but also includes relevant information from conference calls and workshop discussions held in the course of WP4. The report summarises contributions from the following organizations and Distribution System Operators: ESB, RWE, ENEL, Dansk Energi, EDF, IBERDROLA, Tecnalia, ENDESA, Daimler Europe and Nissan Europe.

The report is further informed by ESB involvement in MERGE, EPRI and the EU Focus Group on European ElectroMobility.

The market of electro-mobility and the associated deployment of recharging infrastructure today is still at a very early stage. Numerous pilot projects are currently under operation. The report at hand shows relevant aspects that need to be considered when new charging posts are to be erected. Technical requirements differ from country to country and partly from company to company so technical solutions do also. In general it can be said that there are usually good reasons for particular technical solutions. Thus the report does not assess whether solution A compared to solution B is “better” or “worse” but identifies the topics which are important to be resolved when dealing with different categories of recharging infrastructure. An index about these topics can be found in section 10 of this report. The technical questions which have been created to collect the data set for this report are very relevant to the definition of minimum requirements, therefore the survey itself can be considered to be a “list of minimum requirements for recharging infrastructure”.

Furthermore the report shows that for some technical aspects a trend towards a common technical solution can be observed whereas for others this is not (yet) the case.

The most relevant technical aspects including the percentage of agreement are depicted as an overview in Table 3.

The data shows there are 3 major categories of charge point infrastructure being installed throughout the contributing European jurisdictions Public and On Street charging infrastructure, Fast Charging infrastructure and Home Charging infrastructure. An element of publicly accessible infrastructure connected to privately owned electrical infrastructure is included.

On the basis of the data received the installations being specified by the participants indicates a trend toward the Mode 3 Type 2 variety for the home charging and street/public charging. France in general is installing Mode 3 Type 3. In some parts of Ireland and the UK, Mode 3 with tethered cables and Yasaki connectors are being installed for home use.

In general the installations being specified by the survey participants for fast charging are of the 50kW DC CHAdeMO variety.

Electrical connections to the on street Charge Post generally take the form of a direct connection from the utility low voltage network to the base of the charge post, where the utility/grid interface and protection is located. Some jurisdictions deploy an interface pillar either underground or at a safe location away from the charge post to protect the grids tails at the base of the post.

The interface protection and charge post protection generally consists of Fuses, MCBs, RCDs and/or RCBOs, and combinations thereof. Component sizing is designed to achieve discrimination and meet expected load current, with similar sizing of MCBs and RCDs. Generally Type C and D MCBs are used. The RCD type at present is Type A but there are indications in line with developments within IEC Technical Committees suggesting a move towards Type B RCDs as the final standard, which provide protection against DC fault currents over and above Type A RCDs. In general all RCDS have a 30mA trip setting for personal electric shock protection.

The findings of this survey indicate a variation across a range of earthing systems from TN-C-S, TN-S, TN-C and TT. This is the expected result as earthing systems tend to be strongly linked to national wiring regulations. It is important to note that there is an ongoing debate within the electrical standardisation community on the most appropriate earthing arrangements for electric vehicles that minimise the risk of electric shock under fault conditions.

The second objective of this report was the identification of cost drivers in relation to erection, operation and maintenance of recharging infrastructure.

The price/cost ranges reported vary broadly. An overview about cost aspects is presented in Table 4 of this report.

The average costs of On Street and Public/Private charging infrastructure vary as follows from the data collected so far. The variation in costs goes from €5500 to €25000 including installation and ancillary equipment on a per charge post basis. Civil costs drive the costs on the high end of the installation costs/prices.

DC charging units vary in price from €13k to €50k per unit. Installation costs vary from €3500 to €6000. An average all in installed system was €48000 due to high civil costs at some installations.

Home charging units vary in cost from €265 to some very substantial costs. However we have established that the very high costs were associated with a trial that included a lot of infrastructure upgrading by way of local network improvements.

The actual costs identified in this study for AC and DC infrastructure including installation costs, are significantly higher than the estimated costs identified in studies carried out in the G4V and MERGE projects.

Therefore the report provides an early picture of the emerging infrastructure being installed at the time of writing. Acknowledging that participants are generally at an early stage in their programmes, consideration should be given to updating the data on a timely basis as participants make more progress in their designs and volumes of installations completed. This will enable developments, improvements and learning to be shared and disseminated amongst the participants. This will complement information available from progress and developments on interoperability and other general standardisation issues, which are on-going at the time of writing. The developments can be reported on through updating this report and/or through other associated Green eMotion deliverables.

Whilst projects are at an early stage this early Green eMotion deliverable indicates that very positive progress is being made in terms of the infrastructure implemented to date.

2 General Introduction

2.1 Background

The major importance of reducing carbon emissions from road transportation has seen a range of initiatives across the EU aimed directly at enabling a significant shift towards the development and deployment of electric vehicles. As a result of these initiatives a large proportion of motor companies are developing fully electric and plug-in hybrid vehicles. In order to fully exploit these opportunities, a large scale rollout of EV infrastructure for home, on street and fast charging is required.

2.2 MERGE

The recently concluded MERGE[1] (Mobile Energy Resources in Grids of Electricity) project mission was to evaluate the impacts that electric vehicles (EV) will have on the European Union (EU) electric power systems with regards to planning, operation and market functioning. The focus is placed on EV and SmartGrid/MicroGrid simultaneous deployment, together with renewable energy increase, leading to CO_2 emission reduction through the identification of enabling technologies and advanced control approaches. The MERGE concept is aimed at the development of a management and control concept to facilitate the large-scale integration of electric vehicles with the electric grid. Data and concepts from MERGE have been looked at for infrastructure programs in the EU as a starting point for designs and design philosophies of infrastructure for some of the survey participants.

2.3 European Commission Mandate M/468

European Commission Mandate M/468 to EU Standardisation organisations CEN, CENELEC and ETSI was to develop or review existing standards in order to:

- Ensure interoperability and connectivity between the electricity supply point and the charger of electric vehicles, including those based on removable batteries, so that this charger can be connected and be interoperable in all EU States;
- Ensure interoperability and connectivity between the charger of electric vehicle- if the charger is not on board- and the electric vehicle and its removable battery, so that a charger can be connected, can be interoperable and re-charge all types of electric vehicles and their batteries;

- Appropriately consider any smart-charging issue with respect to the charging of electric vehicles;
- Appropriately consider safety risks and electromagnetic compatibility of the charger of electric vehicles in the field of Directive 2006/95/EC (LVD) and Directive 2004/108/EC (EMC).

The European Commission mandate issued in June 2010 and a stakeholder Focus Group on European Electro-Mobility was formed to respond to the mandate. The focus group consisted of representatives of international and European standards organisations as well as from the different services of the European Commission and societal stakeholders.

The Focus Group issued its report in June 2011. The report is titled the Report of the CEN-CENELEC[5] Focus Group on European Electro-Mobility Standardisation for road vehicles and associated infrastructure. The report has been approved by the Technical Boards of CEN[2] and CENELEC[3] and is published on the CEN and CENELEC websites.

2.4 Grid for Vehicles (G4V)

G4V is called the “European Roadmap Towards the Infrastructure Enabling the Mass Market of Electric Vehicles”. G4V studied the research and energy policy aspects in relation to EV mobility. G4V reviewed EU energy policies. The G4V project developed a “Main framework for smartgrids, EVs and Research” that directly led into the Green eMotion project. G4V produced an overview of standardisation activities of the IEC task groups for conductive recharging stations for electric vehicles.

2.5 EU Green eMotion Project

The EU Green eMotion[4] project was mobilised in early 2011. It is about the development and demonstration of a unique and user-friendly framework for green electromobility in Europe. Green eMotion aims at enabling mass deployment of electromobility in Europe. To achieve this, major players from industry, the energy sector, municipalities as well as universities and research institutions have joined forces to develop and demonstrate a commonly accepted and user-friendly framework consisting of interoperable and scalable technical solutions in connection with a sustainable business platform. The Smart Grids development, innovative ICT solutions, different types of electric vehicles (EV) as well as urban mobility concepts will be taken into account for the implementation of this framework.

Green eMotion will connect ten ongoing regional and national electromobility initiatives leveraging on the results and comparing the different technology approaches to ensure the best solutions prevail for the EU single market. A virtual marketplace will be created to enable the different actors to interact

and to allow for new high-value transportation services as well as EV-user convenience in billing (EU Clearing House).

Furthermore, the project will contribute to the improvement and development of new and existing standards for electromobility interfaces. The elaborated technological solutions will be demonstrated in all participating demonstration regions to prove the interoperability of the framework. Green eMotion will facilitate the understanding of all stakeholders about the parameters which influence the achievement of best possible results for society, environment as well as economy and thus ensure transfer of best practices. As a result, policy makers, urban planners and electric utilities will receive a reference model for a sustainable rollout of electromobility in Europe. The commitment of industry players ensures the focus of the project on the market after demonstration. By proving efficient and user-friendly solutions which are also profitable for businesses, the Green eMotion framework plans to accomplish EU wide acceptance of all stakeholders. The Green eMotion project runs until May 2015. The Green eMotion project is organised through 11 Work Packages as follows:

WP1 Synchronise demonstration activities in different demonstration regions
WP2 Urban electromobility concepts, policies and regulation
WP3 Electromobility services/ICT Solutions
WP4 Grid EV-olution
WP5 Recharging infrastructures
WP6 Demonstration of EV Technology – validation and contribution to standardisation
WP7 Harmonisation of technology and standards
WP8 Framework demonstration
WP9 Technical, Environmental, Economic and Social Evaluation
WP10 Dissemination
WP11 Project Management

3 Work Package 4 and Task 4.1 Deliverables

The following is the Report and Assessment of Results, including Questionnaire/Survey data of respondents for the Green eMotion Project Work Package 4, Task 1. The participants in T4.1 are ESB, RWE, Enel, ENDESA, EDF, Alstom, PPC, Tecnalia, IREC, EURELECTRIC, Dansk Energi, Iberdrola, Daimler, Nissan Europe and Renault. ESB is the lead partner for Task 4.1.
The Deliverable D4.1 focuses on the recharging infrastructure available and deployed as of today. Future functionalities as well as requirements for future recharging infrastructure is being investigated and reported in Deliverable 5.1

3.1 Work Package 4

Work Package 4 is titled Grid EV-olution. The overall objectives of Work Package 4 (WP4) are to use the outcomes and learning from the numerous on-going demonstration field trials of the consortium partners to develop an infrastructural EV charging grid which:

- Provides adequate capacity
- Is oriented to the needs of the EV customer
- Is established using broadly accepted principles to agreed standards of safety, economic and technical capability
- Will integrate all existing standards and incorporate new standards currently under development
- Will be fully integrated with the transmission and distribution grid
- Will facilitate EV charging by any EV customer, travelling anywhere in Europe
- Will facilitate matching EV power requirements to Renewable Energy Sources

3.2 Tasks in Work package 4

There are five tasks in WP4 which are:

- Specification for minimum requirements for charging spots
- Recommendations for grid supporting opportunities of EV's
- The smart (distribution) grid: from demonstration to mass market deployment
- Guidelines for infrastructure deployment from utility perspective
- Survey of new functionalities

3.3 Task 4.1 Key Objectives

A key goal of Task 4.1 is to review the existing approaches being deployed in existing European field trials in relation to EV recharging infrastructure. The review will contribute to the development of common functional requirements including details on electrical connections and interface arrangements, including costs.

- Assess existing charging posts and functionalities
- Develop common functional requirements
- Connection and wiring regulations
- Cost assessment of recharging infrastructure and drivers of lifetime costs

The bullet points outlined above are elaborated in the following Chapters 4 to Chapter 7.

3.4 Data Compilation and Survey Design

At an early stage it was decided that the most efficient way to collect information and data from the various pilot projects in progress was by way of a survey. This is in line with the approaches taken in other work groups. The particular questions asked in the survey were compiled by ESB ecars with input and agreement from the participants. Surveys were designed to cover technical and cost data. A number of draft surveys were circulated to the WP4 participants in order to get agreement on the most appropriate list of questions. Comments and recommendations were evaluated and integrated before the final survey documents were issued. The full list of questions and responses are available in Appendix 1.

3.5 Statistical Sample and Interpretation of Findings

A number of key aspects to the survey structure, contributors, responses, timing, are important to point out and comment on. These are summarised in the following points and must be borne in mind when interpreting the findings.

Sample size was small in that a total of only 10 respondents were available to contribute data and information. Respondents were generally at an early stage of infrastructure rollout, with some still at a planning stage with no or very little infrastructure installed. Some respondents were removed or somewhat distant from their colleague teams involved in the rollout and were dependent on them for responses to a range of technical questions. Sample answers were given to help with the interpretation of the questions.

A number of the observations/comments included in this report emanated from direct discussion between the authors and participants at workshops and conference calls.

4 Assessment of Existing Charging Infrastructure/Functionalities

The following sections give an overview of types of sockets and plugs, street side public charging, of fast public charging, induction charging and home charge points currently in use. See survey data from questions/responses in Appendix 1.

4.1 Types of Plugs and Sockets and Modes of Use

A specific terminology has evolved in relation to plug and socket types as well as communication modes for controlling power transfer.

In general Type 1 is a combination of domestic and industrial plugs and sockets which have been the standard types of sockets and plugs used throughout Europe for many years. The Type 1 devices listed below are for diverse purposes used safely with amperages from 13A to 125A. These plugs and sockets are generally associated with Mode 1 which implies no communications capacity for the purpose of controlling power transfer level.

Type 2 plugs and sockets are relatively new types of plugs and sockets specifically designed for use with Electric Vehicles. These plugs and sockets are equipped with extra pilot/control pins for the initialization of two way communications with the plugged in cars. The plugs and sockets also contain the usual 3 phase, neutral and earth pins. This makes for a combination of 7 pins for both plugs and sockets. These plugs and sockets are generally associated with Mode 3. Mode 3 allows communication between the charger and car to control power transfer levels and only energise the socket once the circuit is complete providing enhanced safety over and above Type1 Mode1.

Type 3 plugs and sockets whilst a different shape to Type 2, are functionally similar in that they enable Mode 3 control. Type 3 are a shuttered type socket.

Mode 2 enables connection between a Type 1 socket and a car operating under Mode 3. This is accomplished by inserting a control box into the cable between the Type 1 socket and the car. The control box emulates the Mode 3 protocol. Generally only a low level of power transfer is allowed.

Mode 4 has been defined as the communications protocol for the DC charger to communicate with the car through the DC plug and socket.

The following tables show the types of plugs and sockets and modes of use of those connectors in Table 1 for types and specifications and Table 2 for the modes of use of said connectors.

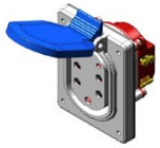
	Type 1	Type 2	Type 3	DC CHAdeMO	Comments
Phase	**Single-Phase**	**Single Phase/Three Phase**	**Single Phase/Three Phase**	**DC Socket and Plug**	
Current	**13A**	**13A**	**13A**		
	16A	**16A**	**16A**		
	32A	**32A**	**32A**		
	63A	**70A (single phase) 63A (three phase)**		**125A**	
Voltage	**230V**	**500V**	**500V**	**500V DC**	
No. of Pins	**5/2/3**	**7**	**5 or 7**	**4**	
Sockets					
Plugs					**Operation of the DC Yazaki is three phase 63A AC in and inverted to DC 125A 500V out.**
Identification	**Sockets and Plugs: 5 pin industiral, Schuko 2 pin domestic and 3 pin domestic**	**Mennekes**	**Scame**	**DC Yazaki**	

Table 1: Type Definitions of Plugs and Sockets

	Type 1	Type 2	Type 3	DC CHAdeMO	Comments
Mode 1	**No control just plug in and charge**	**Not Available**	**Not Available**	**Not Available**	
Mode 2	**Control through control box inline in cable see the figure in the Comments column**	**Not Available**	**Not Available**	**Not Available**	
Mode 3	**Not Available**	**Control through a PWM signal transmitted from the car to the charge point as per IEC 62196-2. A signal that identifies the amperage the car can take. The signal is two way generated by both.**	**Control through a PWM signal transmitted from the car to the charge point as per IEC 62196-2. A signal that identifies the amperage the car can take. The signal is two way generated by both.**	**Not Available**	
Mode 4	**Not Available**	**Not Available**	**Not Available**	**DC charging following the CHaDeMO standard**	

Table 2: Mode Definitions of Plugs and Sockets

There are legacy Type 1 sockets installed across Europe and there are Mode 3 Type 3 sockets mostly in France. In the border regions of France it appears that there are installations of combination Mode 3 Type 2 and Mode 3 Type 3 units complying with IEC 62196-2 and 62196-3. In Spain it appears that some Mode 1 Type 1 Schuko sockets are still being installed regularly and Mode 3 Type 2 units are also being installed as listed in Tables 1 and 2 above.

4.2 AC Street Side and Public unit Typical Arrangements

Street side units are posts within the public charging network that are located at the sides of public streets and are usually grid connected. Public charge points are charge points of all varieties that are part of a public EV infrastructure and are not necessarily grid connected. The following is an overview of Street Side and Public Charge Point Designs Currently used in EU Trials.

In general the data showed that for Public and On Street Charging there is a trend across Europe to use the Mode 3 Type 2 seven pin double headed sockets (see Tables 3 & 4). Most charge posts are being installed at 22kW, 3Φ, 32A, 230V AC per socket. Most installations are equipped with GPRS, programmable logic control and the electrical gear required to facilitate EV charging and billing. Some charge post installations are being installed in Spain as Mode 1 and Mode 2 “Schuko” sockets. Installations in France are primarily of the Type 3 variety (see Tables 1 & 2). While the majority of installations are 22kWs the designs vary from 3.52kW to 44kW per socket. Some of these low power sockets are legacy 3 pin sockets in Ireland and the UK. Some Type 1 industrial sockets are being installed by the public and some are legacy with individual Grid Operators (GOs).

An electric charge post installation configuration includes a grid connection. Some different methods for these grid connections include an outside junction box called an interface pillar, other methods include a junction box inside of the charge point called a cable branch box and another method is by an underground junction box called a vault. See Figures 1 through 4 below which shows these three methods and a typical installation layout.

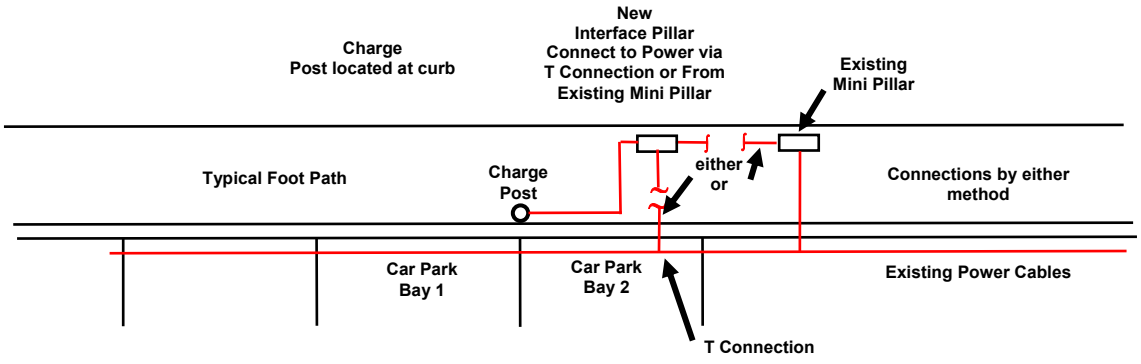


Figure 1: Typical Electrical Installation Layout

Figure 2: Typical Electrical Installation Configuration With an Interface Pillar

Figure 3: Typical Electrical Installation With an Underground Grid Interface

Figure 4: Typical Electrical Installation Configuration With a Direct Underground Grid Connection

Figure 2 is an example of the use of an interface pillar (see Figure 15) and a charge post. Figure 3 shows a charge post with an underground vault just behind it. There is a mode 2 box attached to the charge post also. Figure 3 is an example of an underground connection inside of an underground vault that is being used on some charge post installations (see Figure 16). Figure 4 is an example of a direct underground connection that is being used on some charge post installations (see Figure 17).

.

Figure 5: Shuttered Mode 3, Type 2 Street Charge Post

In plug and socket type definitions Table 1 above and the mode definitions Table 2 above, the control of each type and mode of socket shown in the tables gives the indication of how each type and mode works in concert.

The survey results in Appendix 1 and listed in Table 3 indicates that Mode 3 Type 2 is the most popular device installed in Street side and Public installations see Figure 5 above. After that is the Mode 3 Type 3 then Mode 2 Type 1, see Survey question 1. b. of Street [and Public] Charge Post Questions:.

4.3 Fast Public Charge Systems

Public Fast Charging is primarily taking the form of DC chargers generally specified as 50kW Mode 4, CHAdeMO.

4.3.1 DC Charge Posts

At the time of writing ESB ecars have experience from over 20 such installations and feedback is positive. The DC chargers are charging typically a Mitsubishi iMiev or Nissan Leaf to 80% full charge in approximately 30 minutes with some variances. ESB ecars generally locate the DC fast chargers at petrol stations with good customer facilities including food and beverages. The model is working well so far.

Figure 6: DC Mode 4 CHAdeMO Charging Station

A second variety of fast charger is a 44kW per socket, double socket, 3Φ, 63A, 230V AC charge post. At the time of writing no feedback or details are available on this charger.

4.3.2 DC AC Combination Charge Posts

At the time of writing RWE has been installing combination charge posts which have both DC and AC. DC is delivered at 500V 125A 50kW Mode 4 as per IEC 61851 and AC is delivered at 230V 32A 22Kw Mode 3 as per IEC 61851.

Figure 7: DC and AC Combination Charging Station

4.3.3 Battery Swap Station

On the basis of the survey results to date Denmark is the first jurisdiction in Europe to install battery swap stations.

Figure 8: Battery Swap Station

There is one Battery swap station just recently completed in Copenhagen. There is a plan to install 19 more swap stations in Denmark in 2012. Very little technical, operational or cost data was available at the time of writing as the project is at a very early stage.

4.4 Induction Charging

4.4.1 EV Induction Charging System

A Non-contact charging system allows charging an EV without a connecting cable, simply by parking it in a designated spot, much like charging an electric toothbrush or shaver.

Figure 9: Induction or Non-contact Charging System

Electric power is supplied via magnetic induction from a primary power-supply coil in the parking surface to a secondary coil in the vehicle. When the primary coil is electrically charged it generates a magnetic field that induces current in the secondary coil so it charges the batteries with no wired connections.

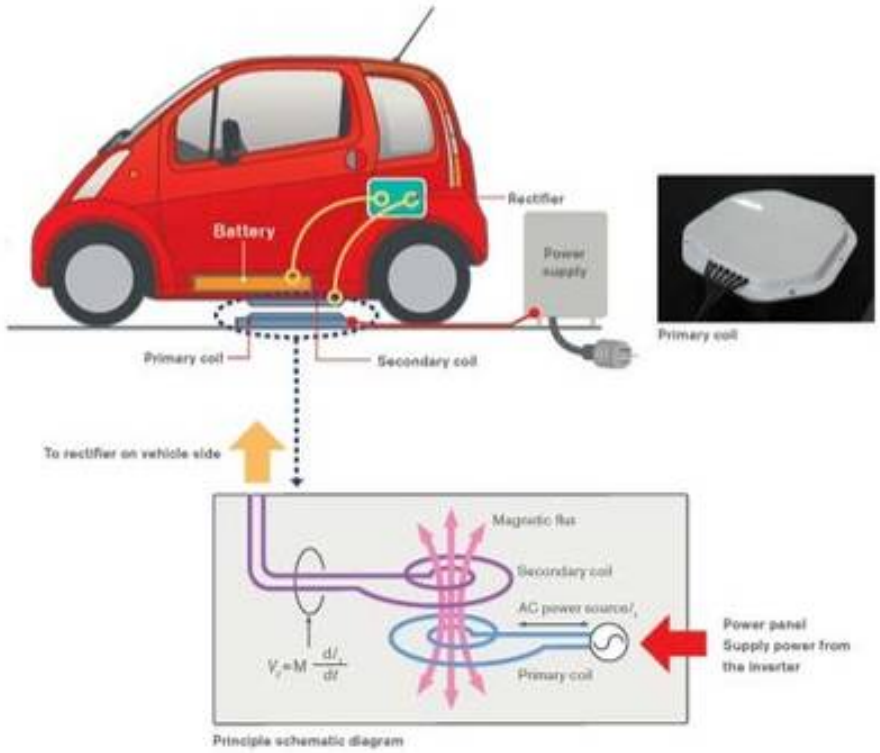


Figure 10: EV Induction Charging System Schematic

Figures 9 and 10 are based upon developments by Nissan

4.4.2 Demonstration Induction Charging

Demonstration of fast induction charging is planned for WP5 of the Green eMotion project. There will be one demonstration pilot plant in Dublin Ireland at Dublin's international airport.

4.5 Home Charge Point Arrangements

The majority of participant installations are again Mode 3 Type 2 at 16A single phase. Variations are in the form of Mode 3 Type 3, legacy 3 pin and Schuko plugs and sockets, variations include industrial sockets and the experimental mix that the general public have been installing. Wiring of the charge point is as per all of the participant's local codes. Half of the respondents install home charge points on the surface of the home near the car's parking spot. Most of the participants do not install meters; the charge point is installed within the house's meter boundary. Most of the participants have variable night rate tariffs already available to EV owners. The charge point in Figure 13 below is a combination charge point with controls for grid manipulation of power usage.

Figure 11: Mode 3 Type 2 Home Charge Point Socket with Sealed Door

Figure 12: Mode 3 Type 2 Home Charge Point Cable Attached

Figure 13 : Mode 3 Type 2 Combined with Mode 1 Type 1

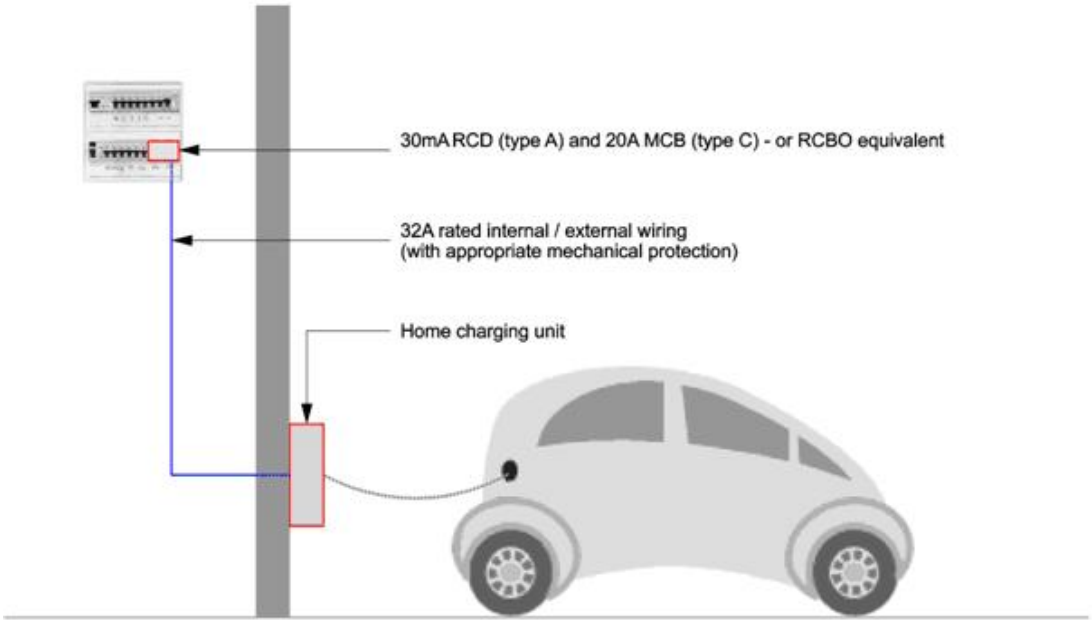


Figure 14: Home Installation Guide

5 Development of Common Functional Requirements

5.1 Introduction

Experience to date from the various pilot projects and data compiled in the course of the survey responses indicates a reasonably consistent approach to the various design functionalities for home, on-street and fast charging. However, variations are evident and further investigation, in service experience and reviews are required to establish optimal common functional standards that will adequately address the different infrastructural conditions in the EU. Further input and analysis is also required to ensure that the common functional standards ensure that future customer/EV expectations from a recharging infrastructure are fulfilled. These customer expectations will evolve with time, experience and use and will require on-going monitoring.

5.2 Charging Point Capability

The current offering from charge post manufacturers for home charge units are single phase 16A. Early indications are that such design functionality adequately meets customer's expectations while at the same time posing no undue burden on domestic home utility connections. This situation should be consistent across EU jurisdictions. Opportunities exist for utilities that provide a stronger utility grid home connection to allow the rating of the home charge unit to increase to 32A single phase and for some jurisdictions and utilities to increase to 3 phase. This situation will vary considerably across EU but should not impact or restrict roll-out in any serious way. In the various pilot and demonstration projects all cars are single phase 16A but this will change.

On-street posts at present are available with 16A single phase and 32A three phase with the possibility to increase to 63A three phase. With this level of design functionality available and planned it is expected that an adequate range of design options will be available to meet both grid requirements and restrictions and customers expectations as far as can be expected and within reason.

5.3 Achieving Common Functional requirements

A review of the fundamental technical capabilities of the range of charge points available from manufacturers reviewed as part of this study indicates that the market is capable of supplying charge points that meet the basic requirements. Whilst the basic functionality requirements are met, all other aspects of charge points vary and are particular to each individual supplier. The foundation design is different as is the enclosure, layout and arrangement

of internal components, socket housing and configuration, materials used, display, shape, size, style and weight amongst others. Other differences include ease of manual handling, ease of installation, access for maintenance, repair, component change out and testing.

The longer term achievement of the goals of low cost, long life, modularity and upgradeability should be considered in terms of the following considerations and criteria. These are laid out in terms of the following main sub components or constituent parts of the infrastructure.

5.4 Foundation Design

A key aspect of on-street post design is the foundation design. All post suppliers reviewed to date have different foundation designs. Some are simple anchor, some are metal frame based, and some are very heavy preformed concrete ballast. The foundation design and space requirement have implications for location where footpaths are congested with services, have implications on civil costs, have impacts on post replacement and maintenance and lifetime costs.

The achievement of a common foundation design standard and/or a least a common interface plate that would accommodate a range of manufacturers charge posts would contribute to ease of replacement in terms of upgrading, repair and overall lifetime costs. Post would simply be unscrewed from the interface plate and the replacement post screwed back into place and reconnected electrically. This approach can also decouple the civil works from the EV Charging Post installation, which can be helpful in mass rollouts.
Foundation metals used should be durable, galvanised or otherwise designed for long life.

5.5 Enclosure and Charge Post Body

The enclosure or housing of the charge post is a key component of the infrastructure. Charge posts reviewed as part of this work package show a huge variation in materials used, shape, layout, weight and surface treatment for graffiti and UV durability. Access and locking arrangement can have implications for deliberate interference, vandalism and subsequent electrical safety. The overall aesthetic appearance of the charge post can impact on customer and public acceptance as a piece of street furniture. The overall shape and configuration of the post will impact on the internal component layout options as well as ease of access for maintenance and repair. All of the above considerations will impact on durability and lifetime costs.

Based on experience to date a key functional design requirement is the Ingress Protection (IP) Rating of the post, particularly as it applies to moisture

ingress and condensation. Some posts have been observed to be very wet inside under various climatic conditions, in particular when a very wet, moisture laden atmosphere cools quickly at night causing extensive condensation on internal components. This can have serious implications for electronics and other internal components, as well as for cost, maintenance and overall long life durability.

Use of Plastic or equivalent body shell minimises risk of Touch Voltage as they can be double insulated. The UV immunity of such shells will need to be suitable for the particular environment in which they are placed.

5.6 Socket and Socket Enclosure

One of the most discussed and debated aspects of charge points to date is the issue of interoperability as it applies to the available 'Types' of sockets, to which the EV user plugs in the car. Once a call is made and a particular type of socket is selected it is almost impossible or very expensive to change out the socket. It certainly could never be done on site. As the type options are limited and well defined, consideration should be given to designing the socket enclosure to allow enough space within the socket enclosure part of the post to accommodate a plate and terminal arrangement to allow the socket be changed out with ease and at low cost should the need arise.

5.7 External Socket Doors

A number of different arrangements have been observed for on-street socket doors. Some take the form of manual/mechanical flaps or spring loaded doors. Some have more sophisticated door or socket electrically driven slider mechanisms, some have electromagnet door control mechanisms. Some domestic installations have a lock and key mechanism. All have varying implications for durability, maintenance, long life and cost. All designs have further implications for customer satisfaction and acceptance as this is a main area where the customer interacts with the post.

More feedback from pilot projects as well as a review of customer expectations and experience would provide valuable input to informing the optimum long term design.

5.8 Modularity and Upgradeability

All chargeposts reviewed to date are very different in terms of size, shape, layout, internal arrangements. Each is unique to each manufacturer, and different positives and negatives can be cited for different aspects of different posts. This is to be expected at this stage in the development and deployment

of charging infrastructure. In the short to medium term manufacturers will compete on design functionality and cost as well as meeting customer expectations. The nature of a chargepost in terms of delivering a significant quantity of electrical power with electronic control and communication capabilities in a harsh open environment with significant public safety issues is not a trivial challenge. The longer terms goals of low cost and long life can best be met if the design functionality could converge towards a common, modular and readily upgradeable layout and design.

5.9 Regulatory and Metering

It is early stages yet in the development of electrical vehicle infrastructure to determine the best business models under which the activity should ultimately be managed and organised. Some utilities are making the case that on-street posts should be regulated assets whilst others are arguing that they should be privately managed. Aspects of these arrangements are being piloted as part of the Green eMotion project and findings are awaited.

Metering and meter data management for multiple customers accessing electricity through the same meter require further elaboration as they will impact on the functional design and costs associated with the infrastructure.
No regulatory authority to date has stated an official position outlining how the market should be organised, how meter data is to be handled, managed and reconciled. No meter model, asset ownership guideline has been elaborated. The overall position of the regulatory authorities under which these pilot projects are proceeding is one of general co-operation whist the development phases of the infrastructure is evolving. Feedback form pilots will inform the decision making.

Currently the EU Meter Instrument Directive MID 2004\22\EC covers electric energy billing and metrology. The MID sets out ways in which measuring instruments can be compliant and how conformity can be achieved. It is generally accepted that MID predates the era and concepts of Smart Metering and as such will require to be changed in a number of respects to facilitate all the benefits of smart metering and EV infrastructure roll-out.

5.10 A Note on DC Chargers

The main observation so far on DC charging infrastructure in terms of functional design is the physical weight of the DC Yazaki connector and associated cable and ergonomics associated with connecting the charging nozzle to the car. It is understood that this is under review at the time of writing.

6 Electric Utility Interface Connection and Protection Requirements Including Earthing

6.1 Electrical Connections

The configuration and protection requirements for all grid connections are generally determined in conditions laid down by the local utility operating at the point of common coupling. The conditions are generally based on a combination of IEC, National Wiring Rules of the Country and the local Electric Utility connection rules.

Electrical connections to the on street charge post generally take the form of a direct connection from the utility low voltage network to the base of the charge post, where the utility/grid interface and protection is located. Some jurisdictions, Ireland in particular, deploy an interface pillar to house the interface and protection as shown in Figure 15 below.

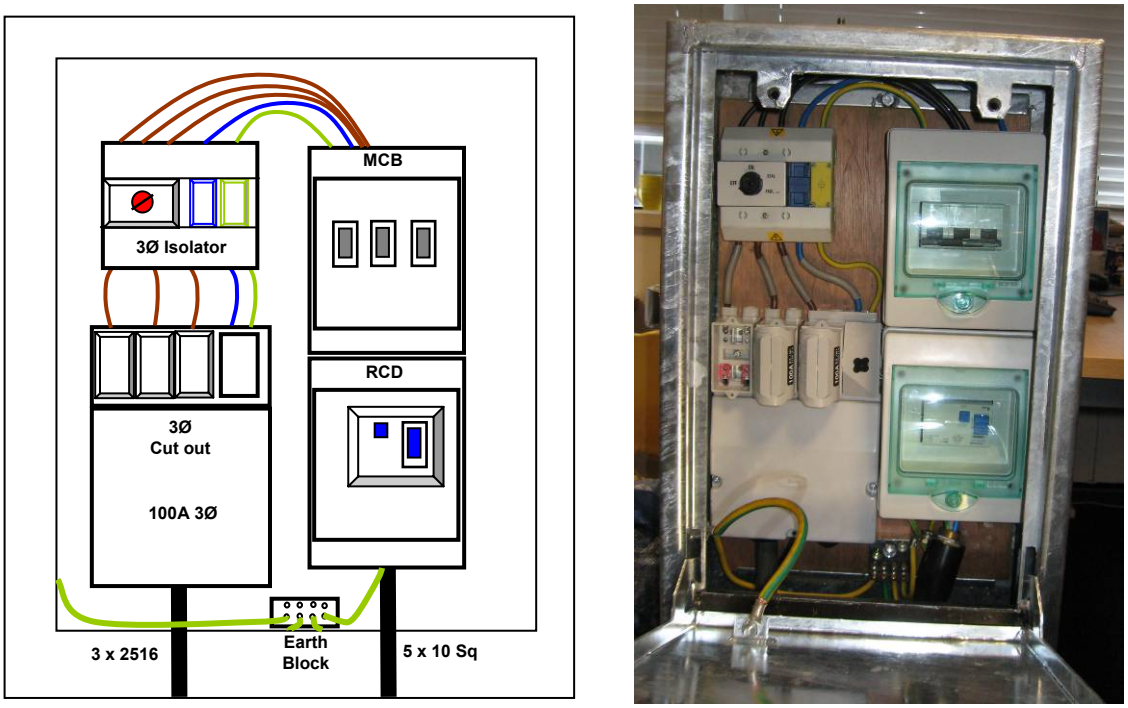


Figure 15: Street Charge Point Interface Pillar

The schematics outlined below illustrate the three configuration options available for connecting charge points to the low voltage grid. Some jurisdictions have a preference based on National Wiring Rules to connect the charge point through an interface pillar which includes protection that will provide personal shock protection for any inadvertent contact with the grid tails. Some jurisdictions provide this protection in a vault. Some jurisdictions connect directly to the low voltage system with no protection on the tails but with the tails contained in a strengthened enclosure.

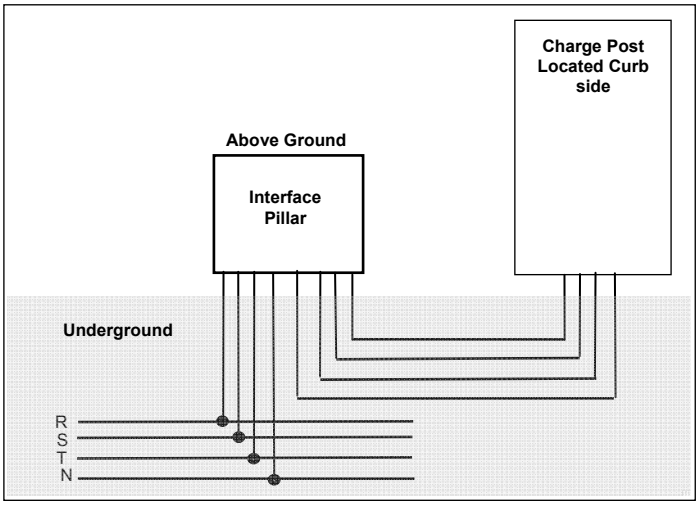


Figure 16: Charge Post Connected through an interface pillar

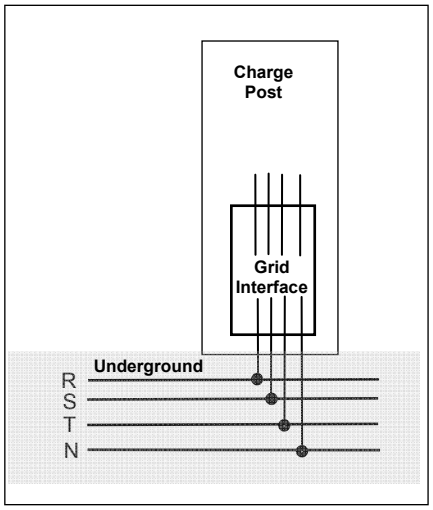


Figure 17: Charge Post Connected Directly Underground

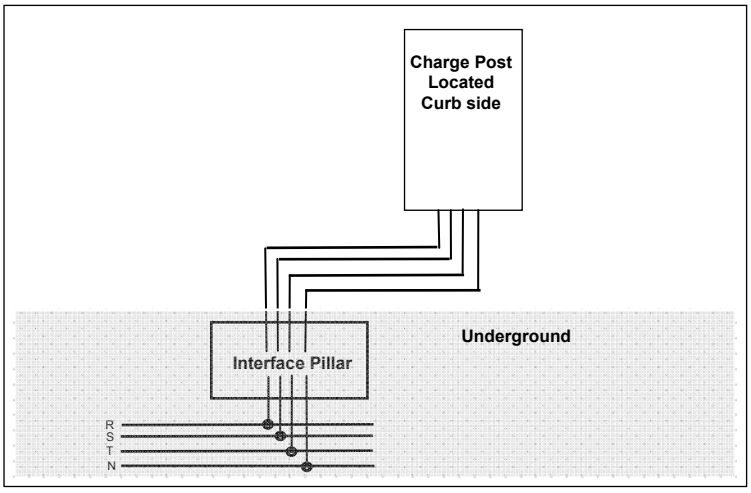


Figure 18: Charge Post Connected Through Underground Vault

6.2 Interface Protection

The interface protection and charge post protection generally consists of Fuses, MCBs, RCDs and/or RCBOs, and combinations thereof. Component sizing is designed to achieve discrimination and meet expected load current, with similar sizing of MCBs and RCDs. Generally Type C and D MCBs are used. The RCD type at present is Type A but there are indications in line with developments within IEC Technical Committees suggesting a move towards Type B RCDs as the final standard. In general all RCDS have a 30mA trip setting for personal electric shock protection.

Some jurisdictions require personal shock protection where there could be a risk that the utility cables could become exposed at ground level in the event of accidental impact with electrically fed street furniture, in this case a charge post. This is the case in Ireland where as per Figures 1 and 15 shown earlier, the utility interface placed at a safe position away from the post contains an RCD giving electrical shock protection in the event of the cables at the base of the post becoming exposed. Other utilities reduce the risk by enclosing the grid interface in a strengthened metallic enclosure at the base of the post.

6.3 Earthing

The purpose of earthing is to ensure that in the event of a fault between conductors and exposed conductive parts that sufficient current will flow in order to ensure that protective devices will operate at the required current settings and within the permitted time. The earthiness of an installation is a function of the soil type and moisture content. A number of earthing arrangements are defined and used in particular applications in different jurisdictions.

In a TN-C-S system the earth and neutral are combined on the supply side to the installation and separated within the installation. In a TN-S system the earth and neutral are separated on both the supply side and within the installation. In a TN-C system the earth and neutral are combined throughout. In a TT system the electrical supply makes no contribution to the earthing at the installation which is entirely dependent on its own earth.

The advantages of TN-S and TN-C systems are that very good earth connectivity can be provided at the installation independent of the local earthing conditions but serious problems can and do arise in the event of an inadvertent break in the neutral.

Whilst no new standard has emerged yet a general trend towards an additional supplementary earth rod or earth mat either at the charge post or interface pillar for on-street is evident.

No trend has been identified in relation to home charger installation earthing arrangements. However, a dedicated RCD does provide an additional protective measure.

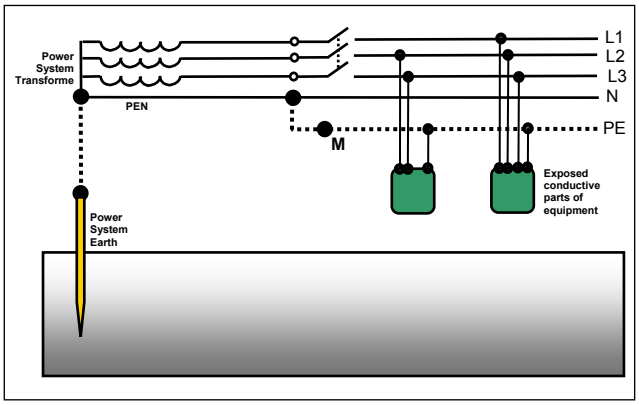


Figure 19: TN-C-S system

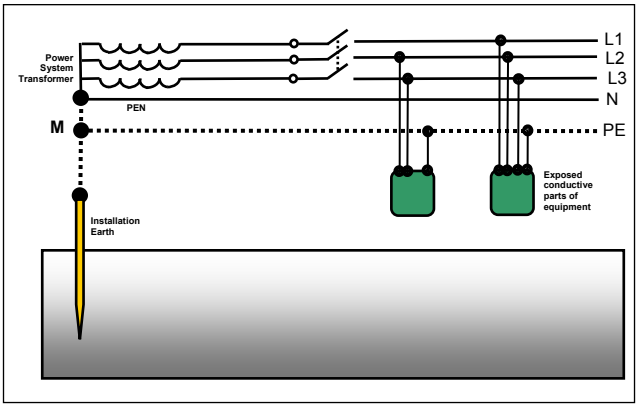


Figure 20: TN-S system

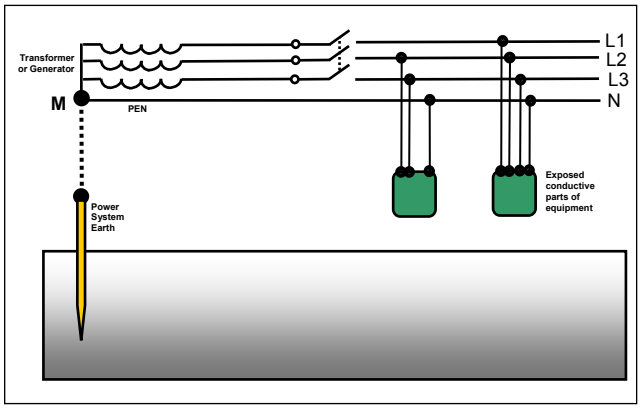


Figure 21: TN-C system

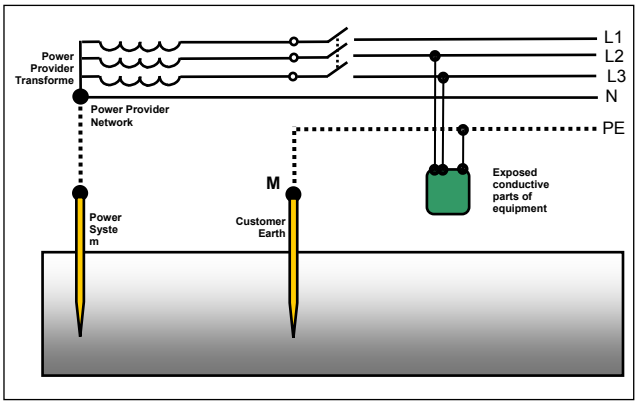


Figure 22: TT system

The findings of this survey indicate a variation across a range of earthing systems from, TN-C-S, TN-S, TN-C and TT. This is the expected result as earthing systems tend to be strongly linked to national wiring regulations. It is important to note that there is an on going debate within the electrotechnical standardisation community on the most appropriate earthing arrangements for electrical vehicles that minimise the risk of electric shock under fault conditions.

6.4 Charge Post Electrical Safety Functionality

The higher proportion of the public and home charge points covered by the survey responses operated in Mode 3 charging mode. This mode has an inherent level of electrical safety in that the socket pins will have no electrical voltage until the electrical circuit to the car is completed and proper communication with the car is established by the charge post. This design functionality considerably reduces inadvertent electrical shock risks.

The survey results also show a consistent application of Residual Current Devices (RCD) which provide further electrical shock risk mitigation in the event of an inadvertent earth fault during charging or handling under fault conditions.

The survey results indicated a consistent approach to short circuit and overload protection through the application of fuses and Miniature Circuit Breakers (MCB) and combinations thereof. In some cases RCD and MCB functionality was combined through the application of an RCBO. RCDs were generally of Type A with a 30mA trip setting in line with personal electric shock protection standards.

6.5 Home Earthing Arrangements for Charge Points

As is the case for street and public, for home charge points the available earthing configuration options are a function of Local Utility standards and relevant National Wiring Rules standards. Notwithstanding this, there is considerable debate on-going as to what the optimum earthing configuration is for car charging and how this is related to the home earthing configuration.

7 Cost Assessment of Recharging Infrastructure and drivers of Lifetime Costs

7.1 Cost Assessment

A notable feature of the data collected under the cost survey is the wide spread of costs associated with the full range of responses. When some of the cost responses were queried, some, but not all were explained on the basis that they included a component of utility network upgrading in order to allow the demonstrations projects proceed.

It is clear that the costs associated with charge post purchasing are significant for home, on-street and DC units, considering the nature of the devices. No details are available yet on the costing for battery swap installations but they can be expected to be significant. It is probably reasonable to presume that a large element of the cost is associated with recovery of development costs. In time it would be reasonable to assume that the procurement cost of charge units will reduce considerably as development costs are recovered, volumes increase and designs standardize.

Similarly as volumes increase competitive tendering will drive costs down, see Figure 23 Cost vs. Quantity/Time Curve Based Upon Demand, also known in economic terms as the Learning Curve[6].

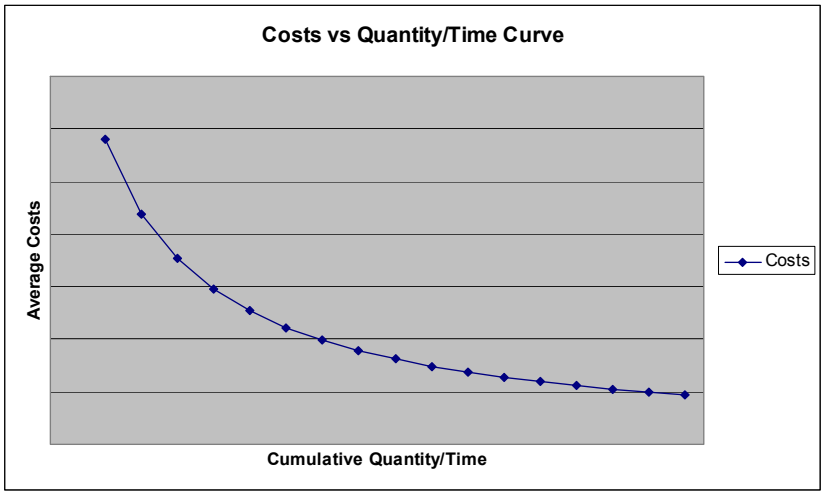


Figure 23: Costs vs. Quantity/Time Curve Based Upon Demand

The main cost drivers associated with the projects reviewed are:

- Purchase price of units from suppliers
- Civil works and reinstatement costs
- Installation & Electrical connection costs

A breakdown of costs collected so far is given in Table 4.

The average costs of On Street and Public/Private charging infrastructure vary as follows from the data collected so far. The variation in costs goes from €5500 to €25000 including installation and ancillary equipment on a per charge post basis. Civil costs drive the costs on the high end of the installation costs/prices.

DC charging units vary in price from €13k to €50k per unit. Installation costs vary from €3500 to €6000. An average all in installed system was €48000 due to high civil costs at some installations.

Home charging units vary in cost from €265 to some very substantial costs. However we have established that the very high costs were associated with a trial that included a lot of infrastructure upgrading by way of local network improvements.

The cost findings of this report indicate that the actual costs incurred in procuring and installing AC and DC public charging infrastructure is significantly higher than estimates identified and reported in the G4V and MERGE projects. Whilst it can be reasonable to expect that as volumes increase costs will reduce, the actual figures obtained are notable.

Because of the low levels of activity and the numbers of electric vehicles using infrastructure at present, it is very difficult to collect data and information on operational costs, maintenance costs and replacement costs.

As projects mobilize towards higher levels of activity more data will need to be collected for dissemination and input to the work of WP9.

It remains to be seen how the industry will develop in terms of convergence of components and design in the coming years. Recommendations are included in this report that will help in addressing this. As development costs are recovered and as production volumes increase, the unit costs should reduce very considerably. At present the sum of the costs of the individual components associated with the on-street posts is considered to be very much less than a thousand euro, yet the purchase price of such completed posts can be over six thousand euro.

If the volume of manufacturing increases to a level where the purchase price is low in comparison to the maintenance costs then this will impact on the total lifetime costs and the optimum approach to maintenance, repair and renewal.

7.2 Charge Post Electronics

For communications and control charge posts contain a range of modern electronic devices and systems in order to deliver the required communication and control functions. Such devices and systems will be affected to varying degrees by harmonics, voltage fluctuations, and by the extent to which the IP rating matches and protects the internals in the environment to which the post is subjected. Whilst particular effects may accelerate degradation, the generally accepted life of electronic components is 15 years. Technical obsolescence can kick in as early as 8 years.

Evidence from feedback received to date indicates that already a degree of component replacement and upgrading is happening across a range of manufacturer's equipment on pilot projects involved in this study.
If as outlined in Section 5.8 earlier, designs can converge towards a standardized layout that facilitates modularity and upgradeability, lifetime costs can be significantly reduced as well as improving chargepost availability and customer satisfaction.

7.3 Central Legislators, Local Councils and Planning Authorities

A key observation and discussion item on which there was broad agreement within the group was the opportunities for improvements in co-ordination between central government and local councils where sometimes long delays were encountered in granting permission and approvals for the installation of public charging infrastructure. This would enable a faster roll out in many jurisdictions.

Another recognised improvement discussed would be where planning authorities would require new developments whether domestic, commercial or industrial/workplace to be designed and constructed to accommodate charging points for electric vehicles, with expansion capabilities. This would mean that civil and some electrical infrastructure facilities could be built in at a stage of the project when it would be cheapest to do so. This would have the potential to reduce the costs associated with infrastructure roll out and contribute to an overall reduction in lifetime costs.

8 Summary, Discussion and Further Work

8.1 General

The general picture emerging from the work of WP 4.1 is that whilst a range of projects are mobilised, they are at an early stage of implementation. This is putting limits on the amount of data, experience and learning that can be captured and disseminated. Notwithstanding this progress can be demonstrated across a broad front.

8.2 IEC, ISO and SAE and EU Focus Group on ElectroMobility

At the time of writing of this report there is ongoing debate and discussion in relation to a range of standardisation issues covering plugs and sockets. A solution is critical if customer expectations around interoperability are to be met.

8.3 Further Work

As mentioned in some subsections above, participants and contributors are at an early stage in their various programmes. As programmes progress, more data, experience and learning will become available which should be captured and shared amongst participants. Periodic updates would be very informative. This information could be achieved through the authors collaborating further with the partners in the course of the project or separately re-issuing an appropriate questionnaire when pilot projects have advanced to a stage when more useful information is available. The option also exists of elaborating on progress through associated work packages, in particular Deliverable 5.1.

8.4 Recommendations

The challenges of achieving low cost and interoperability depend on timely decisions being made on critical items of infrastructure. Chapter 5 of this report outline an approach to functional design achieving modularity and upgradeability that can contribute significantly to life cost reduction. Decisions in this area could be made now without delay, in particular about a common foundation interface plate.

Similarly whilst the standards bodies and their representative have deliberated extensively on plug and socket types, the timescale in which agreement could be reached could be too long. A decision should be made now without further delay on this critical item which has a major effect on interoperability.

The tables on the following pages are an effort to "Summarise" the information given by the participants in their survey responses. Appendixes 1 and 2 are a compiled version of the actual responses of the survey participants.

A general note: Of the two car companies one is installing home charge units. The other is installing nothing.

10 responses possible

Survey Topic	Type of Charge Point Number of Responses	Similarities	% Agree	Difference 1	Difference 2	Comment
	Street Charge Posts					
Grid connections	9 responses	Almost all of the survey participants who responded to this question are making separate connections to the grid.	**72%**	Some participants are connecting to local private organizations exclusively.	NA	Difference 1 shows up for practical reasons
Street post sockets	8 responses	The majority of the survey participants who responded to this question are installing Mode 3 Type 2 sockets	**56%**	There are legacy Mode 1 and Mode 2 sockets installed and there are Type 3 sockets mostly in France	NA	The differences are related to regions and to charge post sizes. Single phase charge posts tend to be single headed 3 pin, and Schuko sockets. France likes the Mode 3 Type 3 socket and parts of Spain are 50/50 on Schuko and Mode 3 Type 2.
Parasitic losses	6 responses	There are two distinct ways presented in the data to quantify parasitic losses	**50%/50%**	A formula is used to calculate the losses and the cost for this is charged to customers	A meter is used to measure the losses and the cost for this is charged to customers	NA
Meter location	6 responses	Almost all of the survey participants are installing revenue meters. Some are installed in the charge posts others are up stream of the posts and some install at both locations	**1 in CP 1 both before & in CP 3 x 50%/50% 1 x 5 different ways**	There are legacy charge posts from pilot projects which have non revenue grade meters	There are cases where the revenue grade meters are installed up stream of the charge posts.	In some cases a private group is paying for the power and has a sub-meter arrangement.
Enclosure protection	7 responses	Almost all of the survey participants have installed IP44 enclosure protection in their charge posts	**93%**	Some participants are installing protection that is better than IP44 such as IP56	NA	Installation of enclosures rated higher than IP44 is due to environment, locations and practicality
Additional protection and equipment	7 responses	Overcurrent and earth fault protection is provided by almost all of the participants as both. Some participants are providing overcurent and overvoltage protection.	**57%**	Some participants are protecting against short circuit but earth fault is not specifically mentioned.	NA	
Remote control features	7 responses	Breaker reclosers, PLCs, charge point backoffice management and the electrical devices needed to automate the functions of the charge points are available in the majority of the installations	**93%**	There are cheaper versions of charge posts these have less automation	NA	NA
Typical charge point loads	7 responses	The majority of the survey participants are installing 3 phase 32A, 22kW per socket, double socket charge posts	**86%**	There are single phase and three phase; 13A, 16A and 63A at 230V variations of the basic charge post design but most fit the basic description listed in the previous column	NA	NA
Charge post site configurations	6 responses	Charge points are being daisy chained and installation locations are being expanded and future expansion is being installed as the project progress	**83%**	Some participants are installing for sub-metered locations where they are only providing a connection with a load requirement from a customer	NA	NA
Installation standards rules and authorities	8 responses	All of the standards rules codes and authorities are primarily governed by the local governments which have their own laws.	**100%**	The main differences for installations is the local rules and laws governing electrical installations combined with the IEC and 61851.	NA	NA
Charge post structural protections	6 responses	Most footings and concrete work is light concrete to enable easy removal of charge posts. Many of he posts are made of a tear away metal a the base. Bollards fenders and curbs of various survey participants are common	**50% 33% & 17%**	Germany are installing robust foundations and structurally robust charge post designs. Most of their charge posts are installed about 1/2 metre from curb side.	Denmark are relying on street curbs only	NA
Key criteria for locating charge posts	7 responses	All of the participants are installing charge posts with almost the same criteria - ease of connection, high visibility, high profile, grid capacity, accessibility, multiple parking bays, customer request and parking turnover	**96%**	In Italy they have an added process whereby they have a computer model that they add to the mix	Other variations are minor	NA
Charge post fault reporting and recovery	7 responses	All of the participants are installing charge posts with backoffice functions that report faults and failures. When faults and failures are reported maintenance personnel respond or IT personnel can fix some things remotely	**86%**	No differences at all	NA	NA
Vandal and theft protection	8 responses	Charge posts have locking systems to prevent power theft. Vandal protection is not a specified requirement of most participants	**63%**	Some participants specify paint and graffiti proof surfaces on their charge post infrastructure	NA	NA
Common standards	6 responses	All participants are providing charge posts that comply with IC Standard 61851	**100%**	No differences at all	NA	NA
Planning permissions	6 responses	Planning authorities have special rules for electrical installations in two thirds of the participant's localities. These special laws allow planning exemptions for certain installations	**67% no 33% yes**	The other third has to get planning permission for every installation they undertake	NA	NA
Extras and junction boxes	6 responses	Most of the responding participants have installed an up stream junction box of some type for connection and protection devices	**100%**	The primary differences are in the location and construction of these boxes. The can be made of concrete, steel and plastic. Some junction boxes are designed as an integral part of the charge posts.	NA	All of these junction boxes and their connection/protection systems are governed by local codes and standards for each geographic location.

Table 3: Generalised Summary of Answers to Technical Survey

Survey Topic	Type of Charge Point Number of Responses	Similarities	% Agree	Difference 1	Difference 2	Comment
	Junction boxes to support street charge posts					
Terminations between the grid and the charge posts	7 responses	All of the participants have installed Phase Neutral and earthing.	**100%**	Some of the participants have added communications cabling	NA	NA
Earth fault protection upstream of post	6 responses	For the most of the participants an RCD is combined with a locally installed Earth rod	**67%**	In two cases only an RCD is installed	In one case one of the participants has installed a 4 wire earthed star point	NA
Electrical protection systems at the junction with the grid	6 responses	Most installations are putting in standard MCB and Fuses	**83%**	One participant is installing Magneto-thermal protection switches	NA	NA
Overcurrent protection	6 responses	Curve C MCB three-phase 40A	**83%**	Curve C Magneto-thermal three phase 32A	NA	The differences appear to be due to automation
Earth fault protection for post and junction box	6 responses	RCD Type A 30mA (no delay) for both the post and the box	**100%**	There are minor differences which are related to practicality and location convenience	NA	NA
Types of earthing for participant regions	6 responses	Ireland: TNCS, Germany: TNCS, Italy: TT, Denmark TNCS, Spain: TT TN and IT, France TT	**50%/50%**	There are several differences due to geographic localities there are few similarities	Spain has a special case of TN-S used infrequently	NA
Earthing systems are about as diverse as the earthing types	6 responses	Earth rods, mats, integrated with the charge post foundations barrier copper wire etc.	**33% 33%** 17% & 17%	There are several differences due to local practice and practicality there are a few similarities	NA	NA
Remote control features	5 responses	There are no remote control features in most of the installed junction boxes	**80%**	In Italy they are the exception they have remote control features in their equipment upstream of the charge points including the junction boxes	NA	NA
	DC Fast Chargers					
Grid connections	3 responses	Usually from a transformer	**100%**	Italy have not installed DC, Denmark are installing DC and Battery swap stations	There are minor differences based upon practical reasons but the majority are transformer connections as required.	NA
Sockets	5 responses	Mode 4 CHAdeMO	**100%**	Italy have not installed DC, Denmark are installing DC and Battery swap stations		
Parasitic losses	4 responses	The DC charge posts will be metered up stream of the post	**75%**	In one case a formula is used to calculate the losses and the cost for this is charged to customers	NA	NA
Meter location	4 responses	The DC charge posts will be metered up stream of the post	**75%**	In one case a meter is in the DC charge post	NA	NA
Typical charge point loads	6 responses	3 phase 55kW 50hz AC input to the charge point 400V AC / 300V-500V DC (CHAdeMO) output at 50kW	**83%**	No differences at all	NA	NA
Charge post site configurations	4 responses	Service station fore courts	**50%**	EV dealerships are also installing DC charge points	No decision has been made regarding standard installations by the other participants who responded	NA
Installation standards rules and authorities	5 responses	The same comments that apply to street posts apply to DC charging	**100%**	The same comments that apply to street posts apply to DC charging	One respondent was a consultant that is not installing DC but agrees with the approach of the others	NA
Key criteria for locating charge posts	5 responses	The same location criteria applies to the DC charge posts as the street charge posts.	**100%**	Several service stations have independently installed charge posts near big cities. Ireland is using 60km on all motorways as their primary installation criteria otherwise there is agreement between the responses.	One respondent was a consultant that is not installing DC but agrees with the approach of the others.	Italy are not installing DC and they are not respondents to this question.
Charge post fault reporting and recovery	5 responses	The same comments that apply to street posts apply to DC charging	**100%**	The same comments that apply to street posts apply to DC charging	One respondent was a consultant that is not installing DC but agrees with the approach of the others.	NA
Vandal and theft protection	5 responses	The same comments that apply to street posts apply to DC charging	**100%**	The same comments that apply to street posts apply to DC charging	One respondent was a consultant that is not installing DC but agrees with the approach of the others.	NA
Common standards	5 responses	The same comments that apply to street posts apply to DC charging	**100%**	The same comments that apply to street posts apply to DC charging	One respondent was a consultant that is not installing DC but agrees with the approach of the others.	NA
Planning permissions	5 responses	The same comments that apply to street posts apply to DC charging	**100%**	The same comments that apply to street posts apply to DC charging	One respondent was a consultant that is not installing DC but agrees with the approach of the others.	NA
Extras and junction boxes	5 responses	The same comments that apply to street posts apply to DC charging	**100%**	The same comments that apply to street posts apply to DC charging	One respondent was a consultant that is not installing DC but agrees with the approach of the others.	NA
	Home Charge Points					
Charging Tariffs	8 responses	Most of the participants have variable night rate tariffs.	**85%**	Some regions in Spain do not have these variable tariffs yet	All the participants anticipate that there will be a tariff that will give the customer better pricing when Renewable energy is available on the grid.	Italy already control home charging for grid reasons.
Meter location	8 responses	Most of the participants do not install meters the charge point is installed within the house meter boundary	**75%**	In Italy the meter is separate. In Denmark the meter separate.		
Key criteria for locating home charge points	6 responses	Half of the respondents install on the surface of the home near the car's parking spot	**50%/50%**	Half of the respondents state that the installations vary due to conditions.	Germany are not installing home charge points	NA
Electrical protection systems	9 responses	Wiring is as per all of the participant's local codes.	**0% Each is different**			All are using dedicated circuits and RCD or RCBO protection
Charge Point Configurations	8 responses	The majority of installations are Mode 3 Type 2 at 16A single phase	**56%**	In France they are installing Mode 3 Type 3 sockets. In Denmark some installations are Mode 3 Type 3. Germany are installing 3 phase Mode 3 Type 2 at 16A and 32A. In Spain they are installing Schuko sockets and Mode 3 Type 2 sockets. Ireland is installing Mode 3 Type 2.	The EV owners that are installing their own charge points have installed various devices.	

Table 3 Continued

Type of Charge Point	Cost Item for Charge Point	€ Low to High Costs		€ Average of low to high	Comments
Street Charge Posts		2700 to 6700		€4,800	
	Extras	400 to 600		€500	
	Civil work	1000 to 11500		€3,500	
	Grid Work	500 to 4000		€2,250	
	Post connections	100 to 800		€450	
	Commissioning	250 to 650		€350	
	Branding and parking spot painting	600 to 800		€700	
	Installed Total:	**€5,550**	**€25,050**	**€12,550**	
	Operations and Maintenance	100 to 2100 per anum		300 per anum expected	
	Comms and back office systems	36 to 60 per anum		€48 per anum	
	Annual Costs:	**€136**	**€2,160**	**€348**	
Home Charge Points		200 to 1700		€950	
	Extras	15 to 2000		€1,008	Electrical work and extras is out of the ordinary on the high end
	Electrical work	50 to 7000		€3,525	Electrical work and extras is out of the ordinary on the high end
	Grid work	0 to 2000		€500	Electrical work and extras is out of the ordinary on the high end
	Multi-tariff costs	0 to 300		€150	
	Commissioning	0 to 650		€325	
	Installed Total:	**€265**	**€13,650**	**€6,458**	
	Operations and Maintenance	0 to 200 per anum		€10	
	Comms and back office systems	0 to 60 per anum		5 per anum very few installed	In one case a particpant reported a whole package for a multilple charge point demonstration was €80000
	Annual Costs:	**€0**	**€260**	**€15**	
DC Fast Charge Posts		10000 to 50000		€30,000	
	Extras	400 to 3600		€2,000	
	Civil work	700 to 16000		€8,350	
	Grid Work	3500 to 7000		€5,250	
	Commissioning	500 to 3000		€1,750	
	Branding and parking spot painting	600 to 800		€700	
	Installed Total:	**€15,750**	**€66,000**	**€48,050**	
	Operations and Maintenance	3000 to 6000 per anum		4500 per anum	
	Comms and back office systems	1000 to 3000 per anum		1500 per anum	
	Annual Costs:	**€4,000**	**€9,000**	**€6,000**	
Battery Swap Stations		**1.0 to 1.3 million**		**€1,150,000**	

Table 4: Generalised Summary of Answers to Cost/Price Survey

9 References:

1. **MERGE Project: http://www.EV-MERGE.eu**
2. **CEN European Committee for Standardisation: http://www.cen.eu/cen/pages/default.aspx**
3. **CENELEC European Committee for Electrotechnical Standardisation: http://www.cenelec.eu/**
4. **Green eMotion web site: http://www.greenemotion-project.eu/home/index.php**
5. **Report of the CEN/CENELC Focus Group on European Mobility**
6. **Learning Curve Theory (Paper F5): http://www.pakistanacca.com/2010/05/12/learning-curve-thoery-paper-f5/**

Data for the Report of the Results of Technical and Cost/Price Surveys

10 Technical Survey Questions for Minimum Specification for Charging Infrastructure

Street Charge Post Questions: *Page no.*

1. Grid Connection 49
2. Metering 50
3. Protection 52
4. Electrical loads 62
5. Standards, rules and/or authorities 63
6. Charge Post Structural Protection 66
7. Security provisions 69
8. Inspections carried out and intervals of inspections 71
9. Maintenance carried out and intervals of maintenance 72
10. Civil Requirements for Charge Posts 75
11. Permissions and permits 78
12. Replacements 80
13. Charge point customer identification and payments 81
14. Remote testing of charge points 81
15. Remote reset of charge post after fault condition 82

Home Charge Post Questions:

1. Multiple price tariff 82
2. Utility control tariff 83
3. Renewable energy tariff 83
4. Metering 84
5. Location and mounting guidelines 86
6. Power connection guidelines 89
7. Protection 91
8. Commissioning and test requirements 96
9. Time circuits on board the charge point units 98
10. Power quality and protection standards, rules and authorities 99

DC Charge Post Questions:

1. Metering 101
2. Dedicated transformer 101
3. Design guidelines for site and location 102
4. DC charger 3Φ circuits 103
5. DC charger ratings 104
6. Harmonics, standards, rules and/or authorities 106
7. Civil engineering standards, rules and/or authorities 106
8. Pre-certifications 107
9. Fire protection, standards, rules and/or authorities 108
10. Emergency switching 109
11. Human attendance 111
12. Electrical protection 112
13. Power supply requirements 113

Equipment and installation guidelines:

1. **Key criteria for street post and DC charge point locations** **116**

Appendix 1: Technical Survey Responses

The following questions refer to three types of charge point installations Street Charge Posts, Home Charge Points and DC Charge Points. Please state the following in your response: How many of each type have been installed and what situations as stated below have been encountered?

Please provide geographic variations (if known) of the following information and indicate where the variations are required. Additional information regarding where the responses are known to differ for each question is information that is valuable in this survey.

Currently Ireland: as of 15/11/2011 Ireland has:
21 DC Fast Chargers operating (single charge point posts)
2 DC Fast Chargers under construction
35 (70 points) AC Street Posts 3Φ, 32A, 2 Socket (Mode 3 Type 2) Operating
14 (28 points) AC Street Posts 3Φ, 32A, 2 Socket (Mode 3 Type 2) waiting for commissioning
4 (8 points) AC Street Posts 3Φ, 32A, 2 Socket (Mode 3 Type 2) under construction
13 (26 points) AC Street Posts 3Φ, 32A, 2 Socket (Mode 3 Type 2) in design
55 AC home charge points 1Φ, 16A, 1 Socket (Mode 3 Type 2) for EVs sold in Ireland
41 AC experimental home charge points 1Φ, 13A, 1 Socket 3 pin domestic variation with smart metering
24 AC Irish utility employee pilot project home charge points 1Φ, 13A, 1 Socket 3 pin domestic variation some with smart meters some without.

The 1500 AC charge point roll out of infrastructure for Ireland has begun for equipment Tendered and ordered. It is expected to have 40 installed in November 60 in December and 90 installed in January of 2012.
The Irish utility expects to have installed 1500 AC Street Points by June 2012.
It is expected that there will be 6 more DC Fast Chargers installed by end of Q1 2012.
Irish utility expect to have installed 2000 home charge points for 2000 cars (all makes and models Mode 3 Type 2 compatible) when that amount of new cars have been sold.

Currently in Denmark as of 3/11/2011 Denmark has:
Approx. 200 CP without billing possibilities
1 Fast DC Charger, 3-5 very soon.
1 Battery Swap Station

The big roll out of infrastructure has not yet begun in Denmark, it is planned to have fleet operators:
ChooseEV in cooperation with Siemens: 75 Fast Charge and 5000 semi public CP before 2015
Better place 19 battery swap stations and 550 public CP in Q2 2012
Other fleet operators also plan putting up infrastructure, but no numbers have been presented so far.

Street [and Public] Charge Post Questions:

1. **Grid Connection**
   a. **Is there a separate connection to the grid or is the Charge Post (CP) integrated into the grid?**
   [Ireland: almost always a separate connection is made to the grid. Some exceptions have occurred at public private installations.]

   [Germany: a separate connection is made to the grid.]

   [Italy: the Charge Post has been installed both integrated and with a separate connection into the grid, depending on the business model applied in the region. According to the DSO business model, wherever it is applied, the DSO integrates the street charging spots within the grid (asset owner and DSO convergence, like in Pisa location of Italian utility demo). Where such business model is not applied, the street CPs have a separate connection to the grid (e.g. Rome demonstrator).]

   [Denmark: already installed charging posts are mostly semi public, where the energy is given away for free. The CPs are primarily connected to the local installation.]

   [Spain1: internal switch to isolate the charging point from the AC distribution grid (fuente: documento ZIV)]

   [Spain2: almost always a separate connection is made to the grid. Some exceptions have occurred at Public Private Installations.]

   [International car manufacturer1: has no response]

   [Spain3: that almost always a separate connection is made to the grid.]

   [International car manufacturer2: in addition to street AC chargers there is mode 4 with JEVS G 105 plug (CHAdeMO plug). See section on DC Quick charge points]

   [France: a separate connection is generally required. Some exceptions have occurred, for instance if the charge post is connected to an inner distribution grid.]

   b. **Are you proscribing mode 1, mode 2, mode 3 or mode 4 charge point infrastructure? What type of sockets are you specifying?**
   [Ireland: mode 3 with type 2 sockets is prescribed.]

   [Germany: mode 3 with type 2 sockets is prescribed.]

   [Italy: they are prescribing Mode 3 as stated by the Italian regulation on charging points open to public access (either street or private ones), with either type 2 or type 3 sockets.]

   [Denmark: already installed CPs are primarily mode 2, but for the planned roll out in 2012, mode 3 with type 2 connector is foreseen.]

   [Spain1: modes 1 and 2 with Schuko sockets are being prescribed]

   [Spain2: mode 3 when possible or mode 4. Anyway at least mode 2 should be used. Mode 1 might be permitted for low power vehicles (mopeds, for example)]

[International car manufacturer1: has no response]

[Spain3: the prescribe mode 3 with type 2 sockets. Also SCHUKO and CHADEMO for fast recharge.]

[International car manufacturer2: has no response]

[A French utility state: in France the “Green Book” on public charging infrastructure required both mode 1 (domestic socket) et mode 3 with type 3 sockets.]

2. **Metering**
   a. **How are parasitic losses accounted for, is there a meter to cover charger power costs and a second meter to cover electric vehicle power costs?**
   [Ireland: no parasitic losses are being absorbed by the grid in the short term as, at present, the power is free to the car owners. Eventually those losses may be added to customer charging costs by formula or measured and charged someway, but the grid is wholly owned and managed by Irish utility. Thus it can be absorbed as long as there are few cars on the road.]

   [Germany: parasitic losses are being metered before the CP and at the socket.]

   [Italy: no parasitic losses are accounted for, current tariff are in a flat fashion so
   there is no additional charge to the customer due to the use of a single meter to cover charge power costs. Those losses may be later on taken into account through an ex-post analysis, especially if the grid is owned and managed by the asset owner.]

   [Denmark: the main part of CPs are at the moment not equipped with meters. For the planned roll out in 2012, the typical solution will be that each CP has a meter for revenue grade meters, and a common meter to cover the charger costs]

   [Spain1: have no answer given]

   [Spain2: thinking on the future and business models (not in present free energy), by default, the DSO will take care of reading legal meterings, and the e-mobility provider will invoice according to a secondary meter.]

   [International car manufacturer1: has no response]

   [Spain3: Parasitic losses are not taken into account]]

   [International car manufacturer2: has no response]

   [France: up to now, parasitic losses are not taken into account]

   b. **Is metering required (either in CP or feeder pillar)?**
   [Ireland: metering is located in the charge post]

   [Germany: in the charge post and before the charge post.]

[Italy: the metering is required. Its position depends on the applied business model.]

[Denmark: depends on the business model. If you have a CP connected in an existing installation, and give the energy away for free, no additional metering is required. If the CP has its own connection point, metering is required.]

[Spain1: have no answer given]

[Spain2: legal metering is not compulsory. There are five connections schemes allowed by the Spanish regulation, the main meter is centralised on the grid “border” but, in some cases, it is required a secondary meter near the connection point (including the charge post in the streets)]

[International car manufacturer1: have no answer given]

[Spain3: In the charge post and before the charge post]

[International car manufacturer2: have no answer given]

[France: yes, either in CP or feeder pillar]

c. **Revenue grade meter?**
[Ireland: going forward installation will be a 4 quadrant revenue grade one per socket meter]

[Germany: we have revenue grade meters]

[Italy: the installed meter is a 4 quadrant bidirectional smart revenue grade meter.]

[Denmark: 4 quadrant revenue grade one per socket meters is expected]

[Spain1: have no answer given]

[Spain2: legal metering is not compulsory: Main meters depend on the general metering regulation applied to all other meters (not specific for electric vehicles). Secondary meters should be Class A, according to EN50470-1 or EN50470-3, resolution < 0.1 kWh.]

[International car manufacturer1: have no answer given]

[Spain3: the installed meter is a 4 quadrant bidirectional smart revenue grade meter]

[International car manufacturer2: have no answer given]

[France: revenue grade meter is only required at the distribution interface. In the charge post, either revenue grade or submeter can be used]

d. **Non revenue grade meter?**
[Ireland: for the initial 140 post installations non revenue grade meters have been installed and they will be converted to revenue grade meters in future]

[Germany: No]

[Italy: the installed meter is a 4 quadrant bidirectional smart revenue grade meter.]

[Denmark: yes, in cases where for instance hotels put up a CP without charging the customer]

[Spain1: have no answer given]

[Spain2: legal metering is not compulsory. Secondary meters can be used also for revenue calculation. During demonstration projects energy might not be charged but meters will not be different to revenue grade meters.]

[International car manufacturer1: have no answer given]

[Spain3: legal metering is not compulsory]

[International car manufacturer2: have no answer given]

[France: non revenue grade meter may be only used in the charge post]

e. **Meter location (utility side or submetering arrangement)? – i.e. is it in a distribution pillar**
[Ireland: the metering is at the socket outlet therefore the arrangement can be both arrangements]

[Germany: metering is at the socket outlet and before the CP]

[Italy: the metering is within the CP where it is integrated into the grid. The metering is doubled (both in the CP and in the feeder pillar) where the asset owner does not act as the local DSO.]

[Denmark: the main part of CPs are at the moment not equipped with meters. For the planned roll out in 2012, the typical solution will be that each CP has a meter for revenue grade meters, and a common meter to cover the charger costs]

[Spain1: have no answer given]

[Spain2: some meters are located inside the CP, others in the distribution pillar. Legislation allows all possibilities according to the five electrical installation schemes defined by it.]

[International car manufacturer1: have no answer given]

[Spain3: CP always have metering capabilities]

[International car manufacturer2: have no answer given]

[France: revenue grade meter can be located inside or in a distribution pillar]

3. **Protection**
   a. **What enclosures are required?**
   [Ireland: IP 44 is a minimum requirement but IP56 or better is desired]

   [Germany: IP 44 is a minimum requirement but IP56 or better is desired]

   [Italy: IP 44.]

[Denmark: depended on the environmental conditions at the location]

[Spain1: IP 44 is a minimum requirement.]

[Spain2: minimum IP44 for cable conduits. Better than IP55 for outside CPs]

[International car manufacturer1: have no answer given]

[Spain3: minimum IP44 for cable conduits. Better than IP55 for outside CPs]

[International car manufacturer2: RCD in single-phase AC station: Type A. If additional RCD is considered upstream, it shall be Type A or Type B.

RCD in 3-phase AC station: Type B. If the local regulation allowed it, the head line RCD could be type A only if the charging station is equipped with a specific protection device against the DC current (current that could affect the good functionality of this type A RCD). If additional RCD is considered upstream, it shall be of the same time.

Plus, the vehicle must have a means of detection in the case of insulation defect. In this case, if the protection of the installation failed to get activated, the vehicle will have to stop the load via the pilot line so that the charging station opens its contactors. Maximum failure detection time: 100ms
The detection device in the charging station will also ensure that level of DC leakage current will not affect good functionality of possible type A RCD upstream.]

[France: IP 44 is a minimum requirement]

b. Additional distribution boards / protection devices?
[Ireland: overcurrent and earth fault protection are required both in the charge post and in the interface pillar]

[Germany: overcurrent and earth fault protection are required both in the charge post and in the interface pillar]

[Italy: wherever the DSO business model is applied, the Italian utility provides overcurrent, short circuit, earth fault protection inside the CP. If other business models are locally applied, the protection devices are within the feeder pillar.]

[Denmark: national legislation must not be violated. CPs can be installed as stand alone or as a part of an existing installation. Depending on the type of installation, solutions may differ.]

[Spain1: Fuente: document de ZIV:

- Protection against overcurrents, overvoltages and short-circuits,
- Differential protection against accidental grounding
- Secure grounding of internal power electronics
- Non-conductive body shell
- Internal switch to isolate the charging pint from the AC distribution grid]

[Spain2: both the distribution circuit and the CP should be protected by means of a RCD (the first should be retarded for selectivity reasons). Each CP should have an overcurrent protection. Distribution circuits with more than

one charging station should be also protected with over-current protections. For all schemes, the connection with the utility network (upstream the meter board) will be also protected with over-current devices.
The distribution circuit should have, in addition, an overvoltage protection. If the distance between the distribution board and the CP is longer than 10 m, a second device will be installed at the CT and coordinated with the upstream one.]

[International car manufacturer1: have no answer given]

[Spain3: both the distribution circuit and the CP are protected by an RCD]

[International car manufacturer2: have no answer given]

[France: overcurrent and earth fault protection are required both in the charge post and in the interface pillar]

c. **What terminations are required?**
[Ireland: phase, neutral and earth connections only. No hard wire communications required]

[Germany: phase, neutral and earth connections only. No hard wire communications required]

[Italy: Phases, Neutral, Earth and Pilot wires are needed for power and safety purposes (Mode-3 Pilot). Also, PLC communication takes place through a hard wire.]

[Denmark: phase, neutral and earth connections only. No hard wire communications required]

[Spain1: phase, neutral and earth connections.]

[Spain2: according to IEC61851
For charge modes 1 and 2: phase, neutral and protection connections. For charge modes 3 and 4, connectors and terminals should be according to EN 62196-2 and 62196-3 and included in a EVSE (Electrical Vehicle Supply Equipment) that complies with IEC 61851-1]

[International car manufacturer1: have no answer given]

[Spain3: according to IEC61851
For charge modes 1 and 2: phase, neutral and protection connections. For charge modes 3 and 4, connectors and terminals should be according to EN 62196-2 and 62196-3 and included in a EVSE (Electrical Vehicle Supply Equipment) that complies with IEC 61851-1]

[International car manufacturer2: have no answer given]

[France: phase, neutral and earth connections only.]

d. **What over-current protection is installed upstream of the charge post?**
[Ireland: Standard MCB and fuses are used]

[Germany: Standard MCB and fuses are used]

[Italy: Magneto-thermal protection switch is used.]

[Denmark: Standard MCB and fuses are used]

[Spain1: have no answer given]

[Spain2: automatic switch according to EN62196-2
Standard MCB and fuses.
Each CP will be protected individually with over.-current devices meeting EN 60898, EN 61009 and EN 60947-2.]

[International car manufacturer1: have no answer given]

[Spain3: automatic switch according to EN62196-2
Standard MCB and fuses.
Each CP will be protected individually with over.-current devices meeting EN 60898, EN 61009 and EN 60947-2.]

[International car manufacturer2: RCD in single-phase AC station: Type A. If additional RCD is considered upstream, it shall be Type A or Type B.

RCD in 3-phase AC station: Type B. If the local regulation allowed it, the head line RCD could be type A only if the charging station is equipped with a specific protection device against the DC current (current that could affect the good functionality of this type A RCD). If additional RCD is considered upstream, it shall be of the same time.

Plus, the vehicle must have a means of detection in the case of insulation defect. In this case, if the protection of the installation failed to get activated, the vehicle will have to stop the load via the pilot line so that the charging station opens its contactors. Maximum failure detection time: 100ms
The detection device in the charging station will also ensure that level of DC leakage current will not affect good functionality of possible type A RCD upstream.]

[France: Standard MCB and fuses are used]

e. **What is the type and rating of this over-current protection?**
[Ireland: Curve C MCB three-phase 40A is used]

[Germany: Curve C MCB three-phase 40A is used]

[Italy: Curve C Magneto-thermal three-phase 32A is used.]

[Denmark: question not understood]

[Spain1: have no answer given]

[Spain2: 16A, 32A, or 63A according to EN62196-2
Installations in which mode 1 or 2 charging will be foreseen, the circuit breaker protecting the connection terminal should have a maximum 10A, curve C, characteristics.
In general, the circuit breaker for CPs will be of 10, 16A in one phase charging points and of 16, 32 or 63A for three-phase charge.
Three phase circuits with more than one CP will have 16A, 32A, 50A or 63A circuit breakers depending on the installed power (11kW, 22kW, 35kW or 44 kW). A maximum number of CP is defined for each level (3, 6, 9, 12).]

[International car manufacturer1: have no answer given]

[Spain3: 16A, 32A, or 63A according to EN62196-2
Installations in which mode 1 or 2 charging will be foreseen, the circuit breaker protecting the connection terminal should have a maximum 10A, curve C, characteristics.
In general, the circuit breaker for CPs will be of 10, 16A in one phase charging points and of 16, 32 or 63A for three-phase charge.
Three phase circuits with more than one CP will have 16A, 32A, 50A or 63A circuit breakers depending on the installed power (11kW, 22kW, 35kW or 44 kW). A maximum number of CP is defined for each level (3, 6, 9, 12).]

[International car manufacturer2: RCD in single-phase AC station: Type A. If additional RCD is considered upstream, it shall be Type A or Type B.

RCD in 3-phase AC station: Type B. If the local regulation allowed it, the head line RCD could be type A only if the charging station is equipped with a specific protection device against the DC current (current that could affect the good functionality of this type A RCD). If additional RCD is considered upstream, it shall be of the same time.

Plus, the vehicle must have a means of detection in the case of insulation defect. In this case, if the protection of the installation failed to get activated, the vehicle will have to stop the load via the pilot line so that the charging station opens its contactors. Maximum failure detection time: 100ms
The detection device in the charging station will also ensure that level of DC leakage current will not affect good functionality of possible type A RCD upstream.]

[France: Curve D MCB three-phase 90A is used]

f. What earth leakage protection is installed upstream of the charge post?
[Ireland: an RCD in combination with local earth rod is used. Irish utility use an earth rod in top soil areas and earth mats in rocky or cobbled areas]

[Germany: RCD in combination with local earth imbedded into the foundations of the charge posts is used.]

[Italy: RCD with earth rod is used.]

[Denmark: Fuses. Typical 4 wire with earthed starpoint.]

[Spain1: have no answer given]

[Spain2: RCD]

[International car manufacturer1: have no answer given]

[Spain3: RCD]

[International car manufacturer2: have no answer given]

[France: RCD]

g. What is the type and rating of this earth leakage protection?
[Ireland: an RCD Type A 30ms/30mA is used]

[Germany: RCD Type A 30ms/30mA is used]

[Italy: RCD type A 30 mA (DSO model, installed inside the street CP).]

[Denmark: None]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: RCD type A 30 mA (DSO model, installed inside the street CP).]

[International car manufacturer2: have no answer given]

[France: RCD Type A or Type B if three phase used for non isolated charger]

h. What IP ratings are required?

i. For charge posts in the closed state.

[Ireland: IP 44 is a minimum requirement but IP56 or better is desired]

[Germany: IP 44 is a minimum requirement but IP56 or better is desired]

[Italy: IP 44.]

[Denmark: IP 44 is a minimum requirement but IP56 or better is desired]

[Spain1: IP44]

[Spain2: Better than IP55 for outside CPs]

[International car manufacturer1: have no answer given]

[Spain3: Better than IP55 for outside CPs]

[International car manufacturer2: have no answer given]

[France: IP 44 is a minimum requirement]

ii. For charge posts in the charging state.

[Ireland: IP 44 is a minimum requirement but IP56 or better is desired]

[A participating Germany utility state: IP 44 is a minimum requirement but IP56 or better is desired]

[Italy: IP 44.]

[Denmark: IP 44 is a minimum requirement but IP56 or better is desired]

[Spain1: IP44]

[Spain2: Better than IP55 for outside CPs]

[International car manufacturer1: have no answer given]

[Spain3: Better than IP55 for outside CPs]

[International car manufacturer2: have no answer given]

[France: IP 44 is a minimum requirement]

i. **What over-current (MCB/Fuse) protection is installed in both CP and/or feeder pillar (i.e. types / settings)?**
[Ireland: Curve C MCB three-phase 40A is used. Ireland: an RCD in combination with local earth rod is used. Irish utility use an earth rod in top soil areas and earth mats in rocky or cobbled areas]

[Germany: RCD in combination with local earth imbedded into the foundations of the charge posts.]

[Italy: Curve C MCB three-phase 32 A (22 kW CP) installed within CP where the DSO model is applied. In case this model is not applied there is an added Curve C MCB three-phase 63 A inside the feeder pillar.]

[Denmark: question not understood]

[Spain1: have no answer given]

[Spain2: automatic switch according to EN62196-2
Standard MCB and fuses.
Each CP will be protected individually with over.-current devices meeting EN 60898, EN 61009 and EN 60947-2.
and
16A, 32A, or 63A according to EN62196-2
Installations in which mode 1 or 2 charging will be foreseen, the circuit breaker protecting the connection terminal should have a maximum 10A, curve C, characteristics.
In general, the circuit breaker for CPs will be of 10, 16A in one phase charging points and of 16, 32 or 63A for three-phase charge.
Three phase circuits with more than one CP will have 16A, 32A, 50A or 63A circuit breakers depending on the installed power (11kW, 22kW, 35kW or 44 kW). A maximum number of CP is defined for each level (3, 6, 9, 12).]

[International car manufacturer1: have no answer given]

[Spain3: automatic switch according to EN62196-2
Standard MCB and fuses]

[International car manufacturer2: have no answer given]

[France: Curve D MCB three-phase 90A is used and RCD]

j. **What earth fault protection is installed in both CP and /or feeder pillar/vault (i.e. types / settings)?**
[Ireland: an RCD Type A 30mA (no delay) in charge post and see g above for interface pillar. For 3 Φ a Type B will be used.]

[Germany: RCD Type A 30mA (no delay) in charge post and see g above for interface pillar. For 3 Φ a Type B will be used.]

[Italy: RCD type A 30 mA (installed outside the street CPs where the DSO model is not applied) and RCD type A 30 mA (installed inside the street CP). Note that RCD and MCB embedded in the CP are combined into one unit (RCBO).]

[Denmark: RCD Type A 30mA in charge post and see g above for interface pillar.]

[Spain1: have no answer given]

[Spain2: RCD Type A 30 mA according to EN 61008, EN 61009 and EN 60947-2. Those CP installed in public areas or charge stations should be prepared to permit their automatic reconnection, complying also with EN 50557. RCD installation upstream should be selective or retarded with respect to the CP RCD.]

[International car manufacturer1: have no answer given]

[Spain3: RCD Type A 30 mA]

[International car manufacturer2: have no answer given]

[France: RCD Type A 30mA (no delay) in charge post and see g above for interface pillar. For 3 Φ a Type B will be used if non isolated charger are used.]

k. **What earthing system is in place at the interface point (i.e. TT / TNCS) and what earthing is installed at the feeder pillar/vault and CP – please provide sketches?**
[Ireland: the common earthing is: TNCS]

[Germany: the common earthing is: TNCS]

[Italy: the interface between LV grid and the street CP is TNC system. Starting from the metering section, the device itself (the street CP) behaves as a TT system with own earth rod.]

[Denmark: the Typical TNCS]

[Spain1: have no answer given]

[Spain2: Normally in Spain the most common system is the TT. But in installations not belonging to the utility all three connection systems could be deployed (TT, TN or IT). In the special cases in which the TN system is in place only the TN-S system will be used.]

[International car manufacturer1: have no answer given]

[Spain3: Normally in Spain the most common system is the TT. But in installations not belonging to the utility all three connection systems could be deployed (TT, TN or IT). In the special cases in which the TN system is in place only the TN-S system will be used.]

[International car manufacturer2: have no answer given]

[France: TT]

l. **Is the earth connection an integrated feature of the charge post or is it separately installed by the installation contractor?**
[Ireland: currently the installation contractor is required to install an earth rod or mat. If the manufacturer is providing earthing on the post then this policy may be reconsidered.]

[Germany: Integrated feature of the charge posts]

[Italy: the earth connection is separately installed by the asset owner (which can be or not the installation contractor).]

[Denmark: the installation contractor is required to install ensure appropriate protection. The solution may differ.]

[Spain1: have no answer given]

[Spain2: the regulation does not say who should install the earth, it states only that the circuit should have a protection conductor, that the general installation should be provided with an earth rod or mat and that each charge device should be individually protected by an RCD Type A 30 mA according to EN 61008, EN 61009 and EN 60947-2. Those CP installed in public areas or charge stations should be prepared to permit their automatic reconnection, complying also with EN 50557. RCD installation upstream should be selective or retarded with respect to the CP RCD.]

[International car manufacturer1: have no answer given]

[Spain3: the regulation does not say who should install the earth, it states only that the circuit should have a protection conductor]

[International car manufacturer2: have no answer given]

[France: the earth connection is integrated in the charge post.]

m. **Is remote control / operation a feature of the CP electrical design (i.e. reclosers / PLC signalling from utility)?**
[Ireland: yes, these are integrated into charge point management system]

[Germany: Yes, integrated into charge point management system]

[Italy: remote control is a feature of the CP electrical design (PLC towards the car and towards utility through a GPRS link).]

[Denmark: yes and no. Where payments are not foreseen, no control is expected.]

[Spain1: all PRV-P have communication via LV PLC links to the main PRV-M station]

[Spain2: the RCD might have the reclosing function RCD Type A 30 mA according to EN 61008, EN 61009 and EN 60947-2. Those CP installed in public areas or charge stations should be prepared to permit their automatic reconnection, complying also with EN 50557. RCD installation upstream should be selective or retarded with respect to the CP RCD.]

[International car manufacturer1: have no answer given]

[Spain3: remote control is a feature of the CP electrical design (towards utility through a GPRS link)]

[International car manufacturer2: have no answer given]

[France: yes generally, integrated into charge point management system]

i. **For distribution pillars**
[Ireland: No]

[Germany: No]

[Italy: No, remote control is embedded up to LV/MV substations.]

[Denmark: No]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: No, remote control is embedded up to LV/MV substations]

[International car manufacturer2: have no answer given]

[France: No]

n. **Where there are RCDs fitted in the charge post and the utility interface pillar/vault/cable box do you seek to achieve discrimination for a trip [Yes or No]?**
[Ireland: Yes]

[Germany: No]

[Italy: Yes]

[Denmark: have no answer given]

[Spain1: have no answer given]

[Spain2: Yes]

[International car manufacturer1: have no answer given]

[Spain3: Yes]

[International car manufacturer2: have no answer given]

[France: do not understand question?]

i. **If yes how?**
[Ireland: through charge post software i.e. active unit response polling.]

[A participating German utility have no answer given]

[Italy: with an RCB on every single line between the feeder pillar and the charging spot.]

[Denmark: have no answer given]

[Spain1: have answer given]

[Spain2: it might be either time retarded or selective by any other means]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: Do not understand question?]

4. **What electrical loads are expected?**
   a. **Amps**
   [Ireland: 32A]

   [Germany: 32A and 63A]

   [Italy: 32A]

   [Denmark: typical16A 1Φ , prepared for 3Φ. CP for 32A and 63A may be installed in selected locations]

   [Spain1: 16A]

   [Spain2: <16A, 32A, 63A]

   [International car manufacturer1: have no answer given]

   [Spain3: <16A, 32A, 63A]

   [International car manufacturer2: have no answer given]

   [France: 16 to 32A]

   b. **kWatts**
   [Ireland: 22kW per socket]

   [Germany: 22kW and 44kW per socket]

   [Italy: 22kW per socket]

   [Denmark: typical 3,7-11kW optional 22 and 43kW]

   [Spain1: 3.52kW per socket]

   [Spain2: maximum 44 kW three phase. Max 3,7 kW single phase.]

[International car manufacturer1: have no answer given]

[Spain3: maximum 44 kW three phase. Max 3,7 kW single phase]

[International car manufacturer2: have no answer given]

[France: 3 to 22kW per socket]

c. **1Φ or 3Φ**
[Ireland: mainly 3Φ and some 1Φ]

[Germany: 3Φ]

[Italy: 3Φ]

[Denmark: 1Φ and 3Φ]

[Spain1: 1Φ]

[Spain2: 1Φ and 3Φ]

[International car manufacturer1: have no answer given]

[Spain3: 1Φ and 3Φ]

[International car manufacturer2: have no answer given]

[France: 1Φ and 3Φ]

d. **AC or DC**
[Ireland: AC and some DC]

[Germany: AC and some DC]

[Italy: AC, DC to be exploited in the future]

[Denmark: AC battery swapping instead of DC]

[Spain1: have no answer given]

[Spain2: AC and few DC]

[International car manufacturer1: have no answer given]

[Spain3: AC and few DC]

[International car manufacturer2: have no answer given]

[France: AC]

e. **Have quiescent loads been calculated / accounted for (i.e. non-charging loads)?**
[In Ireland: no but will be in the future]

[Germany: no but will be in the future]

[Italy: No]

[Denmark: have no answer, question not understood]

[Spain1: have no answer given]

[Spain2: we believe not]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: no but will be in the future]

f. **Are CPs daisy chained?**
[Ireland: no but may be in the future]

[Germany: no but may be in the future]

[Italy: no]

[Denmark: no but may be in the future]

[Spain1: have no answer given]

[Spain2: many manufactures implement master slave structures]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes, depending on the design]

g. **Is expansion capability addressed?**
[Ireland: in certain locations]

[Germany: in certain locations]

[Italy: No]

[Denmark: in certain locations]

[Spain1: have no answer given]

[Spain2: yes in the case of many manufactures]

[International car manufacturer1: have no answer given]

[Spain3: yes in the case of many manufactures]

[International car manufacturer2: have no answer given]

[France: in certain locations]

5. **What are the standards, rules and/or authorities?**
   a. **For wiring?**
   [Ireland: ET101 from the ElectroTechnical Council of Ireland]

   [Germany: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1; the German electric codes]

   [Italy: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1.
   Authority of Electricity and Gas (Italy Regulator for business models).]

   [A participating Denish utility state: Stærkstrømsbekendtgørelsen (based on HD 364 series with National exemptions).]

   [Spain1: have no answer given]

   [Spain2: Spanish Low voltage Code and its extension for EV (ITC BT 52 "Instalaciones con fines especiales. Infraestructura para la recarga de vehículos eléctricos")]

   [International car manufacturer1: have no answer given]

   [Spain3: In Spain Reglamento electrotécnico de baja tensión (Spain). Ministerio Industria.]

   [International car manufacturer2: have no answer given]

   [France: NFC 14-100 and NFC 15-100]

   b. **For 1Φ & 3Φ?**
   [Ireland: there are no differences]

   [Germany: no differences]

   [Italy: no differences]

   [Denmark: no differences]

   [Spain1: no answer given]

   [Spain2: no differences]

   [International car manufacturer1: have no answer given]

   [Spain3: no differences]

   [International car manufacturer2: have no answer given]

   [France: no differences]

   c. **Do your CPs comply with the IC standard 61851?**
   [Ireland: yes]

   [Germany: yes]

   [Italy: yes]

[Denmark: yes]

[Spain1: have no answer given]

[Spain2: yes]

[International car manufacturer1: have no answer given]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: yes]

6. **Charge Post Structural Protection**
   a. **What type of mechanical barrier protection is provided, if any?**
   [Ireland: fender bollards are included between charge posts, connection pillars and cars at car park installations. Most street side installations rely on street curbs for protection but in some cases bollards will be required for these installations too.]

   [Germany: none provided German charge posts are robust design and located minimum of 400mm from curbs.]

   [Italy: embedded with the street CP there is a mechanical blocking system that prevent from accessing the socket without identification.]

   [Denmark: most street side installations rely on street curbs for protection]

   [Spain1: have no answer given]

   [Spain2: many different possibilities according to CP manufacturers and regulation, but the enclosure must comply with UNE-EN 62208. In general, the minimum protection level should be IK08, but CPs and other electrical panels should be protected according to IK10 from external mechanical impacts. Protection against mechanical external damage should be considering severe impacts (AG3 according to UNE HD 60394-5-51 standard).]

   [International car manufacturer1: have no answer given]

   [Spain3: in some cases we use bollards. In other cases no protections are used]

   [International car manufacturer2: have no answer given]

   [France: It depends on the local authorities requirements and rules. Some shock protection can be installed such as street curbs and bollards]

   b. **Are footings designed to protect post structures?**
   [Ireland: footings are installed with light concrete to allow for future changes and to compensate for impact allowing a post to tear away to protect cars not the post]

   [Germany: footings are installed as heavy concrete structures underground and are robust.]

[Italy: the charging post are installed on a cement base and when required the CP is protected with specific barriers agreed with the municipality (according to the visual impact rules).]

[Denmark: have no answer, question not understood]

[Spain1: have no answer given]

[Spain2: many different possibilities according to CP manufacturers]

[International car manufacturer1: have no answer given]

[Spain3: many different possibilities according to CP manufacturers]

[International car manufacturer2: have no answer given]

[France: Footings are generally installed with concrete to allow for future changes and to compensate for impact allowing a post to tear away to protect cars not the post]

c. **What are the design guidelines for site selection and post locations?**
[Ireland: site selection criteria is based upon ease of connection combined with visibility, high profile, grid capacity, accessibility, multiple parking bays and turnover]

[Germany: site selection criteria is based upon ease of connection combined with visibility, high profile, grid capacity, accessibility, multiple parking bays and turnover]

[Italy: Site selection and post locations are the output of a combined process between the expectations from municipality and a properly designed algorithm that takes into account several variables that may affect electromobility deployment: i.e. frequency and availability of public services, number of potential customers, available parking, site attractiveness, mobility flow analysis.]

[Denmark: have no answer, question not understood]

[Spain1: ease of connection, grid capacity and accessibility]

[Spain2: states: site selection criteria is based upon ease of connection combined with visibility, high profile, grid capacity, accessibility, multiple parking bays and turnover makes sense, but there are many different possibilities according to CP manufacturers: maybe the order should be turnover and value for customers, grid capacity, accessibility, high profile, visibility, multiple parking bays.]

[International car manufacturer1: have no answer given]

[Spain3: site selection criteria is based upon ease of connection combined with visibility, high profile, grid capacity, accessibility, multiple parking bays and turnover. Also where is required by the customer.]

[International car manufacturer2: have no answer given]

[France: site selection criteria is based upon ease of connection combined with visibility, high profile, grid capacity, accessibility, multiple parking bays and turnover]

d. **Do you have the capability to remotely monitor CP faults (what types and how)?**
[Ireland: the charge posts shall provide real time Fault/Damage notification through the internet to the ESB offices and to the maintenance contractors.]

[Germany: the charge posts shall provide real time Fault/Damage notification through the internet to the German offices and to the maintenance contractors.]

[Italy: the charge posts can provide real time Fault/Damage notification through GPRS by accessing an infrastructure management system properly designed.]

[Denmark: in some cases]

[Spain1: have no answer given]

[Spain2: many different possibilities according to CP manufacturers and qualities]

[International car manufacturer1: have no answer given]

[Spain3: the charge posts shall provide real time Fault/Damage notification through the internet to the control center in Spanish offices.]

[International car manufacturer2: have no answer given]

[France: yes, most of the faults]

e. **If failures and faults are discovered on a CP how do you respond?**
[Ireland: maintenance contracts require response to Fault/Damage within 1 hour in Dublin and 2 hours outside of Dublin]

[Germany: maintenance contracts require response to Fault/Damage]

[Italy: maintenance is sorted within the Italian utility itself without subcontractors. The CP is immediately disconnected from the grid as soon as the fault/damage is remotely detected by the infrastructure management system. Once the problem is detected, a damage assessment is done remotely and possibly sorted without local maintenance.]

[Denmark: have no answer given, question not understood]

[Spain1: have no answer given]

[Spain2: many different possibilities according to different e-mobility providers]

[International car manufacturer1: have no answer given]

[Spain3: at this time, we have no data.]

[International car manufacturer2: have no answer given]

[France: a maintenance team is sent to response to Fault/Damage]

f. **Are charge posts typically fed from a pillar or vault?**
[Ireland: typically feed street side charge posts from an interface pillar]

[Germany: feed street side charge posts from a Cable Branch Box a vault or an interface pillar can be used for connection if the Cable Branch Box is not possible to install. The Cable Branch Box includes fuses for disconnect only.]

[Italy: street CPs are fed through wires coming from the feeder pillar.]

[Denmark: have no answer given, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: both]

7. **What type of security is provided?**
   a. **Vandal resistance**
   [Ireland: the only security that is provided is overhead lighting and car barriers]

   [Germany: the only security that is provided is overhead lighting and robust steel casing of the charge posts.]

   [Italy: forcing the CP is remotely detected with anti-tamper system and ISO 10664 anti-theft screws.]

   [Denmark: none]

   [Spain1: we just provide overhead lighting]

   [Spain2: this is even mentioned in the ITC 52 Regulation, referring to the cables. But usually vandal resistance is implemented, depending on CP manufacturers and quality]

   [International car manufacturer1: have no answer given]

   [Spain3: yes, the post is designed to vandal resistance.]

   [International car manufacturer2: have no answer given]

   [France: by design]

   b. **Theft prevention**
   [Ireland: theft prevention for power is provided by the post activation software and theft prevention for the equipment is provided by lockable doors on the charge posts]

[Germany: theft prevention for power is provided by the post activation software and theft prevention for the equipment is provided by lockable doors on the charge posts]

[Italy: theft prevention for power is provided by the identification methodology (RF ID) and theft prevention for the CP is guaranteed through the anti-tamper system and cement base installation.]

[Denmark: theft prevention for power is provided by the post activation software where available. In other semi public places where power is given away, the owner is responsible. Theft prevention for the equipment is provided by lockable doors on the charge posts]

[Spain1: have no answer given]

[Spain2: depending on CP manufacturers and quality, theft prevention for power is typically provided by the post activation software and theft prevention for the equipment is provided by lockable doors on the charge posts]

[International car manufacturer1: have no answer given]

[Spain3: theft prevention for power is provided by the post activation software and theft prevention for the equipment is provided by lockable doors on the charge posts]
[International car manufacturer2: have no answer given]

[France: lockable doors + ID required to charge]

c. **Graffiti resistance**
[Ireland: graffiti resistant surface is on some charge posts that Irish utility have installed only because it came as standard by the manufacturer but this is not a requirement of the Irish utility specification]

[Germany: none provided]

[Italy: yes]

[Denmark: have no answer, question not understood]

[Spain1: have no answer given]

[Spain2: depending on CP manufacturers and quality, it is typically required]

[International car manufacturer1: have no answer given]

[Spain3: some of Spanish charge posts have graffiti resistant surface but not all because are prototypes.]

[International car manufacturer2: have no answer given]

[France: usually, anti-graffiti paint is required]

d. **Impact and crumple design**

[Ireland: impact and crumple design which includes a street post's capacity to shear from its foundation if hit by a car in an accident is a standard provided by the post manufacturers Irish utility are using]

[Germany: impact and crumple design is not provided.]

[Italy: impact and crumple have been properly assessed through IEC-61851-22 Par. 11.2.2 (Mechanical Impact) and Par. 11.2.3 (Stability).]

[Denmark: have no answer, question not understood]

[Spain1: have no answer given]

[Spain2: according to ITC 52 Regulation the protection of electric equipment must be over IK08, and over IK10 for external CPs]

[International car manufacturer1: have no answer given]

[Spain3: according to ITC 52 Regulation the protection of electric equipment must be over IK08, and over IK10 for external CPs]

[International car manufacturer2: have no answer given]

[France: It depends on the charge post design and the local authorities]

8. **What types of inspections are carried out and at what intervals?**
   a. **RCD testing?**

[Ireland: at initial commissioning and installation a Loop Impedance test is required to show that the earth rod impedance matches the impedance that is common for the earth in the area that the charge post is installed. A contactor closure test and RCD test is also initiated by the contractor using a special plug with PWM activation signals that mimic an electric car. This test kit has been purchased from the charge post manufacturers. These tests are carried out as per the Irish electric code ET 101 and as per the test certificates of the RECI and ECSSA the electrician certification board. An on going maintenance test process has been negotiated with an installation company that services charge posts. They service posts that are indicating faults and they do a yearly maintenance check of the equipment as per the manufacturer specifications and the testing done at commissioning]

[A participating German utility state; at initial commissioning and installation a Loop Impedance test is required to show that the earth impedance matches the impedance that is expected for the earth in the area that the charge post is installed. A contactor closure test and RCD test is also initiated by the contractor using a special plug with PWM activation signals that mimic an electric car. This test kit has been commissioned by a major German company as the charge post manufacturer. These tests are carried out as per the German electric codes.]

[Italy: RCD testing has been done at the installation in according to the regulation.]

[Denmark: at initial commissioning and installation a Loop Impedance test is required to show that the earth rod impedance matches the impedance that is common for the earth in the area that the charge post is installed. A contactor

closure test and RCD test is also initiated by the contractor.
In Stærkstrømsbekendtgørelsen installations must be inspected periodically to ensure safety. The interval is however not stated directly. Typically RCD's are tested once a year.]

[Spain1: have no answer given]

[Spain2: according to the ITC 52 Regulation, an initial inspection is required when the charging installation requires a project (all Mode 4, the outdoors over 5 kW, or the charging infrastructures over 50 kW managed by e-mobility providers). According to the Low voltage Code ITC 05, Periodical inspections will take place every 5 years, for those installations that required an initial inspection. RCD operation is part of the test performed.]

[International car manufacturer1: have no answer given]

[Spain3: according to ITC 52 Regulation]

[International car manufacturer2: have no answer given]

[France: RCD are tested at the periodic visit]

b. Meter certifications?
[Ireland: meters are certified as revenue grade and shall be maintained as per revenue grade meter requirements in the Irish utility]

[Germany: meters are certified as revenue grade and shall be maintained as per revenue grade meter requirements in Germany.]

[Italy: meters are certified as revenue grade, MID certified and are able to be integrated in smart grid style addictions to the network (e.g. charge management for overload renewable integration, vehicle to grid functionalities).]

[Denmark: meters are certified as revenue grade and shall be maintained as per revenue grade meter requirements]

[Spain1: have no answer given]

[Spain2: All meters should be certified, both main and secondary. See also 2c above. According to ITC 52 Regulation, revenue or secondary meters can be installed. In this case, they must be able to measure at least active power, their resolution should be better than 0,1 kWh, and they must comply with meter certification according to Royal Decree 889/2006]

[International car manufacturer1: have no answer given]

[Spain3: According to ITC 52 Regulation]

[International car manufacturer2: have no answer given]

[France: only revenue grade meters are certified]

9. What type of maintenance is carried out and at what intervals?

a. Data downloads
[Ireland: maintenance is continuous]

[Germany: continuous]

[Italy: when required during charge process management through the GPRS link established between the CP and the infrastructure management system. Also, when required for software updates through either GPRS link or on-site maintenance.]

[Denmark: continuous]

[Spain1: have no answer given]

[Spain2: depending on e-mobility providers]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: continuous]

b. Network access

[Ireland: real-time communication with central control system during/after active use. Bulk transfer of queued charging transaction data after any connectivity outage]

[Germany: real-time communication with central control system during/after active use. Bulk transfer of queued charging transaction data after any connectivity outage]

[Italy: real-time communication with central control system during/after active use. Bulk transfer of queued charging transaction data after any connectivity outage.]

[Denmark: where CP can communicate: Real-time communication with central control system during/after active use. Bulk transfer of queued charging transaction data after any connectivity outage]

[Spain1: all PRV-P have communication via LV PLC links to the main PRV-M station]

[Spain2: depending on e-mobility providers]

[International car manufacturer1: have no answer given]

[Spain3: all PRV-P have communication via LV PLC links to the main PRV-M station]

[International car manufacturer2: have no answer given]

[France: real-time communication with central control system during/after active use. Bulk transfer of queued charging transaction data after any connectivity outage]

c. Internet access

[Ireland: not usually required]

[Germany: not usually required]

[Italy: not required (maybe to be exploited in the future).]

[Denmark: none]

[Spain1: have no answer given]

[Spain2: depending on e-mobility providers]

[International car manufacturer1: have no answer given]

[Spain3: depending on e-mobility providers]

[International car manufacturer2: have no answer given]

[France: not usually required]

d. Part change out

[Ireland: as required due to real time communications or from customer queries]

[Germany: as required due to real time communications or from customer queries]

[Italy: as they become available and/or as required.]

[Denmark: have no answer given, question not understood]

[Spain1: have no answer given]

[Spain2: depending on e-mobility providers]

[International car manufacturer1: have no answer given]

[Spain3: depending on e-mobility providers]

[International car manufacturer2: have no answer given]

[A participating French utility have no answer given, question not understood?]

e. Upgrades

[Ireland: as they become available and as required]

[Germany: as they become available and as required]

[Italy: As they become available and as required.]

[Denmark: have no answer given, question not understood]

[Spain1: remote firmware upgrade.]

[Spain2: depending on e-mobility providers]

[International car manufacturer1: have no answer given]

[Spain3: depending on e-mobility providers]

[International car manufacturer2: have no answer given]

[France: as they become available and as required]

f. Spares

[Ireland: some high demand items i.e. extra foundations RCBOs etc. otherwise as required]

[Germany: some high demand items otherwise as required]

[Italy: spares availability is guaranteed close to every CP site.]

[Denmark: have no answer given, question not understood]

[Spain1: some extra items for the most weak parts of the system.]

[Spain2: depending on e-mobility providers]

[International car manufacturer1: have no answer given]

[Spain3: depending on e-mobility providers]

[International car manufacturer2: have no answer given]

[France: local installation personnel may have some spare parts]

10. Civil Requirements for Charge Posts

a. What types of mountings are required?

i. Street surface

[Ireland: yes]

[Germany: yes]

[Italy: yes]

[Denmark: yes]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: yes]

ii. Underground

[Ireland: yes]

[Germany: yes]

[Italy: yes]

[Denmark: yes]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: yes]

iii. Foundation

[Ireland: yes]

[Germany: yes]

[Italy: yes]

[Denmark: yes]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: yes]

iv. Wall

[Ireland: yes]

[Germany: yes]

[Italy: yes]

[Denmark: yes]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: yes]

b. What foundations and anchors are required?

i. Deep earth foundations with vaults

[Ireland: no]

[Germany: yes with concrete foundations]

[Italy: yes]

[Denmark: have no answer given, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: no]

ii. Single steel plate bolt to concrete

[Ireland: yes]

[Germany: no]

[Italy: yes in some applications]

[Denmark: have no answer given, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes]

iii. Steel plate and strut

[Ireland: yes]

[Germany: no]

[Italy: yes]

[Denmark: have no answer given, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes]

iv. **Concrete vault**
[Ireland: yes]

[Germany: no]

[Italy: yes]

[Denmark: have no answer given, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: no]

v. **Steel Junction Box**
[Ireland: yes]

[Germany: only when required]

[Italy: no]

[Denmark: have no answer given, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes]

11. **Permissions and permits**
    a. **Does installation require planning permissions (including signage / road markings)?**
    [Ireland: no when the installation is located street side an under the jurisdiction of the councils that can give permission for certain street furniture. No when the charge post has been determined to be a sub station type

portion the distribution grid. Yes when the installation is located on private land such as supermarket.]

[Germany: no, when the installation is located street side an under the jurisdiction of the councils that can give permission for certain street furniture. No, when the charge post has been determined to be a sub station type portion the distribution grid. Yes, when the installation is located on private land.]

[Italy: yes. All the installation on the street side require specific planning permissions as well as the installation on private premises/land.]

[Denmark: no when the installation is located street side an under the jurisdiction of the councils that can give permission for certain street furniture. No when the charge post has been determined to be a sub station type portion the distribution grid. Yes when the installation is located on private land such as supermarket.]

[Spain1: yes]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: generally yes, depending on local authorities requirements]

b. **Does installation require way leave permissions?**
[Ireland: same as in a above]

[Germany: same as in a above]

[Italy: yes]

[Denmark: Same as in a above]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer have no answer given]

[France: Same as in a above]

c. **What Municipal Authorities and what regulations are required to comply with?**
[Ireland: the local city councils, the energy regulator, the county councils and Irish law]

[Germany: the local city councils, the energy regulator, the county councils and German law]

[Italy: the local city councils, the energy regulator, the county councils and laws.]

[Denmark: the local city councils, the energy regulator, the county councils and Danish law]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer2: have no answer given]

[Spain3: the local city councils, the energy regulator, the county councils and Spanish law]

[France: to be completed by ongoing national French survey]

12. **How is it planned to handle replacements?**
    a. **What requirements are being sought to ensure interchange-ability of different charge posts, from different manufacturers?**
    [Ireland: each installation has its own foundation requirements but all charge posts are installed with light concrete so that it can be dug out of the ground and replaced with another brand]

    [Germany: the utility are only installing their charge post design interchange-ability is not foreseen with any other manufacturer of charge posts.]

    [Italy: every installed CP is compliant to the unique Italian utility project requirements: therefore different manufacturers currently supply interchangeable CPs.]

    [Denmark: each installation has its own foundation requirements but all charge posts are installed with light concrete so that it can be dug out of the ground and replaced with another brand]

    [Spain1: have no answer given]

    [Spain2: have no answer given]

    [International car manufacturer1: have no answer given]

    [Spain3: have no answer given]

    [International car manufacturer2: have no answer given]

    [France: the local authorities decides whether they require interchange-ability or not]

    b. **Is it planned to require vendors to standardize charge post foundations in the future?**
    [Ireland: a standard design may be desirable. Irish utility has already replaced 3 pin socket charge posts with 7 pin socket posts and this change has resulted in one vendor redesigning the 7 pin socket foundations to accept the

initial 3 pin post foundations. Since the charge post manufacturer was the same company this was easily achieved.]

[Germany: no see a above.]

[Italy: every installed CP is compliant to the unique Italian utility project requirements: therefore different manufacturers currently supply interchangeable CPs.]

[Denmark: a standard design may be desirable.]

[Spain1: a standard design may be desirable.]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: no, at this moment.]

13. **How is the charge point customer identified and how do they pay?**

[Ireland: RFID]

[Germany: prepaid RFID card, mobile app., debit card, credit cards, cash etc.]

[Italy: RFID]

[Denmark: customer gets the power for free, RFID card or credit cards]

[Spain1: RFID for customer's identification and bank account to pay]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: ID card is required. Payment method depends on the local authorities policy. Usually, payment is required during parking.]

14. **Does your charge point system allow you to remotely test the charge points?**

[Ireland: yes]

[Germany: yes]

[Italy: yes]

[Denmark: no]

[Spain1: the system central unit can monitor and manage multiple charging points.]

[Spain2: depending on e-mobility providers]

[International car manufacturer1: have no answer given]

[Spain3: depending on e-mobility providers]

[International car manufacturer2: have no answer given]

[France: yes]

15. **Does your charge point system allow you to remotely reset the charge post after a fault condition?**
    [Ireland: yes]

    [Germany: yes]

    [Italy: yes]

    [Denmark: no]

    [Spain1: have no answer given]

    [Spain2: have no answer given]

    [International car manufacturer1: have no answer given]

    [Spain3: have no answer given]

    [International car manufacturer2: have no answer given]

    [France: yes, but may depends on the fault type]

Home Charge Point Questions:

[France: does not directly install home charge point, except for demonstration purposes.]

1. **Do your customers have the option of having multiple tariffs to allow for charging at times that cost less than others?**
   [Ireland: there are night rate tariffs that are a lower price than day rate tariffs]

   [Germany: there are night rate tariffs that are a lower price than day rate tariffs]

   [Italy: there are night rate tariffs that are a lower price than day rate tariff (off-peak and peak
   ones).]

   [Denmark: no]

   [Spain1: have no answer given]

   [Spain2: there are two and three period tariffs. The last one was designed for EV charging at nights, although all consumers are allowed to contract it.]

   [International car manufacturer1: is installing home charge points and has implemented a pre-version of the ISO 15118 together with a German utility that allows for the download of tariff tables into the vehicle for smart charging. Beginning in 2012 we will offer the

confirmed ISO 15118 standard, including the software stack and physical layer (PowerLine Communication GreenPhy compatible)]

[Spain3: not yet. In Spain there will be a new law for EV tariffs]

[International car manufacturer2: have no answer given]

[France: night tariffs are available if subscribed (generally from 22pm to 6am) that can be used for the electrical car]

2. **Do your customers have the option of choosing a tariff that allows the utility to activate, slow down charging or deactivate their charge point remotely?**
[Ireland: no]

[Germany: no]

[Italy: no, but this is a key feature already technically guaranteed by charge management. We are able to perform it but it is not yet applied due to lack of regulation and technology from the EV side.]

[Denmark: no]

[Spain1: have no answer given]

[Spain2: not at the moment.]

[International car manufacturer1: is installing home charge points and has implemented a pre-version of the ISO 15118 together with a German utility that allows for the download of tariff tables into the vehicle for smart charging. Beginning in 2012 we will offer the confirmed ISO 15118 standard, including the software stack and physical layer (PowerLine Communication GreenPhy compatible)]

[Spain3: not yet.]

[International car manufacturer2: have no answer given]

[France: no]

3. **Do your customers have the option of choosing a tariff that allows them to get a better price when cheaper or renewable energy is available?**
[Ireland: no but there is talk of a tariff that will allow the customer to charge at a lower price when the windpower is high]

[Germany: no but it is intended that a tariff will allow the customer to be charged at a lower price when the windpower is high]

[Italy: no, but this is a key feature already technically guaranteed by charge management. We are able to perform it but it is not yet applied due to lack of regulation and technology from the EV side.]

[Denmark: no but there is talk of a tariff that will allow the customer to charge at a lower price when the windpower is high]

[Spain1: have no answer given]

[Spain2: not at the moment.]

[International car manufacturer1: currently as an OEM, we don't offer electricity tariffs, but we have developed enabling technology for this type of smart charge functionality.]

[Spain3: not yet]

[International car manufacturer2: have no answer given]

[France: no]

4. **Metering**
   a. **Is metering required?**
   [Ireland: no, the home charge points installed are the within the home owner's circuit boundary thus most customers are having time based variable tariff meters installed in their houses]

   [Germany: no, the home charge points installed are the within the home owner's circuit boundary thus most customers are having time based variable tariff meters installed in their houses]

   [Italy: yes, through a dedicated connection.]

   [Denmark: no, it is not required. In cases where the fleet operator is including energy in the monthly rate, revenue grade metering is required.]

   [Spain1: have no answer given]

   [Spain2: no, a secondary meter is optional.]

   [International car manufacturer1: no, the home charge points installed are the within the home owner's circuit boundary thus most customers are having time based variable tariff meters installed in their houses]

   [Spain3: not required by law]

   [International car manufacturer2: have no answer given]

   [France: no, the home charge points installed are the within the home owner's circuit boundary thus most customers are having time based variable tariff meters installed in their houses]

   b. **Revenue grade meter?**
   [Ireland: only at the house]

   [Germany: only at the house]

   [Italy: yes]

   [Denmark: no, it is not required. In cases where the fleet operator is including energy in the monthly rate, revenue grade metering is required.]

   [Spain1: only at the house]

   [Spain2: only at the house]

   [International car manufacturer1: only at the house]

   [Spain3: only at the house]

[International car manufacturer2: have no answer given]

[France: only at the house]

c. **Non revenue grade meter?**
[Ireland: no]

[Germany: no]

[Italy: yes, through a dedicated connection.]

[Denmark: if EV is used for ancillary services, online measuring is required.]

[Spain1: have no answer given]

[Spain2: no, optional]

[International car manufacturer1: no]

[Spain3: no]

[International car manufacturer2: have no answer given]

[France: no]

d. **Meter location?**
[Ireland: house meter]

[Germany: house meter]

[Italy: inside the charging box.]

[Denmark: revenue grade meter placed near charging spot]

[Spain1: have no answer given]

[Spain2: house meter]

[International car manufacturer1: house meter]

[Spain3: house meter]

[International car manufacturer2: have no answer given]

[France: house meter]

e. **Is second metering viable?**
[Ireland: yes but not required]

[Germany: yes but not required]

[Italy: depending on the applied business model, where the DSO one is not applied, there shall be a second metering system outside the charging box.]

[Denmark: yes but not required]

[Spain1: have no answer given]

[Spain2: yes but not required]

[International car manufacturer1: yes but not required]

[Spain3: yes but not required]

[International car manufacturer2: have no answer given]

[France: yes but not required]

5. **What are the guidelines for home charge point location and mounting?**
   [Italy: please note that the following answers to question 5 for us are under the assumption of using the Distribution System Operator (DSO) business model.]
   a. **Surface wiring only?**
   [Ireland: yes]

   [Germany: not Applicable as electric car owners install their own home chargers]

   [Italy: It depends on the specific scenario/installation premises.]

   [Denmark: no]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: standard installs yes, but customers can make requests.]

   [Spain3: yes]

   [International car manufacturer2: have no answer given]

   [France: no specific guidelines required]

   b. **Is the home charge point installation limited to within 10 metres of the customer distribution board?**
   [Ireland: yes]

   [Germany: not applicable as electric car owners install their own home chargers]

   [Italy: no, in the DSO business model the charging point belongs to the distribution grid.]

   [Denmark: no]

   [Spain1: have no answer given]

   [Spain2: 20 meters]

   [International car manufacturer1: ??, I don't think so]

   [Spain3: yes]

   [International car manufacturer2: have no answer given]

[France: no]

c. **Is the home charge point unit surface mounted on an outside wall of the home with the assumption that the electricity distribution board is within same?**
[Ireland: yes]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no, in the DSO business model the charging point belongs to the distribution grid.]

[Denmark: no]

[Spain1: have no answer given]

[Spain2: yes but sometimes the CP has is own meter]

[International car manufacturer1: question not understood]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: no]

d. **Is a separate circuit installed from the existing distribution board, for the house with all safety equipment included for this new circuit?**
[Ireland: yes]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no, everything is embedded.]

[Denmark: yes]

[Spain1: have no answer given]

[Spain2: yes]

[International car manufacturer1: only if necessary]

[Spain3: yes]

[International car manufacturer2: this point is crucial. As Ireland: the circuit must be dedicated for the domestic charging station.]

[France: yes]

e. **Does the customer have to get any consents required (e.g. landlord's), apartment dwellers and do the customers submit written permission from their apartment management to install a charge point in the apartment car park?**
[Ireland: yes]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: yes, except for detached houses.]

[Denmark: yes, this should be the method.]

[Spain1: have no answer given]

[Spain2: yes]

[International car manufacturer1: yes]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: Yes]

f. **Is the installation based upon the assumption that the customer's existing wiring system is in line with current Wiring Rules of the location.**
[Ireland: yes]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: yes]

[Denmark: yes, only authorised electricians are allowed to do installations.]

[Spain1: have no answer given]

[Spain2: yes]

[International car manufacturer1: yes]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: yes, but is has to be checked]

g. **Is the installation contractor allowed to if in his/her opinion, that the home wiring is substandard in anyway, refuse to install a home charge point until the customer fixes the wiring before installation can occur?**
[Ireland: yes]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: yes]

[Denmark: yes]

[Spain1: have no answer given]

[Spain2: yes]

[International car manufacturer1: the customer will receive a free "pre-check" before Home Charger is ordered. Based upon pre-check, a quote is given from the SPX our contracted electrician. If price is higher than the standard installation

procedure, difference is explained. The customer always has option of getting a quote from different non-SPX electrician]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: yes]

h. **Does a home installation process allow for the customer to negotiate additional costs for changes to configuration of installation after evaluation of the information provided in a through h above?**
[Ireland: yes]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no]

[Denmark: yes, this is most likely the method.]

[Spain1: have no answer given]

[Spain2: depending on e-mobility provider or the DSO]

[International car manufacturer1: yes]

[Spain3: yes]

[International car manufacturer2: have no answer given]

[France: yes, depending on the contract signed when the car is purchased]

6. **Power Connection Guidelines for home charge point circuits**
   a. **Existing?**
   [Ireland: if an existing circuit is used to Tap-Off from for power, for the home charge point the circuit has to be capable of sustaining a 32A draw at 230V for 6 to 7 hours. Thus the capacity of the circuit has to be robust as in a sub-distribution circuit provided to a garage sub-distribution board.]

   [Germany: not applicable as electric car owners install their own home chargers]

   [Italy: yes and it is related to the standard regulation for dedicated 3kW connection.]

   [Denmark: mode 2 and 3 are foreseen. Installations must be made in accordance with national legislation, typically 16A single phase]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: charge point manual states that connections go up to 16 square wire. Parameters 3 x 16A or 3 x 32A.]

   [Spain3: have no answer given]

   [International car manufacturer2: have no answer given]

[France: according to NFC 15-100 standard (French domestic electric circuit installation standard). Note that NFC 15-100 standard is under revision for the EV charge point installation]

b. Mains connections?

[Ireland: mains connections are only allowed down stream of the customer meter at the customer's metering cabinet and are "not desirable" but, these have been installed when no other option is available. An installation at the metering cabinet requires a small sub-distribution board to be installed in the metering cabinet.]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: mains connections are established by conceiving the charging spot as an added stand-alone electrical load with embedded metering.]

[Denmark: main connections only allowed in the existing distribution board, or a separate installation must be made.]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: charge point manual recommends that a separate circuit be installed in the existing distribution board.]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: according to NFC 15-100 standard (French domestic electric circuit installation standard)]

c. Customer distribution boards?

[Ireland: Tap-Off from the customer distribution boards is the most desirable installation as an additional circuit that can handle a 32A load is installed in the customer's distribution board and the charge point is installed from this dedicated circuit]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no]

[Denmark: Tap-Off from the customer distribution boards is the most desirable installation as an additional circuit that can handle a 32A load is installed in the customer's distribution board and the charge point is installed from this dedicated circuit]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: charge point manual recommends that a separate circuit be installed in the existing distribution board with a 3 x 16A or a 3 x 32A connection.]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: according to NFC 15-100 standard (French domestic electric circuit installation standard)]

d. Additional distribution boards?

[Ireland: additional sub distribution boards have been installed in many cases and the installation has been mainly dictated by the requirements of the customer's desire to charge their cars in remote locations. The location if it is over 10 metres has determined that a remote distribution board is located so as to span the distance from the main meter board to the remote charge point location and has been installed by the customers not the Irish utility.]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no]

[Denmark: none]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: charge point manual recommends that a separate circuit be installed in the existing distribution board with a 3 x 16A or a 3 x 32A connection.]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: according to NFC 15-100 standard (French domestic electric circuit installation standard)]

7. Protection

a. Does an installation require a dedicated circuit?

[Ireland: a dedicated circuit is all that Irish utility is installing]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: all protections are embedded.]

[Denmark: not required but preferred.]

[Spain1: have no answer given]

[Spain2: yes]

[International car manufacturer1: charge point manual recommends that a separate circuit be installed in the existing distribution board with a 3 x 16A or a 3 x 32A connection.]

[Spain3: yes]

[International car manufacturer2: this point is crucial. As Ireland: the circuit must be dedicated for the domestic charging station.]

[France: yes]

b. What protection is supplied for this installation?

i. RCD – if so what type

[Ireland: an RCD, an RCBO and an MCB is permissible Ireland is using an RCBO for most installations]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no]

[Denmark: no]

[Spain1: have no answer given]

[Spain2: yes. RCD Type A 30 mA according to EN 61008, EN 61009 and EN 60947-2. Those CP installed in public areas or charge stations should be prepared to permit their automatic reconnection, complying also with EN 50557. RCD installation upstream should be selective or retarded with respect to the CP RCD.]

[International car manufacturer1: charge point manual states an F1 circuit breaker 16A/32A* (30mA trigger current; all-phase fuse protection) or Circuit line breaker 16A/32A* (Type A; all-phase fuse protection) * for the use of the charging station with 22kW power, the F1 circuit breaker and circuit line breaker must be dimensioned for 32A nominal current in all cases.]

[Spain2: yes. RCD Type A 30 mA]

[International car manufacturer2: for the NISSAN LEAF it's preferable to have a curve B. For RENUALT vehicles a curve D.]

[France: no]

ii. MCB – if so what characteristic

[Ireland: an RCD, an RCBO and an MCB is permissible Ireland is using an RCBO for most installations]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no]

[Denmark: no]

[Spain1: have no answer given]

[Spain2: yes. 16A, 32A, or 63A according to EN62196-2
Installations in which mode 1 or 2 charging will be foreseen, the circuit breaker protecting the connection terminal should have a maximum 10A, curve C, characteristics.
In general, the circuit breaker for CPs will be of 10, 16A in one phase charing points and of 16, 32 or 63A for three-phase charge.

Three phase circuits with more than one CP will have 16A, 32A, 50A or 63A circuit breakers depending on the installed power (11kW, 22kW, 35kW or 44 kW). A maximum number of CP is defined for each level (3, 6, 9, 12).]

[International car manufacturer1: charge point manual states an F1 circuit breaker 16A/32A* (30mA trigger current; all-phase fuse protection) or Circuit line breaker 16A/32A* (Type A; all-phase fuse protection) * for the use of the charging station with 22kW power, the F1 circuit breaker and circuit line breaker must be dimensioned for 32A nominal current in all cases.]

[Spain3: yes. 16A, 32A, or 63A]

[International car manufacturer2: have no answer given]

[France: no]

iii. RCBO

[Ireland: yes 20A, Type A earth leakage protection, Curve C overcurrent protection]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: yes, RCD type A 30 mA and MCB curve C 32 A.]

[Denmark: have no answer, question not understood]

[Spain1: have no answer given]

[Spain2: as long as it provides the same protection that the RCD and the MCB it should be permitted.]

[International car manufacturer1: charge point manual states an F1 circuit breaker 16A/32A* (30mA trigger current; all-phase fuse protection) or Circuit line breaker 16A/32A* (Type A; all-phase fuse protection) * for the use of the charging station with 22kW power, the F1 circuit breaker and circuit line breaker must be dimensioned for 32A nominal current in all cases.]

[Spain3: as long as it provides the same protection that the RCD and the MCB it should be permitted]

[International car manufacturer2: have no answer given]

[France: yes 20 A, - IEC 61009-1 Type A specified Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses]

c. What cable size and cable size/length criteria is required for this installation?

[Ireland: the cable size is determined by voltage drop calculations based upon less than 4% allowed over the distance (10 m) at 32A, 230V.]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: the cable size is determined by voltage drop calculations based upon less than a 4% allowed over the distance (from the feeder pillar) at 16A, 230V.]

[Denmark: the cable size is determined by voltage drop calculations based upon less than 4% allowed]

[Spain1: have no answer given]

[Spain2: the maximum voltage drop allowable in each circuit from its origin to the charging point cannot be higher than 5%. Cables should be made of copper and their section will not be smaller than 2,5mm^2.]

[International car manufacturer1: charge point manual states that connections go up to 16 square wire. Parameters 3 x 16A or 3 x 32A.]

[Spain3: the maximum voltage drop allowable in each circuit from its origin to the charging point cannot be higher than 5%.]

[International car manufacturer2: have no answer given]

[France: the cable size is determined by voltage drop calculations based upon less than 5% allowed over the distance (NFC 15-100), typically 45 m]

d. What are the loads and load characteristics

i. Amps?

[Ireland: 32A]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: 16A.]

[Denmark: typically 16A]

[Spain1: have no answer given]

[Spain2: maximum 32 A (three phases), 16 A (single phase) / 30mA earth fault]

[International car manufacturer1: charge point manual states that connections go up to 16 square wire. Parameters 3 x 16A or 3 x 32A.]

[Spain3: maximum 32 A (three phases), 16 A (single phase) / 30mA earth fault]

[International car manufacturer2: have no answer given]

[France: 16 A]

ii. Volts?

[Ireland: 230V]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: 230V]

[Denmark: 230V]

[Spain1: have no answer given]

[Spain2: 400V (three phases) / 230 V (single phase)]

[International car manufacturer1: 400V (three phases) / 230 V (single phase)]

[Spain3: 400V (three phases) / 230 V (single phase)]

[International car manufacturer2: have no answer given]

[France: 230V]

iii. **Trips?**
[Ireland: 20A overcurrent / 30mA earth fault]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: 16A overcurrent / 30mA earth fault.]

[Denmark: 16A / 30mA earth fault]

[Spain1: have no answer given]

[Spain2: maximum 32 A (three phases), 16 A (single phase) / 30mA earth fault]

[International car manufacturer1: charge point manual states an F1 circuit breaker 16A/32A* (30mA trigger current; all-phase fuse protection) or Circuit line breaker 16A/32A* (Type A; all-phase fuse protection) * for the use of the charging station with 22kW power, the F1 circuit breaker and circuit line breaker must be dimensioned for 32A nominal current in all cases.]

[Spain3: maximum 32 A (three phases), 16 A (single phase) / 30mA earth fault]

[International car manufacturer2: have no answer given]

[France: 16A overcurrent / 30mA earth fault]

e. **From existing outside utilities RX?**
[Ireland: earth fault loop impedance test]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: the manual states the installer shall provide earthing and short circuit protection]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[A participating French utility have no answer given]

8. **Commissioning test requirements?**
   a. **What are the standards, rules and/or authorities for wiring?**
   [Ireland: the standard is the Irish standard ET 101]

   [Germany: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1.
   the German regulator and the German electric code.]

   [Italy: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1.
   Authority of Electricity and Gas (Italy Regulator for business models).]

   [Denmark: Stærkstrømsbekendtgørelsen (based on HD 364 series with National exemptions.]

   [Spain1: have no answer given]

   [Spain2: the Spanish Low voltage Code which refers to existing standards when needed]

   [International car manufacturer1: Local/National regulations]

   [Spain3: Reglamento electrotécnico de baja tension. Ministerio Industria (Spain)]

   [International car manufacturer2: have no answer given]

   [France: NFC 15-100]

   b. **What are the standards, rules and/or authorities for 1Φ & 3Φ?**
   [Ireland: the standard is the Irish standard ET 101]

   [Germany: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1.
   the German regulator and the German electric code.]

   [Italy: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1.
   Authority of Electricity and Gas (Italy Regulator for business models) only for single phase.]

   [Denmark: Stærkstrømsbekendtgørelsen (based on HD 364 series with National exemptions.]

   [Spain1: have no answer given]

   [Spain2: the Spanish Low voltage Code which refers to existing standards when needed]

   [International car manufacturer1: Local/National regulations]

   [Spain3: Reglamento electrotécnico de baja tension. Ministerio Industria (Spain)]

[International car manufacturer2: have no answer given]

[France: NFC 15-100]

c. **What are the standards, rules and/or authorities for meter locations?**
[Same as above. They should comply with the protection grades indicated by UNE 20324 and UNE-EN 50102 depending on where they will be located]

i. **Indoor**
[Ireland: wall mounted mainly beside distribution board]

[Germany: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1 the German regulator and the German electric code.]

[Italy: embedded in the charging spot.]

[Denmark: wall mounted]

[Spain1: have no answer given]

[Spain2: wall mounted mainly beside distribution board. Same as b above. They should comply with the protection grades indicated by UNE 20324 and UNE-EN 50102 depending on where they will be located]

[International car manufacturer1: local]

[Spain3: wall mounted mainly beside distribution board]

[International car manufacturer2: have no answer given]

[France: Wall mounted mainly beside distribution board]

ii. **Outdoor**
[Ireland: wall embedded PVC box]

[Germany: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1 the German regulator and the German electric code.]

[Italy: Embedded in the charging spot.]

[Denmark: In wall embedded cubicle or build in]

[Spain1: have no answer given]

[Spain2: in wall embedded PVC box]

[International car manufacturer1: local]

[Spain3: in wall embedded PVC box]

[International car manufacturer2: have no answer given]

[France: in wall embedded PVC box]

iii. **Garage**
[Ireland: wall embedded PVC box]

[Germany: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1 the German regulator and the German electric code.]

[Italy: Embedded in the charging spot.]

[Denmark: In wall embedded cubicle or build in]

[Spain1: have no answer given]

[Spain2: in wall embedded PVC box]

[International car manufacturer1: local]

[Spain3: in wall embedded PVC box]

[International car manufacturer2: have no answer given]

[France: in wall embedded PVC box]

iv. Apartments

[Ireland: either in basement of apartment block or at indoor garages]

[Germany: IEC/CEI 61851, IEC 62196, CEI 69-6; CEI CT 312-1 the German regulator and the German electric code.]

[Italy: either in basement of apartment block or at indoor garages. Always embedded in the charging spot.]

[Denmark: typical in apartment or basement]

[Spain1: have no answer given]

[Spain2: either in basement of apartment block or at indoor garages]

[International car manufacturer1: local]

[Spain3: either in basement of apartment block or at indoor garages]

[International car manufacturer2: have no answer given]

[France: either in basement of apartment block or at indoor garages]

9. Are there time circuits on board the charge point units being installed?

[Ireland: no most of the new cars that are now on the market have a time circuit in the car so the timed charge is part of the car and does not have to be in the charge point]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no: most of the new cars that are now on the market have a time circuit in the car so the timed charge is part of the car and does not have to be in the charge point.]

[Denmark: “Yes and no” typical home CP type 3 are foreseen to deliver ancillary services. Therefore communication I required to enable smart charging]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: no]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: no, unless required by the home owner]

10. **Power quality and protection requirements and standards, rules and/or authorities followed**
    a. **Earthing, grounding and bonding?**
    [Ireland: as per ET101]

    [Germany: not applicable as electric car owners install their own home chargers]

    [Italy: EN 50160 all power quality duties are covered by IEC]

    [Denmark: as per stærkstrømsbekendtgørelsen.]

    [Spain1: have no answer given]

    [Spain2: Low voltage Code]

    [International car manufacturer1: local]

    [Spain3: Low voltage Code]

    [International car manufacturer2: have no answer given]

    [France: NFC 15-100]

    b. **Harmonics?**
    [Ireland: as per ET101]

    [Germany: not applicable as electric car owners install their own home chargers]

    [Italy: EN 50160 and IEC 6100]

    [Denmark: as per stærkstrømsbekendtgørelsen.]

    [Spain1: have no answer given]

    [Spain2: as per the EN 50160 from the network point of view and as per the IEC standard for the electrical devices connected to the network.]

    [International car manufacturer1: local]

    [Spain3: as per the EN 50160 from the network point of view and as per the IEC standard for the electrical devices connected to the network]

    [International car manufacturer2: have no answer given]

    [France: NFC 15-100]

    c. **IEC**

[This is the legal standard in Ireland]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: EN 50160 and IEC 6100]

[Denmark: as per stærkstrømsbekendtgørelsen.]

[Spain1: have no answer given]

[Spain2: this is the legal standard in Spain]

[International car manufacturer1: yes]

[Spain3: this is the legal standard in Spain]

[International car manufacturer2: have no answer given]

[A participating French utility have no answer given]

d. IEEE

[No legal standing in Ireland]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no]

[Denmark: no]

[Spain1: have no answer given]

[Spain2: no legal standing in Spain, unless referred by a legislative document]

[International car manufacturer1: unknown at this time]

[Spain3: no legal standing in Spain]

[International car manufacturer2: have no answer given]

[A participating French utility have no answer given]

e. IEE

[No legal standing in Ireland]

[Germany: not applicable as electric car owners install their own home chargers]

[Italy: no]

[Denmark: no]

[Spain1: have no answer given]

[Spain2: no legal standing in Spain, unless referred by a legislative document]

[International car manufacturer1: unknown at this time]

[Spain3: no legal standing in Spain]

[International car manufacturer2: have no answer given]

[A participating French utility have no answer given]

DC Charge Point Questions:

1. **Where is the grid power to the DC charge point meter located?**
   [Ireland: no grid power to the DC charge point is metered the DC charge posts have their own metering for the charging of the cars. Parasitic losses are being absorbed by the grid in the short term as, at present, the power is free to the car owners. Eventually those losses may be added to customer charging costs by formula or measured and charged someway, but the grid is wholly owned and managed by Irish utility. Thus it can be absorbed as long as there are few cars on the road.]

   [Germany: the grid power to the DC charge point is metered before the charger and the DC charge posts have their own metering for the charging of the cars.]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: the main part of CPs are at the moment not equipped with meters. For the planned roll out in 2012, the typical solution will be that each CP has a meter for revenue grade meters, and a common meter to cover the charger costs]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: have no answer given]

   [Spain3: At this moment, DC charging stations are installed either on private parkings and petrol stations]

   [International car manufacturer2: have no answer given]

   [France: the DC charging stations will be installed either on street (in that case, a meter will be located at the distribution interface), private parking, such as gas station (with no obligation to have a meter in this case)]

2. **Is there a separate dedicated transformer allocated to the DC charge point?**
   [Ireland: most of the time there is not a separate transformer at the site and since most sites are Petrol stations they almost all have at least 50% spare capacity at the site transformer. If there is a requirement to add a transformer one will be added to the location in question.]

   [A participating German utility have no answer given]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: This is evaluated for each installation. If spare in the existing transformer is sufficient, no additionally transformer is required. Connection to the grid is paid for, either a fixed amount per A or the real costs depending of the size of the installation.]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: Yes, if it is required]

[International car manufacturer2: have no answer given]

[France: it depends of the spare capacity of the local grid and transformer. May be required if necessary]

3. **What are the design guidelines for site selection and DC charge point location?**
   a. **Filling Stations**
   [Ireland: the primary choice for the installation of DC fast chargers is Filling Stations located at 60 kM intervals along major motorways and national roads across Ireland]

   [A participating German utility have no answer given]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: depending on traffic patterns, on strategic locations along the highways and main roads (Stated in the EDISON project).]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: have no answer given]

   [Spain3: No specific guidelines, installed as requested]

   [International car manufacturer2: have no answer given]

   [France: under consideration. None so far]

   b. **City street**
   [Ireland: the secondary locations inside of cities are at car dealerships exclusively car dealerships that sell electric cars]

   [A participating German utility have no answer given]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: strategic places and companies willing to put up a fast charge. E.g. at ABB.]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: none so far.]

c. **Motorways**
[Ireland: the primary choice for the installation of DC fast chargers is Filling Stations located at 60 kM intervals along major motorways and national roads across Ireland]

[A participating German utility have no answer given]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: depending on traffic patterns, on strategic locations along the highways and main roads (Stated in the EDISON project).]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: none so far.]

4. **DC charger's 3Φ circuits**
   a. **Dedicated supply?**
   [Ireland: no]

   [Germany: no]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: depends on the local conditions]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: have no answer given]

   [Spain3: have no answer given]

   [International car manufacturer2: have no answer given]

   [France: no]

b. **Shared supply?**
[Ireland: yes]

[Germany: yes]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: depends on the local conditions]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes]

c. **Sub-distribution boards?**
[Ireland: yes]

[Germany: yes]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: depends on the local conditions]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes]

5. **DC charger's ratings typical and list variations**
   a. **kWs?**
   [Ireland: 50 kWs]

   [Germany: 50 kWs]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: 50kW Some are prepared for 3 phase AC.]

   [Spain1: have no answer given]

[Spain2: 44 kW is the maximum power in AC considered (three phase, 63A)]

[International car manufacturer1: have no answer given]

[Spain3: 44 kW is the maximum power in AC considered (three phase, 63A)]

[International car manufacturer2: note: 50 kW is the output power.]

[France: 50 kWs]

b. **Amps?**
[Ireland: 72A per phase AC / 125A DC max]

[Germany: 72A per phase AC / 125A DC max]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: 63A per phase AC / approx.125A DC max]

[Spain1: have no answer given]

[Spain2: 63 A per phase AC]

[International car manufacturer1: have no answer given]

[Spain3: 63 A per phase AC]

[International car manufacturer2: have no answer given]

[France: 72A per phase AC / 125A DC max]

c. **Volts?**
[Ireland: 400V AC / 300-500V DC (CHAdeMO)]

[Germany: 400V AC / 300-500V DC (CHAdeMO)]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: 400V AC / 300-500V DC]

[Spain1: have no answer given]

[Spain2: 400V AC]

[International car manufacturer1: have no answer given]

[Spain3: 400V AC]

[International car manufacturer2: have no answer given]

[France: 400V AC / 300-500V DC (CHAdeMO)]

d. **PWM & Hz?**

[Ireland: 50Hz AC on input supply]

[Germany: 50Hz AC on input supply]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: 50Hz AC on input supply]

[Spain1: have no answer given]

[Spain2: 50 Hz AC on input supply]

[International car manufacturer1: have no answer given]

[Spain3: 50 Hz AC on input supply]

[International car manufacturer2: have no answer given]

[France: 50Hz AC on input supply]

6. **What harmonic restrictions if any, and what standards, rules and/or authorities apply?**
[Ireland: less than 5% THD as per IEEE 519 and/or IEC EEE 555]

[Germany: less than 5% THD as per IEEE 519 and/or IEC EEE 555]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: IEC 61000-3-12]

[International car manufacturer1: have no answer given]

[Spain3: IEC 61000-3-12]

[International car manufacturer2: have no answer given]

[France: IEC 61000-3-12 and 61851-23 (]

7. **Civil engineering standards, rules and/or authorities?**
[Ireland: none specific for the chargers but the standard Irish Civil building/safety requirements and Irish utility safety requirements apply. Risk assessments and safety statements are required.]

[Germany: the standard German Civil building/safety requirements and German utility safety requirements apply. Risk assessments and safety statements are required.]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: none]

8. **Pre-certifications for DC chargers**
   a. **CE mark?**
   [Ireland: yes]

   [Germany: yes]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: yes]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: have no answer given]

   [Spain3: have no answer given]

   [International car manufacturer2: have no answer given]

   [France: yes]

   b. **CHAdeMO?**
   [Ireland: yes]

   [Germany: yes]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: yes]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: have no answer given]

   [Spain3: Yes]

   [International car manufacturer2: have no answer given]

[France: yes]

9. **What fire protection measures are implemented and what regulations, standards, rules and/or authorities are followed**
   a. **ATEX?**
   [Ireland: yes]

   [Germany: yes]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: no answer, question not understood]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: have no answer given]

   [Spain3: have no answer given]

   [International car manufacturer2: have no answer given]

   [France: to be defined]

   b. **NFPA?**
   [Ireland: no]

   [Germany: not applicable]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

   [Denmark: no answer, question not understood]

   [Spain1: have no answer given]

   [Spain2: have no answer given]

   [International car manufacturer1: have no answer given]

   [Spain3: have no answer given]

   [International car manufacturer2: have no answer given]

   [France: to be defined]

   c. **Others?**
   [Ireland: no]

   [Germany: not applicable]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: no]

10. What emergency switching is installed?

a. Deadman nozzle switch?

[Ireland: yes]

[Germany: yes]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes]

b. Manual override?

i. Red mushroom button

[Ireland: yes]

[Germany: yes]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes]

c. **Automated override?**
[Ireland: yes]

[Germany: yes]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes]

d. **Remote override?**
[Ireland: yes on some units]

[Germany: yes on some units]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: yes on some units]

e. **Emergency switch**
   i. **Total Supply Disconnect**
   [Ireland: yes]

   [Germany: yes]

   [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: TBD]

ii. **Fuel Systems Only**
[Ireland: yes]

[Germany: yes]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: no answer, question not understood]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: TBD]

11. **What human attendance or non-attendance is required for your DC charge points?**
[Ireland: Petrol Station Four Court attendants are present at Petrol Stations.]

[Germany: Petrol Station Four Court attendants are present at Petrol Stations.]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: none]

[Spain1: have no answer given]

[Spain2: have no answer given]

[International car manufacturer1: have no answer given]

[Spain3: have no answer given]

[International car manufacturer2: have no answer given]

[France: TBD]

12. **What electrical protection measures are implemented and what regulations, standards, rules and/or authorities are followed?**
    a. **What overcurrent protection is installed at both the feeder pillar/vault and DC charger (state types and settings)?**
    [Ireland: in the Interface pillar (200A fuses / 100A Type C) MCB - various MCB types installed in DC chargers]

    [Germany: a Cable Branch Box with (200A fuses / 100A Type C) MCB - various MCB types installed in DC chargers]

    [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

    [Denmark: no answer, question not understood]

    [Spain1: have no answer given]

    [Spain2: 63 A installed at the CP (depending on power)]

    [International car manufacturer1: have no answer given]

    [Spain3: 63 A installed at the CP (depending on power)]

    [International car manufacturer2: have no answer given]

    [France: to be defined]

    b. **What earth fault protection is installed at both the feeder pillar/vault and DC charger (state types and settings)?**
    [Ireland: RCD Type A (S delay 100ms / 100mA) in interface pillar – various RCD types installed in DC chargers]

    [Germany: RCD Type A (S delay 100ms / 100mA) in interface pillar – various RCD types installed in DC chargers]

    [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

    [Denmark: no answer, question not understood]

    [Spain1: have no answer given]

    [Spain2: RCD Type A 30mA in DC chargers]

    [International car manufacturer1: have no answer given]

    [Spain3: RCD Type A 30mA in DC chargers]

    [International car manufacturer2: have no answer given]

    [France: RCD Type A (30 mA) for non isolated charger, or type B (30 mA) for non isolated charger]

c. **What standards are applicable (IEC, IEEE, IEE)?**
[Ireland: IEC, IEEE, IEE, CHAdeMO and applicable Irish Law]

[Germany: IEC, IEEE, IEE, CHAdeMO and applicable German Law]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: IEC, CHAdeMO and Stærkstrømsbekendtgørelsen]

[Spain1: have no answer given]

[Spain2: as in other CPs]

[International car manufacturer1: have no answer given]

[Spain3: as in other CPs]

[International car manufacturer2: have no answer given]

[France: NFC 15-100 and EIC 61851-1 and 23]

13. **What are the power supply requirements**
    a. **Single DC charger installations?**
    [Ireland: 50kW]

    [France: 50kW]

    [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

    [Denmark: 50kW]

    [Spain1: have no answer given]

    [Spain2: normally 44 kW]

    [International car manufacturer1: have no answer given]

    [Spain3: normally 44 kW]

    [International car manufacturer2: from 50 to 60 kVA]

    [France: 50kW]

    b. **Multiple DC charger installations?**
    [Ireland: 100kW capacity as multiples of 50kW is installed at some sites]

    [Germany: 100kW capacity as multiples of 50kW is installed at some sites]

    [DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

    [Denmark: none, relevant sites will be prepared for multiple Charger]

[Spain1: have no answer given]

[Spain2: it does not matter if charge mode. Maximum 44 kW per circuit (12 charge stations and 63 A maximum), but circuits could be several depending on capacity availability at the site]

[International car manufacturer1: have no answer given]

[Spain3: Maximum 44 kW per circuit (12 charge stations and 63 A maximum), but circuits could be several depending on capacity availability at the site]

[International car manufacturer2: multiples of 50-60 kVA]

[France: 100kW capacity as multiples of 50kW is installed at some sites]

c. **DC chargers and AC chargers in single location?**
[Ireland: 1 DC and 1 AC double headed = 94kW]

[Germany: 1 DC and 1 AC double headed = 94kW]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: none]

[Spain1: have no answer given]

[Spain2: it does not matter if charge mode. Maximum 44 kW per circuit (12 charge stations and 63 A maximum), but circuits could be several depending on capacity availability at the site]

[International car manufacturer1: have no answer given]

[Spain3: Maximum 44 kW per circuit (12 charge stations and 63 A maximum), but circuits could be several depending on capacity availability at the site]

[International car manufacturer2: have no answer given]

[France: 1 DC and 1 AC double headed = 94kW]

d. **Capacity requirement where a MV supply is required for an installation?**
[Ireland: Where LV supply is inadequate an MV supply can be used. Transformer sizes are typcially 100kVA / 200kVA / 400kVA]

[Germany: Where LV supply is inadequate an MV supply can be used. Transformer sizes are typcially 100kVA / 200kVA / 400kVA]

[DC CHARGING IS STILL UNDER EVALUATION FROM THE ITLAIAN UTILITY SIDE.]

[Denmark: Where LV supply is inadequate an MV supply can be used. Transformer sizes are typcially 100kVA / 200kVA / 400kVA]

[Spain1: have no answer given]

[Spain2: the electricity distributor may require the connection in MV depending on the capacity requirement. Deployed transformer sizes are typically 400 / 630 kVA.]

[International car manufacturer1: have no answer given]

[Spain3: the electricity distributor may require the connection in MV depending on the capacity requirement. Deployed transformer sizes are typically 400 / 630 kVA]

[International car manufacturer2: have no answer given]

[France: where LV supply is inadequate an MV supply can be used. Transformer sizes are typcially 100kVA / 200kVA / 400kVA]

Appendix 1:
Please fill in your typical equipment and installation guidelines and arrangements:

Overall Charge Point Location and Installation Guide

Criteria for Selecting most Street and DC Charge Point Locations

Key criteria for selecting charge point locations are:

1. [**Visibility** – Ireland: Charge points should be easily visible and recognisable by cars passing, (e.g. in front of IRELAND Head Office, Dublin) on main streets and towns.]

   [**Visibility** – Germany: Charge points should be easily visible and recognisable by cars passing, (e.g. in front of GERMANY Office, Dortmund) on main streets and towns.]

   [**Visibility** – Denmark: Charge points should be easily visible and recognisable by cars passing, on main streets and towns.]

2. [**High Profile** – Ireland: During the initial phase, it is highly desirable that the public notice and recognise charge points in high profile urban areas, (e.g. St Stephan's Green, Council Offices etc.).]

   [**High Profile** – Germany: During the initial phase, it is highly desirable that the public notice and recognise charge points in high profile urban areas.]

   [**High Profile** – Denmark: During the initial phase, it is highly desirable that the public notice and recognise charge points in high profile urban areas.]

3. [**Accessibility** – Ireland: 24 hour access is highly desirable but not required. A reasonable time for access to a customer charging a vehicle is all that is required. Shopping areas that close at night can be ideal for a lot of reasons.]

   [**Accessibility** – Germany: 24 hour access is highly desirable but not required. A reasonable time for access to a customer charging a vehicle is all that is required. Shopping areas that close at night can be ideal for a lot of reasons.]

   [**Accessibility** – Denmark: 24 hour access is highly desirable but not required. A reasonable time for access to a customer charging a vehicle is all that is required. Shopping areas that close at night can be ideal for a lot of reasons.]

4. [**Parking** – Ireland: Ideally the car parking spot(s) should be dedicated to EV parking with some kind of EV parking identification and restrictions to allow EV parking only. If this is not an option then the location should be an area that is frequently used for parking.]

   [**Parking** – Germany: Ideally the car parking spot(s) should be dedicated to EV parking with some kind of EV parking identification and restrictions to allow EV parking only. If this is not an option then the location should be an area that is frequently used for parking.]

   [**Parking** – Denmark: Ideally the car parking spot(s) should be dedicated to EV parking with some kind of EV parking identification and restrictions to allow EV parking only. If this is not an option then the location should be an area that is frequently used for parking.]

5. [**Turnover** – Ireland: Parking spots should allow a car to be parked for a minimum of 1 hour (ideally 2 hours) with a high turnover in any 24 hour period (e.g. a shopping centre).]

   [**Turnover** – Germany: Parking spots should allow a car to be parked for a minimum of 1 hour (ideally 2 hours) with a high turnover in any 24 hour period (e.g. a shopping centre).]

   [**Turnover** – Denmark: Parking spots should allow a car to be parked for a minimum of 1 hour (ideally 2 hours) with a high turnover in any 24 hour period (e.g. a shopping centre).]

6. [**Multiple Parking Bays** – Ireland: There should be two dedicated EV parking spots adjacent to one another (heightened visibility, use of the dual headed socket).]

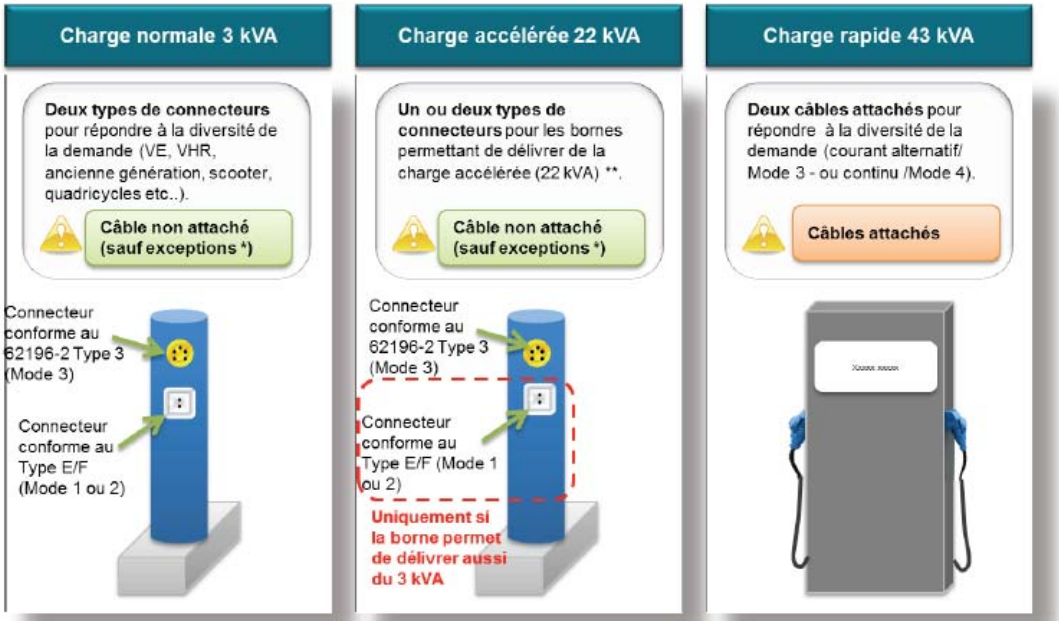
   [**Multiple Parking Bays** – Germany: There should be two dedicated EV parking spots adjacent to one another (heightened visibility, use of the dual headed socket).]

   [**Multiple Parking Bays** – Denmark: There should be two dedicated EV parking spots adjacent to one another (heightened visibility, use of the dual headed socket).]

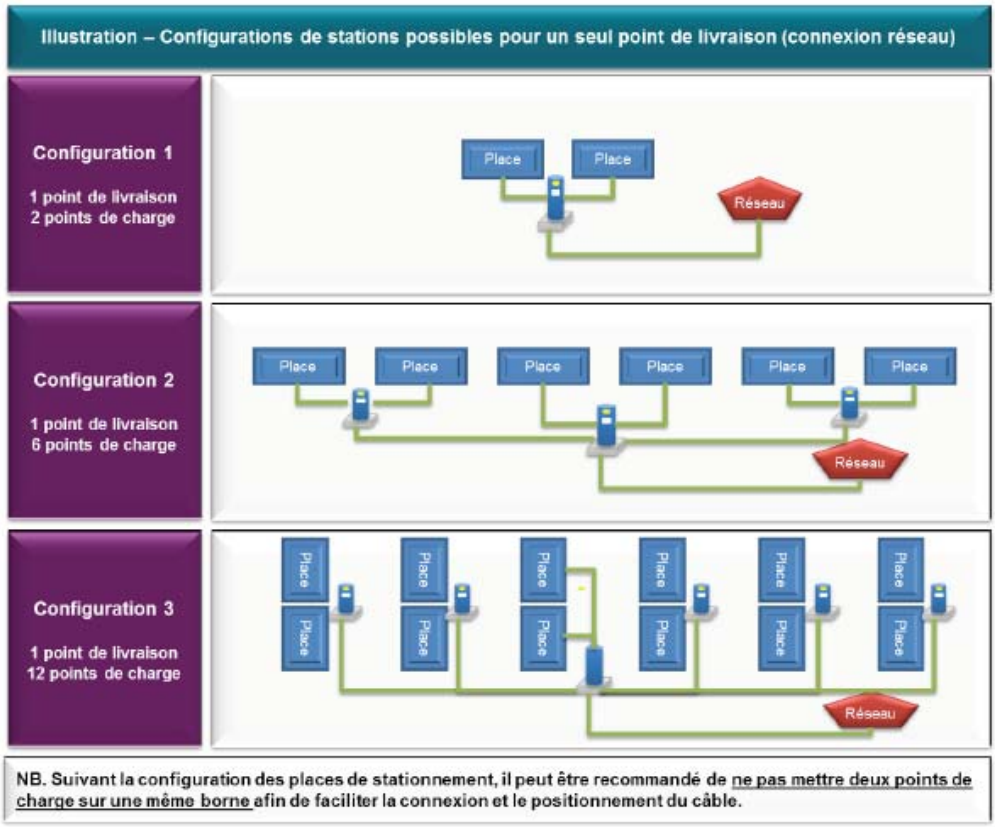
Although SPAIN doesn't install CPs, the criteria listed above as per Ireland's criteria seem adequate

In Spain multiple [street side charge post installation] criteria are kept by the different providers

Typical equipement in France for public infrastructure (Green Book)



Example of configuration for public charging infrastructure (Green Book)



Dimensions

Home Charge Point Location and Installation Strategies

Criteria for Selecting Charge Point Locations

Key criteria for successful home charge point installations:

1. [FRANCE do not install home Chare Point, only for demonstration purpose]
2. [Customers getting charge points are pre approved for installations by FRANCE regarding the demonstration needs]
3. [Installation times and final locations of the charge points is negotiated by the installation contractors and the customers.]
4. [NFC15-100 standard is required]

Criteria for Selecting Charge Point Locations

Key criteria for selecting charge point locations:

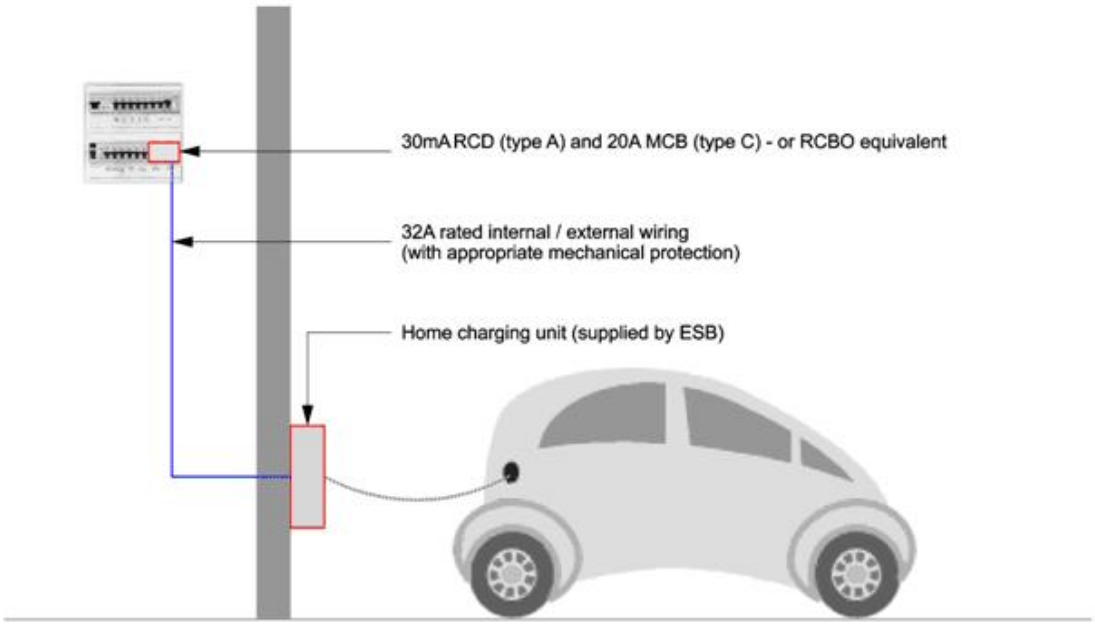
No DC charge point installed at this moment in France

Ireland: Home Charge Point Location and Installation Strategies

Criteria for Selecting Charge Point Locations

Key criteria for successful home charge point installations:

1. [IRELAND are providing 2000 free home charge points for the first 2000 electric car purchasers which meet Irish national requirements for sustainable energy. Charge point location is determined by customer requirements combined with standard terms and conditions for installation.]
2. [The type of charge point installed is determined by agreements with the car companies, users and the ESB.]
3. [Customers getting charge points are pre approved for installations by IRELAND based upon data collected via web site and through short customer interviews designed to determine installation success.]
4. [Installation times and final locations of the charge points is negotiated by the installation contractors and the customers.]
5. [Installation of the charge points is governed by the Irish national wiring standard ET 101 and the requirements of the IRELAND (see the home installation wiring diagram below).]



ITALY'S Home Charge Point Location and Installation Strategies
Criteria for Selecting Charge Point Locations

Key criteria for successful home charge point installations:

1. Italy is providing hundreds of home charge points with flat tariff option within the national electro-mobility pilot project, started in 2010. Thanks to the embedded metering and independent supply wiring, Italy's home charge points can be installed according to customer needs without any restrictions except for safety and terms and conditions.
2. Home charge point regulation framework is in progress in Italy.

The following is Italy's Criteria for the realization of Public infrastructure

Site selection and post locations are the output of a combined process between the expectations from municipality and a properly designed algorithm that calculated an indicator of mobility as arithmetic weighted average of a lot of variables:

1. **Attraction capacity** – Presence of School, University, Shopping Centre, Offices, Industrial Area.
2. **Parking/Interchange** – Presence of Railway and Metro Stations, Parking on Street or Dedicated Parking Spaces
3. **Number of residents**

For every potential site was studied also the presence of grid connection and was evaluated the following civil works and requirements.

SPAIN: Criteria for installing most Street Charge Point Locations

Key criteria for selecting street charge point locations are:
Grid capacity
Accessibility – 24 hour access is highly desirable but not required. A reasonable time for access to a customer charging a vehicle is all that is required. Charging points must be in a good location, easy to access and find.
Visibility – Charge points should be easily visible and recognisable
Multiple Parking Bays – There should be two dedicated EV parking spots adjacent to one another (heightened visibility, use of the dual headed socket).

Spain: Home Charge Point Location and Installation Strategies
Criteria for Selecting Charge Point Locations

Steps followed by Spanish regulation to foster the EV:

1. The general framework for EV deployment in Spain is the “Integral Strategy for EV deployment in Spain”, where the actions and objectives are set up.
2. 62000 residential CPs were foreseen by 2014. Now this figure seems too optimistic (together with the overall 263000 CP and 250000 EV expected for this year).
3. A key action is a new technical instruction devoted to EV within the Low voltage Code (ITC BT 52 “Instalaciones con fines especiales. Infraestructura para la recarga de vehículos eléctricos”), where all the protection criteria or allowable electric setups are detailed.
4. According to a previous legislation, former need for consensus to allow a neighbour to install a CP in a collective garage was replaced by simple information to the neighbourhood about the decision to implement this installation.

Ireland's DC Charge Point Location and Installation Strategies

Criteria for Selecting Charge Point Locations

Key criteria for selecting charge point locations:

1. [IRELAND have committed to installation of DC fast charging stations at 60km intervals on most major road networks crossing the country.]
2. [Almost all installations have occurred at Petrol Station fore courts located near major motorways.]
3. [DC charger installations have been initiated by A car company dealerships and DC chargers were installed at specific garages around the country.]
4. [Adequate grid supply has been readily available at most locations at site transformers.]
5. [Some A car company dealerships were required to upgrade their power requirements at their locations.]

Appendix 2: Technical Cost/Price Survey Responses

The following questions refer to three types of charge point installations Street Charge Posts, Home Charge Points and DC Charge Points. Please state the following in your response: How many of each type have been installed and what situations as stated below have been encountered?

Please provide geographic variations (if known) of the following information and indicate where the variations are required. Additional information regarding where the responses are known to differ for each question is information that is valuable in this survey.

Technical Cost Survey

Work Package 4, Task 1

The following questions refer to three types of charge point installations Street Charge Posts, Home Charge Points and DC Charge Points. Please state the following in your response: How many of each type have been installed and what costs as stated below have been encountered?

Please provide geographic variations (if known) of the following information and indicate where the variations are required. Additional information regarding where the responses are known to differ for each question is information that is valuable in this survey.

Survey Responses

The following questions refer to the costs/price of three types of charge point installations Street Charge Posts, Home Charge Points and DC Charge Points.

Please provide geographic variations (if known) of the following information and indicate where the variations are required. Additional information regarding where the responses are known to differ for each question is information that is valuable in this survey.

Street [and Public] Charge Post Questions:

1. **What method do you use to install street Charge Posts (CPs) including any public private charging units (i.e. wall mount in car parks)**
    a. **Install by using an all in one specialist contractor?**
    [Ireland: Some charge points such as public/private installations are being undertaken by a specialist contractor.]

    [Germany: No]

    [Italy: Yes, when there is a separate connection to the grid]

    [Denmark: NA]

    [Spain1: No]

    [An international car company: NA]

    [Spain3: Yes]

    [France: Yes]

    b. **Install by using power company personnel?**
    [Ireland: Installation of some Irish utility car park charge points and many of the street posts is currently undertaken by Irish utility Network personnel.]

    [Germany: Yes]

    [Italy: See point e]

    [Denmark: NA]

    [Spain1: No]

    [An international car company: NA]

[Spain3: NA]

[France: Yes]

c. **Install by using more than one specialist contractor?**
[Ireland: This is not currently the case there is only one specialist contractor under contract, but after a tender process this will very likely change.]

[Germany: Yes]

[Italy: No]

[Denmark: NA]

[Spain1: Yes]

[An international car company: NA]

[Spain3: Yes]

[France: Yes]

d. **Install by using sub-contractors managed by power company personnel?**
[Ireland: Yes]

[Germany: Yes]

[Italy: See point e]

[Denmark: NA]

[Spain1: No]

[An international car company: NA]

[Spain3: Yes]

[France: Yes]

e. **Install by using a combination of the methods listed above?**
[Ireland: Yes see a. b. & d.]

[Germany: NA]

[Italy: When the CP is integrated into the grid (DSO model) there is a combination of methods b. and d.]

[Denmark: NA]

[Spain1: No]

[An international car company: NA]

[Spain3: NA]

[France: Sometimes. I t depends on the nature of the charging units, some of them could be still in some “prototype” status requiring an installation by the utility personnel or some special contractor.]

f. **Install by other methods?**
[Ireland: Some installations have taken place using a combination of Irish utility Networks and private contractors hired by companies owning publicly accessible private car parks.]

[Germany: NA]

[Italy: No]

[Denmark: NA]

[Spain1: No]

[An international car company: NA]

[Spain3: NA]

[France: NA]

2. **Elaborating on the methods of installation listed above please answer the following:**
   a. **Give a range of the money paid for the charge posts:**
   [Ireland: Public charge posts: Lowest cost €2700 for 1Φ, 32A, 2 socket posts and highest cost €6700 for 3Φ, 32A, 2 socket posts.]
   [Ireland: Average costs €4800 for posts of all varieties but mostly 3Φ, 32A, 2 socket posts]

   [Germany: NA]

   [Italy: Lowest cost 1500 Highest cost 2500€]

   [Denmark: AC CP approx. 6000 EUR (1 year old price)]

   [Spain1: The average cost is in the range of 3000-3500€. This cost includes the charge post and additional equipment.]

   [An international car company: NA]

   [Spain3: Street Post 2000€-4000€]
   [Spain3: Parking 1000€-2000€]

   [France: 2200 € (parking charge post) to 3000 € (street charge post]
   [France: 2600 €]
   [France: Those are 3 kW charge spots]

   b. **Give a range of the money paid for any extra equipment you require to install a charge post:**
   [Ireland: Branding costs to spray the unit are between €300 and €500 and to paint two parking spaces is €300]
   [Ireland: Lowest cost €400 and Highest cost €600 (junction boxes upstream of post)]
   [Ireland: Average cost €500 (best guess)]

[Ireland: Interface pillar (junction boxes) one required with street side charge posts and wall boxes.]

[Germany: NA]

[Italy: Included in the CP cost]

[Denmark: NA]

[Spain1: This cost is included in 2.a. section]

[An international car company: NA]

[Spain3: NA]

[France: +500 € for a 3 to 22kW charge post]
[France: NA]
[France: Extra cost for a three phase post, including a new GFCI]

c. **Give a range of the money paid for the civil/underground portion of the installation:**
[Ireland: Lowest cost €1300 and Highest cost €3100]
[Ireland: Average cost €2500 (best guess)]

[Germany: Low to High costs 300€ - 3800€]
[Germany: Average cost 450€]
[Germany: The costs depend on the surface of the ground and the distance between the site where the charging post should be placed and the cable in the street where a connection to the grid can be established.]

[Italy: We consider this cost as the total cost for civil and electric works Lowest cost 1000€, Highest cost 5500€, Average 2500€ in case of DSO model]
[Italy: Lowest cost 1500€, Highest cost 11500€ Average 3500€ when there is a separate connection to the grid.]

[Denmark: NA]

[Spain1: The average cost is 3000€ for each charge post installed. This cost includes the Grid portion, the post connection portion and the commissioning portion of the installation.]

[An international car company: NA]

[Spain3: NA]

[France: Average 1500 € for a 3 kW post to 3300 € for a 22 kW station]
[France: From the French official “Green Book” on public charging infrastructures]

d. **Give a range of the money paid for the Grid portion of the installation:**
[Ireland: Grid costs are absorbed by Irish utility Networks an agreed budget is in place]

[Germany: Low to High costs 1700€ - 4000
[Germany: Average cost 2800€]

[Italy: For 22KW (3-phase)installation 2100€ according to national authority tariff]
[Italy: For 3KW (1-phase)installation 450€ according to national authority tariff]

[Denmark: NA]

[Spain1: This cost is included in 2.c. section]

[An international car company: NA]

[Spain3: Street Post 500€-1200€]
[Spain3: Not in Parking]

[France: It depends on the local grid configuration related to the location of the charging post. It is difficult to estimate without a thorough examination of the local constraints.

e. **Give a range of the money paid for the post connection portion of the installation:**
[Ireland: This cost is absorbed by Irish utility Networks and Irish utility an agreed budget is in place]

[Germany: 100€ - 500€]
[Germany: 180€]

[Italy: Included in the point c]

[Denmark: NA]

[Spain1: This cost is included in 2.c. section]

[An international car company: NA]

[Spain3: Street 300€]
[Spain3: Parking 300€]

[France: From 200 € (3kW) to 800 € (22 kW) for the grid connection]

f. **Give a range of the money paid for the commissioning portion of the installation:**
[Ireland: This cost is absorbed by Irish utility Networks and Irish utility an agreed budget is in place. Commissioning of the post by the manufacturer is included with the price of the post. In future these costs will become part of an installation contract with a sub contractor.]

[Germany: Low to high costs 250€ - 650€
[Germany: Average cost 350€]
Depends on the amount of stations that can be commissioned during one day and on the distances that have to be driven between each station. Work schedule vs. journey time]

[Italy: Included in the point c.]

[Denmark: NA]

[Spain1: This cost is included in 2.c. section]

[An international car company: NA]

[Spain3: NA]

[France: Not known at the moment. Commissioning issues are being debated right now with ERDF (France: DSO). It can depend of the complexity of the charging stations, the number of posts etc.]

g. Give a range of the money paid for the continuous operation and maintenance of your charge posts infrastructure.

[Ireland: This cost is absorbed by Irish utility Networks and Irish utility an agreed budget is in place. Commissioning of the post by the manufacturer is included with the price of the post. In future these costs will become part of an installation contract with a sub contractor.]

[Germany: Low to high costs 100€ - 2100€]
[Germany: Average costs 300€ per annum]
[Germany: This depends on cases of vandalism, failures caused by cars, inducing circuit breaking, accidents or by theft.]

[Italy: Lowest cost 500€ and Highest cost 750€ per year and per CP]
[Italy: Average 600€ per year and per CP]

[Denmark: NA]

[Spain1: The charge post infrastructure has been set up recently, so the continuous operation and maintenance cost data have not yet been estimated. This money paid will probably be available in 2012.]

[An international car company: NA]

[Spain3: Street Post 150€-200€/month]
[Spain3: Parking 50€/month]

[France: Unknown. This is too early to tell, since only of few of them are installed and feedback not done yet. Furthermore, it depends of the type of supervision your provide. Today's stations are still prototypes dedicated to experimentations. Any operating cost estimation is irrelevant at this point and can not serve for future indication.]

h. Give a range of the money paid for any remote operational communications and backend systems.

[Ireland: Average cost in € 4.80 pm = €57.60 per annum per charge point. Rough break down €3 comms costs and APN/VPN support, €1 IT Support costs (time costs) and €0.80 CPMS costs]

[Germany: NA]

[Italy: 46€/year per CP (SIM card cost)]
[Italy: 80000€/year per backend system to manage all the CPs in the demonstration projects]

[Denmark: NA]

[Spain1: The communication card cost is 5€ per month.
Other cost???]

[An international car company: NA]

[Spain3: Street Post 9€/month]
[Spain3: Parking 9€/month]

[France: 3 € / month per charging stations (which may have several charging spots]
[France: Standards monthly SIM card cost at French installations for 3G communication]

3. **Variations on street post types (please fill in the following for a basic variation to item 2 above):**
   Describe Variation 1:
   a. Explain or NA
      [Ireland: Wall mounted charge points: Lowest cost €2700 for 1Φ, 32A, 2 socket posts and highest cost €6700 for 3Φ, 32A, 2 socket posts.]
      [Ireland: Average costs €4800 for posts of all varieties but mostly 3Φ, 32A, 2 socket posts]

      [Germany: The charge posts do not differ that much, the posts are manufactured by different companies, the dimensions and the equipment inside does not differ.]

      [Italy: NA]

      [Denmark: NA]

      [Spain1: NA]

      [An international car company: NA]

      [Spain3: NA]

      [France: Only one street post type is done at French installations at the moment]

   b. Give a range of the money paid for the charge posts:
      [Ireland: NA]

      [Germany: NA]

      [Italy: NA]

      [Denmark: NA]

      [Spain1: NA]

      [An international car company: NA]

      [Spain3: NA]

      [France: NA]

   c. Give a range of the money paid for any extra equipment you require to install a charge post:
      [Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

d. Give a range of the money paid for the civil/underground portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

e. Give a range of the money paid for the Grid portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

f. Give a range of the money paid for the post connection portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

g. **Give a range of the money paid for the commissioning portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

h. **Give a range of the money paid for the continuous operation and maintenance of your charge posts infrastructure.**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

i. **Give a range of the money paid for any remote operational communications and backend systems.**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

4. **Variations on street post types (please fill in the following for a basic variation to items 2 and 3 above):**
   Describe Variation 2:
   a. [Ireland: NA]

   [Germany: NA]

   [Italy: NA]

   [Denmark: NA]

   [Spain1: NA]

   [An international car company: NA]

   [Spain3: NA]

   [France: NA]

   b. **Give a range of the money paid for the charge posts:**
   [Ireland: NA]

   [Germany: NA]

   [Italy: NA]

   [Denmark: NA]

   [Spain1: NA]

   [An international car company: NA]

   [Spain3: NA]

   [France: NA]

   c. **Give a range of the money paid for any extra equipment you require to install a charge post:**
   [Ireland: NA]

   [Germany: NA]

   [Italy: NA]

   [Denmark: NA]

   [Spain1: NA]

   [An international car company: NA]

[Spain3: NA]

[France: NA]

d. Give a range of the money paid for the civil/underground portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

e. Give a range of the money paid for the Grid portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

f. Give a range of the money paid for the post connection portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

g. **Give a range of the money paid for the commissioning portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

h. **Give a range of the money paid for the continuous operation and maintenance of your charge posts infrastructure.**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

i. **Give a range of the money paid for any remote operational communications and backend systems.**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

5. **Variations on street post types (please fill in the following for a basic variation to items 2, 3 and 4 above):**

Describe Variation 3:

a. [Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

b. Give a range of the money paid for the charge posts:
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

c. Give a range of the money paid for any extra equipment you require to install a charge post:
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

d. Give a range of the money paid for the civil/underground portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

e. **Give a range of the money paid for the Grid portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

f. **Give a range of the money paid for the post connection portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

g. **Give a range of the money paid for the commissioning portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

h. **Give a range of the money paid for the continuous operation and maintenance of your charge posts infrastructure.**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

i. **Give a range of the money paid for any remote operational communications and backend systems.**
[Ireland: NA]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

Home Charge Point Questions:

1. **Do your customers have the option of having multiple tariffs to allow for charging at times that cost less than others?**
[Ireland: Yes]

[Italy: No, at the moment there is only a flat tariff in the demonstration project.]

[Spain3: Yes. Off-peak tariffs during the night if customer has contracted it. There is still a draft version of a “Super valley” tariff with great discounts during off-peak hours]

[France: No]

2. **What method do you use to install Home Charge Points (HCPs)**
   a. **Install by using an all in one specialist contractor?**

      [Ireland: Yes]

      [Germany: No]

      [Italy: Yes, when there is a separate connection to the grid]

      [Denmark: NA]

      [Spain1: NA]

      [An international car company: Currently we have brokered all installations business, including the handling or orders and billing, to SPX Europe. The HCP itself is a directed buy component from KEBA. We are currently only offering one wallbox design (400 Volt, 32A, no attached cable) For future HCP we will offer different variants regarding power levels and communication capabilities (i.e. PLC)]

      [Spain3: Yes]

      [France: Yes]

   b. **Install by using your company personnel?**

      [Ireland: Yes]

      [Germany: Yes]

      [Italy: See point e. below]

      [Denmark: NA]

      [Spain1: NA]

      [An international car company: No]

      [Spain3: No]

      [France: Yes]

   c. **Install by using more than one specialist contractor?**

      [Ireland: Yes]

      [Germany: Yes]

      [Italy: No]

      [Denmark: NA]

      [Spain1: NA]

      [An international car company: No]

      [Spain3: Yes]

      [France: Yes]

d. Install by using sub-contractors managed by your company personnel?

[Ireland: No]

[Germany: Yes]

[Italy: See point e. below]

[Denmark: NA]

[Spain1: NA]

[An international car company: No]

[Spain3: Yes]

[France: Yes]

e. Install by using a combination of the methods listed above?

[Ireland: For installation in homes, for the general public, two specialist contractors have received a portion of a competitive tender. Installations at Irish utility sites have been undertaken by Irish utility personnel. Installations at selected businesses have been undertaken by the business' personnel.]

[Germany: According to the charging product several contractors, specialized for each product are installing the charging infrastructure.]

[Italy: When the CP is integrated into the grid (DSO model) there is a combination of methods b. and d.]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: No]

[France: YES, sometimes. I t depends on the type of charge point. Some of them could be still in some "prototype" status requiring an installation by the utility personnel or some special contractor]

f. Install by other methods?

[Ireland: NA]

[Germany: NA]

[Italy: No]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: No]

[France: NA]

3. **Elaborating on the methods of installation listed above please answer the following:**

   a. **Give a range of the money paid for the HCPs:**

   [Ireland: Lowest cost in €615 and highest cost in €755]
   [Ireland: Average cost €654 (Currently best guess prices may drop after tender)]
   [Ireland: 100 at €755, 150 at €595, 200 at €695 and 250 at €615]

   [Germany: NA]

   [Italy: Wall Box Home Charger single phase mode 3 without connection to the communication centre]
   [Italy: 1000€]

   [Denmark: CP at home is approx. 1500 EUR including meter]

   [Spain1: NA]

   [An international car company: Customer cost for HCP (400 volt, 22kW, without mode 3 cable) is 689 EUR, without VAT. These costs are for demonstration projects (several hundred vehicles). Customer price for volume products in 2012 expected to be]

   [Spain3: 1,200-1,700€]
   [Spain3: Average cost 1,600€]

   [France: 200 € (basic mode 1 system) to 1500 € (mode 3 /and/or communicating systems)]
   [France: Those system are still either prototype system for demonstration purposes or in early commercialisation]

   b. **Give a range of the money paid for any extra equipment you require to install an HCP:**

   [Ireland: €15 for RCBOs]
   [Ireland: RCBOs for home consumer unit circuits. Wire and fasteners supplied by installation contractors as part of installation prices.]

   [Germany: Low to high cost 100€ - 2000€]
   [Germany: Average cost 300€]
   [Germany: Depending on the upstream Installation – modern installation vs. equipment from 1970 or older - and the distance between charging point and upstream installation that has to be bypassed by a cable.]

   [Italy: Included in the CP cost]

   [Denmark: NA]

   [Spain1: NA]

   [An international car company: Mode 3 cable currently separate, 230 EUR]

   [Spain3: Included in home electrical costs]

   [France: +200 € to 500 €]

[France: Those are extra costs are for the communicating system if required]

c. **Give a range of the money paid for the home electrical portion of the installation:**

[Ireland: Lowest cost €140 and highest cost in €235]
[Ireland: Average cost in €165 (best guess dependant upon final install numbers)]
[Ireland: 60% at €140, 30% at €190 and 10% at €235]

[Germany: Low to high cost 50€ - 300€]
[Germany: Average cost 180€]

[Italy: Civil works are included]
[Italy: Lowest cost 250€ Highest cost 2500€ Average 500€ in the DSO model]
[Italy: Lowest cost 700€ Highest cost 7000€ Average 1500€ when there is a separate connection to the grid]

[Denmark: NA]

[Spain1: NA]

[An international car company: €649 EUR in Germany, in car ports or garage with available 400 volt service Following is included within standard installation: Installation and material of up to 6m cable in the garage, additional in line fuse or safety device, if required, installation of the wallbox including mounting fixtures, wiring of wallbox, wallbox function test, before quotation or installation. Each additional installation on same visit (for fleet customers primarily), is 362 EUR. Standard installation for other countries varies: France 845 EUR, Netherlands 934 EUR…]

[Spain3: 250-350€ (including extra electrical equipment and labour costs)]

[France: Estimate 100 € to 1000 €, depending on the required work at home for the EV dedicated electric line Lowest cost in € and Highest cost in €]

d. **Give a range of the money paid for the Grid electrical portion of the installation:**

[Ireland: There have been no upgrades or changes required for the grid due to home charge points.]

[Germany: Low to high cost 0€ - 2000€]
[Germany: Average cost 500€]
[Germany: This depends on the different types of charging infrastructure there has not been a need to ask for an application for grid access]

[Italy: Grid connection cost]
[Italy: For 3KW (1-phase) installation 450€ according to national authority tariff]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: 0 €]
[France: No extra cost for Grid connection (homes are already grid connected]

e. Give a range of the money paid for any meter upgrade/change portion of the installation:

[Ireland: Meter upgrade for a two tariff meter will increase the standing charge by approximately €10]
[Ireland: Night rate per kWh is approximately half of the day rate of approximately 16 €cents]

[Germany: Low to high cost 0 – 200€
[Germany: Average cost 90€]

[Italy: Embedded in the CP cost]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: 150-300€ - depending on the percentage of power increased]

[France: 20 € (DSO meter) to 40 € (submeter)]
[France: Submeters or DSO meters are already part of the home charger.]

f. Give a range of the money paid for the commissioning portion of the installation:

[Ireland: This pricing/cost is included in most of the installation prices.]

[Germany: Low to high cost 300€ - 650€]
[Germany: Average cost 450€]
[Germany: This depends on the infrastructure installed]

[Italy: Included in the point c. above]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: Unknow at that point]
[France: NA]

g. Give a range of the money paid for any remote operational communications and backend systems.

[Ireland: For *connected charge points* using the CPMS system the same costs would apply ie, [Average cost in € 4.80 pm = €57.60 per annum per charge point. Rough break down €3 comms costs and APN/VPN support, €1 IT Support costs (time costs) and €0.80 CPMS costs]
However the vast majority of Home CPs are not part of the CPMS network.]

[Germany: NA]

[Italy: 46€/year per CP (SIM card cost)]
[Italy: 80000€/year per backend system to manage all the CPs in the demonstration projects]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: HCP installation without remote operational communications]

[France: 3 € / month for the 3G SIM Card]
[France: At that point, no the home charge point uses an Internet box]

4. **Variations on HCPs types (please fill in the following for a basic variation to item 2 above):**
   Describe Variation 1:

   [Ireland: Some of the home charge points are essentially dumb and others are intelligent. The dumb points are sockets that will communicate with the cars via PWM signals the smarter sockets have an additional smart home circuit that communicates via WIFI to both a home control system and/or the grid. Variation 1 is the dumb system.]

   [Germany: Smart Charging Box 22kW communication with the German Backend]

   [Italy: NA]

   [Denmark: NA]

   [Spain1: NA]

   [An international car company: NA]

   [Spain3: HCP single phase mode 3 without connection to the communication centre for condominium installed in community car parks]

   [France: NA]

   a. **Give a range of the money paid for the HCPs:**
      [Ireland: Price in €615]

      [Germany: NA]

      [Italy: NA]

      [Denmark: NA]

      [Spain1: NA]

      [An international car company: NA]

      [Spain3: 1,900€-4,000€]
      [Spain3: Average cost 2,500€ (best guess)]

[France: NA]

b. Give a range of the money paid for any extra equipment you require to install an HCP:

[Ireland: Same as 3 above]

[Germany: Low to high cost 200-2000€]
[Germany: Average cost 500€]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

c. Give a range of the money paid for the home electrical portion of the installation:

[Ireland: Same as 3 above]

[Germany: Low to high cost 100€ - 500€]
[Germany: Average cost 300€]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: The range is too wide to give a reliable amount, depends on each case it may vary up to 3,000€]

[France: NA]

d. Give a range of the money paid for the Grid electrical portion of the installation:

[Ireland: Same as 3 above]

[Germany: Low to high cost 400€ -2500]
[Germany: Average cost 1700€]
[Germany: This depends on the local DSO, (whether a second meter might be fixed in the system), and on the existing grid connection of the household.]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

e. Give a range of the money paid for any meter upgrade/change portion of the installation:

[Ireland: Same as 3 above]

[Germany: Low to high cost80 – 300€]
[Germany: Average cost 200€]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: 150-300€ - depending on the percentage of power increased]

[France: NA]

f. Give a range of the money paid for the commissioning portion of the installation:

[Ireland: Same as 3 above]

[Germany: Low to high cost 300€ - 450€]
[Germany: Average cost 350€]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

g. Give a range of the money paid for any remote operational communications and backend systems.

[Ireland: Same as 3 above]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: HCP installation without remote operational communications]

[France: NA]

5. **Variations on HCP types (please fill in the following for a basic variation to items 2 and 3 above):**
   Describe Variation 2:

   [Ireland: Some of the home charge points are essentially dumb and others are intelligent. The dumb points are sockets that will communicate with the cars via PWM signals the smarter sockets have an additional smart home circuit that communicates via WIFI to both a home control system and/or the grid. Variation 2 is the smart system.]

   [Germany: Charging Box HOME 11kW]

   [Italy: NA]

   [Denmark: NA]

   [Spain1: NA]

   [An international car company: NA]

   [Spain3: NA]

   [France: NA]

   a. **Give a range of the money paid for the HCPs:**

      [Ireland: Lowest cost in €615 and highest cost in €755]
      [Ireland: Average cost €654 (Currently best guess prices may drop after tender)]
      [Ireland: 100 at €755, 150 at €595 and 250 at €615]

      [Germany: NA]

      [Italy: NA]

      [Denmark: NA]

      [Spain1: NA]

      [An international car company: NA]

      [Spain3: NA]

      [France: NA]

   b. **Give a range of the money paid for any extra equipment you require to install an HCP:**

      [Ireland: There may be extra equipment required in the purchase of a smart home system. This system will require back office communications to connect to the grid and to manipulate the entire smart home.]

      [Germany: Low to high cost 50€ - 300€]
      [Germany: Average cost 150€]

This depends on the existing upstream installation]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

c. Give a range of the money paid for the home electrical portion of the installation:

[Ireland: Same as 3 above]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

d. Give a range of the money paid for the Grid electrical portion of the installation:

[Ireland: There have been no upgrades or changes required for the grid due the smart home charge points, but it is expected when varied tariffs are implemented there will be costs associated with the back office.]

[Germany: 0€ cost]
[Germany: This is not necessary for 11 kW]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

e. Give a range of the money paid for any meter upgrade/change portion of the installation:

[Ireland: Same as 3 above]

[Germany: 0€ cost]
[Germany: This is not necessary]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

f. Give a range of the money paid for the commissioning portion of the installation:

[Ireland: Same as 3 above]

[Germany: Low to high cost 250€ - 350€]
[Germany: Average cost 320€]
[Germany: This depends on contractor]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

g. Give a range of the money paid for any remote operational communications and backend systems.

[Ireland: Same as Variation 1 above]

[Germany: No remote communication]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

6. Variations on HCP types (please fill in the following for a basic variation to items 2, 3 and 4 above):
Describe Variation 3:

[Ireland: Variation 3 is not much different from the dumb sockets. The differences are aesthetics and quality of product.]

[Germany: German charging box Easy design – body 11kW]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

a. Give a range of the money paid for the HCPs:

[Ireland: Same as Variation 1 above]

[Germany: NA]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

b. Give a range of the money paid for any extra equipment you require to install an HCP:

[Ireland: Same as Variation 1 above]

[Germany: Low to high cost 80 – 400€]
[Germany: Average cost 250€]
[Germany: This depends on installation requirements e.g. RENAULT Z.E.READY]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

c. Give a range of the money paid for the home electrical portion of the installation:

[Ireland: Same as Variation 1 above]

[Germany: Low to high cost 0€ - 200€]
[Germany: Average cost 120€]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

d. Give a range of the money paid for the Grid electrical portion of the installation:

[Ireland: Same as Variation 1 above]

[Germany: 0€ cost]
[Germany: This is not necessary for 11kW]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

e. Give a range of the money paid for any meter upgrade/change portion of the installation:

[Ireland: Same as Variation 1 above]

[Germany: 0€ cost]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

f. Give a range of the money paid for the commissioning portion of the installation:

[Ireland: Same as Variation 1 above]

[Germany: Low to high cost 200 - 250€]
[Germany: Average cost 250€]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

g. **Give a range of the money paid for any remote operational communications and backend systems.**
[Ireland: Same as Variation 1 above]

[Germany: No communication]

[Italy: NA]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

DC Charge Point Questions:

1. **What method do you use to install DC Charge Posts (DCPs)**
   a. **Install by using an all in one specialist contractor?**
   [Ireland: Yes see below]

   [Germany: No]

   [Italy: do not have DC at this time]

   [Denmark: NA]

   [Spain1: NA]

   [An international car company: NA]

   [Spain3: No]

   [France: Today, France does not install any DC Charge Point]

   b. **Install by using power company personnel?**
   [Ireland: Yes see below]

   [Germany: No]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: No]

[France: Today, France does not install any DC Charge Point]

c. **Install by using more than one specialist contractor?**
[Ireland: Yes see below]

[Germany: No]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: No]

[France: Today, France does not install any DC Charge Point]

d. **Install by using sub-contractors managed by power company personnel?**
[Ireland: Yes see below]

[Germany: No]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: No]

[France: Today, France does not install any DC Charge Point]

e. **Install by using a combination of the methods listed above?**
[Ireland: All installations are taking place using a combination of Irish utility Networks, a specialist contractor and private contractors hired by companies owning publicly fuelling station forecourts and auto dealer garages. The specialist contractor is commissioning and connecting the DC charge post and the private contractors are handling civil works and the Irish utility Networks personnel are connecting the service to the grid.]

[Germany: Yes]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: France does not install any DC Charge Point]

f. **Install by other methods?**
[Ireland: Yes see below]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: Today, France does not install any DC Charge Point]

2. **Elaborating on the methods of installation listed above please answer the following:**
   a. **Give a range of the money paid for the DCPs:**
   [Ireland: Lowest cost €10,000 and Highest cost in €26,055 (lowest cost is without Irish utility's specification)]
   [Ireland: Average cost for Irish utility €19,290 (Currently best guess, prices have dropped)]
   [Ireland: 5 at €22,029, 16 at €22,600, 5 at 26,055 and 16 at €13,000]

   [Germany: NA]

   [Italy: do not have DC at this time]

   [Denmark: 1 DC Fast Charge 50.000 €, Grid connection approx. 6000 € (100A)]

   [Spain1: NA]

   [An international car company: NA]

   [Spain3: Lowest cost 20,000 € and 26,000 installed]
   [Spain3: Average cost in 23000 € (best guess)]

   [France: Today, France does not install any DC Charge Point]

   b. **Give a range of the money paid for any extra equipment you require to install a DCP:**

[Ireland: Branding costs to spray the unit are between €300 and €500 and to paint one parking space is €150]
[Ireland: Large interface Pillar €1100
Switchgear €1500 (excluding combined AC chargepoint switchgear)
Cabling + electrical labour costs €1000
Costs should also be included for Irish utility time, however this is difficult to capture at this stage as it has not been logged.]

[Germany: Low to high cost 400€ - 3500€]
[Germany: Average cost 2200€]
[Germany: Special meter board for the converter unit of the meter and the circuit breaker needed, Station has to be transported with a transporter including a forklift,]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: Lowest cost in 2000 € and Highest cost in 5000 €]
[Spain3: Average cost in 3000 € (best guess)]

[France: Today, France does not install any DC Charge Point]

c. **Give a range of the money paid for the civil/underground portion of the installation:**
[Ireland: Civil costs have varied between €4,000 and €16,000 (this includes ducting, vaults, reinstatment of surfaces etc.)]

[Germany: Low to high cost 700€ - 4300€]
[Germany: Average cost 2100€]
[Germany: This depends on the surface of the ground and the distance between the site where the charging post should be placed and the cable in the street where a connection to the grid can be established. Fundament is composed and delivered with a crane truck]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: Lowest cost in 7000 € and Highest cost in 15000 €]
[Spain3: Average cost in 10000 € (best guess)]

[France: Today, France does not install any DC Charge Point]

d. **Give a range of the money paid for the Grid portion of the installation:**
[Ireland: The Irish utility Network costs of Grid connection are not separated out at this time]

[Germany: Low to high cost 3500€ - 7000€]

[Germany: Average cost 5100€]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: Lowest cost in 3000 € and Highest cost in 5000 €]
[Spain3: Average cost in 4000 € (best guess)]
[Spain3: If power available.]

[France: Today, France does not install any DC Charge Point]

e. **Give a range of the money paid for the DCP connection portion of the installation:**
[Ireland: Costs of DCP connection are not separated out at this time connections are made by the installation contractor and the manufacturer. These costs are included with the installation and the purchase of the equipment.]

[Germany: Low to high cost 300€ - 1200]
[Germany: Average cost 700€]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: Lowest cost in 300 € and Highest cost in 1000 €]
[Spain3: Average cost in 500 € (best guess)]

[France: Today, France does not install any DC Charge Point]

f. **Give a range of the money paid for the commissioning portion of the installation:**
[Ireland: One contractor has installed and commissioned competitor's equipment at a price of €1,050]

[Germany: Low to high cost 550€ - 1250€]
[Germany: Average cost 650€]
[Germany: This depends on the amount of stations that can be commissioned during one day and on the distances that have to be driven between each station. Work schedule and journey time]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: Lowest cost in 500 € and Highest cost in 3000 €]
[Spain3: Average cost in 1000 € (best guess if possible)]

[France: Today, France does not install any DC Charge Point]

g. Give a range of the money paid for the continuous operation and maintenance of your DC charge post infrastructure.

[Ireland: Continuous operational cost has not been calculated.]
[Ireland: Maintenance contract is in place but no regular maintenance has taken place yet.]

[Germany: Low to high cost 400€ - 2200€]
[Germany: Average cost 1400€]
[Germany: This depends on journey schedule and the amount of troubles caused by customers, vandalism and faulty equipment.]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: Lowest cost in 3000 € and Highest cost in 6000 € of an individual installed charge point]
[Spain3: Average cost in 4000 € (best guess if possible) of an individual installed charge point]
[Spain3: Cost per year]

[France: Today, France does not install any DC Charge Point]

h. Give a range of the money paid for any remote operational communications and backend systems.

[Ireland: Compliance with connectivity requirements, comms module, Rfid Reader, and support for OCPP are a responsibility of the DC Charger vendor. Thereafter standard support costs will apply [Average cost in € 4.80 pm = €57.60 per annum per charge point. Rough break down €3 comms costs and APN/VPN support, €1 IT Support costs (time costs) and €0.80 CPMS costs]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: Lowest cost in 1000 € and Highest cost in 3000 € of an individual installed charge point]
[Spain3: Average cost in 1500 € (best guess if possible) of an individual installed charge point]
[Spain3: Cost per year on a 100 charger basis.]

[France: Today, France does not install any DC Charge Point]

3. **Variations on DC post types (please fill in the following for a basic variation to item 2 above):**

Describe Variation 1:

a. [Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

b. Give a range of the money paid for the DCPs:

[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

c. Give a range of the money paid for any extra equipment you require to install a DCPs:

[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

d. **Give a range of the money paid for the civil/underground portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

e. **Give a range of the money paid for the Grid portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

f. **Give a range of the money paid for the post connection portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

g. **Give a range of the money paid for the commissioning portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

h. **Give a range of the money paid for the continuous operation and maintenance of your DC charge post infrastructure.**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

i. **Give a range of the money paid for any remote operational communications and backend systems.**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

4. **Variations on DC post types (please fill in the following for a basic variation to items 2 and 3 above):**
   a. **Describe Variation 2:**
   [Ireland: NA]

   [Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

b. Give a range of the money paid for the DCPs:
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

c. Give a range of the money paid for any extra equipment you require to install a DCPs:
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

d. Give a range of the money paid for the civil/underground portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

e. **Give a range of the money paid for the Grid portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

f. **Give a range of the money paid for the post connection portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

g. **Give a range of the money paid for the commissioning portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

h. Give a range of the money paid for any remote operational communications and backend systems.
[Ireland: Compliance with connectivity requirements, comms module, Rfid Reader, and support for OCPP are a responsibility of the DC Charger vendor. Thereafter standard support costs will apply [Average cost in € 4.80 pm = €57.60 per annum per charge point. Rough break down €3 comms costs and APN/VPN support, €1 IT Support costs (time costs) and €0.80 CPMS costs]
[Lowest cost in € and Highest cost in € of an individual installed charge point]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

5. Variations on DC post types (please fill in the following for a basic variation to items 2, 3 and 4 above):
Describe Variation 3:
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

a. Give a range of the money paid for the DCPs:
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

b. Give a range of the money paid for any extra equipment you require to install a DCPs:
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

c. Give a range of the money paid for the civil/underground portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

d. Give a range of the money paid for the Grid portion of the installation:
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

e. **Give a range of the money paid for the post connection portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

f. **Give a range of the money paid for the commissioning portion of the installation:**
[Ireland: NA]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

g. **Give a range of the money paid for any remote operational communications and backend systems.**
[Ireland: Compliance with connectivity requirements, comms module, Rfid Reader, and support for OCPP are a responsibility of the DC Charger vendor. Thereafter standard support costs will apply [Average cost in € 4.80 pm = €57.60 per annum per charge point. Rough break down €3 comms costs and APN/VPN support, €1 IT Support costs (time costs) and €0.80 CPMS costs]

[Germany: NA]

[Italy: do not have DC at this time]

[Denmark: NA]

[Spain1: NA]

[An international car company: NA]

[Spain3: NA]

[France: NA]

Appendix 1:
Please fill in your typical/average overall cost for each of the installation arrangements listed above:

1. **Street Charge Posts:**
    a. **Give a range of the overall cost of an average installation inclusive of grid costs equipment costs and installation costs:**
    [Ireland: Lowest cost in €4700 and Highest cost in €10900]
    [Ireland: Average cost in €7800]

    [Germany: Low to high cost 2300€ - 6500€
    [Germany: Average cost 3500€]

    [Italy: For 22KW installation
    Lowest 3100€ Highest 6600 Average 4600€ in the DSO model
    Lowest 3600€ Highest 13600 Average 5600€ in the separate connection]
    [Italy: For 3KW installation
    Lowest 1450€ Highest 5950 Average 2950€ in the DSO model
    Lowest 1950€ Highest 11950 Average 3950€ in the separate connection]

    [Spain3: Lowest cost in 3000 € and Highest cost in 5500 €]
    [Spain3: Average cost in 4000€]
    [Spain3: O&M not included]

    [France: 3900 € (3 kW parking public charge post) to 7400 € (22 kW street charge post]
    [5500 €]

2. **Home Charge Points:**
    b. **Give a range of the overall cost of an average installation inclusive of grid costs equipment costs and installation costs:**
    [Ireland: Lowest cost in € 780 and Highest cost in €1015]
    [Ireland: Average cost in €898]

    [Germany: NA]

    [Italy: Lowest 700€ Highest 2950 Average 950€ in the DSO model]
    [Italy: Lowest 1150€ Highest 7450 Average 1950€ in the separate connection]

    [Spain3: Lowest cost in 2000 € and Highest cost in 4500 €]
    [Spain3: Average cost in 2500€]
    [Spain3: O&M not included]

    [France: 400 € to 2000 €]
    [France: 1200 €]

3. **DC Charge Posts:**
    c. **Give a range of the overall cost of an average installation inclusive of grid costs equipment costs and installation costs:**
    [Ireland: €18,950 to €47,150]

    [Germany: Low to high cost 5800€ - 12500€ excl. DC-Station
    [Germany: Average 8400€ excl. DC-Station]

[Germany: Especially changing requirements of public authorities caused increasing costs in due cause of long ways to establish a grid connection, collision detection.]

[Italy: do not have DC at this time]

[Spain3: Lowest cost in 33000 € and Highest cost in 55000 €]
[Spain3: Average cost in 18000€ (best guess if possible)]
[Spain3: O&M not included.]

[France: No DC charge post are installed by France at this moment]