Green eMotion

Development of an European Framework for Electromobility

Deliverable 7.1 – Merged Document

Review of Technologies and Standards in the Demonstration Projects

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Content

List of Figures

List of Abbreviations

WP	Work Package
GeM	Green eMotion Project
DoW	Description of Work (Annex I of Grant Agreement)
AC	Alternating Current
BMS/BCU	Battery Management System/Battery Control Unit
DC	Direct Current
EMC	Electro-Magnetic Compatibility
EV	Electric Vehicle
ICT	Information and Communication Technology
ITS	Intelligent Transport Systems
TCP/IP	Transmission Control Protocol/Internet Protocol
PEV	Plug-in Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
V2V	Vehicle-to-Vehicle
V2G	Vehicle-to-Grid
B2B	Business-to-Business
B2C	Business-to-Consumer
EDI	Electronic Data Interchange
DX	Deliverable number X
DR	Demo Region
EU	European Union
DE	Germany
ES	Spain
DK	Denmark
SW	Sweden
IE	Ireland
IT	Italy
FR	France

Standardization and Legislative bodies

DS	Danish Standards
CEN	European Committee for Standardization
CENELEC	European Committee for Electro-technical Standardization
IEC	International Electro-Technical Commission
ISO	International Organization of Standardization
SAE	Society of Automotive Engineers
NIST	National Institute of Standards and Technology
SGIP	Smart Grid interoperability Panel
PAP	Priority Action Plan (NIST)
V2G	Vehicle to Grip
G4V	Grid for Vehicles (Project)
UL	Underwriters Laboratories
NFPA	National Fire Protection Association
NEC	National Electric Code (NFPA)
NERC	North American Electric Reliability Corporation
ITU	International Telecommunication Union
ETSI	European Telecommunications Standard Institute
IEEE	Institute of Electrical and Electronics Engineers
IRC	ISO/RTO Council

DIN	Deutsches Institut für Normung eV
VDE	Association for Electrical, Electronic & Information Technologies
DKE	German Commission for Electrical, Electronic & Information Technologies
NPE	Nationale Plattform Elektromobilitat
CHAdeMO	CHArge de MOve
ETSI	European Telecommunications Standardization Institute
ESO	European Standardization Organisations
UN-ECE	United Nations Economic Commission for Europe
EN	European Standard
EEC	European Economic Community
CISPR	Comité International Spécial des Perturbations Radioélectriques
TC	Technical Committee

Executive Summary

The objectives of Deliverable 7.1 “Review of technologies and standards in the demonstration projects” are to collect information about technologies and standards within electromobility in Europe and to facilitate the work to be carried out in other Tasks and WPs in the Green eMotion (GeM) Project, providing a first analysis of the current state to point out interoperability issues.

To achieve these objectives, Task 7.1 partners have elaborated:

- Two Excel files, containing:
  - a comprehensive table about the status of standards and standardization activities in the field of Electric Vehicles (EV), with the relevant time frame (“Deliverable_7_1-Part1.xls”), and
  - a table showing the relationship among the technologies used in the Demo Regions and the issues to be taken into account from the point of view of standardization, aiming at interoperability in Europe (“Deliverable_7_1-Part2.xls”).
- A report (the present Word file – “Deliverable_7_1-Merged.doc”):
  - summarizing the technologies used in the Demo Regions (i.e., Electric Vehicles, charging infrastructure, communication capabilities and protocols) as well as their relationship with standards. In this frame the communication protocols, the connectors, the connection mode to the grid and the type of charging allowed are analysed and their advantages and disadvantages in terms of becoming standards are listed
  - including a description of the tables in the Excel files (how they were produced, the information they contain and a set of instructions), and related information (from on-going projects and demo sites).

Several sources of information have been managed during the elaboration of D7.1. In a first stage, information about electromobility from International Standardization Bodies was collected, classified and analysed. Additionally, data from the Demonstration Regions participating in the Green eMotion Project were supplied to the Task 7.1 partners and were managed in order to extract initial conclusions for the following tasks. Also, some International Projects and Focus Groups about electromobility were reviewed in order to take into account their analysis and recommendations.

With the work carried out during this Task 7.1, an extensive amount of standards about electromobility have been identified. Those cover several technologies (Vehicles, Charging Infrastructure, Smart Grid and Communication in general). With this analysis, in the global scope of the standards, gaps and overlapping have been revealed. In the following tasks in the GeM project these issues will be deeply analysed.

The report on “Standardization for Road Vehicle and Associated Infrastructure”, elaborated by the CEN-CENELEC Focus Group on European Electro-Mobility, has played an important role in this document. The main conclusions reached by the Focus Group report have been included in D7.1, due to their relevance to achieve the European interoperability.

In order to supply useful information to the following tasks, the documents will be updated on a six months basis, depending on the new information extracted from the Standardization Bodies and Demo Regions.

Introduction

Deliverable 7.1 consists in the review of technologies and standards in the Demonstration Regions within the Green eMotion Project, which has been divided in three documents for a better comprehension of the contained information.

Document "Deliverable_7_1-Part1.xls".

This Excel table provides information about the status of standards and standardization activities related to electric vehicles, charging points, connection to grid and communication.

To elaborate the standards table, different sources have been managed, mainly International Standardization Bodies, International and National Groups, Committees, Project and Demonstration Sites.

The identified standards have been classified according to different technologies in relation with the Electric Vehicle Interoperability (Vehicles, Charging Point, Connection to Grid and Communication). Additionally, this information has been classified according to subsystems and issues in these technologies (connectors, cables, charger, converter, energy storage, performance, user interface, safety, electromagnetic compatibility (EMC), charging strategies, smart meter, billing service, etc.).

Other important information included in this table is the temporal status of the standards for EV interoperability, in order to identify its grade of updating and development.

The information collected in this table is very extensive. In order to improve the usability of the document, several simplified tables have been produced. In those new tables, it is easier and simpler to identify the standards, which are sorted by EV technologies (Vehicles, Charging Point, Connection to Grid and Communication).

Document "Deliverable_7_1-Part2.xls"

This file consists of an expandable collection of data from the Demo Regions within the GeM project. This Excel table provides information about the status of activities in the Demo Regions, related to electric vehicles, charging points, connection to the grid and communication.
All the information provided by the partner in WP1 has been classified in this second Excel file, to show the relationship between standardization and the real practices carried out in the Demo Regions.

The collected data have been classified according to the different technologies in relation with the Electric Vehicle Interoperability (Vehicles, Charging Point, Connection to Grid and Communication), resulting in a table or matrix of data.

To elaborate this table, two main information sources have been used:

- the Demo Regions within the Green eMotion project (Coordinated with IREC as Site Operation Manager and Task 1.1 leader), and
- the technical specifications of the charging points used in the different Demo Regions (provided by the manufacturers of those charging points).

Document "Deliverable_7_1-Merged.doc"

The present document is the merged version of the previous documents named "Deliverable_7_1-Part1.doc" and "Deliverable_7_1-Part2.doc", which was completed with their associated excel files (as explained before) in order to constitute the final deliverable.

As complementary information to the excel files, this additional document has been created as part of the deliverable 7.1. This document tries to be a guide for the adequate understanding and use of both tables, showing also how the excel files was elaborated.

This report contains information collected from the review of the different technologies used in international demonstration projects and their link with standards (present or under development).

The document also provides additional data coming from a first analysis performed on the information collected in the D7.1 Part 1 excel file. The aim is to summarize the most relevant activities and to highlight the fields where there may not be normalization/standards in play.

The analysis on the technologies used in the Demo regions has been carried out on the available information provided by the regional projects via IREC as Site Operation Manager in charge of coordinating the collection of data from WP1 “Synchronisation of demonstration regions”. The periodic update of this document will also include developments carried out by those regional projects during the lifetime of Green eMotion.
All the documents will be updated on a six months basis, depending on the outcomes of standardisation bodies and the information gathered in the Demo Regions that will be updated and then provided by IREC also every 6 months.

Deliverable 7.1 is a source of information for the next tasks in WP7, as well as for the other WPs in the GeM project.

1. Objectives

1.1. Project Objectives

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 several 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 practices. As 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.

1.2. WP7 Objectives

The harmonization of standards is an essential issue for the mass rollout of EV and plug-in hybrid electric vehicles (PHEV) across the EU. This would allow the user of the EV to find all over the continent the same interfaces for the connection of the vehicle to the recharging infrastructure and, for example, to address the payment of the recharging in similar ways as the “roaming” for his cell phone.

Standardization for electromobility is a difficult task because the problem is multi-fold. EVs can be considered as electrical equipment but also as road vehicles: each aspect having its own regulation and specific standard framework.

The objectives of this work package are to address the problem of standardization of key elements to allow the interoperability of EVs across Europe, with special reference to interfaces (power and signals), with an end goal of creating (de facto) standards. The method proposed will start by an analysis of the protocols at the base of the demonstration projects at the light of the possible options contemplated by established standards and on-going standardization activities. Gaps and inconsistencies will be pointed out in view of future interoperability and indication of the needs and route towards the necessary standardization activities will be drawn, also considering the final certification processes.

1.3. Task 7.1 Objectives

The objective of this task is to review the different technologies used in the demonstration projects and their link with standards (present or under development), in order to point out interoperability issues and to identify gaps and/or missing standards in Europe or world-wide level.

In order to define an initial framework, an updated review of both, the established standards and the ongoing standardization activities has been performed. The activity has been focused on the most critical fields from the point of view of interoperability of Electric Vehicles at European level.

More specifically, the following key objectives were identified:

- Assure the coherence of the technological developments and the compatibility with the existing or ongoing standards at European level.
- Promote interoperability in the frame of the different demonstration projects.
- Identify critical areas to achieve a common standardization
- Contribute to improve existing standards as well as recommend future standards as a consequence of new knowledge gained within the GeM project.

1.4. Deliverable 7.1 Objectives

Deliverable 7.1 consists of several documents containing the review of technologies and standards in the demonstration regions, with the following objectives:

- Two Excel files, containing:
  - a comprehensive table about the status of standards and standardization activities in the field of EV, with its time frame, and
  - a table showing the relationship among the technologies used in the Demo Regions and the issues to be taken into account from the point of view of standardization, aiming at interoperability in Europe.
- A report (Word file):
  - summarizing the technologies used in the Demo Regions (i.e., Electric Vehicles, charging infrastructure, communication capabilities and protocols) as well as their relationship with standards. In this frame the communication protocols, the connectors, the connection mode to the grid and the type of charging allowed are analysed and their advantages and disadvantages in terms of becoming standards are listed
  - including a description of the tables (how they were produced, the information they contain and a set of instructions), and related information (from on-going projects and demo sites).

2. Information included in the Deliverable “Part 1 - Excel Table”

The first table included in Deliverable 7.1 shows the links among:

- Technologies involved in EV interoperability (Vehicle, Charging Point, Connection to Grid and Communication).
- Subsystems included in each technology, i. e., Vehicle: Power Socket/Plug/Connector, Cables, Motor/Charger/Converter, Energy Storage (Batteries/Fuel Cell/Capacitors) or issues related to (Measurement of performance, User Interface, etc.).
- International Standardization Bodies.
- International Committees and Groups.
- International Projects and Demo Sites.
- Standards focused on EV Interoperability.
- Temporal Status of Standards.

2.1. Technologies and Subsystems/Issues

The critical fields for EV Interoperability have been classified by technologies (Vehicle, Charging Infrastructure, Connection to the Grid and Communication). The linkage among these technologies is showed in the diagram of Figure 1.

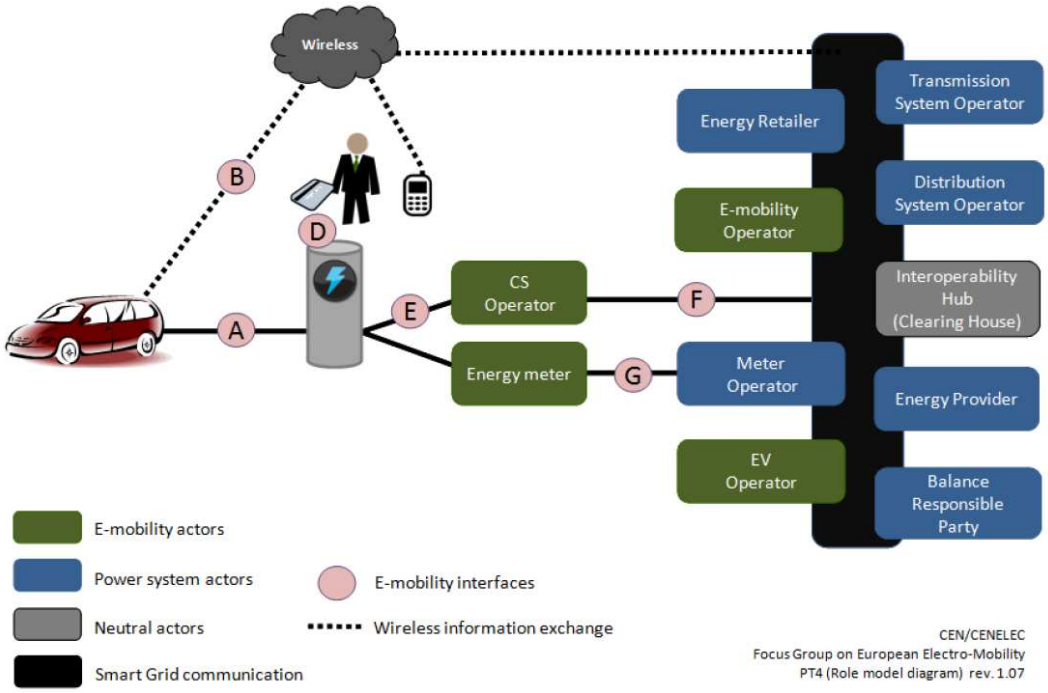


Figure 1. Overview of linkage among technologies in EV interoperability (From CEN/CENELEC Focus Group on European Electro-Mobility).

For each technology there are different systems associated. These systems have been classified, as a sub-type of the main classification, according to their performance in the scope of this study (vehicle, infrastructure, connection to the grid, communications and also final user). The deliverable identifies these systems for each technology (Figure 2).

Also, on each technology, different aspects have been identified from the point of view of regulation in EV specifications (i.e. electrical requirement, safety, EMC, etc.).

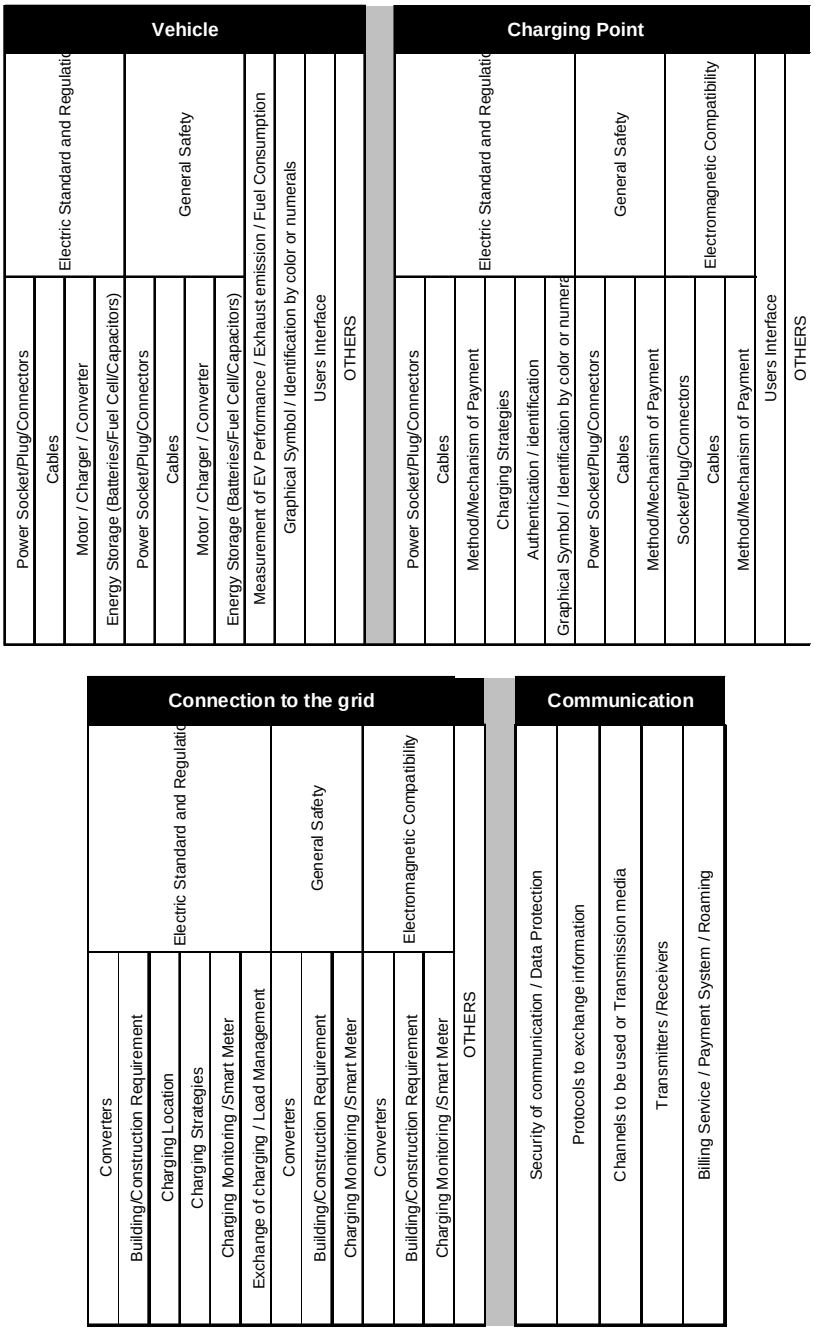


Figure 2. Technologies, systems and other aspects from the point of view of regulation in EV specifications

2.2. Standards

There is an extensive number of standards focused on EVs, their relationships to the infrastructure and to their users. All the identified standards have been included in the Excel table within this deliverable. Finally, some general standards (for Machines, Human Machine Interface, Graphical Symbol, Identification by colour or numerals, etc.) have also been taken into account.

2.3. Standardization Bodies

The main International Standardization Bodies have been taken into consideration to elaborate the present deliverable (see7.3 Internet Databases and Web Sites). These organizations have been working for a long time to elaborate different standards in relation with vehicles, infrastructure and communication. During the preparation of the deliverable, it was found necessary to identify the most important standards from the EV interoperability point of view.

Figure 3. A sample of different Standardization Bodies studied in Task 7.1.

Web sites of the standardization bodies were very useful to find the standards of related to the GeM project as well as the on-going activities in these fields.

Figure 4. Examples of Standardization Bodies web sites used to find standard related information in the GeM project.

2.4. International Committees and Groups

In addition to the standardization bodies, some international Committees and Groups have developed standards and technical reports in relation to the items of interest for the GeM project. This information has also been included in the Excel table.

There are several issues included in these sources of information, from the definition of EV Plugs and Connectors to technical aspects about “Smart Grid” and Data Transmission.

Figure 5. Examples of International Committees and Groups studied during the definition of Deliverable 7.1.

2.5. International Projects and Demo Sites

Other interesting sources of information (technologies used, their link with standards, conclusions, recommendations, etc.) used for this first deliverable in the GeM project have been the different Projects (and relevant Demo Sites) carried out to promote the use of EVs all over the world. Some conclusions, constraints detected and other interesting information are available in their web sites.

Figure 6. Some Projects and Demo Sites in Europe, to promote the use of EVs

3. Management of “Part 1 - Excel Table”

In this part of the document the structure of the excel table is explained, describing the content of each worksheet that makes up the whole document.

Finally, the document shows how to manage the information included in the deliverable.

3.1. Worksheets

The whole document consists of seven worksheets (see Figure 7) arranged in one workbook:

- The first one contains the glossary employed in the deliverable, with the criteria used in the classification of the standard and a list of acronyms.
- The second one shows a list with information available from different International and National Groups and Committees, in relationship with EV Interoperability.
- The last five worksheets (Stand. Bodies (*******)), employ the same structure. Four of them show the information collected in the worksheet “Stand. Bodies (complete)”, in a simplified way (by technologies).
    - The worksheet “Stand. Bodies (complete)” contains all information about the different international standards, developed by the international standardization bodies, classified according to the chosen divisions for the technologies associated to EV interoperability.
    - For easier usage of the data, the other four worksheets “Stand. Bodies (*****)” show extracts of that table sorted by technologies.

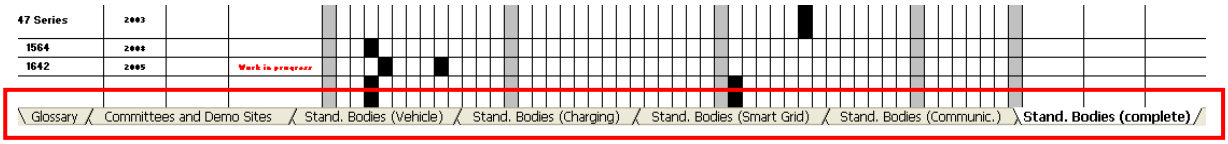


Figure 7. Structure of Deliverable 7.1

3.1.1. Glossary

This first worksheet shows a list of terms to facilitate the understanding and to improve the usability of the following worksheets. It is divided in two different parts: a list with the criteria used in the classification of the standard and a group of acronyms used.

3.1.1.1 Criteria for classification of standards

In order to define a suitable classification of the identified standard into the different technologies, subsystems and additional issues, a relation of criteria has been elaborated. This list of criteria has been included into the worksheet of the deliverable 7.1, called “Glossary” (reproduced in Figure 8).

The adequate definition of these criteria is a very important aspect to achieve the consequent identification of lack of regulation in some issues related to EV Interoperability.

According to these criteria, the identified standards have been classified into the different technologies and issues for each technology.

Power Socket/Plug/Connectors	Development, production, and field analysis of electrical terminals, connectors, and components that constitute the electrical connection systems
	Functional and dimensional requirements
	Interface compatibility requirements
Cables	Dimensions and requirements
	Test methods
Motor / Charger / Converter	AC or DC
	low / medium / high power
	Quick or Fast charging
	Conductive / No Conductive Charging
	Grid feedback option
Energy Storage (Batteries/Fuel Cell/Capacitors)	Physical, electrical, environmental and safety requirements, storage and shipment characteristics, and labeling requirements.
	Description of dimensions, termination, retention, venting system, and other features required in an electric vehicle application.
	Deep discharge and charge cycles in service, expected service life, in cycles, etc
	Provide protection from potentially harmful factors and materials within the battery system that can cause injury to occupants
	Test method and conditions for rating performance
Measurement of EV Performance / Exhaust emission / Fuel Consumption	Measurement of energy performances
	Calculating the total fuel and energy consumption rates of a Plug-In Hybrid Electric Vehicle (PHEV).
	Practices for measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles, Including Plug-in Hybrid Vehicles.
Graphical Symbol / Identification by color or numerals	Labeling guidelines for any electrical storage device at all levels of sub-component, component, subsystem
Users Interface	Ergonomics of human-system interaction
	User system interfaces and symbols
Charging Strategies	AC or DC
	low / medium / high power
	Quick or Fast charging
	Conductive / No Conductive Charging
	Controlled Current Charging / Constant voltage or unregulated DC charging
	With or without communications path for individual billing
	With or without communications path for negotiating electricity rates
	With or without load management (local, smart grid)
	Grid feedback option
Charging Monitoring /Smart Meter	Measure and control electrical energy and demand in power stations
	Provide data for billing, market and network operation, energy management, customer information and other purposes.
Charging Location	Private, semiprivate, public or semipublic charging station
	In combination with parking
	Outdoors, under a roof or in an enclosed space
	While travelling (Fast charging)
Exchange of charging / Load Management	Smart Grid Interoperability / Programmability
	Criteria and requirements for interconnection of distributed resources (DR) with electric power systems (EPS).
	Performance and safety criteria for conductive and wireless charging of electric and plug-in vehicles.
	Provide energy for the home or even provide energy back to the grid

Authentication / identification	Identification methods in relation to interoperable EV charging
	Ergonomic requirements
Method/Mechanism of Payment	Method of Payment Requirements
	Mechanism of Payment Requirements
	Ergonomic requirements
Billing Service / Payment System / Roaming	Ability for a client who already has a service contract to obtain the same service at any location
	Billing Service Requirements
	Payment System Requirements

Building/Construction Requirement	Requeriment for Hazardous locations, Indoor and Outdoor Sites.
	Ergonomic requirements
Security of communication / Data Protection	Security of communication and Data Protection
Protocols to exchange information	Smart Grid Interoperability / Programmability
	Methods for implementing a bidirectional, serial communications link over the vehicle power supply line
	Requirements and specifications for communication between plug-in electric vehicles and the electric power grid, for energy transfer
Channels to be used or Transmission media	Communication requirements associated with smart grid interoperability.
Transmitters /Receivers	Requirements
Converters	Requirements

Figure 8. Criteria for classification of standards, according to aspects of standardization.

3.1.1.2 Acronyms

To make the whole Deliverable 7.1 more understandable, a list of acronyms has been included into the worksheet “Glossary” (see Figure 9), according to the Standardization Bodies / International and National Groups and Committees used.

DS	Danish Standards
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
IEC	International Electro-Technical Commission
ISO	International Organization of Standardization
SAE	Society of Automotive Engineers
NIST	National Institute of Standards and Technology
SGIP	Smart Grid interoperability Panel
PAP	Priority Action Plan (NIST)
V2G	Vehicle to Grip
G4V	Grid for Vehicles (Project)
UL	Underwriters Laboratories
NFPA	National Fire Protection Association
NEC	National Electric Code (NFPA)
NERC	North American Electric Reliability Corporation
ITU	International Telecommunication Union
ETSI	European Telecommunications Standard Institute
IEEE	Institute of Electrical and Electronics Engineers
IRC	ISO/RTO Council
VDE	Association for Electrical, Electronic & Information Technologies
DKE	German Commission for Electrical, Electronic & Information Technologies
NPE	Nationale Plattform Elektromobilitat

Figure 9. Acronyms of Standardization Bodies / International and National Groups and Committees.

3.1.2. Committees, Groups, Projects and Demo Sites

The next worksheet in the deliverable shows the information collected from the Committees, Working Groups (see extract in Figure 10), Projects and Demo Sites (see extract in Figure 11).

International and National Groups and Committees										
IRC (USA)	NEP (Germany)	SGIP / NIST (USA)	V2G / NIST (USA)	CHAdeMO Association	EV Plug alliance					

Figure 10. International and National Groups and Committees

International and National Projects / Demo Sites																			
ICT for Electromobility (Germany)																			
e-Mobility Berlin	Harz.EE mobility	GridSurfer	Smart Wheels	Future Fleet	MeRegioMobil	eE-Tour Allgäu	Edison Project (Denmark)	Plan Piloto Puntos de Recarga (Spain)	Projet Kleber (France + Germany)	Model Regions Electric Mobility (Germany)	G4V (Europe)	eMobility (Europe)	Cityelec (Spain)	Tecmusa (Spain)	VERDE (Spain)	Movele (Spain)	MOBI.E (Portugal)		

Figure 11. International and National Projects / Demo Sites

For each item, the table gives information about the type of document developed by the organization, their title and temporal status (date of publication or work in progress).

3.1.3. Standardization Bodies

In the next worksheets, included in the deliverable, the different international standards (developed by the international standardization bodies, Figure 12) have been classified according to the chosen divisions for the technologies associated to EV interoperability.

Standardization Bodies												
DS	CENELEC/CEN	IEC	ISO	ITU	IEEE	SAE	UL	NEC	NERC	Smart Energy 2.0	European Parliament	OTHERS

Figure 12. Standardization Bodies.

To improve the usability of the deliverable, the information about each technology (vehicle, charging point, connection to grid and communication) has been presented individually (i.e., a worksheet per technology). However, the last worksheet in the deliverable presents all the information in just one table, to show the interconnection among all the technologies and regulations related.

3.1.3.1 Standards on Vehicle

Standards that have been identified as focused on vehicles have also been classified into the subsystems and items showed in Figure 13.

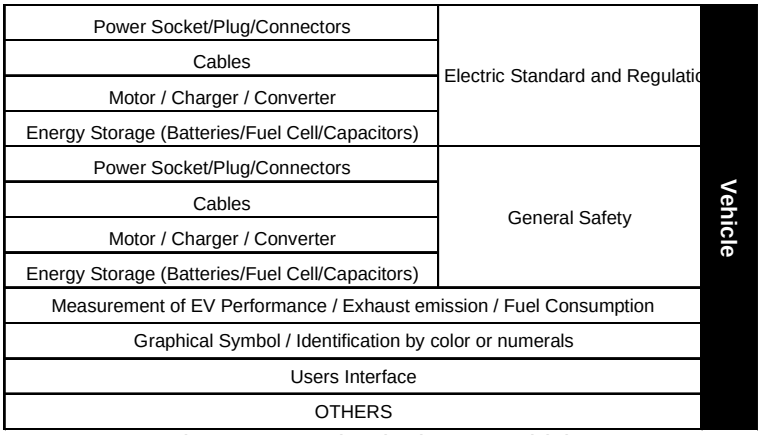


Figure 13. Technologies on Vehicles

3.1.3.2 Standards on Charging Point

As done in the previous section "Standards on Vehicle", standards related to the charging point infrastructure have also been organised into a secondary classification according to what is shown in Figure 14.

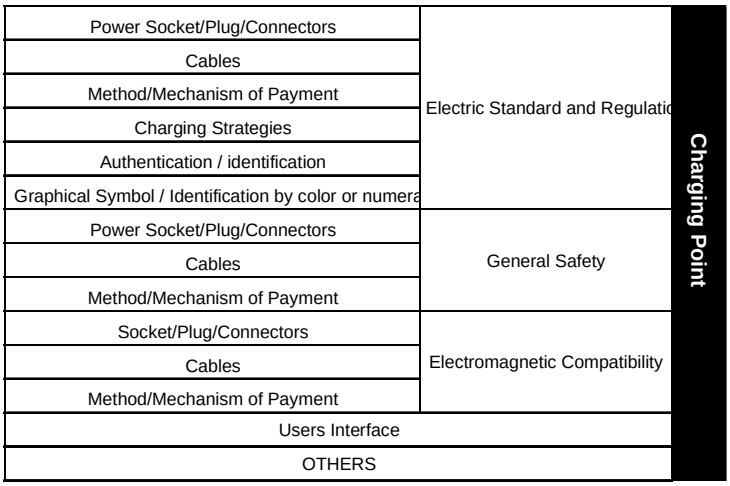


Figure 14. Technologies on Charging Point.

3.1.3.3 Standards on Connection to the grid

A similar kind of secondary classification has also been used for standards related with the connection to the grid according to what is shown in Figure 15.

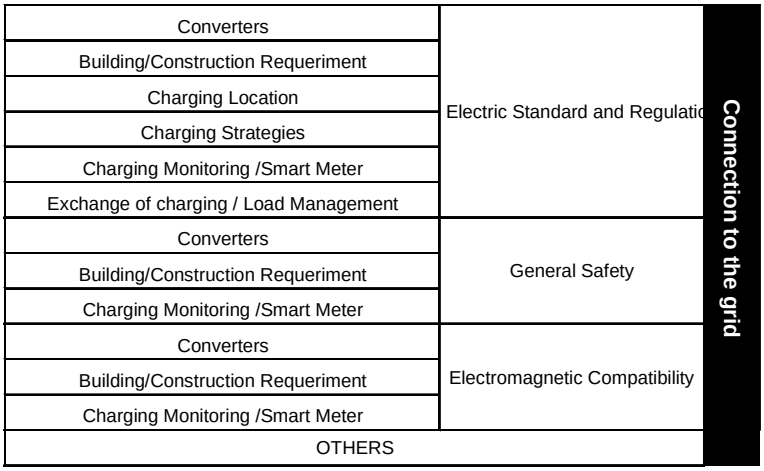


Figure 15. Technologies on Connection to Grid.

3.1.3.4 Standards on Communication

As for the last technological field, Figure 16 shows the secondary classification for standards related with communication.

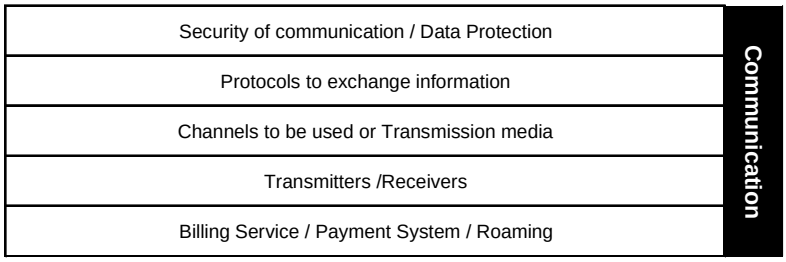


Figure 16. Technologies on Communication.

3.1.3.5 Complete Information

Figure 17 shows the general structure used in all worksheets where standard have been classified (i.e., Standards on Vehicle, Standards on Charging Point, Standards on Connection to Grid, Standards on Communication and, finally, all the previous standards in just one table).

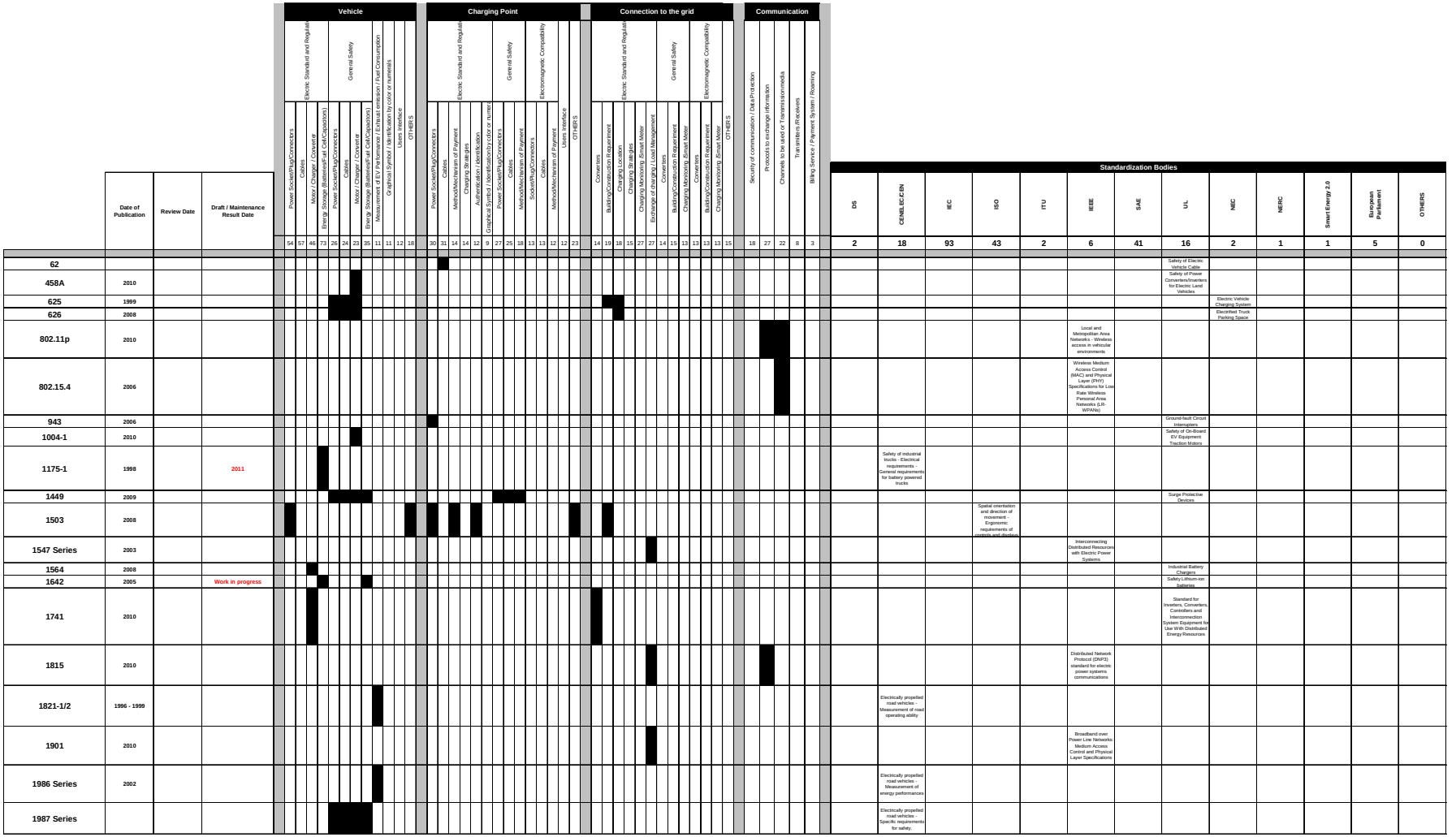


Figure 17. Detail of the Deliverable 7.1 – Excel table

3.2. Management of worksheets

3.2.1. Location of Standards (by code)

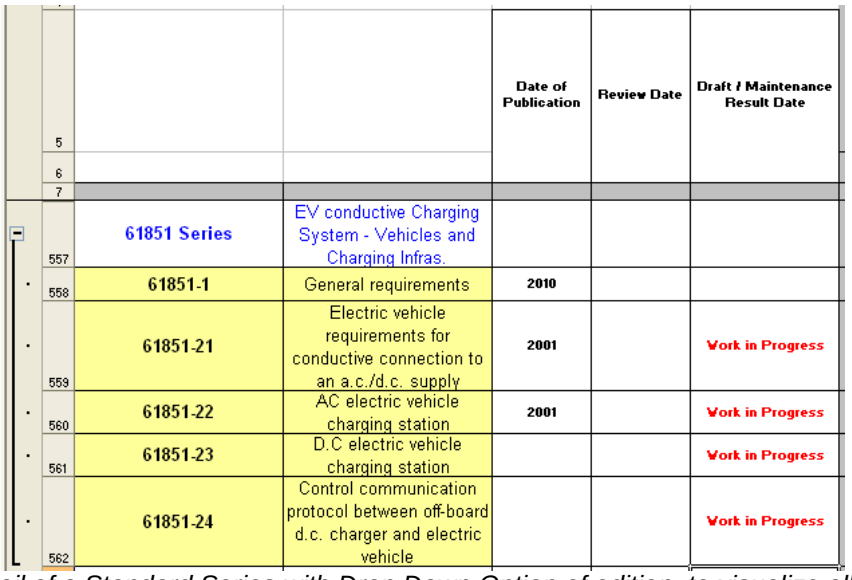
In general, the standards are identified by a numerical code. Each Standardization Body uses a specific method in order to codify their standards. To simplify the use of the table, the standards have been introduced in a column of the table in a specific order, independently of the standardization body that developed them. To simplify the searching of a particular standard in the table, these have been placed in ascending order according to their numbering (see Figure 18).

In general, additional figures are introduced in the numerical code, such as letters, but in the development of this deliverable that aspect has not been taken into account, with the exception of the SAE Standards, which are named with letter "J" before the code. For this reason, the SAE standards have been placed at the end of the standard list.

	Date of Publication	Review Date	Draft / Maintenance Result Date
62			
70 Article 625	1999	2011	2014
70 Article 626	2008	2011	2014
458A	2010		
802.11p	2010		
802.15.4	2006		
943	2006		
1004-1	2010		
1175-1	1998		2011
1449	2009		
1503	2008		
1547 Series	2003		

Figure 18. Location of Standards and Temporal Status.

There are standard whose main code is common for several standards (e.g., IEC 61851 Series in Figure 19). The full list of standards can be hided or can be shown through an edition option available in the excel file.



			Date of Publication	Review Date	Draft / Maintenance Result Date
5					
6					
7					
557	61851 Series	EV conductive Charging System - Vehicles and Charging Infras.			
558	61851-1	General requirements	2010		
559	61851-21	Electric vehicle requirements for conductive connection to an a.c./d.c. supply	2001		Work in Progress
560	61851-22	AC electric vehicle charging station	2001		Work in Progress
561	61851-23	D.C electric vehicle charging station			Work in Progress
562	61851-24	Control communication protocol between off-board d.c. charger and electric vehicle			Work in Progress

Figure 19. Detail of a Standard Series with Drop Down Option of edition, to visualize all the standards included.

3.2.2. Temporal Status

A very important issue in WP7, and for the GeM project in general, is to report about the time frame of the standardization activities along with the expected developments/issues dates of standards. This information is placed in the table in three different columns (Date of publication, Review date or Draft / Maintenance Result Date), trying to take into account this important objective in the deliverable.

3.2.2.1 Date of Publication

Under this concept, the date of the first publication of each standard is shown (Figure 18).

3.2.2.2 Review Date

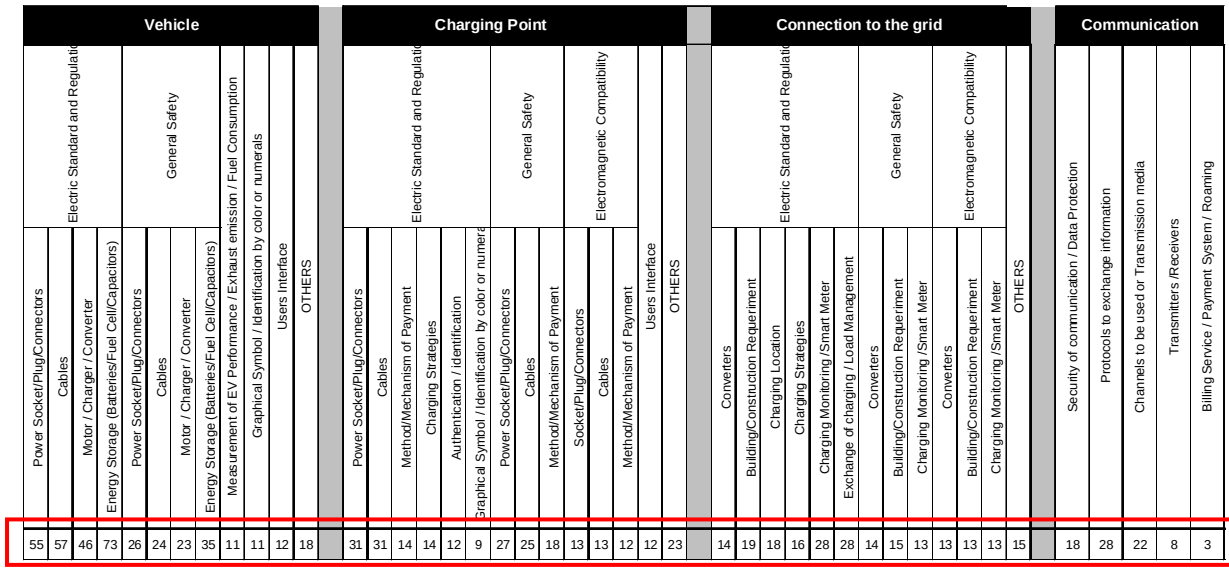
In this column, the date of the last update of each document has been registered (Figure 18).

3.2.2.3 Draft / Maintenance Result Date

The information in this part of the table corresponds to the estimated date in which the standard/report or new version of the documents will be available for the public (Figure 18). If a standard is only available as draft version the field for date of publication will remain empty and in the field draft/maintenance result date the date of the latest draft version will be shown.

3.2.3. Quantity of Standards

In order to identify the lack of regulation in the aspects related to EV Interoperability, a counter has been included in the top row of the table (see Figure 20 and Figure 21). The numerical figure introduced in the table should help in the identification and comparison in each technology / standardization body. In order to find this lack of regulation, the user should search for the cells with the lower value (for instance in Figure 20, there are 73 standards about Energy Storage against only 3 on Billing Service/Payment System/Roaming). This Excel file easily identifies entities with extensive work in standardization about vehicle, charging point, connection to the grid or communication (i.e., the International Electro Technical Commission – IEC in Figure 21).



Vehicle												Charging Point												Connection to the grid												Communication				
Electric Standard and Regulatio			General Safety				Measurement of EV Performance / Exhaust emission / Fuel Consumption	Graphical Symbol / Identification by color or numerals	Users Interface	OTHERS		Electric Standard and Regulatio			General Safety			Electromagnetic Compatibility		Users Interface	OTHERS		Electric Standard and Regulatio				General Safety			Electromagnetic Compatibility			OTHERS						
Power Socket/Plug/Connectors	Cables	Motor / Charger / Converter	Energy Storage (Batteries/Fuel Cell/Capacitors)	Power Socket/Plug/Connectors	Cables	Motor / Charger / Converter	Energy Storage (Batteries/Fuel Cell/Capacitors)					Power Socket/Plug/Connectors	Cables	Method/Mechanism of Payment	Charging Strategies	Authentication / identification	Graphical Symbol / Identification by color or numerals	Power Socket/Plug/Connectors	Cables	Method/Mechanism of Payment	Socket/Plug/Connectors	Cables	Method/Mechanism of Payment			Converters	Building/Constuction Requirment	Charging Location	Charging Strategies	Charging Monitoring /Smart Meter	Exchange of charging / Load Management	Converters	Building/Constuction Requirment	Charging Monitoring /Smart Meter	Converters	Building/Constuction Requirment	Charging Monitoring /Smart Meter		Security of communication / Data Protection	Protocols to exchange information	Channels to be used or Transmission media	Transmitters /Receivers	Billing Service / Payment System/ Roaming
55	57	46	73	26	24	23	35	11	11	12	18	31	31	14	14	12	9	27	25	18	13	13	12	12	23	14	19	18	16	28	28	14	15	13	13	13	13	15	18	28	22	8	3

Figure 20. Number of standards linked to each technology and issue.

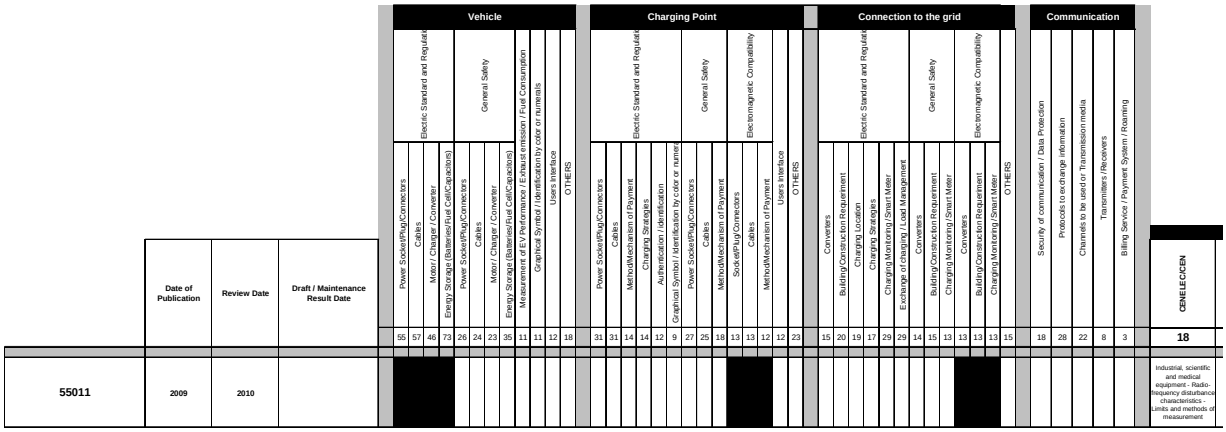
Standardization Bodies													
DS	CENELEC/CEN	IEC	ISO	ITU	IEEE	SAE	UL	NFPA	NERC	Smart Energy 2.0	European Parliament	VDE (DKE)	OTHERS
2	18	95	43	2	6	41	16	2	1	1	5	1	0

Figure 21. Number of standards developed by each standardization body.

The field of application of a unique standard could affect to several technologies (vehicle, charging infrastructure, Smart Grid and/or Communication). For this reason a same standard could be located in two o more sheets into the excel file, according to the classification by technologies (Figure 22).

In this sense, the total number of identified standards from CEN/CENELEC, for example, is 18, but the distribution by technologies is the following:

- Vehicles, 17 standards,
- Charging Point, 6 standards,
- Smart Grid, 4 standards, and finally,
- Communications, 1 standard.



Vehicle												Charging Point												Connection to the grid												Communication				
Electric Standard and Regulatio			General Safety				Measurement of EV Performance / Exhaust emission / Fuel Consumption	Graphical Symbol / Identification by color or numerals	Users Interface	OTHERS		Electric Standard and Regulatio			General Safety			Electromagnetic Compatibility		Users Interface	OTHERS		Electric Standard and Regulatio				General Safety			Electromagnetic Compatibility			OTHERS						
Power Socket/Plug/Connectors	Cables	Motor / Charger / Converter	Energy Storage (Batteries/Fuel Cell/Capacitors)	Power Socket/Plug/Connectors	Cables	Motor / Charger / Converter	Energy Storage (Batteries/Fuel Cell/Capacitors)					Power Socket/Plug/Connectors	Cables	Method/Mechanism of Payment	Charging Strategies	Authentication / identification	Graphical Symbol / Identification by color or numerals	Power Socket/Plug/Connectors	Cables	Method/Mechanism of Payment	Socket/Plug/Connectors	Cables	Method/Mechanism of Payment			Converters	Building/Constuction Requirment	Charging Location	Charging Strategies	Charging Monitoring /Smart Meter	Exchange of charging / Load Management	Converters	Building/Constuction Requirment	Charging Monitoring /Smart Meter	Converters	Building/Constuction Requirment	Charging Monitoring /Smart Meter		Security of communication / Data Protection	Protocols to exchange information	Channels to be used or Transmission media	Transmitters /Receivers	Billing Service / Payment System / Roaming
55	57	46	73	26	24	23	35	11	11	12	18	31	31	14	14	12	9	27	25	18	13	13	12	12	23	15	20	19	17	29	14	15	13	13	13	13	15	18	28	22	8	3

Date of Publication	Review Date	Draft / Maintenance Result Date	CENELEC/CEN
55011	2009	2010	18

Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement

Figure 22. Detail of a unique standard classified in several technologies at the same time.

In counting the standards number, additionally to the standards clearly located in the classification by technologies, the standards whose field of applications is under study have also been taken into account.
In the tables, these standards are identified with red crosses in the cell instead of a cell shadowed in black.
The classification of these standards has been proposed by some GeM partners, and their definitive classification is under study.

4. Information from the Demonstration Regions

A very important point for Task 7.1 in the GeM project is collecting real information from the Demonstration Projects in order to know the characteristic of the vehicles, charging points, smart grid and communication used. All technologies related to interfaces, and therefore affecting interoperability, will be monitored in the frame of each demonstration project in the GeM project.

Where possible the technologies will be linked to the identified and/or used standards, in order to have a framework of standardization level, so that missing topics could be easily identified and integrated.

With the information collected in Deliverable 7.1, an analysis of the gaps of current status of technologies and standard will be made in the following tasks in the GeM project (Task 7.2 and 7.3), to ensure that EV interoperability in Europe will be reached.

4.1. Evaluation of the Demo Regions. Information included in the second Excel Table ("Part 2 – Excel Table")

Task 7.1 partners will analyse the information according to the standards currently being used in the demo regions. This information is collected in the second excel file within Deliverable 7.1.
The methodology to realise this analysis will be defined according to the type of information supplied, and also according to the format used in the file that contains these information from the Demo Sites.

The second excel table of Deliverable 7.1 shows the links among:

- Technologies involved in EV interoperability (Vehicle, Charging Point, Connection to Grid and Communication)
- The basic information from the Demo Regions to determine the grade of standardization that could be achieved (energy transmission mode, charging strategies, information to be supplied by the communication systems, payment methods, charging point characteristics, etc.)
- Other issues related to standardisation in the fields of the above mentioned technologies (charging operation, communication among user, vehicle and electric supply equipment, authentication protocol, plug and connector, etc.) that may have arisen during the setting up and running of demonstration activities in the Demo Regions.

A data matrix has been created into an excel file to show the relationship among the previous listed items.

The information collected in the data matrix comes from the Demo Regions participating in the GeM Project. Since the demonstration projects on those Regions are still running, the Excel file will be updated on a six months basis with the information supplied by IREC, during the life time of the Green eMotion Project.
In the current version of the Deliverable, data were provided on September 29th, supplying information from nine different Demo Regions (named by IREC as DE1, ES1, ES2, ES3, ES4, DK3, IE1, IT1 and FR1).

4.1.1. Technologies

The critical fields for EV Interoperability have been classified by technologies (Vehicle, Charging Infrastructure, Connection to the Grid and Communication). The linkage among these technologies is shown in Figure 1.

In this second table, the same classification of the technologies used in the first table of D7.1 (Vehicle, Charging Infrastructure, Connection to the Grid and Communication) has been used to ensure consistency and comprehension of the data from the Demo Regions.

4.1.2. Basic Information

Partners in Task 7.1 have been analysing information from the Demo Regions; the complete list of information requested is:

- Electricity supply chain:
  - Distribution network
- Charging system:
  - Charge point description
  - V2G condition:
    - Allowance
    - V2G mode
  - Authentication techniques
  - Charging mode
  - Communication protocols
    - Between EV and charging spot
    - Between charging spot and operator
    - Between charging spot operator and clearing house
  - Output connector
    - Socket outlet / connector
    - Type of socket(s) or connector(s)
- Electric Vehicle
  - Type/model of vehicles
  - Battery technology
  - V2G
  - Vehicle manufacturer telematics

This structure follows the survey (“Critical data list”) defined in Task 1.1 within the GeM project. It was defined in a later stage as subset of requested data to facilitate the data transmission between both tasks. Afterwards, the structure of the data has been modified to display the information in a more comprehensive way, classifying the information and complementing it with additional data.

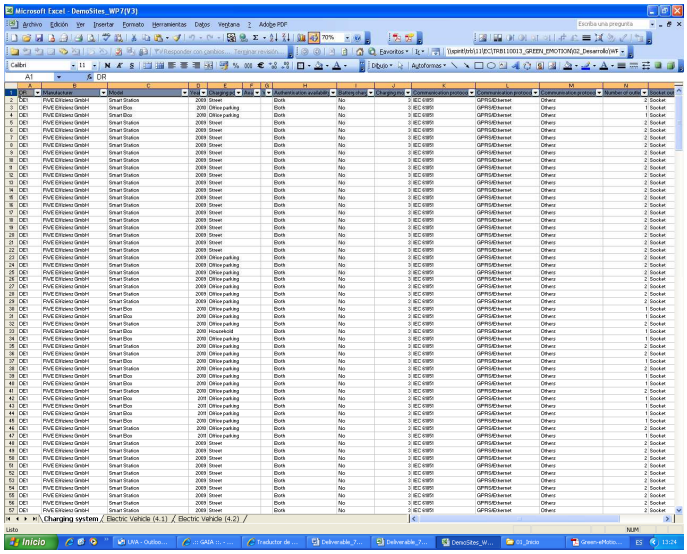
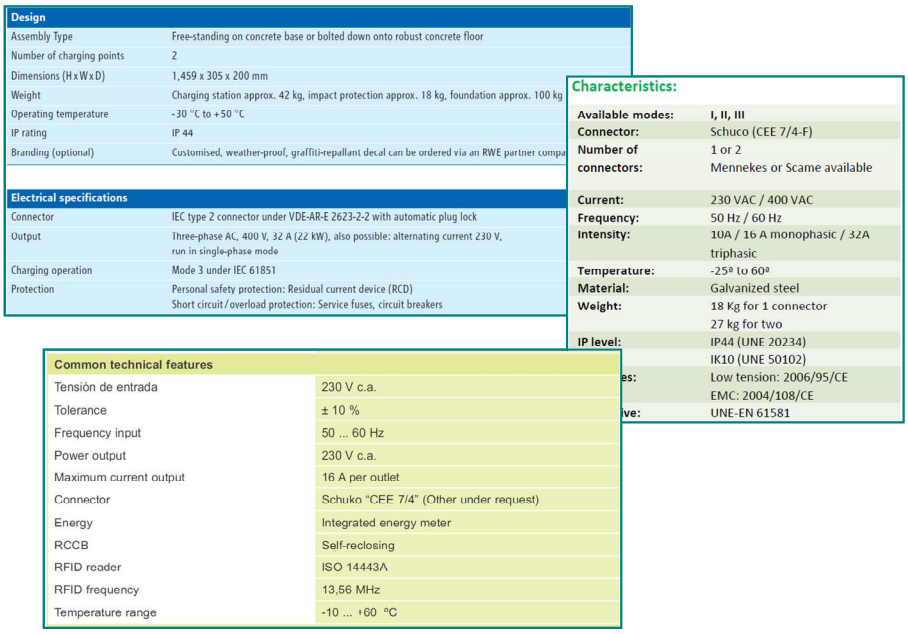


Figure 23. Raw data for the Deliverable 7.1 – Part 2, as supplied by IREC.

The information was supplied by IREC, in the form of several tables, using excel files (Figure 23).

To elaborate D7.1 – Part 2, the partners in Task 7.1 reclassified the information supplied by IREC and collected from the GeM Demo Regions, according to the objectives to be achieved within the deliverable.

Additionally, once identified the suppliers and models of the charging points installed in the Demo Regions, the authors of the Deliverable 7.1 – Part 2 have consulted the data sheets of the different charging systems to complete the information that was not directly available from the Demo Regions (see Figure 24).



Design	
Assembly Type	Free-standing on concrete base or bolted down onto robust concrete floor
Number of charging points	2
Dimensions (H x W x D)	1,459 x 305 x 200 mm
Weight	Charging station approx. 42 kg, impact protection approx. 18 kg, foundation approx. 100 kg
Operating temperature	-30 °C to +50 °C
IP rating	IP 44
Branding (optional)	Customised, weather-proof, graffiti-repellant decal can be ordered via an RWE partner compa

Electrical specifications	
Connector	IEC type 2 connector under VDE-AR-E 2623-2-2 with automatic plug lock
Output	Three-phase AC, 400 V, 32 A (22 kW), also possible: alternating current 230 V, run in single-phase mode
Charging operation	Mode 3 under IEC 61851
Protection	Personal safety protection: Residual current device (RCD) Short circuit / overload protection: Service fuses, circuit breakers

Characteristics:	
Available modes:	I, II, III
Connector:	Schuco (CEE 7/4-F)
Number of connectors:	1 or 2 Mennekes or Scame available
Current:	230 VAC / 400 VAC
Frequency:	50 Hz / 60 Hz
Intensity:	10A / 16 A monophasic / 32A triphasic
Temperature:	-25º to 60º
Material:	Galvanized steel
Weight:	18 Kg for 1 connector 27 kg for two
IP level:	IP44 (UNE 20234) IK10 (UNE 50102)
es:	Low tension: 2006/95/CE EMC: 2004/108/CE
ive:	UNE-EN 61581

Common technical features	
Tensión de entrada	230 V c.a.
Tolerance	± 10 %
Frequency input	50 ... 60 Hz
Power output	230 V c.a.
Maximum current output	16 A per outlet
Connector	Schuko "CEE 7/4" (Other under request)
Energy	Integrated energy meter
RCCB	Self-reclosing
RFID reader	ISO 14443A
RFID frequency	13,56 MHz
Temperature range	-10 ... +60 °C

Figure 24. Details of data sheets of different charging systems used in the GeM Project.

4.1.3. Issues to Standardize

In the first part of D7.1, a sub-classification of the technologies has been carried out in order to divide the main items regarding the European electric interoperability (vehicle, charging point, smart grid and communication). These have been split into subsystems and issues related to technologies (plug, connector, cables, charger, converter, energy storage, performance, user interface, safety, EMC, charging strategies, smart meter, billing service, etc.).

To achieve the needed interoperability, these items are the focus of the different activities carried out by standardization groups in Europe, and for this reason those are the target in the collection of data from the different Demo Region in the GeM project.
With this information, it is possible to identify the grade of standardization taken into account in each Demo Region and in each technology involved in electric mobility.

In the matrix of data that forms the Deliverable 7.1 – Part 2, the issues related to standardization are located in the first three rows of the table, as explained later in this document. In this part of the table, items like charging operation mode, charging point socket, charging vehicle inlet, communication among vehicle, charging point, operator and/or users, authentication protocol, payment method, etc., have been taken into account.

5. Management of “Part 2 - Excel Table”

In this part of the document the structure of the second excel table is explained, describing the content of each section that makes up the whole table.

5.1. Main Worksheet

The Excel File of the Deliverable 7.1 – Part 2 is a unique table (Figure 25) that contains the information provided by the GeM Demo Regions. This information has been post-processed by the Task 7.1 partners, in order to become as useful and easy to be used as possible.

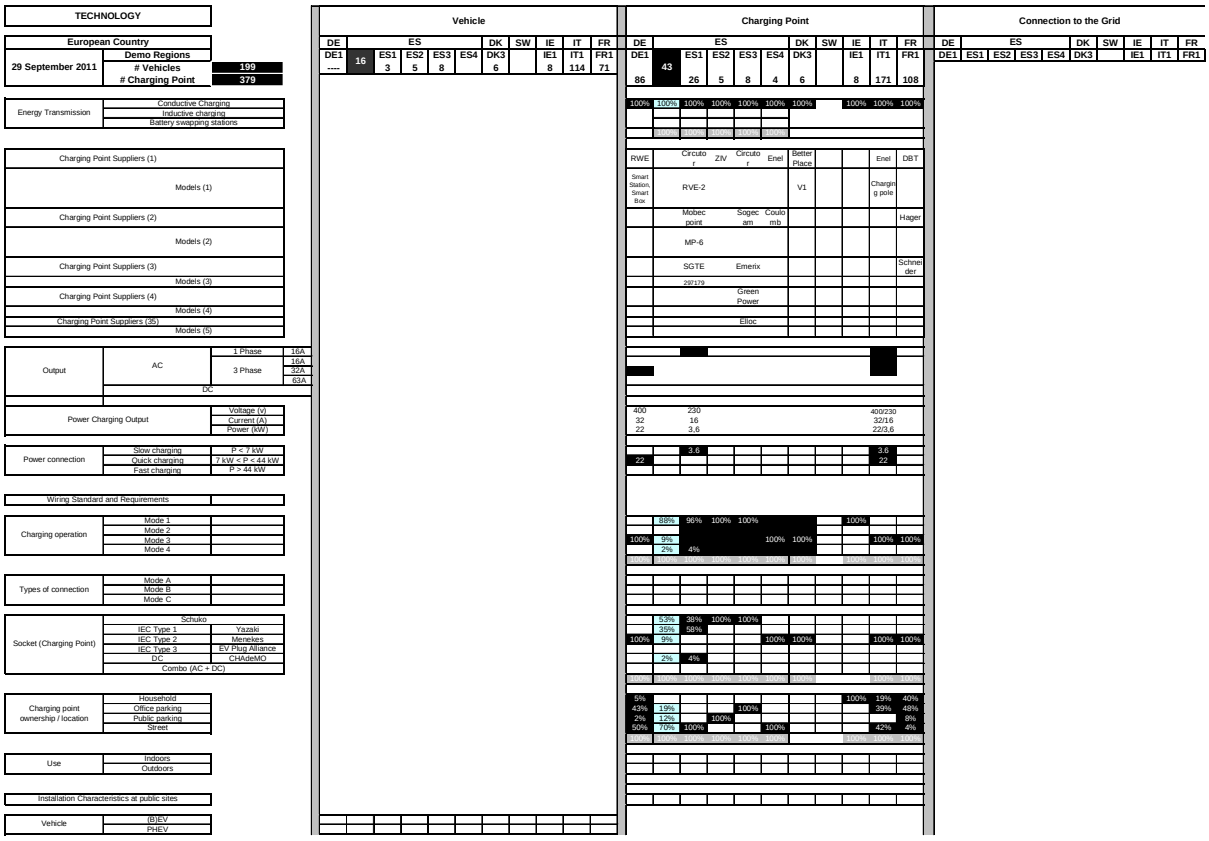


Figure 25. Detail of the structure of Deliverable 7.1- Part 2.

The information supplied has been placed in a matrix of data (columns and rows), according to the criteria described in the following subsections.

5.1.1. Available Information

The information supplied by the Demo Regions in the GeM Project, and collected by IREC, could be classified into quantitative and qualitative data.

5.1.1.1 Quantitative information

The term “quantitative” refers to data or information that can be enumerated (measurable amounts). In the deliverable 7.1 – Part 2, this information has been used to extract conclusions, e.g. the grade of use of the different types of plug into the Demo Regions (see Figure 26) and/or countries.

European Country	
29 September 2011	Demo Regions

Socket (Charging Point)		
	Schuko	
	IEC Type 1	Yazaki
	IEC Type 2	Menekes
	IEC Type 3	EV Plug Alliance
	DC	CHAdeMO
	Combo (AC + DC)	

DE	ES					DK	SW	IE	IT	FR
DE1	43	ES1	ES2	ES3	ES4	DK3		IE1	IT1	FR1
	53%	38%	100%	100%						
	35%	58%								
100%	9%				100%	100%			100%	100%
	2%	4%								
100%	100%	100%	100%	100%	100%	100%			100%	100%

Figure 26. Type of analysis carried out in Task 7.1 from the provided information.

5.1.1.2 Qualitative Information

Qualitative, on the other hand, refers to conditions or information that can, at most, be only partially enumerated. Furthermore, qualitative information often takes the form of subjective, interpretive or symbolic expressions of meaning.

Several examples of this kind of information have been collected in the deliverable 7.1 – Part 2, e.g., the names of the charging point suppliers in each Demo Regions and their models (Figure 27).

TECHNOLOGY

European Country		
29 September 2011	Demo Regions # Charging Point	379
Charging Point Suppliers (1)		
Models (1)		
Charging Point Suppliers (2)		
Models (2)		
Charging Point Suppliers (3)		
Models (3)		
Charging Point Suppliers (4)		
Models (4)		
Charging Point Suppliers (35)		
Models (5)		

Charging Point										
DE	ES					DK	SW	IE	IT	FR
DE1 86		ES1 26	ES2 5	ES3 8	ES4 4	DK3 6		IE1 8	IT1 171	FR1 108
RWE		Circutor	ZIV	Circutor	Enel	Better Place			Enel	DBT
Smart Station, Smart Box		RVE-2				V1			Charging pole	
		Mobecpoint		Sogecam	Coulomb					Hager
		MP-6								
		SGTE		Emerix						Schneider
		297179								
				Green Power						
				Elloc						

Figure 27. Example of qualitative information in the supplied data.

5.1.2. Columns

In the matrix of data, the information has been placed in columns. As a function of the data type from the Demo Region, these have been introduced in a specific column into the table. This classification has been done according to the involved technology and the Demo Region that supplied the information or the country of origin for each Demo Region.

5.1.2.1 Technologies

The classification of technologies follows the same principles as previous cases (vehicles, charging point, smart grid and communication).

5.1.2.1.1. Vehicles

Under this category, the information taken into account is exclusively related to vehicles.

This part in the deliverable allows partners in Task 7.1 to enumerate the amount of vehicles that each Demo Region and country brings to the GeM Project (Figure 28 shows the currently available information).

European Country		DE	ES				DK	SW	IE	IT	FR
Demo Regions		DE1	ES1	ES2	ES3	ES4	DK3		IE1	IT1	FR1
# Vehicles	199	----	16	3	5	8	6		8	114	71

Figure 28. Global amount of vehicles, and vehicles in each DR and Country.

5.1.2.1.2. Charging Points

Under this category, the information considered is exclusively related to charging points.
This part in the deliverable allows enumerating the amount of charging points that each Demo Region and country offers to the GeM Project (Figure 29 shows the currently available information).

European Country		DE	ES				DK	SW	IE	IT	FR
Demo Regions		DE1	ES1	ES2	ES3	ES4	DK3		IE1	IT1	FR1
# Charging Point	379	86	43	26	5	8	4	6		8	171	108

Figure 29. Global quantity of charging points and total amount of them for each DR and Country.

5.1.2.1.3. Smart Grid

This section has not incorporated relevant information into the data matrix, so far. On future reviews of the Deliverable this section will be updated.

5.1.2.1.4. Communication

In this field, the table displays information about standards, systems and protocols used during the authentication and communication in general (see example in Figure 30).

TECHNOLOGY	
European Country	
29 September 2011	Demo Regions
Authentication Availability (With Charging Point)	None
	Vehicle
	Users
	Vehicle and Users (Both)

Communication										
DE	ES					DK	SW	IE	IT	FR
DE1		ES1	ES2	ES3	ES4	DK3		IE1	IT1	FR1
								100%		
	28%	46%				100%				55%
100%	72%	54%	100%	100%	100%				100%	45%
100%	100%	100%	100%	100%	100%	100%		100%	100%	100%

Figure 30. Details about the authentication Availability of the Charging Point ("None" category meaning no authentication is available)

In some cases, the model (and supplier) of the charging point has been taken into account; this allows the user to identify the main characteristics and communication capability of the charging points (Figure 31).

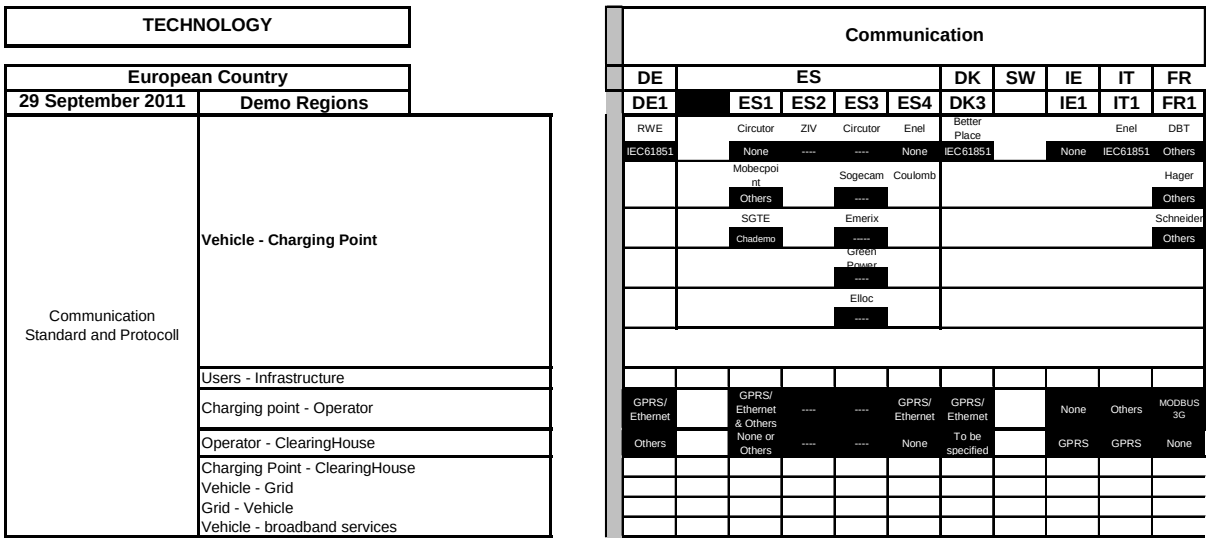


Figure 31. Characteristics regarding the communication (standards and protocols) capabilities of the charging point.

5.1.2.1.5. Extra Column

An additional column has been placed in the excel file to display the information related to several technologies at the same time. This extra column has been called in the table: “Simultaneously Several Technologies”.

As an example, Figure 32 shows information about the directionality of the charging process, which involves the vehicle, the charging points and the infrastructure.

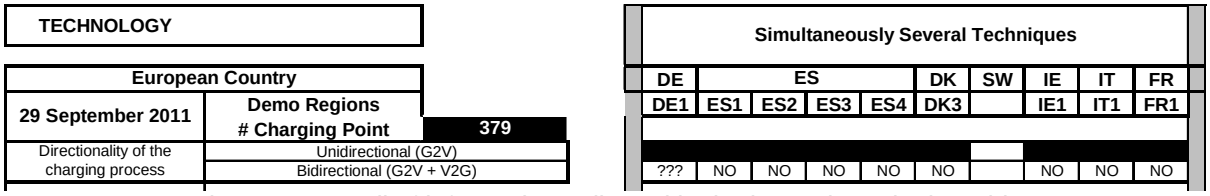


Figure 32. Detail of information collected in the last column in the table

5.1.2.2 Demo Regions

The demonstration regions, which are part of Green eMotion, participate with their ongoing projects in order to share existing activities and experiences. The information from the Demo Regions has been analysed by each specific project or by country, mainly because a country can host several Demo Projects.

A collection of data has been made available for each Demo Region, and the items associated to this information are the same for all of them. This situation allows to analyse the information as an individual case, or together with several Demo Regions at the same time: by cities, by region, by countries, by European zones - south, north, east, west.

At this moment, the analysis introduced in the table follows two criteria: firstly by each Demo Region and secondly by countries. In the following paragraph, both are detailed.

5.1.2.2.1. Demo Projects

The information of each Demo Region is located in just one column, under its acronym (according to the criteria used by IREC: “XXY”, where XX is the code of the country and Y is the number of Demo Region in the country). For each one of them, the number of vehicles and the number of charging points is displayed to assess the global infrastructure implemented and used in the GeM Project (Figure 33).

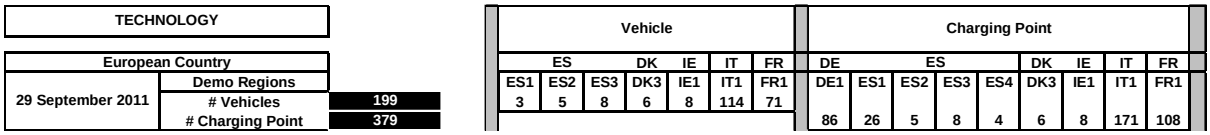


Figure 33. Accounting for number of vehicles and charging points in the Demo Region.

5.1.2.2.2. Countries

A column has been introduced into the matrix for each country. This summarizes all the information from the Demo Regions in the country under analysis. This column is shadowed with a different colour (sky-blue) against the Demo Region (source of the information), which is in black, for a better differentiation (see Figure 34).

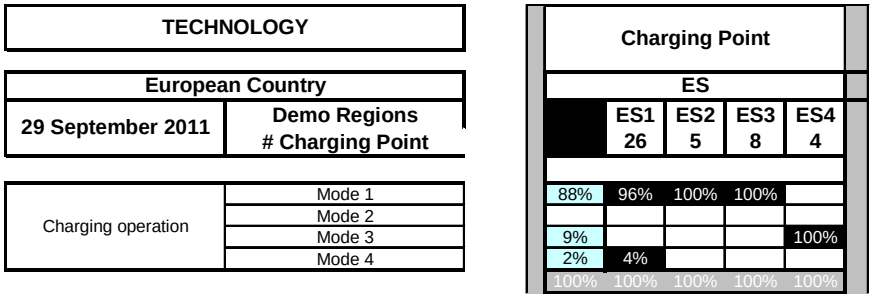


Figure 34. Example of analysis by Demo Regions (ES1, ES2, ES3 and ES4) or Country (ES).

5.1.3. Rows

In addition to the columns of the table, the rows complete the matrix of data in the excel file. Only for a specific combination of technologies, the rows contain information from the Demo Regions. It means that a part of the matrix is empty (see extract of the table in Figure 25).

In the main matrix there are different submatrixes or subtables. These display the linking among the different technologies, demo regions or countries, as well as issues about the electric mobility (see Figure 25). These submatrixes or subtables have been defined by the contents of the rows in the first three columns in the main table.

According to the content of these first columns of the main table, the submatrixes contain different information, ranging from only qualitative information (a name or a model - Figure 27 -, a “true (black)” o “false (white)” sentence - Figure 35 -), to a quantitative information (as a percentage of use of a technology - Figure 34 - or a value of a charging parameter - Figure 36 -).

TECHNOLOGY	
European Country	
29 September 2011	Demo Regions
Authentication Protocoll / System	RFID Card (ISO 14443A) Integrated Circuit Card (ICC) Magnetic Stripe Card

Communication										
DE	ES					DK	SW	IE	IT	FR
DE1		ES1	ES2	ES3	ES4	DK3		IE1	IT1	FR1

Figure 35. Sub-table with "true" (black) and "false" (white) information.

TECHNOLOGY		
European Country		
29 September 2011	Demo Regions # Charging Point	379
Power Charging Output		Voltage (v)
		Current (A)
		Power (kW)
Power connection	Slow charging	P < 7 kW
	Quick charging	7 kW < P < 44 kW
	Fast charging	P > 44 kW

Charging Point										
DE	ES					DK	SW	IE	IT	FR
DE1		ES1	ES2	ES3	ES4	DK3		IE1	IT1	FR1
86		26	5	8	4	6		8	171	108
400	230								400/230	
32	16								32/16	
22	3,6								22/3,6	
		3.6							3.6	
22									22	

Figure 36. Sub-table with values of different parameters of charging.

6. Conclusions

6.1. Analysis of Technologies and Standards (Focus on Interoperability)

In this section, the initial conclusions of this study are shown, which were extracted from the standard classification in the table (Deliverable 7.1 – Part 1, Excel File) and from the documentation analysed in the Task 7.1 of the GeM project.
As included in the Table of the Deliverable 7.1 – Part 1 (see Figure 10 and Figure 11), the documentation has been collected mainly from the International Committees and Groups, and also, from International Projects and Demo Sites.

These initial conclusions have been validated with the analysis carried out about the target of the standards identified (developed or in developing) and the amount of standards existing in each technology employed in its classification (see Figure 20).

As a first conclusion, it is clear that there are a great amount of relevant standards in the established sectors “automotive technology” and “electrical engineering”. These should be appropriately utilized and made known. In these technological fields, there was an extensive work about development of standards carried out by the international standardization bodies. Currently, there are many technical groups developing new standards or working in their updating, all of them take into account the new challenges of the EV.

From the point of view of the WP7 Objectives, two main issues have been identified in the analysis carried out during the elaboration of the Deliverable 7.1 – Part 1:

- It is possible that a specific aspect of EV interoperability is not covered by any standard.
- It could be, otherwise, that an aspect in the EV interoperability is covered by several standards, with different proposals, even in opposite directions.

The conclusions have been classified into different items as follow.

6.1.1. General

As the CEN-CENELEC Focus Group on European Electro-Mobility announce in the “Standardization for Road Vehicle and Associated Infrastructure” report, although standards and other documents drafted by different bodies - be they in ISO, IEC, UN-ECE or other bodies - do use the same or similar terms, the related **definitions** are sometimes different or even conflicting, which may lead to misunderstanding. For this reason, it strongly recommends that terms and definitions be harmonised.

Also, in this same report a recommendation is proposed about the necessity of a coordination of **standardization** activities during the critical phase of writing new standard or updating existing standard on Electro-Mobility and make recommendations accordingly.

At present, national and international standardization concepts compete with one another. However, since road vehicle markets are international, efforts should aim towards developing international standards right from the start. The same applies to interfaces between electric vehicles and infrastructure. Standardization at national or European level alone is considered to be inadequate.
It is therefore essential that national standards proposals be processed quickly and that national results be transferred to international standardization as soon as possible (Source: German Standardization Roadmap for Electromobility, NPE).

A general recommendation extracted from the German Standardization Roadmap for Electromobility report is that standards must be clear and unambiguous. To encourage innovation, standards should be function-related and should avoid the definition of specific technical solutions (i.e. they should be

performance-based rather than descriptive). Nevertheless, some technical solutions need to be defined in interface standards to ensure interoperability (e.g. between vehicles and the network infrastructure).

According to what is issued in the "German Standardization Roadmap for Electromobility" report (NPE), it must be possible to charge electric vehicles "everywhere, at all times": **interoperability** of vehicles of different makes with the infrastructure provided by various operators must be ensured.
The standardization of charging techniques and billing/payment systems must ensure the development of a charging interface that is user-oriented, uniform, safe and easy-to-operate. User interests must have priority over the interests of individual companies.

About to achieve the necessary interoperability for charging all over Europe, currently available standards and regulations do not include all necessary requirements. Thereby, the CEN-CENELEC Focus Group recommends to discuss and agree additional requirements for charging specifications and testing procedures, based on experience gained in the ongoing development process and demonstration projects, and to bring them into amendments to the IEC 61851/EN 61851 series without delay.

According to the **Electromagnetic compatibility** of electric vehicles and charging stations, at present, Directive 72/245/EEC (and its amendments, in particular 2004/104/EC from the EMC point of view) establishes the requirements for the whole vehicle and for the electrical and electronic sub-assemblies. In future, EC automotive type approval for EMC purposes will thus be obtained only through application of the revised UN-ECE Regulation 10, which will include all relevant EMC aspects for EV's related to connections to the power grid. Additionally, in "Standardization for Road Vehicle and Associated Infrastructure" report from the CEN-CENELEC Focus Group, also the following recommendations are made, among other:

- The regulatory framework and unifying testing methods to the latest standards (CISPR, IEC and ISO) should be simplified
- CEN-CENELEC, ISO and IEC should work together for the improvement and completion of the EMC standards for electric vehicles.
- To update and complete the EMC requirements in order to take into account the current status of the electric vehicle, communications and power distribution technologies.
- To update the EMC requirements of Directive 72/245/EC as well as to propose amendment of regulation UN-ECE 10, in consideration of the whole electrical vehicle specificities, when connected to the network or not.

In addition, taking into account ongoing ISO-IEC standardization developments, the CEN-CENELEC Focus Group prioritise the topics that need to be addressed most urgently:

- safety of charging installations;
- plug-in interoperability;
- EMC provisions for charging station and vehicle;
- communication protocols for V2G;
- quick battery exchange (as soon as reference dimensions are available)

6.1.2. Vehicle

About **electrical safety at the vehicle inlet**, in the CEN-CENELEC Focus Group Report it is commented that the coherence between regulations and requirements of electrical safety standards should be checked and the texts updated if necessary. CEN-CENELEC Focus Group recommends that UN-ECE Regulations and existing standards must be checked and possibly updated. The safety of energy feedback requires close correspondence between IEC 61851-21 (presently under revision) and ISO 6469-3-2. At European level, very close relations should be established between CENELEC TC 64, TC 23 BX, TC 69X and CEN TC 301.

About **batteries**, these are an essential element of the total cost and viability of electric vehicle technology. Also, other uses for batteries, fixed or removable, may also be envisaged, including their

use to temporarily balance the grid (Vehicle-to-Grid reverse energy applications) or the re-use of these batteries at the end of their "vehicle" life for applications that may be outside the domain of electro-mobility. Switchable batteries may also add further possibilities for the increase of range, and should therefore be an integral part of the standardization work to be considered.
These additional technical aspects would impose supplementary requirements in terms of standards, such as supply chain and infrastructure interfaces, as the batteries will have an existence inside and outside of the vehicles. (Source: CEN-CENELEC Focus Group Report).

Also, in the “Standardization for Road Vehicle and Associated Infrastructure” report from the CEN-CENELEC Focus Group, the following recommendations about batteries are made:

- Parameters for state of health should be defined in standards to allow for re-use of batteries.
- Standardization of battery module sizes could be undertaken when the automobile industry considers the subject to be mature. This may lead to a need for standardization of interfaces. Standardization could also be undertaken for battery packs for battery exchange stations as well as for batteries for light electric vehicles.
- A set of minimum requirements for battery information should be collected, stored and extracted from the battery by BMS/BCU. Stored battery data should follow a standard format/coding specification to allow access and correct interpretation.
- A European Standard should be drafted for battery safety labelling (applying the Dresden Agreement).
- Create a battery switch station standard with safety, energy needs, exchangeability, accessibility, data and communication framework.
- Create a unique standard that clearly defines the interfaces of removable batteries, to allow for battery switching on electric vehicles that have been designed for this application. Such interfaces should define the mechanical fixation points, the electric power connectors, the data connectors, the cooling fluids and their interfaces and the data formats that could be used during the charging of the batteries.

In addition, a recommendation by NPE: Studies must be carried out to determine how battery systems can be brought into a **safe** condition after a severe crash, and the need for standardization is to be determined on the basis of these studies. Research results need to be implemented in standards, e.g. for defined interfaces for the safe discharging of damaged batteries, as quickly as possible.

Standardization of the structure of **emergency rescue guidelines** (including isolation of voltage sources by rescuers) is considered to be a medium-term requirement. Simple and reliable methods of identifying vehicles for rescue purposes (indicators for HV, Li+, hazardous substances, etc.) need to be defined. Urgent action is considered necessary in this field in the German Standardization Roadmap Report (NPE).

6.1.3. Charging Point

In order to facilitate the adoption of electro-mobility, the charging should be as convenient and as low cost as possible while providing an acceptable level of safety. This inherently implies the implementation of simple uniform charging systems both for the home and for publicly accessible charging places.

According to information showed in the CEN-CENELEC Focus Group Report, the ideal situation of having a single standard for all applications is not possible in practice. There will likely be a variety of standards to meet the needs of different vehicle types, different charging situations and different environments.

6.1.3.1 General

Alternating and direct current charging will be used. The international community has accordingly already defined different “modes” of charging for each of the four principal cases.

° The use of charging **Mode 1** should be allowed for small vehicles such as scooters or quadricycles.

° **Mode 2** is not recommended for publicly accessible places, except for locations specifically destined to be used by small vehicles in the L1 to L7 category

° Home and Public AC charging of EV of categories M and N should preferably be done using **Mode 3**, which concerns a dedicated **charging station for AC**. These charging stations or devices offer all protective measures itself and may be used for the public infrastructure but also in business or even domestic environments. Mode 3 offers the potential for a safe, user-friendly, powerful and harmonized smart charging infrastructure in Europe based, for both single and three-phase supply, on dedicated charging devices. For this purpose a single solution for plugs and socket outlets should be defined. Every car should provide appropriate cable sets to use mode 3.

° **Mode 4** defines **DC charging** using an external battery charger and is mainly intended for rapid charging. Even though Mode 4 charging capability is presently available only on some vehicles in the market, there is a strong interest of the automotive industry to establish DC charging. Technical concepts are still under development, including the standardization of a harmonised solution. The Focus Group considers that a single solution should be provided in the mid-term

So, different connectors are included in current standards; although the 31st of March 2011 was the envisaged deadline to achieve by the CEN CENELEC Focus Group an agreement about the directions toward common standards (and possibly also connectors) to be used in Europe, a final decision is still to be taken.

Different OEM **fast charge options** will exist in the near future. Vehicles presently circulating in Europe provide Mode 3 (AC) up to 7 kW and a separate connector for Mode 4 (DC) fast charge. Connectors allowing for both AC and DC charge at a unique vehicle inlet (termed “Combo”) are also being studied and proposed for future use but are not presently exploited (Source: CEN-CENELEC Focus Group Report).

For the **vehicle inlet and connector**, different candidates – both with combined AC/DC connectors and pure DC connectors – are described in the working documents of IEC SC 23H (PT 62196-3). This standardization project is at an early stage. According to this item, the CEN-CENELEC Focus Group recommends the following:

- For the short term, the DC configurations of type 2 or type 1 connectors and the integration of CHAdeMO, as well as the requirements for charging stations and vehicles should be finalised for standardization in Europe by the relevant TCs.
- Europe should endeavour to define a combined solution for a unique vehicle inlet (“combo”). The solution should be harmonised with the US market. For this purpose a speed up of the related standardization activities is demanded
- If there is a significant delay in international standardization projects caused by non-European contributions, a transfer and accelerated finalisation at European level could be envisaged. Since CHAdeMO-compliant vehicles are on the market in Europe a satisfactory solution for these vehicles should be sought urgently
- Since future parts of IEC 62196 will most likely be “catalogue standards”, and also IEC 61851-1 will not specify the type of accessories to be used for mode 4 charging, it will be necessary to specify which accessories are required on a European level by an appropriate standardization group

Considering the use of **industrial plugs and socket-outlets** (EN 60309-2) on the infrastructure side, the CEN-CENELEC Focus Group recommends to consider and transpose into standards the applicability, relevance and outcomes of national **wiring rules** on EV charging applications (Mode 1, 2, 3 and 4) in general and for the use of EN 60309-2 accessories. Also the Focus Group recommends that EN 60309-2 could be used as an interim solution for mode 1 and 2 as it is transposed as a European Standard. The system is useable immediately. Extra standard text should be introduced to the next edition of EN 61851-1 immediately if deemed necessary by CENELEC TC 69X.

In the CEN-CENELEC Focus Group Report it is commented that some interoperability problems clearly result from the existence of different **wiring requirements** at national level in different European countries. This situation needs to be addressed through a study of the detailed legislation and the different requirement that exist, to be followed as appropriated by European regulatory actions to remedy the problem.
The recommendation given in the CEN-CENELEC Focus Group Report is to make an urgent study about the effect of different national wiring rules and other regulatory requirements on the technical propositions made for cross-border interoperability of socket-outlets for charging. The results should be taken into account by regulators, as required.

Additionally, about **Plug and Socket-outlet**, the Focus Group recommends to define one unique footprint with five power contacts covering applications from 1 phase to 3 phases & neutral (from 16 to 63 A minimum) with protective earth and additional 2 auxiliary contacts for control system according to mode 3 of a future EN 61851-1. Type 2 or Type 3-c of the future EN 62196-2 will correspond to this definition.

About the **electrical safety at the charging station**, failures in the control unit of a charging station can lead to the situation that voltage is present at the socket outlet in the absence of a vehicle. In such a case, protection against electric shock should be ensured in the charging station. However, further protective methods could be required.
The CEN-CENELEC Focus Group recommends considering additional requirements for functional safety of the charging station, by the appropriate TCs (CENELEC TC 64 and TC 69X) in future work on IEC 61851-1 and/or IEC 61851-22 (AC) and IEC 61851-23 (DC).

In addition, in the CEN-CENELEC Focus Group Report, **earth connection** is considered as a vital safety requirement for the protection against electric shock. Earth quality requirements are subject to national regulation and may differ from country to country. This Focus Group recommend that relevant TCs (CENELEC TC 64, CLC TC 69X, CEN TC 301) must to consider the possible need for further earth quality verification of the installation for electric vehicle charging, considering the specific needs of electric vehicle usage and different mains network configurations that use different earth and neutral connection schemes.

The use of **graphic symbols** is recommended for the charging station user interface so as to ensure intuitive and safe operation by a wide range of users. The extent to which graphic symbols can be used for man-machine-interaction and safety marking, and the necessity of further standardization remain to be investigated, as should the need for standardization as regards accessibility (Source: German Standardization Roadmap Report, NPE).

In the same report, it is recommended that specifications be defined regarding reliable **internal consumption** in the charging infrastructure, particularly during periods of inactivity. The internal consumption limit in the idle state could be specified as being 1 watt for home charging stations and 5 watts for charging stations in public spaces, in analogy with the rules for domestic appliances.

6.1.3.2 AC Charging Point (mode 1, mode 2 and mode 3)

Charging of batteries from the AC mains requires the following apparatus: an AC/DC converter (rectifier and power factor control), a DC/DC converter for the regulation of the current, and an isolating system (often a transformer for external charging systems).

For AC charging, all the above-mentioned power equipment is located on the vehicle. The electronics may use part of propulsion or traction electronics. Current standards do not require insulation between grid and battery; however this may add extra technical constraints to ensure low leakage currents (both AC and DC).

Requirements on the charging station assemblies will be defined in the project IEC 61439-7 (Low-voltage switchgear and control gear assemblies - Part 7: Assemblies for specific installations at public sites such as marinas, camping sites, market squares and similar applications and for charging station for Electrical Vehicles).

The IEC 61851-1 standard defines the basic characteristics of the charging mode 3 (this mode of operation is destined to be used in all places for AC charge), but it needs some further precisions or amendments.

Further precisions are required on the timing diagrams of Annex A of IEC 61851-1.

Coherence with the evolving SAE 1772 standards should be ensured.

IEC 61851-1 having been ratified as EN 61851-1, it is recommended that the new CENELEC TC 69X launch an amendment procedure immediately in Europe to correct the text in accordance with ongoing discussions and in close harmony with IEC. This should consider the results of ongoing developments

6.1.3.3 DC Charging Point (mode 4)

For DC charging all or part of the equipment is located outside of the vehicle in the charging installation. According to CEN-CENELEC Focus Group Report, two options can be considered:

- Controlled current charging. This method is presently used for all DC charging. The isolating transformer and all the power equipment are located in the charging station.
- Constant voltage or unregulated DC charging: The isolating transformer and the AC/DC converter are off-board and the vehicle electronics are used to regulate the current to the battery. This topology is presently in the prototype stage, which means no standardisation recommendations are needed at the moment.

According with the comments into the CEN-CENELEC Focus Group Report, **DC charging system** has been selected by some car manufacturers for fast-charge. Consequently, corresponding standards need to be drawn up.
The DC charging system presently exploited in Europe on new EVs with such an option is proposed by a not-for-profit association (CHAdeMO), and will be integrated into the upcoming IEC 61851-23 and 61851-24 standards presently discussed.
Other propositions for DC charge and control systems are being introduced into these same standards, with proposals from USA and Germany.
The recommendation from the CEN-CENELEC Focus Group Report is the following: Establish a common European Standard for public DC charging systems. Such a standard could use the “CHAdeMO” proposition as a basis and attempt to ensure backward compatibility with EVs and infrastructure already deployed.

According to information showed in the CEN-CENELEC Focus Group Report, for three-phase supply, special consideration to **DC current leakage** needs to be given for both the vehicle and the charging station. The question of the type of protection needed for three-phase charging systems is to be analysed in order to fix requirements on the vehicle charger and/or the charging station (CENELEC TC 64, CEN TC 301, CENELEC TC 69X), investigating all possible protection means against DC leakage on the vehicle and/or the charging station side.

DC charging stations are fixed installations, and will comply with existing standards and regulations with respect to their integration into the mains supply, and should therefore not require specific standards for grid interface.

The characteristics of assemblies for specific installations at public sites need to be defined. It is proposed that the work of IEC/SC17D concerning standardization project IEC 61439-7 is actively supported. There is no need for further action at the European level at the moment (Source: CEN-CENELEC Focus Group Report).

6.1.3.4 Alternative Technologies

Inductive charging may be expected to be one of the most important charging methods in the long term. This technology is being currently analysed in the following standardisation activities: IEC 61980 (Electric equipment for the supply of energy to electric road vehicles using an inductive coupling - Part 1: General requirements, and Part 2: Manual connection system using a paddle) and DKE (GAK 353.0.1 Inductive charging of electric vehicles, from Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE).

An application of inductive charging is not expected before 2015 for electric road vehicles at a significant scale. At present, CEN-CENELEC Focus Group sees no requirement for establishing a pan-European interoperable infrastructure in the introduction phase of electro-mobility.

In addition to fast charging, the exchange of empty batteries with charged ones (called **battery switching** or **battery swapping**) is another method to power the car in a short time

Battery switching would probably initially be limited to a small number of vehicle models but could become more generalised in the future. CEN-CENELEC Focus Group recommends creating a unique standard that clearly defines the interfaces of removable batteries, to allow for battery switching on electric vehicles that have been designed for this application. Such interfaces should define the mechanical fixation points, the electric power connectors, the data connectors, the cooling fluids and their interfaces and the data formats that could be used during the charging of the batteries.

Also, CEN-CENELEC proposes create a battery switch station standard with safety, energy needs, exchangeability, accessibility, data and communication framework. Also, battery switching station storage of batteries of different vehicle models should be included (including dimensions and mechanical /electrical /communication interfaces for integration, as well as environmental requirements).

6.1.4. Smart Grid

Due to the need to integrate electric vehicles into the energy supply grid, issues concerning distributed energy generation, energy storage and data management play an important role. To interact with the electric vehicles, **smart meters** and an **ICT infrastructure** are necessary. Assuming an infrastructure for both the charging and communication with EVs, different **V2G services** can be provided such as demand response or the participation at reserve energy markets.

The Introduction of EV in the grid will increase the demand for energy and thus solicit and stress the electrical network. The **Smart Charging** concept, where the charging of EV batteries is controlled in time, based on energy costs, grid constraints or availability of renewable energy, has great potential.

As the CEN-CENELEC Focus Group on European Electro-Mobility announce in the “Standardization for Road Vehicle and Associated Infrastructure” report, for the optimisation of electro-mobility and energy use, it is deemed to be indispensable to move toward charging electric vehicles in a smart way.

Standardization issues should be addressed by the CEN-CENELEC-ETSI Smart Grid Coordination Group, in liaison with the CEN-CENELEC Electro-Mobility Coordination Group

According the static load management (negotiating charging time, power and prices), in the German Standardization Roadmap for Electromobility Report is published that it is expected that in the first stage of load management processes for the smart grid, users will be offered the option of choosing the time at which the vehicle is to be charged and the power that is to be drawn in relation to the prices offered. In this scenario, it might be feasible to determine prices at the beginning of the charging process on the basis of energy supply and demand forecasts for the next few hours. From a consumer device viewpoint, this is semi-static load management with temporal dynamics over a range of a few hours. Suitable application protocols need to be standardized for such situations.

Also, EVs may one day enable their owners to **inject** their **non-consumed energy** into the utilities electrical network (Vehicle to Grid). This is most likely to happen in cases like:

- In case of critical peak reached on the network to avoid blackout. Utilities would need to use the available energy in batteries for a very short time and in very rare occasions.
- In case of local blackout caused by storm or heavy snowing episodes. The batteries could by used as back-up power to ensure the autonomy energy in home.

Thus, reverse energy flow from the battery (V2G) is proposed as a possibility to optimize energy control and to facilitate the use of renewable energy on the grid, provided that the influence and effects of charging/discharging of the battery on its life cycle and degradation are solved. Smart grid services will influence charging patterns and contribute to the optimization of energy use. This requires information transfer between the EV and the grid. Specific safety aspects must also be addressed.
About this item, CEN-CENELEC Focus Group recommends, in its report, all aspects of reverse energy flow (safety and control) should be addressed by IEC TC 64 (safety) and TC 57 (smart grid) CEN TC 301 (vehicle aspects) and other relevant TCs

As German Standardization Roadmap for Electromobility Report suggests, to avoid grid instability due to a large number of vehicles needing to be charged at the same time, suitable mechanisms for a controlled restart (e.g. random distribution of delay times) of charging procedures need to be defined and standardized. After power outages, the time at which the electric grid is switched back on is a critical issue.

Such also is issued in the German Standardization Roadmap for Electromobility Report, smart grid standardization should be intensified, as the introduction of electric vehicles means that a relevant consumer device is being added. In view of this situation, harmonization with the smart grid standardization roadmap is necessary.
The time schedule for setting up the smart grid will have to be adapted to electromobility requirements; close cooperation between standardization bodies working on the smart grid and electromobility is desired. During the start-up phase (small vehicle fleet) with a relatively low charging load grid bottlenecks are not expected, but in the medium-term intelligent charging and load management will become a must as the number of vehicles increases.

6.1.5. Communication

The communications arena is complex and involves multiple standards committees in several bodies, including the involvement of ETSI as the third ESO. The communications part is also less mature than other EV standardization issues and requires more definitional work (Source: CEN-CENELEC Focus Group Report).

Different types of ICT connections have a strong influence on the possibility to offer ancillary services, billing process and business models as well as on user convenience. Interactions between components (i.e. Vehicle, Charging Unit (CU) / Charging Point (CP), Electric Vehicle Supply

Equipment (EVSE), Energy Providers / Utilities, Infrastructure Providers (DSO / TSO), Automotive OEMs, Service providers and Intermediaries & Aggregators) are fulfilled via either single- or multi-step (chained) interactions between the components. The interactions are at this time predominantly of a B2B nature; however, over time, the number of B2C interactions will most likely grow as the market place becomes more pervasive. It is, therefore wise to suggest that: to ensure a high degree of standardisation and modularity, interactions between any two components should be self-contained and self-fulfilling (principle of service/function disaggregation) – and this is a basic guiding principle.

To formalise the understanding of component interactions: *transactions are electronic exchanges or, interactions, involving the transfer of information between two parties for specific purposes*. There is a minimum specification for a transaction – this is the mandatory part. There is, also, an optional part which refers to transactions which add value, but are not necessary to enable the end-to end EV charging process (e.g. “can the grid sustain the demand ?”). Finally, there is a desirable (or, future,) part (e.g. “eco-routing”) which is likely to drive future adaptation or extension to the EV charging model. The “transaction chains” between components are likely to vary by implementation: for example, it is anticipated that the Vehicle may communicate with the Marketplace directly (in one scenario) or via an OEM Aggregation Gateway (in another scenario).

There are several possible layers of the communication. The final protocols are very dependent on the EV market design. In accordance with the conclusions issued in the report “WP1.1 Electric Vehicle Technology” (from the Edison Project, November 2010), different **scenarios** can lead to a need for different **communication protocols**.

Examples of what needs to be communicated for different scenarios are the following:

1. Communication between infrastructure and users.
2. Communication between EV and charging post (TCP/IP e.g. dedicate pins or power line communication)
    a. Safety – to ensure ground connection and plug present.
    b. Charge post maximal power capability – to avoid over loading of the installation fuse and over loading of components further up in the system (from charging post to EV).
    c. EV identification – for payment purpose (information forwarded to clearing house).
    d. Current price per kWh.
3. Communication between charging post and clearing house.
    a. EV identification together with X kWh for X Euros (from charging post to clearing house – may be sent in bulk with time delay).
    b. Continuously send current price per kWh (from clearing house to charging post)
4. Communication between EV and fleet operator.
    a. EV battery status and requirements for charging (from EV to fleet operator).
    b. Start, stop and power signals (from fleet operator to EV).

In wireless communication directly between EV and operator, CEN-CENELEC Focus Group on European Electro-Mobility has found gaps in the existing standards. Future vehicles – electrical or otherwise – will be connected with external services through mobile communication for various purposes (e.g. communication for co-operative systems, Mandate M/453). The standards related to communication of whatever kind could be equally applicable for vehicle charging and related needs (e.g. billing). Coherence with current standards for charging should be ensured (Source: CEN-CENELEC Focus Group Report).

About this item, CEN-CENELEC Focus Group recommends, in its report, standardization for the diagnosis protocol, human-machine interface and energy management system for the complete charging system. This new work has to be done in close relation to user groups and electro-mobility system integration.

The design of vehicle/charging station and charging station/infrastructure communications must be a continuous process. Communications between vehicles and the charging infrastructure are being dealt with in ISO/IEC 15118 “Road vehicles – Vehicle to grid communication interface” (ISO/TC 22/SC 3/JWG 1) – this project should be completed without delay.

In terms of the smart grid and communications, a charging station (electric vehicle connected, ready for charging) does not need to be dealt with any differently than any other connected energy consumer or generator (aside from some specific data content). Communications with the charging station must be compatible with all other smart grid communications. It is therefore recommended that relevant developments (e.g. in [standardization] bodies dealing with e-energy and international smart-grid issues) should be observed and adopted (recommended in the German Standardization Roadmap for Electromobility Report, NPE).

Another recommendation from the CEN-CENELEC Focus Group is that a standards work must be established concerning an “interoperability hub”, which can be a generic and neutral concept for mediating between two partners to provide validation services for exchange of technical information, contract relations or security certificates. A joint working group including service providers should be formed within the ESOs to define a cross-border European concept for this hub.

Such an interoperability hub is what in Green eMotion (WP3 “Electromobility services / ICT solutions”) is referred to as Marketplace and supports the requisite business processes needed for European wide mobility of Electric Vehicles. The Marketplace will be public and based on open architecture, common standards and protocols and open standard interfaces with flexible, scalable and state of the art technology.

Aim of WP7, starting with this deliverable and with the continuation of the activity, is to analyze the status of ICT standards presently used for electromobility and the most important issues and needs as highlighted by the demonstration regions. In the described complex and quite immature situation related to ICT standards, this means that the WP7 analysis is going to be mostly focused on the physical and data link layers for the “high level communications”, in addition to the most established “low level communication” field related to control signals. WP3 is also involved with ICT standards (and in particular Task 3.8 “ICT standards and protocols”). However, since the Marketplace in WP3 will be based on transactions, as it will be described in detail in the relevant deliverable D3.9, the primary focus of Task 3.8 will be to understand, document, classify and prioritise the content and operations aspects of the transactions to yield the initial standards specification focus and coverage. The activities of the two WPs will be closely interrelated, with regular contacts on the respective progress. WP3 will take advantage of the main results of WP7 to confirm its analysis on the requirements for the standards and protocols definition that will ensure communication between all actors involved in the EU Marketplace, which GeM is aimed at developing, whereas WP7 will get hints from WP3 on further issues and needs to be addressed.

6.1.6. Billing Service / Payment System / Roaming

Charging points shall be equipped with at least one common on-spot payment method (cash, mobile phone, prepaid card, credit/ EC card, internet payment).

Several standards have been identified according to this issue (ISO/IEC 15118 Series, IEC 61850, and IEC 62055). Apparently, these standards have not been developed specifically for this subject; they seem to have been developed with a more general purpose.

Thereby, CEN-CENELEC Focus Group on European Electro-Mobility has found gaps in the existing standards in identification and standards in relation to roaming. Requirements for identification methods in relation to interoperable EV charging will have to be identified. Current standards within telecommunication, security or ITS may be used for electro-mobility (Source: CEN-CENELEC Focus Group Report).

6.2. Data from the Demonstration Regions within the GeM Project

In this section some preliminary comments are reported concerning the analysis of technologies and standards, as obtained by the first collection of data available from the demonstration regions and organized in “Part 2 – Excel Table”.

The technological issues related to standardization (charging operation, communication among user, vehicle and electric supply equipment, authentication protocol, plug and connector, etc.), which constitute the data matrix rows (and are located in the first three columns of the table), are capable to be changed. Some of the items could be eliminated and others could be added, depending on the information and outcomes provided by the other WPs in the GeM project.

At this moment (September 29th, 2011), the amount of available data is still very limited. This lack of information has not allowed drawing conclusions after its analysis. In the following months the Task 7.1 Partners will obtain more information about the used technologies from the Demo Regions as well as from the parallel activity performed in Task 7.2 “Monitoring and managing the collection of standardization issues and needs”. Therefore, as also originally planned in the Description of Work, until the end of the GeM project the present deliverable will be updated on a six months basis (at the same time that IREC will provide their 6 month update on the Demo Regions data) and the whole information will be analysed again to obtain conclusions. In the last version of Deliverable 7.1, at the end of the project, specific conclusions will be included for every standardization issue involved after analysing the whole information from the demonstration projects in Green eMotion.

The “sublist” of information, requested to the Demo Regions and provided by IREC to complete the present deliverable when still the relevant WP1 deliverable was not finished, is not enough to satisfactorily complete the defined matrix of data. The authors of D7.1 have found problems to complete the data matrix by using exclusively the data provided originally by the different demonstrations.
This situation has resulted in the following suggestions:

- The data matrix, which has been set up having in mind to get a comprehensive description of e-mobility technologies in the GeM project, should be simplified in order to offer only information obtained from the data supplied by the Demo Regions.
- However, the list of information to be requested to the Demo Regions should be completed to be able to fill a minimum number of crucial technological fields defined in such updated data matrix. This situation has been started to be taken care of through the correction actions approved within the last Regional Board and Technical Board, where three new variables are being added to the critical data list and included in the data collection process starting from November 2011. These three variables, requested by several WPs (6 and 7) and by the project Coordinator, are: Brand of the car/Model of the car/Type of Electrical Vehicle (EV). Then, according to what it was approved in the last Regional Board, all requests of new critical data will be studied in detail and, if necessary, further corrective actions would be proposed and implemented after month 12 of the project.

7. Sources of Information

To elaborate Deliverable 7.1, different sources of information have been used.

7.1. Information included in the DoW

At the beginning, information included in the DoW of the project (Figure 37) was taken as a first reference to elaborate the table included in the deliverable.

DoW - Green eMotion Part B Proposal No 265499

Table 16: Green eMotion partners' participation in standardisation initiative

TOPICS / STANDARDS		CEN	CENELEC	IEC	ISO	SAE	OTHERS	AREVA	EDF	ENDESA	RSE	ENEL	FKA	CIDAUT	IBERDROLA	IBM	PPC	RWE	ECN	DAIMLER	BMW	NISSAN	RENAULT	SIEMENS	BETTER PLACE	BOSCH
CHARGING INTERFACE				TC69/WG4						☑										☑			☑	☑	☑	
Part 1	General requirements		FprEN61851-1:2010	61851-1 2nd edition																☑			☑	☑	☑	
Part 21	Electric vehicle requirements for conductive connection to an AC/DC supply		EN61851-21:2002	61851-1 21 under revision (2010-07)																☑						
Part 22	AC Charging Station		EN61851-22:2002	61851-22 2under revision																☑						
Part 23	DC Charging Station		CLC/TS 50457-1:2008	61851-23 (anw) (fpd 2012-11)																☑						
Part 24	Communication Protocol between Off- Board Charger and EV		CLC/TS 50457-2:2008	61851-24 (anw) (fpd 2013-06)																☑						
CONDUCTIVE CHARGING - PLUG SOCKET-OULETS, VEHICLE COUPLERS AND VEHICLES INLETS-				SC23H																☑			☑	☑	☑	
Part 1	Charging Of electric vehicles up to 250A AC and 400A DC		62196-1:2003	62196-1 under revision (fpd 2012-03)																☑						
Part 2	Dimensional interchangeability requirements for AC pin and contact_tube accessories			62196-2 under development (fpd 2012-03																☑						
Part 3	Dimensional interchangeability requirements for AC pin and contact-Tube coupler with rated operating voltage up to1000V DC and rated current up to 400A for dedicated DC charging			62196-3 under revision (fpd 2013-02)																☑						
INDUCTIVE CHARGING				TC69									☑							☑				☑		

Figure 37. Information from Annex I, in "Description of Work" document.

7.2. Contribution from partners

During the processing of Deliverable 7.1 – Part 1 Excel file, the WP7 partners were consulted by the Task Leader. Some partners gave additional information and, even, in some cases they supplied working documents from standardization bodies with information about standards on EVs (see Figure 38).

CEN-CENELEC Focus Group eMobility **PT6 (Existing Standards)**

Standards dealing with specific area of EV-HEV

The hereafter standards are developed within main world-wide technical committees of : CEN, CENELEC, ISO, IEC, SAE, UL.

This document light up existing international standards in orderto allow identification of essential standards for the electric vehicle development.

Then on the basis of this document, in taking into account last technological developments it may appears fields requiring complementary developments.

See on first column : Type of standard
A - General Information
B - Test Methods
C - Safety or EMC requirements
D - Miscellaneous

See on second column classification by relevance (PT6 proposal)
1) Utmost important 2) Important 3) May have some interest 4) Superseded

		Standards built by main International Standardisation Organisations Related to EV components, EV performance and safety specifications							
Type	**Class.**	**Technical Domain \ Standardisation Corpus**	**EN (CEN)**	**EN (CENELEC)**	**ISO**	**IEC**	**SAE**	**UL**	**General Comments**
		Electric road vehicle – Vocabulary							
A	2	Electric road vehicles - Vocabulary			ISO 8713:2005 under revision				
A	3	Electrically propelled road vehicles - Terminology	EN 13447:2001		ISO 8713				
A	2	Graphical symbols for use on equipment				IEC 60417			
A	2	Basic and safety principles for man-machine interface, marking and identification. Identification of conductors by colours or numerals.		EN 60446		IEC 60446			
A	3	Degrees of protection provided by enclosures (IP Code)		EN 60529		IEC 60529			
Type	**Class.**	**Technical Domain \ Standardisation Corpus**	**EN (CEN)**	**EN (CENELEC)**	**ISO**	**IEC**	**SAE**	**UL**	**General Comments**
		Cycles, Mopeds and Motorcycles Applications							
A	1	Electrically propelled mopeds and motorcycles — Terminology			ISO/WD 13062				Vehicles of Category L
A	1	Electrically propelled mopeds and motorcycles - Safety specifications			ISO/WD 13063				Vehicles of Category L
A	1	Battery-electric mopeds and motorcycles, Performance - Reference energy consumption and range			ISO/WD 13064-1				Vehicles of Category L
B	1	Battery-electric mopeds and motorcycles, Performance - Road operating characteristics			ISO/WD 13064-2				Vehicles of Category L
B	1	Cycles - Electrically power assisted cycles - EPAC Bicycles	EN 15194:2009-01						Vehicles of Category L
C	2	Safety requirements for secondary batteries and battery installations. Batteries for use in portable appliances		EN 50272 -4					Vehicles of Category L
A	2	Secondary cells and batteries containing alkaline or other non-acid electrolytes Mechanical tests for sealed portable secondary cells and batteries				IEC 61959			Vehicles of Category L
A	2	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications				IEC 61960			Vehicles of Category L
C	2	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells,		EN 62133		IEC 62133			Vehicles of Category L

Figure 38. Information Detail from CEN-CENELEC Focus Group eMobility (Courtesy of RSE)

7.3. Internet Databases and Web Sites

After identifying the main standardization bodies, other important sources of information used were their Internet Web Sites. When available, International Projects and Demo Sites web sites were also consulted. Below the internet addresses employed during the elaboration of the table in Task 7.1 are shown.

7.3.1. Standardization Bodies (Databases and Web Sites)

DS (Danish Standards)
http://www.ds.dk/en-GB/Services/Publications/Standards/Sider/default.aspx

CEN (European Committee for Standardization)
http://esearch.cen.eu/

CENELEC (European Committee for Electro-technical Standardization)
http://www.cenelec.eu/dyn/www/f?p=104:74:8588174258823959::::FSP_LANG_ID:25

IEC (International Electro-Technical Commission)
http://webstore.iec.ch/

ISO (International Organization of Standardization)
http://www.iso.org/iso/store.htm

IEEE (Institute of Electrical and Electronics Engineers)
http://www.ieee.org/publications_standards/index.html

SAE (Society of Automotive Engineers)
http://standards.sae.org/all/

UL (Underwriters Laboratories)
http://www.ul.com/global/eng/pages/corporate/standards/

NFPA (National Fire Protection Association)
http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=70

NERC (North American Electric Reliability Corporation)
http://www.nerc.com/page.php?cid=2

7.3.2. Project Web Sites

Nationale Plattform Elektromobilität
http://www.bmu.de/verkehr/elektromobilitaet/nationale_plattform_elektromobilitaet/doc/45970.php

Plan Piloto Puntos de Recarga
http://www.cidaut.es/eren/

ICT for Electromobility
http://www.ikt-em.de/en/index.php
http://www.e-energy.de/en/

e-Mobility Berlin
http://www.rwe-mobility.com/web/cms/en/236726/rwemobility/

Harz.EE-mobility
https://www.harzee-mobility.de/index.php

GridSurfer
http://www.ewe.de/ewe-macht-zukunft/grid_surfer.php

Smart Wheels
http://www.smartwheels.de/index.php?article_id=1

Future Fleet
http://www.futurefleet.eu/

MeRegioMobil
http://www.meregio-mobil.de/en/index.php?page=index

eE-Tour Allgäu
http://www.ee-tour.de/start

Edison Project
http://www.edison-net.dk/

Model Regions Electric Mobility
http://www.now-gmbh.de/en/electric-mobility/model-regions.html

CityElec
http://www.cityelec.es

Enel E-Mobility
http://www.enelmobility.it/
http://www.e-mobilityitaly.it/

Tecmusa
http://www.insia-upm.es/proyecto-tecmusa-24-fi.asp

Verde
http://www.cenitverde.es/

Movele
http://www.idae.es/index.php/mod.pags/mem.detalle/relcategoria.1029/id.490/relmenu.52

http://www.idae.es/PtoRec/

Mobi.e
http://www.mobie.pt

MERGE
http://www.ev-merge.eu/

G4V (Grid for Vehicles)
http://www.g4v.eu

7.3.3. Charging Point Suppliers Web Sites

Better Place
www.betterplace.com

Circutor
www.circutor.es

Coulomb Technologies
www.coulombtech.com
www.mychargepoint.net

Ducati Energia
www.ducatienergia.com

E-lloc
www.elloc.es

Emerix
www.e-merlyn.com

Ingeteam
www.ingeteam.com

MobecPoint
www.mobecpoint.com

RWE Effizienz
www.rwe-mobility.com

SGTE
www.sgte-power.com

Sogecam
www.sogecam.es

ZIV
www.ziv.es

Schneider Electric
www.schneider-electric.com/electric-vehicle

8. Definitions

8.1. Ancillary services

Ancillary services are interconnected operations services identified as necessary to effect a transfer of electricity between purchasing and selling entities (transmission) and which a provider of transmission services must include in an open access transmission tariff.

8.2. Clearing House (Telephone Service)

A clearinghouse is a company or association that transfers billing records and/or performs financial clearing functions between carriers that allow their customers to use each other's networks. The clearinghouse receives, validates and accounts for telephone bills for several telephone service providers.

Clearinghouses are particularly important for international billing because they convert different data record formats that may be used by some service providers and convert for the currency exchange rate.

Clearinghouses provide a variety of services, including processing proprietary records (e.g. switch records) into formats understandable by the member carriers' billing systems, validating charges from carriers with intersystem agreements, and extracting unauthorized or un-billable billing records.
Clearinghouses transfer messages in a standard format such as exchange message record (EMR), cellular inter-carrier billing exchange roamer (CIBER), or transferred account process (TAP) format. The EMR format is often used for billing records in traditional wired telecom networks and the CIBER and TAP formats are used for wireless networks.

8.3. Fleet Operator

A fleet operator is defined as an actor that operates a number of EVs in their interaction with the power system, but it is not necessarily the owner of the EVs. The fleet operator can either be an independent actor or it can be the retailer. By pooling the EVs under a common operator they can act together like a larger consumer. The fleet operator can manage the charging of the individual EVs, i.e. automate the charging and provide other services to the EVs. The fleet operator has a contractual agreement with the EV owner that describes the conditions for charging, level of control, payment, etc.

A fleet operator managed system would both ensure that a large share of charging takes place at the least cost hours, regardless of the time of day, and take into account the charging requirements of other users.

The fleet operator version of the scenario involves the delegation of the charging responsibility to a fleet operator (FO), who offers to handle charging of EV's according to a contractual setup. This is possible because the FO is granted full control of the EV charger. Every time a customer EV is grid connected, the FO will set up a charge plan for charging the EV from current time until estimated off-grid time.