eCHARGE 4DRIVERS

Deliverable 1.1

Study questions and KPIs

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Task 1.1	Study questions, impact areas, and KPIs
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List of abbreviations and acronyms

Abbreviation	Meaning
AC	Alternating Current
B2B	Business-to-Business
CAPEX	CAPital EXpenditure
CO2	Carbon Dioxide
CPO	Charging Point Operator
D	Deliverable
DC	Direct Current
eMSP	electroMobility Service Provider
EU	European Union
EV	Electric Vehicle
H2020	Horizon 2020
ID	Identification
ISO	International Organization for Standardization
KPI	Key Performance Indicator
kW	Kilowatt
L-EV/ (L)EV	Light Electric Vehicle
L1e	Light Two—Wheel Powered Vehicle
L3e	Two-Wheel Motorcycle
MS	Milestone
OCPP	Open Charging Point Protocol
OPEX	OPerating EXpense
PnC	Plug and Charge
PV	Photovoltaic
SoC	State of Charge
T	Task

EXECUTIVE SUMMARY

This document aims to understand various aspects related to the usage of the different charging options and linked e-mobility services, to have an overview of the users' quality of experience, to identify the factors that encourage the users' acceptance and so on. It is also fundamental to determine the social, economic, and environmental aspects that are related to the use and uptake of the charging infrastructure offered in public spaces; the factors influencing the technical performance of the charging infrastructure need to be preliminarily clarified.

Chapter 1 introduces briefly the project's scope and it outlines the objectives as well as the structure of this document.

Chapter 2 presents the eCharge4Drivers methodology for defining the impact areas, study questions and Key Performance Indicators (KPIs). The adopted methodology comprises three phases: i) preliminary analysis of best practices, ii) definition of study questions and KPIs in the eCharge4Drivers context and iii) discussion on study questions and KPIs with pilot areas.

The impact areas of eCharge4Drivers have been specified in terms of relation to the topics that will be assessed in the future project activities and the best practices from the project and literature review. In this respect, the defined impact areas to be discussed and examined in the eCharge4Drivers project are:

- **Usage**: Study if the project has an impact on the way users utilize the charging infrastructure and the related services.
- **Quality of Experience (QoE):** Study if the project has an impact on the users' satisfaction and perceptions of the different aspects of the charging experience.
- **Acceptance:** Study if the project has an impact on users' attitude related to the charging infrastructure, the related services and – in general – electromobility
- **Economy & Market**: Study if the project can enable market takeover of public charging infrastructure and to facilitate positive business cases for suppliers of the charging infrastructure and services.
- **Environment & Society**: Study if the project can achieve sustainability improvements and if it can stimulate electric mobility among society.
- **Technical performance**: Study if the technical performance of the developed system is improved.

In Chapter 3, a review of the most important projects and literature on electric vehicles and charging infrastructure has been carried out to identify existing best practices and lessons learnt that will be considered for planning the eCharge4Drivers impact areas, study questions and KPIs. The main message from this overview is that the key to the rollout of a successful charging infrastructure initiative is the understanding of the charging behaviours of EV users in terms of when they charge, how much energy they consume, how long they charge for, and their choice of charging infrastructure type. In this respect, the analysis of the a-priori situation on EV user's charging behaviour and preferences is realised in two levels: i) via collection of historical filed data from demonstration areas and parking agencies in order to identify users' charging behaviour and mobility patterns and ii) via on-line large-scale questionnaires aiming to capture user's charging concerns and expectations.

Chapter 4 analyses the a-priori situation on EV user's charging behaviour. Consortium partners, CPOs and eMSPs, have been consulted to check their historical data availability This deliverable explains which data category has been asked and which type of data is available by the partners. Data availability is highly correlated with the maturity and the progress level of e-mobility in each demonstration area. In light of this, high diversity, as regards the data availability and quality, among the project demonstration areas has been observed. This document provides insights on the data availability and quality in the demonstration areas (Annex I), while the detailed analysis of the collected sets of historical data will be performed in deliverable D1.2 "*A priori users' concerns and expectations relevant to EV charging*".

Chapter 5 presents the relevant study questions for each impact area and provides the details on selected KPIs that can detect the main factors influencing the success of the project by balancing best practices with the needs of eCharge4Drivers. Overall, 24 study questions and 64 KPIs have been identified for the eCharge4Drivers needs (more details in Section 5), which are distributed among the impact areas as follows:

- **Usage**: 8 study questions and 19 KPIs
- **Quality of Experience (QoE):** 9 study questions and 15 KPIs
- **Acceptance:** 3 study questions and 15 KPIs
- **Economy & Market**: 3 study questions and 7 KPIs
- **Environment & Society**: 3 study questions and 5 KPIs
- **Technical performance**: 1 study questions and 3 KPIs

In addition to the aforementioned study questions and KPIs, Chapter 6 introduces a set of technology and service focused ones aiming to capture users' perspective on the functional requirements of the eCharge4Drivers solutions as well as users' experience and attitude towards the demonstrated systems and services.

The set of study questions and KPIs for the a posteriori analysis and evaluation of the eCharge4Drivers technologies and services will be further extended and enhanced during the evaluation phase of the project under the deliverable D6.1: *eCharge4Drivers Impact Assessment Methodology.*

Chapter 7 clarifies the data availability in each demonstration site from CPO and eMSP partners, before the demonstration and after the demonstrations, to address the general study questions and KPIs listed in chapter 5 for which their data is needed. Then, it specifies which topic is demonstrated in each site and the data collection responsibilities.

Chapter 8 provides recommendations for pilot sites in users' engagement and data collection activities. The main recommendations for the following project activities are to use the content of this document by considering the project progress and to facilitate the engagement of local users and other stakeholders in participating to the data collection phase.

This deliverable will be a useful source of information and inspiration for the next activities to be carried out in eCharge4Drivers, as specified in the KPIs' explanation. In facts, this deliverable includes the presentation of the existing relations between each study question and other work packages and tasks in which those KPIs will be measured during the whole project. Moreover, the methodologies and some preliminary guidelines that will be used to collect the necessary data are explained so that the necessary steps that need to be undertaken are clear from the beginning.

1 INTRODUCTION

1.1 Project intro

eCharge4Drivers is an H2020 project running from June 2020 to May 2024 and deployed by a consortium of 32 partners. Charging an electric vehicle (EV) is still not as convenient as refuelling a conventional vehicle, potentially posing a barrier to increase the market uptake of EVs. eCharge4Drivers works to substantially improve the EV charging experience within cities and for long trips. The project will develop and demonstrate user-friendly charging stations and innovative charging solutions as well as smart charging services for the users. By capturing users' perceptions and expectations on the various charging options and their mobility and parking habits, eCharge4Drivers will organise demonstrations in 10 areas across Europe, including metropolitan areas and Trans-European Transport Network (TEN-T) corridors. Charging stations in these areas will offer user-friendly and convenient functionalities for EV drivers of passenger and light vehicles and motorcycles, such as direct payment methods and bigger, user-friendly displays. Using the knowledge generated, the project will also propose an EV Charging Location Planning Tool, fostering the broad implementation of charging infrastructure in Europe.

1.2 Purpose of the deliverable D1.1

This deliverable aims to report the work performed under Task 1.1 "Study questions, impact areas and Key Performance Indicators (KPIs)". Specifically, D1.1 aims to explain the impact areas of the eCharge4Drivers project, which study question will be addressed and which KPIs will be used to measure and evaluate the impact. Task 1.1 provides the setting for the a-priori assessments and the evaluation methodology, that will be detailed and implemented in WP6, focussing on the a-posteriori impact assessment.

The objectives related to this deliverable have been achieved in full and as scheduled.

1.3 Intended audience

Deliverable D1.1 is a public document aiming to provide to e-mobility related stakeholders, mainly charging point Operators and service Providers insights as regard the way eCharge4Drivers will capture and consider users' perspectives, needs and concerns towards developing user-centric charging technologies and services. Furthermore, the definition of the study questions and KPIs can ensure current or potential e-mobility users that diverse aspects are considered for the design and evaluation of the eCharge4Drivers solutions towards improving their charging experience.

1.4 Structure of the deliverable and its relation with other work packages/deliverables

Deliverable D1.1 aims to provide the report of Task 1.1. Chapter 2 explains the methodology used for defining the impact areas, study questions and KPIs. Chapter 3 summarizes the lessons learnt from the project review. Chapter 4 introduces to current data available from Consortium CPOs and eMSPs. Chapter 5 presents the list of study questions and KPIs in the whole project context, including the relevance for further project tasks. Chapter 6 focuses on specific technologies and service-oriented study questions and KPIs. Chapter 7 clarifies pilot sites data availability and specific remarks. Chapter 8 provides recommendations for pilot sites in users' engagement and data collection. Finally, chapter 9 presents final remarks and conclusions. Annex 1 provides tables explaining which historical data category has been made available by Consortium CPOs and eMSPs.

2 METHODOLOGY

To define the eCharge4Drivers study questions and KPIs, three main steps have been established:

1. Preliminary analysis and set-up of study questions and KPIs on electromobility and charging infrastructure projects, considering existing best practices and lessons learnt.
2. Identification of the relevant study questions and KPIs relevant to the eCharge4Drivers context, considering the implementation plan and expected impacts from each research area. The list of selected questions and KPIs is further extended to adequately serve project objectives and needs.
3. Discussion of the study questions and KPIs with each eCharge4Drivers pilot area and agreement on data collection responsibilities.

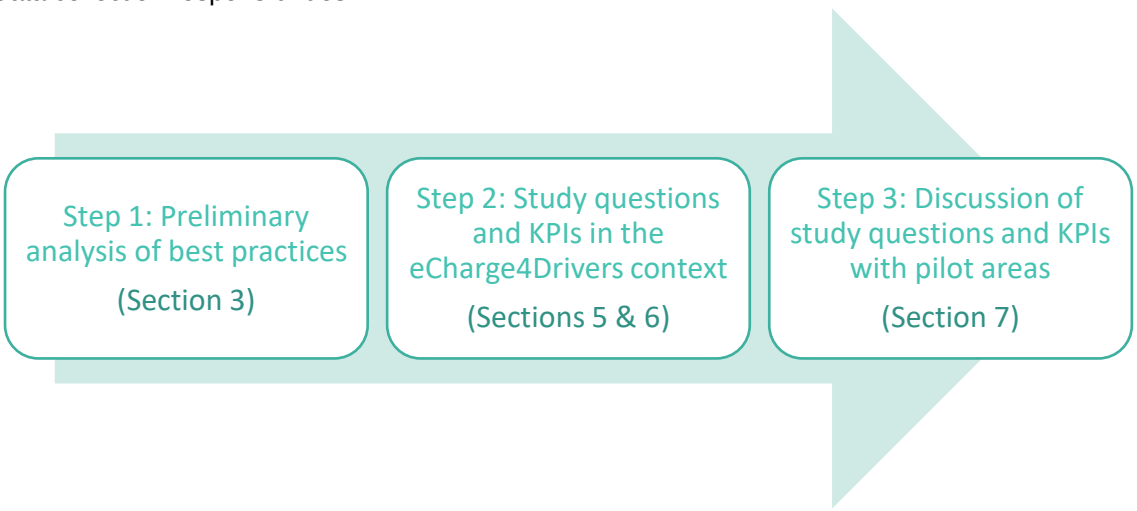

Figure 1 Task 1.1 methodology

In parallel, data availability aspects must be clarified with project partners and data needed to perform the a-priori assessments have been identified. For the needs of the field collection data activities in Task 1.3, consortium CPOs and eMSPs have declared which historical data is going to be provided. This document identifies the data needed for the a-posteriori assessments and defines the data provision responsibilities within the eCharge4Drivers consortium. This initial work will be further extended and finalised in D6.1 "*eCharge4Drivers Impact Assessment Methodology*".

eCharge4Drivers has different data collection phases needed to address the a-priori and a-posteriori analysis. Table 1 provides an overview of the eCharge4Drivers activities in which data collection will occur and the related data collection methodology.

Data Collection tasks and reporting deliverables	Leader	Data collection methodology
Task 1.2: A priori users' concerns and charging expectations (VUB) D1.2: A priori users' concerns and expectations relevant to EV charging	VUB	Questionnaires addressed to: • EV-users (customers of the project partners, people beyond early adopters, urban users, or garage parkers) • Non- EV users (broader population)
Task 1.3: Field data analytics	MOSAIC	• Aggregated real usage data from the CPOs and eMSPs in the consortium

D1.2: A priori users' concerns and expectations relevant to EV charging		• Existing data on mobility and parking habits from previous studies and data by parking agencies of the demonstration areas • Social networks for historical data of user preferences
Task 2.1: Enhanced access to the charging infrastructure D2.1: Design of enhanced services and new charging concepts	MOSAIC	• Interviews with EV users and e-mobility experts before the demonstration phase
Task 2.3: Incentive schemes and tariff structures for the demonstrations D2.2: Accessibility requirements, tariff schemes and incentives	B: SM	• Face to face interviews with investors and authorities before the demonstration phase
Task 5.2: Demonstrations D5.2: Report on demonstrations activities	ICCS + pilot leaders	• Consortium CPOs and eMSPs data collected during the demonstrations
Task 5.3: Data collection monitoring and systems refinement D5.2: Report on demonstrations activities	OTS	• Surveys to users who have participated in the demonstrations (to capture their attitudes towards the demonstrated systems and services) • Surveys to the citizens in the area (to capture their attitudes towards electromobility in general) • Face to face interviews with investors and authorities will be conducted (during the demonstration phase)

Table 1 eCharge4Drivers data collection tasks

To define the impact areas in the overall eCharge4Drivers context, it has been clarified which project activities will focus on the assessment, analysis and use of the data collected. Table 2 provides an overview of the relevant project tasks, related project deliverables and of the topics that will be studied in the assessments.

Assessment tasks and reporting deliverables	Leader	Topics assessed
Task 1.2: A priori users' concerns and charging expectations D1.2: A priori users' concerns and expectations relevant to EV charging	VUB	• Current users charging habits, perceptions, concerns, and expectations as regards different charging options • Current users' mobility and parking habits • Factors influencing users' decision making as regards charging an EV
Task 1.3: Field data analytics D1.2: A priori users' concerns and expectations relevant to EV charging	MOSAIC	Real user patterns or disruptions coming from quantitative data analysis (big data analytics techniques and spatial econometrics)
Task 2.1: Enhanced access to the charging infrastructure	MOSAIC	• Studying which user preferences and other contextual parameters should be

D2.1: Design of enhanced services and new charging concepts		considered by a route planner, to improve the user experience. • Studying which information should be provided to a user and a convenient booking service will be designed • Study the users' preferences with regards to the charging infrastructure design, in terms of accessibility, comfort and impact on the urban environment
Task 2.3: Incentive schemes and tariff structures for the demonstrations D2.2: Accessibility requirements, tariff schemes and incentives	B: SM	• Investors and authorities' concerns as regards the charging infrastructure market area and their attitudes towards future investments.
Task 6.3: A posteriori users' attitudes, evaluation and impact assessment D6.3: Evaluation of project developments, impact assessment and guidelines for future superfast charging systems	ICCS	• Impact of the project developments on users' charging behaviour • Users' experience with charging • Users' attitudes towards the various charging options and services demonstrated • Attitudes of the general population towards electromobility • Investors' and authorities' attitudes towards the demonstrated systems and services • Investors' and authorities' willingness to further invest in charging infrastructure
Task 6.4: Guidelines for improvement of superfast charging systems D6.3: Evaluation of project developments, impact assessment and guidelines for future superfast charging systems	VUB	Technical performance from demonstrations
Task 7.1: EV charging market models D7.1: EV Charging market models	UoS	Analysis of user charging behaviour to develop future market models
Task 7.3: Guidelines for investors and Authorities D7.2: Regulatory and harmonisation recommendations and guidelines for investors and authorities	MOSAIC	Analysis of users' surveys from WP1, stakeholders' views from WP2 and the findings from the demonstrations to develop tariff structures, to maximise the use of charging stations and solutions and to increase gains by the operators.

Table 2 eCharge4Drivers assessment activities

The topics assessed in each eCharge4Drivers analysis and assessment phase, allow identifying which are the areas that are expected to be impacted and which will be the goals of the related study questions. Table 3 defines each impact area, the goals of the study questions that have been identified and the relevance for the project.

Impact area	The goal of the study questions	Relevance in eCharge4Drivers
Usage	Study if the project has an impact on the way users utilize the charging infrastructure and the related services	• A priori analysis reported D1.2 and D2.1. • A posteriori analysis reported in D6.3 and D7.1.
Quality of Experience (QoE)	Study if the project has an impact on the users' satisfaction and perceptions of the different aspects of the charging experience.	• A priori analysis reported D1.2 and D2.1. • A posteriori analysis reported in D6.3 and D7.1.
Acceptance	Study if the project has an impact on users' attitude related to the charging infrastructure, the related services and – in general - electric driving.	• A priori analysis reported D1.2 and D2.1. • A posteriori analysis reported in D6.3 and D7.1.
Economy & Market	Study if the project can enable market takeover of public charging infrastructure and to facilitate positive business cases for suppliers of the charging infrastructure and services.	• A priori analysis reported in D2.2. • A posteriori analysis reported in D7.1 and D7.2
Environment & Society	Study if the project can achieve sustainability improvements and if it can stimulate electric mobility among society.	• A priori analysis reported in D1.2 and D2.1. • A posteriori analysis reported D6.3 and D7.1.
Technical performance	Study if the technical performance of the developed system is improved.	• A posteriori analysis in D6.3.

Table 3 eCharge4Drivers impact areas

3 OVERVIEW OF BEST PRACTICES AND LESSONS LEARNED

This section reports an analysis of existing relevant EU research projects to discover existing best practices and lessons learnt that will be considered for planning the eCharge4Drivers impact areas, study questions and KPIs. The projects that were analysed and used as inspiration for the definition of KPIs for eCharge4Drivers are:

- The ELVITEN project [1], that aims to familiarize citizens with light electric vehicles (L-EVs), proposing replicable usage schemes that can boost sharing or ownership of all the different kind of categories of L-EVs by occasional and systematic urban travellers and by light delivery companies.
- The GreenCharge project [2], that develops smart charging system enabling booking and automatic energy management to balance demand, integrate reusable energy; it also develops business models to encourage the use of EVs and the sharing of energy resources.
- The ASSURED project [3], that aims at boosting the electrification of urban commercial vehicles and their integration with high power fast charging infrastructure, evaluating several infrastructures in different cities across Europe.
- The Green eMotion project [4], that connects ten ongoing regional and national electromobility initiatives leveraging on the results and comparing the different technology approaches to ensure the best solutions prevail for the EU single market.

In ELVITEN, the following impact areas have been identified: L-EVs usage; usage barriers; acceptance; quality of service; environment; economy. First, general study questions and KPIs have been defined for each impact area; then pilot sites specifications have been proposed. A similar approach will be used in eCharge4Drivers, and some study questions and KPIs will be taken from ELVITEN, especially those addressing the peculiarities related to the charging infrastructure.

The GreenCharge evaluation methodology used the CIVITAS Evaluation Framework[1]. It defines methods and provides templates to monitor and evaluate the impact of the project and innovation process. GreenCharge has adopted and customized the CIVITAS Evaluation Framework, focusing on e-mobility. The impact categories were: transport system; energy; economy; environment; society-people; for each impact, general KPIs have been described. For each pilot site, the “focused” KPIs have been selected. eCharge4Drivers will consider GreenCharge KPIs, especially the energy and economy KPIs.

The ASSURED project had used a mix of a bottom-up and top-down approach, involving relations with different stakeholders to develop a “KPI Tree”. The “KPI Tree” provides the detailed specification of KPIs based on the following main criteria: cost; availability/stability; reliability; environmental impacts; performance; quality of service; human factor. Several eCharge4Drivers KPIs will be inspired by ASSURED, especially those related to the technical performance of the eCharge4Drivers solutions.

Green eMotion aimed to facilitate the understanding of all stakeholders about the parameters which may influence the achievement of best possible results for society, environment as well as the economy and, thus, to ensure the transfer of best practices, to create framework plans to accomplish EU wide acceptance of all stakeholders. eCharge4Drivers will learn from the Green eMotion experience in terms of strategies for economic assessment, especially by understanding the usage scenarios considered to develop possible market models. This allows addressing market-related study questions in eCharge4Drivers.

[1] https://civitas.eu/content/evaluation-civitas-evaluation-framework-plus-ii

Several studies have analysed data from EV charging in different cities and managed to gain interesting insight on users' preferences and behaviours, providing relevant recommendations for the industry and policymakers.

For instance, in Robinson's analysis [6] the Switch EV trials in the northeast of England are discussed, focusing on various charge point use cases and their effects on CO2 emissions. It was found that recharging profiles varied between the different user types and locations. Private users peak demand was in the evening at home recharging points. Organisation individual vehicles were recharged primarily upon arrival at work. Organisation pool users recharged at work and public recharging points throughout the working day. It was recommended that pay-as-you-go recharging should be implemented at all public recharging locations, and smart meters should be used to delay recharging at home and work locations until after 23:00 h to reduce peak demand on local power grids and reduce carbon emissions associated with EV recharging.

An analysis of public charging infrastructure located in Amsterdam was undertaken in [9]. The data provided some evidence that the facilitating role of the municipality in developing public charging infrastructure is successful for stimulating electric mobility and enabling zero-emission kilometres driven. Particularly, the demand-driven policy on designating new charging station locations seems effective achieving a relatively high average capacity utilization of the infrastructure. Despite these positive signs the data also showed some concerns. The long connection times of electric vehicles compared to the relatively short charge times point to the difficulty of using the charging stations most effectively. It may provide opportunities for incentives for users, for moving their car once fully charged, or for more flexible charging systems, or for stimulating additional services (e.g. moving services of charged cars) to optimise the use of the current and future charging points.

The results from the Western Australian Electric Vehicle Trial are presented in [7]. The data confirmed that most charging sessions were conducted at business and home locations (55%) while charging stations were only used for 33% of charging events. The EV charging power over time-of-day and aggregated over all charging stations closely resembles a solar PV curve, which means that EV charging stations can ideally be offset by solar PV. Another important finding was that EVs spent significantly more time at a charging station than what was technically required for the charging process. Also, on average, EVs had more than 50% battery charge remaining when they plugged in. This tells us parking spaces are in higher demand than Level-2 charging facilities.

As we may see from the above-mentioned studies, research suggests that the key to the rollout of a successful charging infrastructure initiative is the understanding of the charging behaviours of EV users in terms of when they charge, how much energy they consume, charging session duration and their choice of charging infrastructure type. eCharge4Drivers welcomes these findings and aims to collect a great amount of charging data from ten different pilot sites in Europe, allowing a better understanding of users' behaviours and preferences before and after the innovation brought by the project into the charging infrastructure. To do so, the project will emphasize the usage, quality of service and acceptance. Also, eCharge4Drivers expects to make use of the data collected to address economy, market, environment and technical performance considerations.

The Unified Theory of Acceptance and Use of Technology – UTAUT in [8] explains behavioural intentions to use technology and/or technology as being determined by:

- Performance Expectancy, "the degree to which technology will provide benefits to consumers in performing certain activities",
- Effort Expectancy, "the degree of ease associated with consumers' use of technology",
- Social Influence, "the extent to which consumers perceive that important others believe they should use a particular technology",
- Facilitating conditions, "which refer to consumers' perceptions of the resources and support available to perform the behaviour".

The first three are theorised to influence behavioural intention to use technology, while behavioural intention and facilitating conditions determine behavioural use. Individual difference variables (age, gender, experience) are theorized to moderate various relationships in the model.

In 2012, UTAUT has been expanded by adding three new constructs aiming to predict consumers' behavioural intention to use technology:

- Hedonic Motivation, "the fun or pleasure derived from using a technology",
- Price Value, "the consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them"
- Experience, that "reflects an opportunity to use technology and is typically operationalised as the passage of time from the initial use of technology by an individual" and Habit, "the extent to which people tend to perform behaviours automatically because of learning".

The users' acceptance of the eCharge4Drivers solutions and services and electromobility, in general, will be evaluated using the acceptance constructs from UTAUT.

4 CURRENT DATA

An analysis of currently available data from consortium partners CPOs and eMSPs has been performed to achieve the first important milestone of the project “Aggregated real usage data” (MS1). The availability of these type of information is fundamental to complement the Task 1.2 analysis (focussing on feedback from users and other actors through questionnaires and surveys) with analytical assessments of field data in Task 1.3. The initial data types to be collected from consortium CPOs and eMSPs can be summarized as follows:

- CPOs will provide data from the charging infrastructure
- eMSPs will provide data on:
  - User preferences and booking info (if any)
  - Payments
  - Type of vehicles
  - Data from charging sessions

The table below (Table 4) provides the initial information asked for consortium partners. Annex 1 shows which data categories are available by consortium CPOs and eMSPs. Deliverable D1.2 will provide the results of the analysis conducted with the data collected.

Context	Data	Static / Dynamic	Historical Data	Expected Fields	Format
Charging sessions	Charging sessions by users	Dynamic	Yes	User_ID; Vehicle_ID; VehicleType; Connector; ChargingPoint_ID; StartTime; FinishTime; SOC_Start; SOC_Finish; Energy; Payment; Tariff; VehicleBrand; VehicleModel; CO2Emissions	csv
Infrastructure	Charging Points Occupation	Dynamic	Yes	ChargingStation_ID; ChargingPoint_ID (all); ChargingPoint_Power; ChargingPoint_Connector ChargingPoint_Operator; ChargingPoint_Location; Occupancy; Restrictions (e.g. only for taxis, only for light vehicles etc.)	csv
	Schedule	Static	No	ChargingStation_ID; ChargingPoint_ID (all); MaintenanceSchedule; Schedule;	csv
Vehicles	Vehicle life cycle	Static	No	Vehicle_ID; Vehicle_Type; VehicleBrand; VehicleModel; Mileage; Years; Engine; Battery	csv
	Emissions	Static	No	Energy_Consumption (kWh/km); Emission_level (g/kWh)	csv

Table 4 Current data from CPOs and eMSPs of the eCharge4Drivers Consortium

5 STUDY QUESTIONS, KPIS AND IMPACT AREAS IN THE ECHARGE4DRIVERS CONTEXT

The following sections explain, for each impact area and study question, the relevant KPIs, the general way to measure them, the type of data needed for the measurement, the relevance for further assessments in eCharge4Drivers. The aim is to provide guidelines for eCharge4Drivers partners and for the wider audience on how to address KPIs measurements. The detailed guidelines on how to measure KPIs, such as the time frame for the measurements, the upper and lower boundaries of the measurements, etc., will be specified during the data analysis and assessment phases of the project. A list of KPIs that are useful to address the research questions is provided in this document; eCharge4Drivers partners will be able to update the current indication, depending on actual data availability and future project developments.

5.1.1 Usage

eCharge4Drivers aims to define if the enhanced charging options and charging services developed within the project will lead to a change in the behaviour of users to the use of the different products and services. Understanding usage KPIs in both a-priori and a-posteriori analysis will support the design of the charging infrastructure and services; also, it will provide a useful indication to define new market models and the most appropriate tariff structure and incentives. The following study questions will be addressed:

- How does the use of the charging options change with eCharge4Drivers?
- How does the use of the app-based services change with eCharge4Drivers?
- How does the efficiency of the charging solution change with eCharge4Drivers?
- Does eCharge4Drivers change the users' payment preferences for the EV charge?
- Does eCharge4Drivers improve the availability of the charging infrastructure?
- What is the users' motivation of using the app-based services?
- What are the reasons leading users to charge the (L)EV?
- Are users willing to say how long will they be parked, and which is their SoC when they arrive at the parking to be able to plan the charging of the different users parked?

Below, a description of the KPIs to be addressed is provided.

How does the use of the charging options change with eCharge4Drivers?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Loyalty to the same charging option	Average number/percentage of users who reuse the same charging option more than "n" times in a certain time frame.	Charging point data	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models

Frequency of use of charging options (1)	An average number of uses of each charging options in a certain time frame.	Charging point data	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models
Frequency of use of charging options (2)	Ask users questions about their frequency of use charging options in the same area/neighbourhood in a certain time frame.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models

How does the use of the app-based services change with eCharge4Drivers?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Frequency of use of app-based services	An average number of daily usages of the service in a certain time frame. Recall specifying when data is recorded.	Service provider data	T1.3 A priori quantitative field data analysis T2.1 A priori users' preferences for the design of the booking and route planning service T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators

App users	An average number of app downloads in a certain time frame. Recall specifying when data is recorded.	Service provider data	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
Users uninstalling the app	Average number of app uninstallation in a certain time frame. Recall specifying when data is recorded.	Service provider data	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
App-based services and total charging ratio	The ratio between the average daily number of users of the app-based services and the total charging in the demo site area in a certain time frame (i.e. a percentage of charging sessions being realised by using the app-based booking service in a certain time frame).	Service provider data and charging point data	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

How does the efficiency of the charging solution change with eCharge4Drivers?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Vehicle's charging time	Average time needed to charge the vehicle. Recall: check feasibility to "cluster" different vehicles types	Charging point data	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T6.4 A posteriori technical assessment
Does eCharge4Drivers change the users' payment preferences for the EV charge?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
App-based payments per charging station	An average number of payments by the app for each charging option in a certain time frame.	Charging point data Service provider data	T1.3 A priori quantitative field data analysis[2] T6.3 A posteriori impact analysis on users' behaviours, experience and attitude[3] T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
App-based payments per user	An average number of payments by the app for users in a certain time frame. Recall specifying when data is recorded.	Service provider data	T1.3 A priori quantitative field data analysis[4] T6.3 A posteriori impact analysis on users' behaviours, experience and attitude[5] T7.1 A posteriori users' behaviour

[2] A-priori relevance for pilot sites currently using an app-based payment service.
[3] A-posteriori relevance for pilot sites developing an app-based payment service with eCharge4Drivers.
[4] A-priori relevance for pilot sites currently using an app-based payment service.
[5] A-posteriori relevance for pilot sites developing an app-based payment service with eCharge4Drivers.

			analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
Does eCharge4Drivers improve the availability of the charging infrastructure?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Availability rate (1)	Percentage of charging options that are occupied more than “n” % of the time in a certain time frame.	Charging point data	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Availability rate (2)	Percentage of charging options that are occupied less than “n” % of the time in a certain time frame.	Charging point data	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Average usage ratio of charging options	The ratio between time connected for charging and the total available time, in a certain time frame.	Charging point data	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
What is the users’ motivation for using the app-based services?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Distance of the charging option	Ask users when they check the availability of charging options (e.g. with multiple choice answers: at the start of the trip, during the trip, arriving to the destination)	Users’ answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users’ preferences for the design of the app-based service

Travel type	Ask users for which type of travel they would use the app-based service, e.g. with multiple choice answers: recurrent travel (commuting), sporadic travel (dinner with friends, shopping, etc), long-trips, short-trips, etc ...	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the design of the app-based service

What are the reasons leading users to charge the (L)EV?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Reasons for charging	Ask users questions about typical reasons for charging their (L)EV, e.g. with multiple choice answers.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the charging infrastructure T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models

Are users willing to say how long will they be parked, and which is their SoC when they arrive at the parking to be able to plan the charging of the different users parked?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Users willingness to provide their parking plans	Percentage of users willing to provide their information on parking plans while charging.	Users answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the design of smart charging strategies

Users' willingness to say their current state of charge of the vehicle	Percentage of users willing to provide their information on the state of charge before starting the charging.	Users answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the design of smart charging strategies
Users' willingness to say their desired state of charge of the battery at the departure time	Ask users of the demonstration the desired state of charge of the battery at the departure time	Users answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the design of smart charging strategies

Table 5 Usage KPIs

5.1.2 Quality of Experience (QoE)

eCharge4Drivers aims to study if the quality of users' charging experience changes thanks to the project's innovations. Thus, the users' experience with the charging infrastructure and the related services has to be assessed before and after the demonstrations, to address the design of the eCharge4Drivers products and services and, after the demonstrations, to assess their impact.

The study questions to be addressed are:

- Are users satisfied with the charging option?
- Are users satisfied with the charging services?
- Which is the users' experience in terms of charging options' availability?
- What is the users' experience in terms of range anxiety?
- What is the users' experience with the charging infrastructure accessibility?
- Are users satisfied with the tariff structure of the app-based services?
- Are users satisfied with the information provided by the charging options and by the charging services?
- How does the perception of charging point data management change with eCharge4Drivers?
- What is the user's experience in terms of charging systems' readiness to be used?

Below, a description of the KPIs to be addressed is provided.

Are users satisfied with the charging option?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Satisfaction rate with the charging option	Ask users questions on their level of satisfaction of users with the charging	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations

	option (e.g. on a 1-10 scale)		T2.1 A priori users' preferences for the charging infrastructure T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
Concern rate	Ask users questions on their level of concerns on the charging infrastructure (e.g. on a 1-10 scale)	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators

Are users satisfied with the charging services?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Satisfaction rate with the app-based services	Ask users questions on their level of satisfaction with the app-based services (e.g. on a 1-10 scale)	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the design of the app-based service T6.3 A posteriori impact analysis on users' behaviours,

			experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
Satisfaction rate with the customer service	Ask users questions on their level of satisfaction with the customer service of eMSP/CPO in case of problems (e.g. on a 1-10 scale)	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators

Which is the users' experience in terms of charging options' availability?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Unavailability of charging options due to non-EVs parking	Ask users the average number of times the charging option parking was occupied by non-EVs in a certain time frame.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Unavailability of charging options due to other EVs parking	Ask users the average number of times the charging option parking was occupied by other EVs remaining at the parking lot longer than	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours,

	necessary to charge, in a certain time frame		experience and attitude

What is the users' experience in terms of range anxiety?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Range anxiety improvement rate due to the use of the app-based services	Ask users to which extent the app-based services helped in reducing the range anxiety (e.g. in a 1-10 scale)	Users' answers to a questionnaire	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

What is the users' experience with the charging infrastructure accessibility?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Physical accessibility	Ask users the level of physical accessibility with the charging infrastructure (e.g. in a 1-10 scale)	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the charging infrastructure T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

Are users satisfied with the tariff structure of the app-based services?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Users' willingness to pay the app-based service fee	Ask users if they are willing to pay the app-based service fee.	Users' feedbacks in workshops and focus groups	T2.1 A priori users' preferences for the design of the app-based services

Are users satisfied with the information provided by the charging options and by the charging services?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Users' satisfaction of the information provided by the charging option	Ask users question on their level of satisfaction with the information provided by the charging option.	Users' feedbacks in workshops and focus groups	T2.1 A priori users' preferences for the design of the charging infrastructure T6.3 A posteriori impact analysis on users' behaviours,

			experience and attitude
Users' satisfaction with the information provided by app-based services.	Ask users question on their level of satisfaction with the information provided by the app services linked to the EV charging	Users' feedbacks in workshops and focus groups	T2.1 A priori users' preferences for the design of the app-based service T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Perceived usefulness of app-based services information	Ask users how useful the information provided by app-based services is, in terms of, e.g.: travel changes, predicted occupancy of a charging option, presence of a nearby charging option, etc…	Users' feedbacks in workshops and focus groups	T2.1 A priori users' preferences for the design of the app-based services T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

How does the perception of charging point data management change with eCharge4Drivers?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Data privacy perception rate	Ask users questions related to their perception about data privacy (e.g. in a 1-10 scale)	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models

What is the user's experience in terms of charging systems' readiness to be used?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Users' perception of the readiness of the authentication system	Ask users to which extent the login process for a charging session does not block (e.g. in a 1-10 scale)	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

Users' perception of the readiness of the charging system	Ask users to which extent charging sessions are ready to start immediately (e.g. in a 1-10 scale).	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

Table 6 QoE KPIs

5.1.3 Acceptance

The users' acceptance of the eCharge4Drivers charging solutions and services will be evaluated using the acceptance constructs from UTAUT, as described in Section 3. The users' acceptance will be investigated for each charging solution and service demonstrated in pilot sites. The impact of eCharge4Drivers on users' acceptance of electromobility, in general, will be evaluated as well. Thus, the study questions are the following:

- Are eCharge4Drivers charging options and services accepted by users?
- Does eCharge4Drivers affect users' acceptance of electromobility in general?
- Would users recommend others to use products and services provided by their CPOs and eMSPs?

Below, a description of the KPIs to be addressed is provided.

Are eCharge4Drivers charging options and services accepted by users?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Performance Expectancy (I)	Ask users questions about the benefits they perceive from the charging options and services used.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Effort Expectancy (I)	Ask users questions related to the level of effort needed to use the charging options and services used.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Social Influence (I)	Ask users questions on the influence other people have for their charging habits	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations

			T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Facilitating conditions (I)	Ask users questions about the availability of resources and support to use the charging options and services used.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Hedonic Motivation (I)	Ask users questions about how fun or pleasant it is to use the charging options and services.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Price Value (I)	Ask users questions about benefits from using the charging options and services compared to the monetary cost for using it.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Experience – Habit (I)	Ask users questions about their willingness to use the charging options and services.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

Does eCharge4Drivers affect users' acceptance of electromobility in general?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Performance Expectancy (II)	Ask users questions about the benefits they perceive from electromobility	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations

	compared to conventional mobility.		T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Effort Expectancy (II)	Ask users questions related to the level of effort needed to use an (L)EV compared to other mobility means.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Social Influence (II)	Ask users questions on the influence other people have concerning electromobility.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Facilitating conditions (II)	Ask users questions about the availability of resources and support for electromobility.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Hedonic Motivation (II)	Ask users questions about how fun or pleasant it is to use an (L)EV.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Price Value (II)	Ask users questions about benefits from electromobility compared to the monetary cost for using it.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

Experience – Habit (II)	Ask users questions about their willingness to use an (L)EV	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Would users recommend others to use products and services provided by their CPOs and eMSPs?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Loyalty toward CPOs and eMSPs	Ask users if they would recommend others to use the products and services provided by their CPOs and eMSPs.	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models

Table 7 Acceptance KPIs

5.1.4 Market & Economy

The technologies developed in eCharge4Drivers are expected to provide economic advantages to different market stakeholders; for this reason, interactions with investors, authorities, CPOs and eMSPs will be needed to get their feedback on their economic expectations. Thus, three main study questions will be addressed:

- Does eCharge4Drivers enable more investments?
- Does eCharge4Drivers enable economic advantages to CPOs and eMSPs?
- Do technological advancements by eCharge4Drivers open to new business opportunities?

Below, a set of KPIs is provided.

Does eCharge4Drivers enable more investments?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Willingness to invest in charging services among the stakeholders interviewed	Ask stakeholders their level of willingness to invest in charging services (e.g. in a 1-10 scale).	Investors and Public Authorities feedbacks in workshops and focus groups	T2.3 A priori investors and authorities' concerns and attitudes on investments T6.3 A posteriori impact analysis on

			investors and authorities' attitudes and willingness to invest T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
Does eCharge4Drivers enable economic advantages to CPOs and eMSPs?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
CAPEX of the charging solution or service	Ask CPOs and eMSPs to provide the CAPEX of the charging solution provided. Recall: specify when the data is recorded.	CPOs and eMSPs budget data	T2.3 A priori investors and authorities' concerns and attitudes on investments T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
OPEX of the charging solution or service	Ask CPOs and eMSPs to provide the OPEX of the charging solution provided. Recall: specify when the data is recorded	CPOs and eMSPs budget data	T2.3 A priori investors and authorities' concerns and attitudes on investments T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
Revenues	Ask CPOs and eMSPs to provide their yearly revenues from the charging solution provided. Recall: specify when the data is recorded	CPOs and eMSPs budget data	T2.3 A priori investors and authorities' concerns and attitudes on investments T7.1 A posteriori users' behaviour analysis to develop future market models

			T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
Savings	Ask CPOs and eMSPs to provide their yearly savings. Recall: specify when the data is recorded	CPOs and eMSPs budget data	T2.3 A priori investors and authorities' concerns and attitudes on investments T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
Cost reduction due to balancing	Electricity costs	Charging point data	T1.3 A priori quantitative field data analysis T6.4 A posteriori technical assessment
Do technological advancements by eCharge4Drivers open to new business opportunities?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
CPOs and eMSPs perception of new business opportunities	Ask CPOs and eMSPs questions on their perception of new business opportunities arising from the eCharge4Drivers technological advancements (e.g. in a 1-10 scale). Recall: specify when the data is recorded	CPOs and eMSPs feedbacks in workshops and focus groups	T2.3 A priori investors and authorities' concerns and attitudes on investments T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators

Table 8 Market & Economy KPIs

5.1.5 Environment & Society

The different project developments are expected to unlock the deployment of electromobility and, therefore, to improve the air quality in urban centres and to push for a more liveable urban space for citizens. To define the environmental and societal impacts of the project, three study questions will be addressed:

- Does eCharge4Drivers provide environmental benefits?
- Is the charging infrastructure respectful for the environment?
- Does eCharge4Drivers contribute to a wider spread of (L)EVs?

The related KPIs are explained below.

Does eCharge4Drivers provide environmental benefits?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Users' access to sustainable energy resources	% of respondents that are in the possession or have easy access to sustainable energy resources	Users' answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori expectations on the urban environment T6.3 A posteriori impact analysis on the general population
Is the charging infrastructure respectful for the environment?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Citizens perception on the level of occupancy of the area due to the charging infrastructure	Ask users and the broader population to which extent they feel like the charging infrastructure is obstructive (e.g. in a 1-10 scale)	Users and broader population feedbacks in workshops and focus groups	T2.1 A priori expectations on the urban environment T6.3 A posteriori impact analysis on the general population
Perceived noise emission from the charging infrastructure	Ask users and the broader population to which extent they feel like the charging infrastructure is emitting noise (e.g. in a 1-10 scale)	Users and broader population feedbacks in workshops and focus groups	T2.1 A priori expectations on the urban environment T6.3 A posteriori impact analysis on the general population
Perceived integration of the charging infrastructure in the urban landscape	Ask users and the broader population to which extent they feel like the charging infrastructure is well integrated into the urban landscape (e.g. in a 1-10 scale)	Users and broader population feedbacks in workshops and focus groups	T2.1 A priori expectations on the urban environment T6.3 A posteriori impact analysis on the general population

Does eCharge4Drivers contribute to a wider spread of (L)EVs?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Non-(L)EV drivers willing to shift from conventionally fuelled vehicles to (L)EV in the future	% of respondents, who are not early adopters, urban users, or garage parkers, respond that they would buy an EV.	Broader population answers to a questionnaire	T1.2 A priori analysis on (non-(L)EV) users' habits, concerns and expectations T6.3 A posteriori impact analysis on the general population

Table 9 Environment & Society KPIs

5.1.6 Technical Performance

To assess whether the project provides a technical improvement of the current charging infrastructure and service, the technical performance of the solutions developed has to be studied. This document provides an initial set of study questions and KPIs that will be addressed; however, the list will be further specified while the eCharge4Drivers technical deployments will be run. The evaluation methodology of WP6 will explain in detail how to address the evaluation of the technical performance. The main study questions to be established in the current project phase is:

- Do technical problems improve with eCharge4Drivers?

Below, the set of relevant KPIs is provided.

Do technical problems improve with eCharge4Drivers?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Complaints rate	The ratio between the number of complaints about the charging station received and the total uses of the charging option in a certain time frame.	Charging point data	T1.3 A priori quantitative field data analysis T6.4 A posteriori technical assessment
Technical problems reported during the charging experience	Average technical problems reported by the charging option in a certain time frame.	Charging point data	T1.3 A priori quantitative field data analysis T6.4 A posteriori technical assessment
Technical problems reported by app-based services use	Average technical problems reported by the app-based systems in a certain time frame.	Service provider data	T2.1 A priori users' preferences for the design of the app-based service T6.4 A posteriori technical assessment

Table 10 Technical Performance KPIs

6 ECHARGE4DRIVERS TECHNOLOGY AND SERVICE-ORIENTED FOCUS

The design and development of user-centric charging solutions require a deep understanding of users' perceptions and expectations. In this respect, the users' charging preferences towards project's charging technologies and services should be captured during the preparation phase of the project and be transformed into user requirements guiding the project's technological and service advancements towards as well as during the demonstration phase to identify how EV charging experience is improved by the project's advancements.

6.1 Overview of demonstrated charging technologies and services

6.1.1 Advanced eCharge4Drivers charging systems

- **Advanced charging stations for passenger vehicles and motorcycles**: a variety of charging options for passenger and L3e vehicles - in terms of charging power level (from 20kW up to greater than 150kW) and charging technology (AC and DC) - will be developed offering advanced and user-friendly interfaces and supporting ISO 15118 Plug & Charge.
- **Low-power DC charging for passenger vehicles and scooters**: a central charging station serving simultaneously multiple charging connections for passenger and light electric vehicles will be developed enabling unidirectional charging at 15-45kW as well as bi-directional charging at 11kW and aiming to increase the connection efficiency and minimise the investment cost.
- **Mobile charging service**: electrified bike trailers with exchangeable batteries will be available for commercial and private users for charging passenger vehicles at their parking spot wherever charging stations are not available or do not exist. Enhanced information for the charging process and booking capabilities will be offered by the respective user interface of the mobile charging service
- **Battery swapping stations for L1e vehicles** will be developed equipped with batteries from different manufacturers for serving a variety of electric scooters for commercial and private customers.
- **Charging points at lamp posts** will be developed aiming to minimize the street clutter and the expensive civil works

6.1.2 Advanced eCharge4Drivers charging services

- **Enhanced route planning** will be developed to support users of different social groups to overcome acceptance barriers in the usage of EVs, calculating and proposing different plans based on user profile and preferences and real-time availability of charging stations and parking bays.
- **Multi-user planner** aims to further extend the route planner to optimise multiple charging requests with available charging stations and minimise the waiting times for all users
- **Enhanced booking service** will be developed aiming to improve user's charging and accessibility experience considering real-time availability of charging stations, parking bays and real-time tariffs.
- **Smart charging strategies** a variety of smart charging concepts will be demonstrated to improve the user's charging experience by serving diverse objectives: minimising charging cost considering (dynamic) charging prices and tariffs, charging from renewable energy reducing the environmental impact of the charging process, power-constrained charging for more efficient exploitation of electricity infrastructures, charging aiming to reduce battery degradation, combined EV charging with battery storage operation, bi-directional EV charging and user-controlled charging
- **Predictive diagnostics service** aims to continuously monitor the status of the traction battery of an EV, determine the battery capacity degradation and the maximum available power during

charging/discharging, provide an optimized charging for improving the battery performance and life and inform the user in advance of any problems with the battery

6.2 Indicative technology/service focused study questions/KPIs

This section aims to provide technology and service focused study questions and KPIs that may be used to capture users' perceptions towards the design and development of the project's charging solutions. Establishing technologies' and services' specific KPIs will support the evaluation of the project charging systems and services after the demonstration activities.

This section of the document provides a preliminary list which is defined in respect to the initial identification of the project needs during the preparation project period (M1-M3). This list is expected to be further extended for the project's progress, during the design and evaluation phases.

6.2.1 Advanced eCharge4Drivers charging systems

6.2.1.1 Advanced charging stations for passenger vehicles and motorcycles

The advanced charging stations for passenger vehicles and motorcycles will be monitored and evaluated by using the study sections and KPIs specified in section 5. Further technology-specific study questions and KPIs may be defined later in the project while specifying the evaluation methodology.

6.2.1.2 Low-power DC charging for passenger vehicles and scooters

Impact area: Usage **How does the efficiency of the charging solution change with eCharge4Drivers?**			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Grid supporting time	Average time needed to support the local grid. Recall: check feasibility to "cluster" different vehicles types	Charging point data & local grid operator	T1.3 A priori quantitative field data analysis T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T6.4 A posteriori technical assessment

Table 11 Low-power DC charging for passenger vehicles and scooters: system-specific KPIs

6.2.1.3 Mobile Charging Service

Impact area: Usage How does the efficiency of the charging services change with eCharge4Drivers?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Charging option reaching time	Average time to bring the mobile charger to the car	Service provider data	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T6.4 A posteriori technical assessment
Impact area: Quality of Experience **What is the users' expectation concerning the time performance of the mobile charging service?**			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Charging option reaching time	Ask users questions related to the average time to bring the mobile charger to the car they expect to have with a mobile charger.	Users answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the design of the mobile charging service

Table 12 Mobile Charging Service: system-specific KPIs

6.2.1.4 Battery swapping stations for L1e vehicles

Impact area: Usage How does the efficiency of the charging services change with eCharge4Drivers?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Charging option reaching time	Average time to reach battery swapping stations	Service provider data	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T6.4 A posteriori technical assessment

Battery swapping time	Time to exchange battery including user identification time and check out	Service provider data	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T6.4 A posteriori technical assessment
Availability of fully charged batteries for swapping	SoC of batteries in the station at the time of booking request	Service provider data	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T6.4 A posteriori technical assessment
How versatile the batteries with output converter are in domestic and professional uses in BSS (Battery Swapping Station) transaction?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
The versatility of battery swapping stations	Average time of domestic use of a battery with converter DC-AC VS average time of professional use of a battery with converter DC-AC	Service provider data	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T6.4 A posteriori technical assessment
Impact area: Quality of Experience **What is the users' expectation concerning the time performance of the battery swapping stations?**			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Charging option reaching time	Ask users questions related to the average time to reach the battery swapping stations they expect to have.	Users answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the design of the battery swapping stations

Table 13 Battery swapping stations for L1e vehicles: system-specific KPIs

6.2.1.5 Charging points at lamp posts

The charging points at lamp posts will be monitored and evaluated by using the study sections and KPIs specified in section 5. Further technology-specific study questions and KPIs may be defined later in the project while specifying the evaluation methodology.

6.2.2 Advanced eCharge4Drivers charging services

6.2.2.1 Enhanced route planner

Impact area: Quality of Experience What is users' expectation of information provided by app-based services that could potentially change their travel plans with (L)EV?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Users' expectation on the ability of the route planning service to change route automatically in case of charging option occupancy	Ask users to which extent they perceive as important the ability of the route planner to change route automatically in case of charging option occupancy	Users' feedbacks in workshops and focus groups	T2.1 A priori users' preferences for the design of the route planner

Impact area: Quality of Experience What is users' satisfaction on information provided by app-based services that could potentially change their travel plans with (L)EV?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Users' satisfaction on the ability of the route planning service to change route automatically in case of charging option occupancy	Ask users to which extent they perceive as important the ability of the route planner to change route automatically in case of charging option occupancy	Users' feedbacks in workshops and focus groups	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

Table 14 Enhanced route planner: service specific KPIs

6.2.2.2 Multi-user planner

The multi-user planner will be monitored and evaluated by using the study sections and KPIs specified in section 5. Further technology-specific study questions and KPIs may be defined later in the project while specifying the evaluation methodology

6.2.2.3 Enhanced booking

Impact area: Quality of Experience Which is the users' experience in terms of charging options' availability?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Unavailability rate reported by the app-based booking service	The ratio between the average number of times the user does	Service provider data / Charging point data	T6.3 A posteriori impact analysis on users' behaviours,

	not find an available charging point with the app-based booking service and total requests in a certain time frame.		experience and attitude
Availability rate reported by the app-based booking service	The ratio between the average number of real reservations via the app and the average number of accesses to the app-based booking service in a certain time frame.	Service provider data / Charging point data	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

Table 15 Enhanced booking: service specific KPIs

6.2.2.4 Smart charging strategies

Impact area: Usage What are the users' reasons to use smart charging services?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Users' reasons for using smart charging services	Ask users questions about typical reasons for using the smart charging services e.g. with multiple choice answers	Users answers to a questionnaire	T1.2 A priori analysis on users' habits, concerns and expectations T2.1 A priori users' preferences for the design of smart charging strategies T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models

Impact area: Quality of Experience What is the users' experience in terms of range anxiety with the use of smart charging strategies?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Users' influence of range anxiety on charging type decision	Ask users to which extent the range anxiety influence their decision to use smart charging or "normal charging" (e.g. in a 1-10 scale	Users answers to a questionnaire	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Range anxiety improvement rate due to the use of smart charging strategies	Ask users to which extent the smart charging strategies helped in reducing the range anxiety (e.g. in a 1-10 scale)	Users answers to a questionnaire	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

Table 16 Smart charging strategies: service specific KPIs

6.2.2.5 Predictive diagnostics

Impact area: Usage What is the frequency of use of predictive diagnostic services?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Frequency of use of the predictive diagnostic service	An average number of uses of the predictive diagnostic service in a certain time frame. Recall specifying when data is recorded	Predictive diagnostic service data	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models

Impact area: Quality of Experience Are users satisfied the predictive diagnostic services?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
The satisfaction rate of the predictive diagnostic service	Ask users questions on their level of satisfaction with the predictive diagnostic service (e.g. on a 1-10 scale)	Users' answers to a questionnaire	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude T7.1 A posteriori users' behaviour analysis to develop future market models T7.3 A posteriori users' analysis to develop new tariff structure and to increase gains of operators
Acceptance **Study question: What is the users' acceptance for the predictive diagnostic services?**			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Performance expectancy of the predictive diagnostic service	Ask users questions related to the perceived benefits of using the predictive diagnostic service (e.g. in a 1-10 scale)	Users' answers to a questionnaire	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Social influence on predictive diagnostic services	Ask users questions related to the social influence by other people on using the predictive diagnostic services (e.g. in a 1-10 scale)	Users' answers to a questionnaire	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude
Awareness rate of predictive diagnostic services	Ask users questions on their level awareness on predictive diagnostic services (e.g. in a 1-10 scale)	Users' answers to a questionnaire	T6.3 A posteriori impact analysis on users' behaviours, experience and attitude

Impact area: Technical Performance Study question: Do technical problems improve with eCharge4Drivers?			
KPI	**How to measure the KPI**	**Data needed**	**Relevance in the project**
Technical problems reported during the use of the predictive diagnostic service	Average technical problems reported by the predictive diagnostic service the in a certain time frame (specify)	Predictive diagnostic service data	T6.4 A posteriori technical assessment

Table 17 Predictive diagnostics: service specific KPIs

7 STUDY QUESTIONS AND KPIS IN PILOT AREAS

Based on the eCharge4Driver study questions and KPIs explained in section 5, this document has addressed, for each pilot area, the KPIs that will be studied and agreed on responsibilities for the data collection.

7.1 Overview of KPIs assessed in pilot areas

In general, all KPIs that can be measured with answers to questionnaires or feedbacks through focus groups or workshops will be addressed in all pilot areas before and after the demonstrations. If needed, questionnaires, interviews and focus groups will customise the questions to users or other stakeholders according to the specific charging options and services present in the area. The KPIs that can be measured through CPO's and EMSP's data will not be always measured before and after the demonstration, due to data availability issues.

In the following tables we can see if the data from pilot sites' charging point operators and service providers will be available before (B), after (A) or before and after (B&A) the demonstration. Even though - in general – questionnaires, feedbacks, focus groups or workshops, will be addressed in all pilot areas before and after the demonstrations, the tables provide reminders and remarks about some specific demonstration site, due to different types of charging options and service present in the area.

7.1.1 Usage KPIs in pilot areas

	Barcelona	Grenoble	Berlin	Luxemburg	Zellik	Bari	Austria	Northern Italy	Greece	Turkey
How does the use of charging option change with eCharge4Drivers?										
Loyalty to the same charging station	B&A	B&A[6]	A[7]	B&A	A	B&A	B&A	B&A	A	B&A
Frequency of use of charging stations (1)	B&A	B&A	A	B&A	A	B&A	B&A	B&A	A	B&A
Frequency of use of charging stations (2)	B&A	B&A	B&A	B&A	A	B&A	B&A	B&A	B&A	B&A
How does the use of the app-based services change with eCharge4Drivers?										
Frequency of use of app-based services	B&A	A	A		A	B&A		B&A	A	B&A
App users	B&A	A	A		A	B&A	B&A	B&A	A	B&A
Users uninstalling the app			A		A	B&A		B&A[8]	A	

[6] not relevant/not applicable for mobile charging
[7] not relevant/ not applicable for battery swapping and mobile charging
[8] Recall to specify the area

App-based booking service and total charging ratio					A	A		A	A	
How does the efficiency of the charging services change with eCharge4Drivers?										
Vehicle's charging time	B&A	B&A	A[9]		A	B&A	B&A	B&A	A	
Does eCharge4Drivers change the users' payment preferences for the EV charge?										
App-based payments per charging station	B&A		A		A	B&A	B&A	B&A	A	
App-based payments per user	B&A [10]	A	A		A	B&A	B&A	B&A	A	
Does eCharge4Drivers improve the availability of the charging infrastructure?										
Availability rate (1)	B&A			B&A	A	A	B&A	B&A	A	B&A
Availability rate (2)	B&A			B&A	A	A	B&A	B&A	A	B&A
Average usage ratio of charging options	B&A	A	A	B&A	A		B&A	B&A		
What is the users' motivation for using app-based services?										
The distance of the charging option	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A [11]	B&A	B&A
Travel type	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A [12]	B&A	B&A
What are the reasons leading users to charge the (L)EV?										
Reasons for charging	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Are users willing to say how long will they be parked and which is their SoC when they arrive at the parking to be able to plan the charging of the different users parked?										
Users willingness to provide their parking plans	B&A	B&A	B&A [13]	B&A	B&A	B&A	B&A	B&A [14]	B&A	B&A
Users' willingness to say their current state of	B&A	B&A	B&A [15]	B&A [16]	B&A	B&A	B&A	B&A [17]	B&A	B&A

[9] Not relevant/not applicable for battery swapping
[10] Before only at parking stations
[11] Recall to specify the area
[12] Recall to specify the area
[13] Not relevant/not applicable for battery swapping
[14] Recall to specify the area
[15] Not relevant/not applicable for battery swapping as data on SoC is made available by exchanging an empty or used battery with a full battery
[16] Due to the nature of the area, this KPI may not be relevant for the Luxembourg pilot site.
[17] Recall to specify the area

charge of the vehicle										
Users' willingness to say their desired state of charge of the battery at the departure time	B&A	B&A [18]	B&A [19]	B&A [20]	B&A	B&A	B&A	B&A [21]	B&A	B&A

Table 18 Usage KPIs in pilot areas

7.1.2 Quality of Experience KPIs in Pilot areas

	Barcelona	Grenoble	Berlin	Luxemburg	Zellik	Bari	Austria	Northern Italy	Greece	Turkey
Are users satisfied with the charging option?										
Satisfaction rate with the charging option	B&A	B&A	B&A	B&A [22]	B&A	B&A	B&A	B&A	B&A	B&A
Concern rate	B&A	B&A	B&A	B&A [23]	B&A	B&A	B&A	B&A	B&A	B&A
Are users satisfied with the charging services?										
The satisfaction rate of the app-based services	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
The satisfaction rate of the customer service	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Which is the users' experience in terms of charging stations availability?										
Unavailability of charging options due to non-EVs parking	B&A	B&A [24]	B&A [25]	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Unavailability of charging options due to other EVs parking	B&A	B&A [26]	B&A [27]	B&A	B&A	B&A	B&A	B&A	B&A	B&A
What is the users' experience in terms of range anxiety?										

[18] Limited applicability for mobile charging
[19] Not relevant/not applicable for battery swapping. Limited applicability for mobile charging.
[20] Due to the nature of the area, this KPI may not be relevant for the Luxembourg pilot site
[21] Recall to specify the area
[22] To be asked : 1. For the "Chargy-wide" network, 2. filtered for test site "smart charging".
[23] To be asked : 1. For the "Chargy-wide" network, 2. filtered for test site "smart charging".
[24] Not relevant/not applicable for battery swapping and mobile charging
[25] Not relevant/not applicable for battery swapping and mobile charging
[26] Not relevant/not applicable for battery swapping and mobile charging
[27] Not relevant/not applicable for battery swapping and mobile charging

Range anxiety improvement rate due to the use of the app-based services	A	A	A	A	A	A	A	A	A	A
What is the users' experience with the charging infrastructure accessibility?										
Physical accessibility	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Are users satisfied with the tariff structure of the app-based services?										
Users' willingness to pay the app-based service fee	B	B	B	B	B	B	B	B	B	B
Are users satisfied with the information provided by the charging options and by the charging services?										
Users' satisfaction of the information provided by the charging option	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Users' satisfaction of the information provided by the app-based services	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Perceived usefulness of app-based services information	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
How does the perception of charging point data management change with eCharge4Drivers?										
Data privacy perception rate	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
What is the user's experience in terms of charging systems' readiness to be used?										
Users' perception of the readiness of the authentication system	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Users' perception of the readiness of the charging system	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A

Table 19 QoE KPIs in pilot areas

7.1.3 Acceptance KPIs in Pilot areas

	Barcelona	Grenoble	Berlin	Luxemburg	Zellik	Bari	Austria	Northern Italy	Greece	Turkey
Are eCharge4Drivers charging options and services accepted by users?										
Performance Expectancy (I)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Effort Expectancy (I)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Social Influence (I)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Facilitating conditions (I)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Hedonic Motivation (I)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Price Value (I)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Experience – Habit (I)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Does eCharge4Drivers affect users' acceptance of electromobility in general?										
Performance Expectancy (II)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Effort Expectancy (II)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Social Influence (II)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Facilitating conditions (II)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Hedonic Motivation (II)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Price Value (II)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Experience – Habit (II)	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Would users recommend others to use products and services provided by their CPOs and eMSPs?										
Loyalty toward CPOs and eMSPs	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A

Table 20 Acceptance KPIs in pilot areas

7.1.4 Market & Economy KPIs in Pilot areas

	Barcelona	Grenoble	Berlin	Luxemburg	Zellik	Bari	Austria	Northern Italy	Greece	Turkey
Does eCharge4Drivers enable more investments?										
Willingness to invest in charging services among the stakeholders interviewed	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Does eCharge4Drivers enable economic advantages to CPOs and eMSPs?										
CAPEX of the charging solution or service	A	A	A[28]	A	A	A		A		
OPEX of the charging solution or service	A	A	A[29]	A	A	A	A	A	A	
Revenues	A	A	A[30]	A	A	A		A		B&A [31]
Savings	A	A		A	A	A	A	A		B&A [32]
Cost reduction due to balancing	A			B&A [33]	A		A			
Do technological advancements by eCharge4Drivers open to new business opportunities?										
CPOs and eMSPs perception of new business opportunities	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A

Table 21 Market & Economy KPIs in pilot areas

7.1.5 Environment & Society KPIs in Pilot areas

	Barcelona	Grenoble	Berlin	Luxemburg	Zellik	Bari	Austria	Northern Italy	Greece	Turkey
Does eCharge4Drivers provide environmental benefits?										
Users' access to sustainable energy resources	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A

[28] Variations will be available
[29] Variations will be available
[30] Variations will be available
[31] Only for the demo site area
[32] Only for the demo site area
[33] See specificity in the Luxembourg section description

Is the charging infrastructure respectful for the environment?										
Citizens perception on the level of occupancy of the area due to the charging infrastructure	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Perceived noise emission from the charging infrastructure	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Perceived integration of the charging infrastructure in the urban landscape	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A
Does eCharge4Drivers contribute to a wider spread of EV?										
Non-(L)EV drivers willing to shift from conventionally fuelled vehicles to (L)EV in the future	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A	B&A

Table 22 Environment & Society KPIs in pilot areas

7.1.6 Technical performance KPIs in Pilot areas

	Barcelona	Grenoble	Berlin	Luxemburg	Zelik	Bari	Austria	Northern Italy	Greece	Turkey
Do technical problems improve with eCharge4Drivers?										
Complaints rate	B&A	A	A	B&A	A	B&A	B&A	B&A	A	B&A
Technical problems reported during the charging experience	B&A	A	A	B&A	A	B&A	B&A	B&A	A	B&A
Technical problems reported by app-based services use	B&A	A	A		A	B&A		B&A	A	A

Table 23 Technical performance KPIs in pilot areas

7.2 Overview of specificities in each pilot site

This section provides the details of each pilot site in terms of the current status of the demonstration area, demonstrated features implemented in eCharge4Drivers and data providers.

7.2.1 Barcelona

7.2.1.1 Current e-mobility Status

In the city of Barcelona, there are 4,000 registered EVs. B: SM is the CPO that runs a network of 500 charging stations on public roads and in municipal car parks extended through the diverse districts. The city of Barcelona operates 46 underground car parks, each equipped with up to 12 EV charging points. There are 192 off-street slow charging stations for cars and 174 for LEVs, 112 on-street slow charging stations for LEVs, 4 for eTaxis, 4 for urban freight transport vehicles and 18 fast-charging stations. 10 new fast-charging stations will be installed per year. There are service and app to find a charging station, but charging is for the moment free.

The location of available charging stations is not optimum, some are used very often while others are never used. The majority of charging transactions lasts much longer than required and some charging points are occupied by users not allowed to park. Users do not know if a charging station is occupied or not, there is no booking service available, and no payment means exist.

7.2.1.2 eCharge4Drivers implementation

- User-friendly, low- and high-power charging stations for passenger vehicles and motorcycles supporting ISO 15118 Plug & Charge
- Back-ends supporting ISO 15118 Plug & Charge
- Enhanced route planners
- Enhanced booking service
- Enhanced information during charging
- Smart charging services
- Battery swapping stations for LEVs
- New tariff schemes
- Incentives

7.2.1.3 Data providers

Data needed	Data provider
Charging point data	B:SM will provide the charging point data
Service provider data	B:SM and Electromaps will provide service provider data
Users' data	B:SM and Electromaps will support in reaching pilot site users for filling the questionnaires
Investors' data	B:SM and Electromaps will support in reaching pilot site users for interviews or for filling questionnaires.
Public authorities' data	B:SM will provide public authorities data
Broader population data	B:SM will support in collecting broader population data

Table 24 Data providers in the Barcelona demonstration area

7.2.2 Grenoble

7.2.2.1 Current e-mobility Status

There are around 800 EVs in the Grenoble Municipal Area (GAM) and around 9,000 in Rhône-Alpes (2017 data); the charging point network consists of 40 charging stations (14 fast at 50kW DC and 26 at 22kW AC) and 120 stations for car sharing that need to be redesigned for normal EVs. It is estimated that there are also 35 privately owned charging stations. There are apps to find and pay for a charging station.

More charging stations are needed but there are constraints due to the grid and electricity supply, availability of public space and the high cost of grid connection and the charging station itself. There is no booking service available and interoperability is a barrier. Misbehaviour of some EV drivers is a problem, as they stay plugged when the charge is complete, and misbehaviour of some thermic car drivers too, who park on charging stations' parking spaces.

7.2.2.2 eCharge4Drivers implementation

- User-friendly, low- and high-power charging stations for passenger vehicles and motorcycles supporting ISO 15118 Plug & Charge
- Enhanced booking service
- Smart charging services
- Mobile charging service
- Charging points on lamp posts
- New tariff schemes

7.2.2.3 Data providers

Data needed	Data provider
Charging point data	Chargery: data from mobile charging services CEA: data for smart charging services Grenoble-Alpes Métropole through its operator Bouygues Energies et Services: data for lamp posts Grenoble-Alpes Métropole through its operator Bouygues Energie et Services: data for other charging points
Service provider data	Chargery: data from the app booking service and payment service, demo phase. CRF: predictive diagnostic service data
Users' data	Grenoble Alpes Metropole
Investors' data	Bouygues Energies et Services
Public authorities' data	Grenoble Alpes Metropole
Broader population data	Grenoble Alpes Metropole

Table 25 Data providers in the Grenoble demonstration area

7.2.3 Berlin

7.2.3.1 Current e-mobility Status

In 2018 there were 2,000 EVs registered in Berlin and around 2,500 L1e vehicles. The number of private EVs registered in Berlin reached 6,500 EVs at the end of 2019 and 25,000-30,000 EVs are expected at

the end of the eCharge4Drivers project. There were 0.22 public charging stations per 1000 residents and 3.2 EVs per public charging station in 2018.

Only in 2019 2,500 more shared EV cars have been introduced in Berlin abruptly increasing the charging demand which is not being met, mainly in the city centre. EV users spend a considerable amount of time and energy to find a usable charging station. On the other hand, there is very limited public space in the city centre for additional charging stations with corresponding parking slots. Current CPs have limited interoperability and offer no information to the user before and during the charging process.

Battery charging for LEVs/ L1E vehicles include (almost for all vehicles) the separate charging of the traction battery at home or at the office at low power 230V sockets. Due to limited space and weight restraints of the vehicle, traction batteries offer limited capacity and range. An initial network of battery swapping stations addresses mainly B2B customers and their needs. Expanding this network for private customers will offer battery exchange service everywhere and thus an improved range extension.

7.2.3.2 eCharge4Drivers implementation

- Back-ends supporting ISO 15118 Plug & Charge
- Enhanced booking service
- Mobile charging service
- Battery swapping stations for LEVs
- New tariff schemes
- Incentives

7.2.3.3 Data providers

Data needed	Data provider
Charging point data	Chargery: data from mobile chargers
Service provider data	Chargery: app-based services data
Users' data	Chargery will support in reaching pilot site users for filling the questionnaires.
Investors' data	Chargery will support in reaching pilot site investors for interviews or for filling questionnaires.
Public authorities' data	Pilot site partners – Chargery, Greenpack, HUBJECT – will be the link between the eCharge4Drivers project and local public authorities.
Broader population data	Chargery eMo (Berlin Electromobility Agency)

Table 26 Data providers in the Berlin demonstration area

7.2.4 Luxemburg

7.2.4.1 Current e-mobility Status

The total population of the Grand Duchy of Luxembourg is 602,000 and growing rapidly. In addition to that, nearly 200,000 people cross the French, Belgian and German borders to work in Luxembourg. Luxembourg's stakeholders (Creos Luxembourg S.A., Electris, SudstroumSàrl& Co Secs, Ville de Diekirch, Ville d'Ettelbruck) are deploying and operating 800 public dual charging stations (1,600 charging points) throughout the Grand-Duchy until 2020, the so-called "Chargy" network. Half of the

charging stations are located in local centres and the other half along major roads, e.g. on park and ride places and along the North Sea-Mediterranean Corridor, crossing Luxembourg. All charging stations can be accessed via the “mKaart” (mobility card) providing access to a diverse mobility offering as well as via Plug-Surfing Europe-wide network.

A major problem that the project “Chargy” faces is the lack of respect demonstrated by other drivers. EV parking spaces are often occupied by ICE cars despite obvious marking of the spots, thus leading to unpleasant situations when cars need to be removed.

7.2.4.2 eCharge4Drivers implementation

- Enhanced booking service
- Smart charging services
- Incentives
- EV Charging Location Planning tool

7.2.4.3 Data providers

Data needed	Data provider
Charging point data	Creos (through Nexxtlab)
Service provider data	Creos (through Nexxtlab)
Users’ data	Nexxtlab will establish contacts
Investors’ data	Creos (through Nexxtlab)
Public authorities data	Nexxtlab will establish contact to the Luxembourg’s Ministry of Energy and Spatial Planning
Broader population data	Nexxtlab will establish contacts

Table 27 Data providers in the Luxembourg demonstration area

7.2.4.4 Specific KPIs

Due to the nature of the local context, the Luxembourg pilot site is expected to investigate whether the technologies and services implemented within eCharge4Drivers will affect terms of:

- Future emissions saved thanks to the increased share of renewable energies for charging EVs
- Grid hosting capacity
- Self-consumption optimisation
- Cost reduction due to balancing

Data is available thanks to local stakeholders directly or indirectly involved in the project.

Furthermore, the pilot site is willing to discover if the recent incentives from the Government have raised citizens’ willingness to use public charging solutions.

The methodology to approach this analysis will be specified within the evaluation phase of the project.

7.2.5 Zellik

7.2.5.1 Current e-mobility Status

The demonstration will take place in the Green Energy Park located in an industrial zone at the border between Brussels and Flanders close to the TEN-T network, where 70 companies from different sectors

are active. Green Energy Park is set-up as a living lab to bridge the gap between research, innovation, realisation, and exploitation in the domains of energy and mobility transition, hospital of the future, and smart region. The Green Energy Park infrastructure is currently in build-up with the construction of a carpark with grid connection, energy storage and photovoltaics to accustom the innovative charging solutions from ABB and Powerdale in the eCharge4Drivers projects. The site accommodates 199 parking spots that will be equipped with charging infrastructure according to the demand for EV charging infrastructure of the site. The parking will serve the dayshift of an adjacent hospital (1,000 people per week) and as a carpool parking in the weekends. The Green Energy Park will operate over 10 charging points in a smart charging set-up, 15 chargers are at 7 companies in the industrial zone (semi-private). 40 charging stations for cars are planned by 2021.

The Campus is facing challenges to host in a sustainable way the energy and mobility needs for its over 5,000 employees, over 5,000 students and 500,000 patients with a growth of over 15% the last 10 years. Apart from the centralized charging facilities at the Green Energy Campus, the whole research park also has geographically decentralized charging stations of various types and configurations. The goal of the Green Energy Park is to have one integrated local grid system with centralised and decentralised production to balance energy supply and demand.

7.2.5.2 eCharge4Drivers implementation

- User-friendly, low- and high-power charging stations for passenger vehicles and motorcycles supporting ISO 15118 Plug & Charge
- Back-ends supporting ISO 15118 Plug & Charge
- Low-power DC charging stations supporting ISO 15118 Plug & Charge
- Enhanced route planners
- Enhanced booking service
- Enhanced information during charging
- New tariff schemes
- Incentives

7.2.5.3 Data providers

Data needed	Data provider
Charging point data	ABB and PWD
Service provider data	ABB and PWD
Users' data	VUB will be the liaison for the distribution of user surveys
Investors' data	VUB will be responsible for the connection and conduction of interviews with investors
Public authorities' data	VUB will be the liaison for the connection with public authorities
Broader population data	VUB will be the liaison for the distribution of user surveys

Table 28 Data providers in the Zellik demonstration area

7.2.6 Bari

7.2.6.1 Current e-mobility Status

The Metropolitan City of Bari is included in a project co-funded by Bank European of Investment that estimates the installation of 14,000 new charging points in the next five years in Italy. In the framework

of this project, 20-40 charging stations will be installed in Bari in 2019 and an additional project promoted by Metropolitan City of Bari will provide more charging stations in the city. The services by Route220 to find a charging station and pay cover the area.

Charging stations are not efficiently used. Fast charging systems are not widespread. There is lack of knowledge on charging procedures and a lack of suitable payment systems.

7.2.6.2 eCharge4Drivers implementation

- User-friendly, low- and high-power charging stations for passenger vehicles and motorcycles supporting ISO 15118 Plug & Charge
- Enhanced route planners
- Enhanced booking service
- Enhanced information during charging
- New tariff schemes
- Incentives

7.2.6.3 Data providers

Data needed	Data provider
Charging point data	EVWAY – Route220, ENELX
Service provider data	EVWAY – Route220 (all app-based services)
Users' data	EVWAY – Route220 will circulate questionnaires to its users
Investors' data	EVWAY – Route220, POLIBA and the Municipality of Bari will support in reaching the investors involved in the site for interviews or for filling questionnaires
Public authorities' data	Municipality of Bari
Broader population data	EVWAY – Route220 and POLIBA will support in reaching pilot site broader population for filling the questionnaires

Table 29 Data providers in the Bari demonstration area

7.2.7 Austria

7.2.7.1 Current e-mobility Status

SMATRICS operates in Austria a nationwide high-speed charging network. More than 435 charging stations are already available today. Some 210 of them are high-speed ones with 43kW or 50kW output and are located along motorways and in urban centres, covering also the Rhine – Danube TEN-T corridor. There are around 12,000 active users in Austria.

There is no booking possible today, as there is no reliable information if a charging point is not occupied by a parked vehicle. Plug & Charge feature must be deployed in the network to be ready for the market developments and to improve the user experience. Network connection for super-fast charging stations carries prohibitive connection costs, thus leading to foreseeable shortages of available power to customers.

7.2.7.2 eCharge4Drivers implementation

- Upgrades of high-power charging stations to support ISO 15118 Plug & Charge and OCPP

- Back-ends supporting ISO 15118 Plug & Charge

7.2.7.3 Data providers

Data needed	Data provider
Charging point data	SMATRICS
Service provider data	SMATRICS, VERBUND
Users' data	SMATRICS will support in reaching pilot site users for filling the questionnaires.
Investors' data	SMATRICS will support in reaching the investors involved the site for interviews or for filling questionnaires.
Public authorities' data	SMATRICS will support in reaching public authorities involved in the site for interviews or for filling questionnaires.
Broader population data	SMATRICS will support in reaching the pilot site broader population for filling the questionnaires.

Table 30 Data providers in the Austria demonstration area

7.2.8 Northern Italy

7.2.8.1 Current e-mobility Status

About 13,000 EVs have been registered in Italy since 2010. 2018 presented an increase of 89% compared to 2017. In 2017, in Italy, there were about 2,750 charging stations, 48% of which are installed in the north. In September 2018, the Milan Municipality has approved the installation of 1,000 CPs within the next two years. Route220 has installed charging stations in Trentino Alto-Adige along the "Scandinavian – Mediterranean" corridor, 20 pubic charging stations in Turin and some more in other cities like Mantova (6 CPs), Province of Mantova (5 CPs), Vercelli (3 CPs), Bolzano, Rome and Padova (10 CPs) along the "Mediterranean" corridor. About 3800 clients currently use the Route220 app to charge their vehicles using the infrastructure by Route220 or other CPOs. Furthermore, there are additional 200 clients who are using Route220 infrastructure without the app.

The main problems related to charging in the area are:

- Few of the charging stations are interoperable.
- Route planner that considers charging point locations is not available.
- Booking a charging station cannot be provided at the time being because it is difficult to control illegal parking

7.2.8.2 eCharge4Drivers implementation

- User-friendly, low- and high-power charging stations for passenger vehicles and motorcycles supporting ISO 15118 Plug & Charge
- Back-ends supporting ISO 15118 Plug & Charge
- Enhanced route planners
- Enhanced booking service
- Enhanced information during charging
- New tariff schemes
- Incentives

7.2.8.3 Data providers

Data needed	Data provider
Charging point data	EVWAY – Route220
Service provider data	EVWAY – Route220 (all app-based services)
Users' data	EVWAY – Route220 will circulate questionnaires to its users
Investors' data	EVWAY – Route220 will support in reaching SUB_CPO companies who chose Route220 platform to manage their charging point network
Public authorities' data	EVWAY – Route220 will support in reaching local authorities where charging points are installed.
Broader population data	EVWAY – Route220 and ICOOR will support in reaching pilot site broader population for filling the questionnaires

Table 31 Data providers in the Northern Italy demonstration area

7.2.9 Greece

7.2.9.1 Current e-mobility Status

Around 1,000 EVs are in circulation in Greece, but the number is expected to increase. EV car-sharing services will start operating in summer on two Greek islands. BFS has installed 12 fast-charging stations in petrol stations along major Greek highways and plans to expand their network.

Limited information about the availability of the charging stations is available. Paying for energy is not possible and how a tariff should be designed is not yet clear.

7.2.9.2 eCharge4Drivers implementation

- Upgrades of high-power charging stations to support ISO 15118 Plug & Charge and OCPP
- Back-ends supporting ISO 15118 Plug & Charge
- Enhanced route planners
- Enhanced booking service
- Enhanced information during charging

7.2.9.3 Data providers

Data needed	Data provider
Charging point data	BFS
Service provider data	BFS
Users' data	BFS
Investors' data	To de decided during pilot site meetings. The initial focus group will be the gas stations owners

Public authorities' data	To de decided during pilot site meetings. Municipalities will be the initial focus group.
Broader population data	BFS and ICCS will support in reaching pilot site broader population for filling the questionnaires

Table 32 Data providers in the Greece demonstration area

7.2.10 Turkey

7.2.10.1 Current e-mobility Status

At the end of 2018, there were around 1,200 EV registered in Istanbul, they 2,000 at the end of 2019 and 30,000 are expected at the end of the project. Recently an EV sharing system is available with 30 cars in Istanbul. A new regulation requires that 2 out of 50 parking should offer charging stations. ZES operates 10 fast charging stations and installed such stations at 200 different locations in 2019. Zorlu Energy keeps two different roles in this project which one of them is CPO with Zorlu Energy Solutions Company and the other one is eMSP with its Electrip Company. Those two different affiliates will be providing required datasets.

The main current problems related to charging in the area are:

- Services are not interoperable
- Difficulties in finding suitable places for DC charging
- Charging stations are not efficiently used
- There is no payment system

7.2.10.2 eCharge4Drivers implementation

- User-friendly, low- and high-power charging stations for passenger vehicles and motorcycles supporting ISO 15118 Plug & Charge
- Back-ends supporting ISO 15118 Plug & Charge
- Enhanced route planners
- Enhanced booking service
- Enhanced information during charging

7.2.10.3 Data providers

Data needed	Data provider
Charging point data	Zorlu Energy Solutions will be the provider of CPO data.
Service provider data	Electrip will be the provider of eMSP data.
Users' data	Questionnaires or surveys could be sent via e-mail or other digital solutions to attract surveyors' attention online.
Investors' data	Investors could be the other CPOs or eMSP in this business.
Public authorities' data	Public authorities could be EMRA (Turkish Electricity Market Regulatory Authority) or other stakeholders in EV business.
Broader population data	Conducting an online survey could be more useful to find broader population data.

Table 33 Data providers in the Turkey demonstration area

8 RECOMMENDATIONS FOR USERS' AND STAKEHOLDERS' ENGAGEMENT IN DATA COLLECTION IN PILOT SITES

The project requires the engagement of pilot sites users of (L)EVs to fill the questionnaires needed to retrieve useful data for a-priori and a-posteriori analysis. The project is ambitious in this sense, thus a strong commitment by pilot sites partners is needed to get as many responses as possible. For this reason, this section of the document aims at providing the eCharge4Drivers partners with preliminary guidelines for data collection.

8.1 General recommendations

- Consider the "Data Collection and Reporting Guidelines for European electro-mobility projects" provided by the Joint Research Centre Directorate on Energy, Transport and Climate [5].
- Use this deliverable to guide the development of the questionnaires, understanding which data is needed from CPOs and eMSPs
- However, always take into consideration the current context and project developments
- Select the most appropriate KPIs to choose how to address the impact assessment

8.2 Specific recommendations

8.2.1 Profiling of the users

- Define the different age groups between users
- Explore the users' background before addressing the questions
- Understand who the users are: the collection of basic data about the users will help to define preferences for different clusters (the type of car, annual mileage, personal experience with EV, used recharging point interfaces they use, the usual place for charging (public vs private charging spot)
- Groups of citizens or non-profit organizations that gather around this topic can provide valuable inspiration to others; existing networks can be also exploited for promotion

8.2.2 Engagement techniques

- Consider different engagement techniques for raising citizens' awareness new services
- Engagement techniques should be segmented to the needs of the audience (i.e. young people reached through social media, elderlies might need another approach)
- Raising awareness on the questionnaire and engaging in the data provided should be considered different channels, depending on the target group. Some engagement channels are direct letter, information market, open-air event, presentation, personal explanation at an event, video, media contribution, website, social networks, informal meeting, Questions and Answers, lectures, site visit, and engagement of volunteers.

8.2.3 Formatting of the questionnaire

- The format of the questionnaire can affect people's willingness to fill it out. Surveys should be and/or formatted attractively, clearly printed, well organized, easy to complete and as short as possible – ask only those questions related to your goals and objectives
- Before preparing questionnaires, ask pilot sites' partners to confirm what is included in section 5 of this deliverable

8.2.4 Formulation of the questions

- Include non-technical aspects for EV charging
- Avoid complex questions and unnecessary technical terms and jargon
- Focus on the benefits of the survey in the users' daily EV experience
- Do not forget to include a short description of the project, focusing on the main benefits project will bring to the target group you are addressing
- At the same time, avoid over-excessive statements about the project. Refer to the project's targets and objectives in a simple and moderate way

8.2.5 Sense of (co)- ownership

- Inspire the users as "co-creators" of a new innovative technology
- Assure them that their needs come first, and their participation is valuable for improving EV experience
- Make them feel that their opinion matters
- Prioritise the local stakeholders' benefits (financial, cost-effective etc.) in accordance with their profiles
- Explain thoroughly the sustainability aspects and environmentally friendly solutions of the project and highlight their contribution to sustainability

8.2.6 Correct follow-up

- Keep the users informed and up to date for the results of the survey.
- Let them know that they can easily reach you if they need more explanations or they have questions for the project.

9 CONCLUSIONS

This document has provided an initial framework for eCharge4Drivers partners and for external stakeholders to define the impact areas, the study questions and the KPIs for this project. The content of this document is useful not only for eCharge4Drivers partners but also for external stakeholders dealing with the development of charging technologies and e-mobility services.

The methodology adopted for defining the eCharge4Drivers impact areas, study questions and KPIs comprises three phases: i) preliminary analysis of best practices, ii) definition of study questions and KPIs in the eCharge4Drivers context and iii) discussion on study questions and KPIs with pilot areas.

An overview of the most important, relevant projects and literature on electric vehicles and charging infrastructure has been performed to identify existing best practices and lessons learnt that were considered for specifying the eCharge4Drivers impact areas, study questions and Key Performance Indicators (KPIs). Such an analysis is necessary in order to ensure that the eCharge4Drivers impact areas and data collection potentialities are in line with the need of understanding of users' behaviours and preferences before and after innovations' deployment. This analysis concluded by defining the impact areas to be discussed and examined in the eCharge4Drivers project, as follows:

- **Usage**: Study if the project has an impact on the way users utilize the charging infrastructure and the related services
- **Quality of Experience (QoE):** Study if the project has an impact on the users' satisfaction and perceptions of the different aspects of the charging experience.
- **Acceptance:** Study if the project has an impact on users' attitude related to the charging infrastructure, the related services and – in general - electric driving.
- **Economy & Market**: Study if the project can enable market takeover of public charging infrastructure and to facilitate positive business cases for suppliers of the charging infrastructure and services.
- **Environment & Society**: Study if the project can achieve sustainability improvements and if it can stimulate electric mobility among society.
- **Technical performance**: Study if the technical performance of the developed system is improved.

In respect to the identified impact areas, a set of study questions and the respective KPIs were proposed. Overall, 24 study questions and 64 KPIs have been identified for the eCharge4Drivers needs (more details in Section 5), which are distributed among the impact areas as follows:

- **Usage**: 8 study questions and 19 KPIs
- **Quality of Experience (QoE):** 9 study questions and 15 KPIs
- **Acceptance:** 3 study questions and 15 KPIs
- **Economy & Market**: 3 study questions and 7 KPIs
- **Environment & Society**: 3 study questions and 5 KPIs
- **Technical performance**: 1 study questions and 3 KPIs

In addition to the aforementioned study questions and KPIs, a set of technology and service focused ones have been proposed aiming to capture user's perspective on the functional requirements of the eCharge4Drivers solutions as well as user's experience and attitude towards the demonstrated systems and services.

The quantitative and qualitative data required for the calculation of the proposed eCharge4Drivers KPIs will be collected via surveys, which will be conducted in demonstration areas, and/or will be provided in

pseudonymised format by the CPOs and eMSPs of the eCharge4Drivers'consortium. For the data collection as regards charging preferences and concerns via surveys, user engagement is a very important task. Thus, a preliminary set of guidelines and recommendations for pilot sites in users' engagement and data collection activities is suggested. For the collection of historical data from CPOs and eMSPs from demonstration areas, the availability and quality of data are crucial factors for the extraction of mobile/parking and charging profiles. Data availability and quality are proved to be highly dependent on the maturity level of the e-mobility situation.

The next steps in eCharge4Drivers will be using this document to design and perform the analysis of the current needs and expectations by users and other stakeholders before the eCharge4Drivers demonstrations in pilot sites. In turn, the design and development of the eCharge4Drivers products and services will follow recommendations provided by the a-priori analysis. Some insights provided in this document will be used as a basis to design the evaluation methodology of the eCharge4Drivers demonstration. This KPIs will be complemented with more KPIs that are relevant to the technical performance of the demonstrated systems and solutions and their operational and economic functioning. The data to be recorded and the methodology to calculate the KPIs from the recordings of the demonstrations will be defined. The data format and the necessary sample sizes to get significant results will be further specified.

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ANNEX 1: CURRENT DATA AVAILABILITY

Electromaps (Barcelona pilot site)

Context	Data	Static / Dynamic	Historical Data	Available data category	Format	Data sharing method
Charging sessions	Charging sessions by users	Dynamic	Yes	User_ID; Connector; ChargingPoint_ID; StartTime; FinishTime; Energy	csv	CSV doc with all the data between the start and final dates defined.
Infrastru-cture	Charging Points Occupation	Dynamic	Yes	ChargingStation_ID; ChargingPoint_ID (all); ChargingPoint_Power; ChargingPoint_Connector ChargingPoint_Operator; ChargingPoint_Location;	csv	CSV doc with all the data between the start and final dates defined.

B:SM (Barcelona pilot site)

At the time of deliverable development, B:SM is processing and pseudonymizing the data of the Barcelona demonstration site. Further data will be available later in the project.

GAM (Grenoble pilot site)

Context	Data	Static / Dynamic	Historical Data	Available data category	Format	Data sharing method
Charging sessions	Charging sessions by users	Dynamic	Yes	User_ID; Connector; ChargingPoint_ID; StartTime; FinishTime; Tariff; energy delivered by the charging point during the charging session	csv	Database on a supervision software platform
Infrastru-cture	Charging Points Occupa-tion	Dynamic	Yes	ChargingStation_ID; ChargingPoint_ID (all); ChargingPoint_Power; ChargingPoint_Connector ChargingPoint_Operator; ChargingPoint_Location;	csv	Database on a supervision software platform

*data from July 2020

Berlin pilot site

At the time of deliverable D1.1 writing, the historical data from the Berlin pilot area is available through the Berlin “Energie Atlas”. The full set of historical data is not shared yet, but project partners are in close contact with Berlin stakeholders.

Nexxtlab (Luxemburg pilot site)

Context	Data	Static / Dynamic	Historical Data	Expected Fields	Format	Data sharing method
Charging sessions	Charging sessions by users	Dynamic	Yes	Connector; ChargingPoint_ID; StartTime; FinishTime; Energy	csv	CSV doc with all the data between the start and final dates defined.
Infrastru-cture	Charging Points Occupation	Dynamic	Yes	ChargingStation_ID; ChargingPoint_ID (all); ChargingPoint_Power; ChargingPoint_Connector ChargingPoint_Operator; ChargingPoint_Location; Occupancy.	csv	CSV doc with all the data between the start and final dates defined.

Zellik pilot site

Historical data from the demonstration site in Zellik is not available because the demonstration site is getting equipped during the time of this deliverable writing.

Route 220 (Bari pilot site)

Context	Data	Static / Dynamic	Historical Data	Expected Fields	Format	Data sharing method
Charging sessions	Charging sessions by users	Dynamic	Yes	User_ID; VehicleType (only if the user fill this data in the profile); Connector; ChargingPoint_ID; StartTime; FinishTime; Energy; Payment; Tariff;	Json	CSV doc with all the data between the start and final dates defined.

Infrastru-cture	Charging Points Occupation	Dynamic	Yes	ChargingStation_ID; ChargingPoint_ID (all); ChargingPoint_Power; ChargingPoint_Connector ChargingPoint_Operator; ChargingPoint_Location; Occupancy	Json	CSV doc with all the data between the start and final dates defined.

SMATRICS (Austria pilot site)

Context	Data	Static / Dynamic	Historical Data	Expected Fields	Format	Data sharing method
Charging sessions	Charging sessions by users	Dynamic	Yes	Connector; ChargingPoint_ID; StartTime; FinishTime; Energy; Payment; Tariff;	csv	CSV export by E-Mail / via roaming platform Hubject
Infrastru-cture	Charging Points Occupation	Dynamic	Yes	ChargingStation_ID; ChargingPoint_ID (all); ChargingPoint_Power; ChargingPoint_Connector ChargingPoint_Operator; ChargingPoint_Location; Occupancy; Restrictions (e.g. only for taxis, only for light vehicles etc.)	csv	CSV export by E-Mail / via roaming platform Hubject
	Schedule	Static	No	ChargingStation_ID; ChargingPoint_ID (all); MaintenanceSchedule; Schedule;	csv	CSV export by E-Mail

Route 220 (Northern Italy pilot site)

Context	Data	Static / Dynamic	Historical Data	Expected Fields	Format	Data sharing method

Charging sessions	Charging sessions by users	Dynamic	Yes	User_ID; Vehicle Plate (only if the user fill this data in the profile); VehicleType (only if the user fill this data in the profile); Connector; ChargingPoint_ID; StartTime; FinishTime; Energy; Payment; Tariff; VehicleBrand (only if the user fill this data in the profile); VehicleModel (only if the user fill this data in the profile); CO2Emissions	CSV	CSV doc with all the data between the start and final dates defined.
Infrastru-cture	Charging Points Occupation	Dynamic	Yes	ChargingStation_ID; ChargingPoint_ID (all); ChargingPoint_Power; ChargingPoint_Connector ChargingPoint_Operator; ChargingPoint_Location; Occupancy; Restrictions (e.g. only for taxis, only for light vehicles etc.)	csv	CSV doc with all the data between the start and final dates defined.

Greece pilot site

The Greek demonstration site has no IT-based historical data to the fact that there is no IT system installed yet which can provide such data from the stations of their network. A manual register of historical data is available.

ZES (Turkey pilot site)

Context	Data	Static / Dynamic	Historical Data	Expected Fields	Format	Data sharing method
Charging sessions	Charging sessions by users	Dynamic	Yes	User_ID; Connector; ChargingPoint_ID; StartTime; FinishTime; SOC_Start; SOC_Finish; Energy; Payment; Tariff	CSV	CSV doc with all the data between the start and final dates defined.

Infrastru-cture	Charging Points Occupation	Dynamic	Yes	ChargingStation_ID; ChargingPoint_ID (all); ChargingPoint_Power; ChargingPoint_Connector ChargingPoint_Operator; ChargingPoint_Location; Occupancy; Restrictions (e.g. only for taxis, only for light vehicles etc.)	csv	CSV doc with all the data between the start and final dates defined.