greencharge2020.eu

GreenCharge Project Deliverable: D2.17

Implementation Plan for Barcelona Pilot

Authors: Regina Enrich [Eurecat],Albert Rodríguez [Eurecat], Ricard Soler [Atlantis], Lluis Freixas [Atlantis], Baltasar López [Enchufing], Alberto León [Motit], Valentín Porta [Motit], Sonja Pajkovska [Hubject]

www.civitas.eu

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About GreenCharge

GreenCharge takes us a few important steps closer to achieving one of the dreams of modern cities: a zero-emission transport system based on electric vehicles running on green energy, with traffic jams and parking problems becoming things of the past. The project promotes:

Power to the people!	The GreenCharge dream can only be achieved if people feel confident that they can access charging infrastructure as and when they need it. So GreenCharge is developing a smart charging system that lets people book charging in advance, so that they can easily access the power they need.
The delicate balance of power	If lots of people try to charge their vehicles around the same time (e.g. on returning home from work), public electricity suppliers may struggle to cope with the peaks in demand. So we are developing software for automatic energy management in local areas to balance demand with available supplies. This balancing act combines public supplies and locally produced reusable energy, using local storage as a buffer and staggering the times at which vehicles get charged
Getting the financial incentives right	Electric motors may make the wheels go round, but money makes the world go round. So we are devising and testing business models that encourage use of electric vehicles and sharing of energy resources, allowing all those involved to cooperate in an economically viable way
Showing how it works in practice	GreenCharge is testing all of these innovations in practical trials in Barcelona, Bremen and Oslo. Together, these trials cover a wide variety of factors: vehicle type (scooters, cars, buses), ownership model (private, shared individual use, public transport), charging locations (private residences, workplaces, public spaces, transport hubs), energy management (using solar power, load balancing at one charging station or within a neighbourhood, battery swapping), and charging support (booking, priority charging).

To help cities and municipalities make the transition to zero emission/sustainable mobility, the project is producing three main sets of results: (1) innovative business models; (2) technological support; and (3) guidelines for cost efficient and successful deployment and operation of charging infrastructure for Electric Vehicles (EVs).

The innovative business models are inspired by ideas from the sharing economy, meaning they will show how to use and share the excess capacity of private renewable energy sources (RES), private charging facilities and the batteries of parked EVs in ways that benefit all involved, financially and otherwise.

The technological support will coordinate the power demand of charging with other local demand and local RES, leveraging load flexibility and storage capacity of local stationary batteries and parked EVs. It will also provide user friendly charge planning, booking and billing services for EV users. This will reduce the need for grid investments, address range/charge anxiety and enable sharing of already existing charging facilities for EV fleets.

The guidelines will integrate the experience from the trials and simulations and provide advice on localisation of charging points, grid investment reductions, and policy and public communication measures for accelerating uptake of electromobility.

For more information

Project Coordinator: Joe Gorman, joe.gorman@sintef.no

Dissemination Manager: Arno Schoevaars, arno.schoevaars@pnoconsultants.com

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Executive Summary

This document presents the implementation plan for Barcelona pilot. To link with complementary work presented in D2.16, an overview of the pilot site is provided. Basically the pilot of Barcelona will be realized in Barcelona province, not only Barcelona city. In fact, the pilot is composed by 3 different demonstrators: EURECAT demonstrator, MOTIT demonstrator and Sant Quirze demonstrator.

In EURECAT demonstrator a booking service open to Eurecat employees will be implemented. The service will be available in 2 of the 8 Eurecat offices. It will enable to demonstrate the scenarios for booking of charging points, charging and enforcement at a booked charging point, and smart management of the charging infrastructure combined with other loads in the premises and energy locally generated. The target users are both Eurecat employees, who require a solution for their daily mobility when they shift from ICE cars to electric cars, and Eurecat (as an entity), that should be able to satisfy their staff needs without compromising the operation of the buildings and minimizing the investment in new infrastructure and energy contracts. At the same time, it can be used as a branding to attract talented human resources.

In MOTIT demonstrator the main goal is to improve the operation of the fleet by introducing smart management in the charging process. The charging process is done with battery hubs instead of standard charging points. Taking into account electricity tariffs and operation constraints, an optimization module will calculate the best set-points to be applied. Currently, the batteries are charged as soon as they are connected. Involvement of the users will be tested by incentivizing them to drop the e-scooters nearby a battery hub. Currently, they can drop the e-scooter anyway, and the MOTIT staff spend time and energy to replace the flat batteries by fully charged ones. That target user is mainly the fleet operator, but also users will be involved in the measure that incentivizes dropping of e-scooters nearby battery hubs.

In Sant Quirze demonstrator an existing e-bike sharing service open to train commuters who work in the factories in the industrial area will be upgraded. ICT tools will enhance traceability and security for the fleet operator and added-value to the user. Furthermore, the deployment of a PV panel and a stationary battery, together with the smart charging module will enable the optimization of the charge of batteries with cheaper and greener energy. The main target user is the municipality that will be able to safely expand the service and convince factory managers to invest in the sharing service. The users will benefit from the measures, too, since if successfully proven, the fleet will grow.

The GreenCharge reference architecture will be adapted and instantiated according to the needs of the demonstrator. The basic components are: the in-vehicle system, the booking management system, the charging management system, the energy management system, the e-roaming system and the DER devices (PV panel and stationary battery).

Data will be collected automatically, when possible, both from the systems deployed in the demonstrators and from third parties. In the first group the data to be collected refers to energy consumption in the charging points, energy production of the PV panels, state of charge of EV batteries and the stationary battery and location of assets for e-bikes and e-scooters. The second group corresponds to external data sources that will be used to get information for weather conditions, electricity tariffs and energy mix. In addition, some type of information will be collected manually; mainly the data referring to users and stakeholders feedback. Surveys, workshops and focus groups will be organised before the piloting phase, at an intermediate stage and at the end of the piloting phase. Yet a communication channel will be enabled in the tools available for users (smartphone apps and web-apps) to allow reporting of issues, troublesome, suggestions, praises and complaints.

Low penetration of EVs and sharing services has been identified as a potential risk. That is why three different demonstrators have been selected. Further work is being conducted to engage more members in the Local Reference Group, not only to get access to existing data, but to find candidates for replicability of the tools developed. Furthermore, communication and dissemination activities will be extensively used to engaged users and stakeholders. Workshops, interviews, newsletters will be the main mechanisms used.

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The pilot plan includes a phase for specification, development or adaptation of hardware and software components, lab testing, field testing, baseline data collection and user recruitment, before the actual demonstration phase starts in September-October 2019. The demonstration, which will extend until February 2021, will include two test cycles. Fine tuning and some extra functionalities will be added in the second cycle according to the intermediate evaluation results. During the demonstration phase, data will be collected and support to users will be provided to guarantee the proper running of the services. A final evaluation of data gathered from the pilot site and some simulations will be analysed to extract results and lessons learned for further scalability and replicability.

Further work has to be conducted in order to refine the architecture definition, the implementation plan and supporting activities. Intensive collaboration with WP4, WP5, WP6 and WP8 is required in the next 6 months to be ready for the trial phase in August-September 2019.

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List of Abbreviations

Table 1: List of abbreviations

Abbreviation	Explanation
API	Application Programming Interface
BEMS	Building Energy Management System
BMS	Battery Management System
DER	Distributed Energy Resource
DSO	Distribution System Operator – responsible for operating and maintaining the electricity distribution grid.
ERP	Enterprise Resource Planning
EV	Electric Vehicle
ICE	Internal Combustion Engine
ICT	Information and Communication Technologies
KPI	Key performance Indicator
LEV	Light Electric Vehicle are electric vehicles with 2 or 4 wheels powered by a battery, fuel cell, or hybrid-powered, and generally weighing less than 100 kilograms.
OEM	Original Equipment Manufacturer
PM	Person-month
RES	Renewable Energy Source (see “List of Definitions” below for detail).
TSO	Transmission System Operator
SoC	State of Charge (see “List of Definitions” below for detail).
V2G	Vehicle to Grid, means to use the energy stored in the batteries of EVs connected for charging to provide energy to the grid in peak load situations.
WP	Work Package

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List of Definitions

Table 2: List of definitions

Definition	Explanation
Architecture	The fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution
Baseline	A baseline describes the "before" situation prior to the implementation of the measures. To assess the effect of implementing a measure we need compare with the baseline. Data about the baseline is needed in impact evaluations.
Charge management system	The ICT system supporting the operation of charging facilities, taking care of access control (to charging posts), control of the charging process (through communication with the in-vehicle charging and battery management system, booking, billing and other business related tasks necessary to the operation of a charging service. In GreenCharge it will also be responsible for the communication with the Neighbourhood Energy Management system about the coordination of energy demand of the charging facility with other demand in the neighbourhood and local production within the neighbourhood.
Data collection	Data collection in GreenCharge is an activity to collect data relevant for evaluation (e.g., to calculate the indicators or as input for simulations) and improvement of the technology and business model prototypes, using automatic data collection methods (e.g., system log, Apps that collect data) or manual methods (e.g., survey, interview, focus group).
Energy mix	The distribution among different categories of electric energy sources involved in supplying a given amount of electric energy. Relevant categories include local renewable, grid renewable, local fossil, grid fossil etc. It is often given as a percentage for each category (altogether amounting to 100%) but can also be the fraction of a particular category, for example the fraction of renewables (the green mix).
Energy Smart Neighbourhood (ESN)	An energy smart neighbourhood (ESN) is a group of buildings embedding local RES and local energy storage and using smart control equipment to adapt the energy demand to the local production so as to reduce the burden on the public grid and the power bill. The smart control equipment does this by predicting local energy demand and energy production from local RES and leveraging demand flexibility and local storage resources to shift the loads in a coordinated way within the neighbourhood. The aim is to minimize the amount of energy taken from the grid, the demand peaks and the energy bill. As these may be partially conflicting goals, the inhabitants of the neighbourhood must define policies defining how to balance them. In GreenCharge there is a particular focus on leveraging the demand flexibility and storage capacity of charging EVs, how this will reduce the need for dedicated stationary batteries (very expensive), and the use of local RES to charge the rapidly increasing fleet of EVs.
Fleet management system	An ICT system supporting the operation of a fleet of vehicles owned by a business and used to operate that business, for example the taxies of a taxi company, the delivery cars of a parcel delivery service company, or the cars of a car rental business. Such systems offers a wide variety of functionality

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Definition	Explanation
	supporting tasks related to the management of fleets, such as vehicle tracking, mechanical diagnostics, maintenance planning, and when dealing with EVs, also charge planning and booking.
KPI	Key performance Indicator. KPIs are important indicators to understand the impact of a measures. They are described with definition, context, units and measurement methods.
Local energy production	Energy produced inside a defined collection of one or more energy consumers and/or prosumers. If there are only consumers, the local energy production will always be zero.
Measure	A measure is a mobility or charging related action implemented by a city or other stakeholders, e.g. the implementation of a new infrastructure, the provision of a new service, a new organisation of the travel to work, or activities to change awareness, acceptance or attitude and behaviour of citizens or visitors.
RES	Renewable Energy Source is a category of energy sources which does not involve the burning of fossil fuels as part of the energy production process. The most popular RES are photovoltaic panels, windmills and hydroelectric power plants. Typically the carbon footprint of RES (caused by the building, operation and maintenance of the production facilities) lies in the area of 10 – 50 g CO_2 equivalents per kWh, while for fossil energy sources like natural gas, oil and coal the carbon footprint lies in the area of 500 – 800 g CO2 equivalents per kWh. Nuclear power is not commonly counted as a RES, since the energy production process does consume a fuel and does produce a problematic waste (radioactive material). However, its carbon footprint is in the lower end of the RES range.
Scenario	A scenario describes a specific use of a proposed system by illustrating some interaction with the proposed system as viewed from the outside, e.g., by a user, using specific examples. In GreenCharge, a scenario is a higher level of description of the system and can be modelled using one or several use cases.
State of Charge (SoC)	The state of charge (SoC) is an indication of the amount of energy stored in a battery. It is given as a percentage, meaning the percentage of the full capacity currently available in the battery. The SoC is difficult to measure accurately, but several methods are available to give an approximate value, and most EVs has an instrument on the dashboard showing the SoC.
Use case	A use case describes how a system will be used and is a tool for modelling requirements of a system. In GreenCharge, a scenario is a higher level of description of the system and can be modelled using one or several use cases.

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1 About this Deliverable

1.1 Why would I want to read this deliverable?

You should read this document to get an understanding of the Barcelona pilot site, both the location and constraints and the detailed tests and implementation to be carried out.

1.2 Intended readership/users

This document should be read by all project partners participating in any way in the Barcelona pilot. It is mandatory for the partners and third parties directly involved in the implementation of Barcelona pilot and the pilots coordinator, but it is also recommended for those partners involved in other pilot sites, to find synergies, those partners involved in the implementation of GreenCharge architecture and those in charge of innovation and communication activities, since the planning affects their activities as well.

1.3 Structure

This document contains two, introductory sections, chapter 2 and chapter 3, with an overview of the pilot site, for document completeness; however, the detailed description of the pilot site is in D2.16. The core of the document is contained in chapters 4, 5 and 6, that provide answers to Who, What and When. Chapter 4 describes who will participate by defining the user recruitment mechanisms; chapter 5 describes what will be demonstrated by depicting the instantiations of the GreenCharge architecture with its hardware and software components; chapter 6 describes the implementation plan. At the end of the document the future work to be done is summarized.

1.4 Other project deliverables that may be of interest

Public deliverables:

- **D1.1 Data Management Plan** – Describes the internal procedures for dealing with the collection and handling of data from the pilots in order to make them as open research data, including the necessary permissions for handling private data, and the necessary forms of informed consent and documentation of technical solution for secure data storage.
- **D2.16 Description of Barcelona Pilot and User Needs** – Describe Barcelona pilot in terms of challenges, user needs, use cases, scenarios, stakeholders and locations to be involved and the baseline.
- **D2.18 Pilot Component Preparation for Full-scale Pilot (Barcelona)** – Deployment and testing of software and hardware components to be used in the pilot, to prepare for the full-scale pilot implementation.
- **D2.8 Final Report for Barcelona Pilot: Lessons Learned and Guidelines** - Describe the Barcelona pilot, including the implementation, operation, the tests carried out, services and the data collected. Describe lessons learned and guidelines for replicability of the services tested.

Limited (confidential deliverables):

- **D2.1 Initial Strategic Plan for Pilots** – Describes the user needs aggregated from the pilots' user needs, use cases and scenarios and defines the initial requirements based on the needs and the input from the innovation management. Describes the initial strategic plan for pilots on what to develop, what and when to demonstrate in the pilots, and the initial pilot plans based on these strategies.
- **D2.2 Revised Strategic Plan for Pilots** – Describes the refined user needs and requirements and the revised plan for pilots based on intermediate evaluations and lessons learned from the pilots.

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2 The pilot site

The pilot site in Barcelona covers 3 different demonstrator areas in Barcelona province. A complete description of these demonstrators can be found in *D2.16 Description of Barcelona pilot and user needs*. A summary of them follows:

- EURECAT demonstrator: Eurecat premises are spread over 8 locations over Catalonia. The aim of the organization is to put in place a booking service for in-house charging points open to Eurecat employees driving an EV and travelling from their workplace to other premises. Besides, an energy management system will be added to optimally charge the vehicles taking into account energy locally produced and the rest of loads of the premises.
- MOTIT demonstrator: apart from their headquarters located in the Barcelona neighbouring town of Hospitalet de Llobregat, MOTIT has several premises spread over the city of Barcelona where batteries can be gathered to charge them in hubs. The goal of this demonstrator is to develop tools to optimize the charging process of a fleet of e-scooters from the perspective of the fleet operator of a sharing service. The business model extracted from it is very relevant for the business sustainability. An incentive scheme to engage users to drop the e-scooter near the hub will also be tested.
- Sant Quirze public e-bike sharing service: The goal is to upgrade the existing e-bike sharing service open to commuters travelling by train to reach the factories spread over a wide industrial area in the town. The introduction of ICT tools will allow to enhance traceability of assets, increase security and extract valuable information to extend and improve the service offered to the workers.

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3 Pilot description

3.1 Use cases to be demonstrated

In the following table a summary of the use cases to be implemented in Barcelona pilot site is correlated to the scenarios described in GreenCharge proposal and the demonstrators where they will be tested. A full description of the scenarios and use cases can be found in the deliverable *D2.16 Description of Barcelona pilot and user needs*.

Table 3: List of use cases, scenarios and demonstrators in Barcelona pilot site

Use Case	Scenario	Demonstrator	Short description
UC1:Booking of charging point	SC1-Charge planning and booking	Eurecat demonstrator	A Eurecat employee driving a plug-in electric car books a charging point to recharge her/his car during the visit to other Eurecat premises.
UC2: Charging at a booked charging point	SC2-Charging at booked charging station	Eurecat demonstrator	A Eurecat employee who has previously booked a charging point drives to the charging station to charge his/her e-car at the allocated charging point in the garage.
UC3: Enforcement at a booked charging point	SC3-Booking enforcement	Eurecat demonstrator	A Eurecat employee who has previously booked a charging point for a specific time slot, drives to the premises to charge his e-car and finds that the charging point allocated to him is occupied by another vehicle. The charging station operator handles the situation.
UC4: Optimal charge planning	SC4- Charging in working buildings with common internal grid and parking facilities	Eurecat demonstrator	The smart charging management system calculates the optimal activation of every charging point of the infrastructure taking into account price tariffs, technical and user constraints and availability of renewable energy locally produced.
	SC7: E-Mobility in innovative 'mobility as a service'	MOTIT demonstrator	The smart charging management system calculates the optimal recharge of every battery connected to the hub taking into account price tariffs, technical and operational constraints. In simulation mode, the optimization will take into account energy coming from a potential renewable source.
	SC7: E-Mobility in innovative 'mobility as a service'	St. Quirze demonstrator	The smart charging management system calculates the optimal activation of every charging point of the infrastructure taking into account price tariffs, technical and operational constraints based on utilization of the bikes as well as availability of renewable energy locally produced and stored.

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Use Case	Scenario	Demonstrator	Short description
UC5: DR request	SC4: Charging in working buildings with common internal grid and parking facilities	Eurecat demonstrator	Either for an electrical limitation or for flexibility analysis, the energy manager limits the maximum power allocated to the installation to a certain threshold for a given time period. The Neighbourhood energy management system will provide the optimal set-points for the charging station and the rest of the loads to fulfil the limitation.
UC6: Take an e-bike from the sharing service	SC7: E-Mobility in innovative 'mobility as a service'	St.Quirze demonstrator	A user previously registered to the e-bike sharing service arrives at the train station, opens the app and approaches one of the bikes anchored in the bike station. He unlocks the bicycle and rides to his destination. The sharing management platform will monitor the location of the bike and the SoC to plan the optimal charging of the fleet.
UC7: Return an e-bike from the sharing service	SC7: E-Mobility in innovative 'mobility as a service'	St.Quirze demonstrator	A user who has taken a bike in the morning goes back to the station after her shift to take the train back home. She rides to the sharing station and drops the bike there. She uses the app to complete the process. The sharing management platform updates the status of the fleet and will activate the charging as planned.
UC8: Change drop location for e-scooter	SC7: E-Mobility in innovative 'mobility as a service'	MOTIT demonstrator	A user who has finalised his trip with a MOTIT e-scooter changes his mind: instead of leaving the e-scooter in front of his office, he decides to leave it in the battery hub, 1 block away, to achieve extra minutes to be used in his next trip.

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3.2 Target users and stakeholders

In general, it can be said that target users are EV drivers, especially LEV drivers, EV fleet operators and facility managers. However, it is worthwhile to split the detailed description of these groups into three demonstrators to better present the profile of the target users and stakeholders.

3.2.1 Eurecat demonstrator

The target users of this demonstrator are:

- EV drivers: In particular, they are Eurecat employees driving an electric car. They will have access to a booking service to allocate a charging point to charge their car when they visit a Eurecat office.
- Eurecat facility manager: The tools to be deployed will help the facility manager to organize the booking of the charging points located in the parking garage and to manage the charging points in an optimal way.

The stakeholders involved are the following:

- Facility owner/charging station operator: The booking service of charging points can only be demonstrated in the premises owned by Eurecat. Other Eurecat offices located in buildings owned by third parties are out of the scope of the demonstrator because the facility management has not granted the testing of this system.
- Human Resources department: Its involvement is important to define the policy to be applied. On the one hand, the cost of energy and utilization for the parking garage can be seen as a grievance to other employees, and on the other hand, to cover the needs of EV early adopters can be perceived as a perk to retain talent and for branding purposes (environmental impact sensitivity).

There are other actors that play a much secondary role and are not directly involved in the project, but their actions have an effect in the realization of the use case:

- Energy providers: According to the energy tariffs, the smart optimization of the charging operation can be a successful business case or not. Similarly, the existence of contracts for certified green energy allows EVs to become less pollutant vehicles.
- Public administration: Regulations concerning the installation of charging infrastructures, subsidies for the purchase of electric vehicles and charging infrastructures, penalties or restrictions for high pollutant vehicles facilitates the shift to electro-mobility.
- ICE drivers: Eurecat employees driving an ICE car might find unfair, if not appropriately addressed, that other employees have access to the parking garage while they don't. Currently, the access to the parking garage depends on certain conditions (seniority, career, …). If some spots are reserved for EVs it means that there will be fewer spots for ICEs cars.
- OEM/Car manufacturers: The use of standards facilitates the deployment of charging infrastructure compatible with most type of vehicles. Similarly the existence of open APIs to access in-vehicle systems, especially the State of Charge of the battery, enables the development of ICT tools for smart management and avoiding the need for the user to introduce the SoC in the app.

3.2.2 MOTIT demonstrator

The target users of this demonstrator are:

- MOTIT users: The users might be able to collaborate in the charging process by dropping the scooter near (or in) the battery hub premises. In exchange they will receive an incentive (to be defined shortly). This action will reduce the time and energy needed to collect flat batteries.

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- Fleet operator: The tools to be deployed will help to optimize the charging of the batteries in the hub by applying schedules that take into account the cost of energy and potentially (simulation) the availability of renewable energy locally produced.

There are other actors that play a much secondary role and are not directly involved in the project, but their actions have an effect in the realization of the use case

- Energy providers: According to the energy tariffs, the smart optimization of the charging operation can be a successful business case or not. Similarly, the existence of contracts for certified green energy allows EVs to become less pollutant vehicles.
- Public administration: Regulations concerning the installation of charging infrastructures, subsidies for the purchase of electric vehicles and charging infrastructures, penalties or restrictions for high pollutant vehicles facilitates the shift to electro-mobility.
- OEM: The use of standards facilitates the access to the BMS data. In a scenario where the BMS had a standard interface, the battery hub could be exploited as a service (ChargeAsAService) to other fleet operators or individuals.

3.2.3 Sant Quirze e-bike sharing demonstrator

The target users of this demonstrator are:

- E-bike sharing users: The users will be able to use an app to lock/unlock the bikes, notify breakdowns and receive information of the battery status. Besides they will benefit from a lower carbon footprint since the smart management system will foster the use of green energy.
- Sharing operator (town hall): The sharing operator will benefit from a higher traceability of assets that will increase the security of the system. Besides the data gathered will provide insights on the utilization of the service and will help in the decision-making process of extending the service or prioritize the creation of new bicycle lanes.

There are other actors that play a much secondary role and are not directly involved in the project, but their actions have an effect in the realization of the use case

- Public transport authorities: Public transport fares have an effect on incentivising the usage of public transport. For instance, from January 2019 the cost of a train ticket from Barcelona to Sant Quirze is the same as the cost of any trip within Barcelona and its metropolitan area (half the price as in 2018). Yet more important, the quality of the service (punctuality) and the frequency are key elements to shift from private to public mobility.
- Factory Managers: The aim of the promotion of a sharing service by the town hall was that after being accepted by workers, the companies in the industrial area will buy electric bicycles to their workers as part of their mobility plans. By adding ICT tools, the risks will become lower.

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4 Workshops and other user recruitment initiatives

4.1 Stakeholders involvement

4.1.1 Local Reference Group

A Local Reference Group (LRG) was already designed at the proposal phase of the project. The first members were involved through a Letter of Support. Once the project officially started, the partners directly involved in the pilot site of Barcelona, namely Eurecat, Atlantis, Enchufing and MOTIT, have actively worked to enlarge the LRG with more members through their contact lists and awareness on their involvement in the electro-mobility domain. The LRG covers different aspects of electro-mobility: public authorities in energy domain (ICAEN), public authorities in urban development and mobility in Barcelona Metropolitan Area (AMB), public parking lots operator in Barcelona city (BSM), a drivers club (RACC) and an operator of charging infrastructure (Efimob). Other organisations have expressed their interests in the project such as Barcelona city Council, Sant Quirze municipality, an e-car sharing operator, a low-cost gas station chain and a water utility group.

The purpose of the LRG is to get valuable feedback from the different perspectives covered in order to enhance the tools to be implemented in GreenCharge and to search replicability. In exchange, they will be provided with first-hand information about the project progress and they will be able to use the logo of GreenCharge supporters and CIVITAS for branding.

They were invited to participate to the first business workshop held in Barcelona in November 2018. This is a workshop organised by WP3 leader, PNO, and that will be held yearly. In this workshop, organised in the form of an innovation game, participants were asked to adopt the roles of technology, value-proposition and assessment experts to innovate MOTIT business model. A shift to green energy branding and the exploitation of local RES and demand flexibility were proposed as alternative to a price-based strategy to beat competitors.

The next appointment was the Plenary Meeting to be held in Barcelona in March. It has also organised an Open Day event open to the public, not only Consortium partners, to share the progress of the project.

4.1.2 Uptake Cities Group

There is an Uptake Cities Group organised by ICLEI, consisting of at least 12 cities, which are not partners in the project, but with visions for and interest in the outcome. The group includes another city in Spain, San Sebastian, which has been very active in smart-city and electro-mobility initiatives in recent years. They contribute with user needs and feedback from a variety of urban contexts across Europe, and act as a first group of potential replicators of the solutions developed in GreenCharge. They will provide input for innovation management to ensure that the project stays up to date with market reality and policy changes. In return, the groups will get first-hand knowledge about the project. The uptake cities are selected considering representative distribution over Europe and the level of commitment they offer. Both the Local Reference Group and the Uptake Cities Group will be consulted at each critical step within the project to provide feedback from a user perspective. It is foreseen that city representatives will visit the pilot sites to see the progress of the pilot on the field.

4.2 User recruitment initiatives

The ecosystem for electro-mobility in Catalonia is quite narrow and the number of users in the three demonstrators is low enough to allow individual contact to them. The following mechanism are foreseen for the user recruitment.

4.2.1 Eurecat demonstrator

- Direct communication with the facility manager: At the beginning of the project an interaction with the infrastructure department was initiated to define the scope of the demonstrator and to gather the requirements and needs. Several e-mails and face-to-face meetings have been held and will continue

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for the final definition and deployment of the tools. After the deployment, the communication will continue to follow-up the progress of the trials.

- Interviews with employees who own an electric car: Through conversations with the facility manager, we identified a couple of users that had already expressed their needs to Eurecat in terms of charging requirements. They are early adopters very concerned about electro-mobility and they are aware of other employees with electric cars. The number of EV drivers identified so far is 5. We will interview all them to gather their specific needs in order to properly design the services to be implemented.
- Workshops with potential users of the service: Once the application will be developed and the hardware set-up, a workshop will be organized to present the service and show how it works.
- Mailing communication to all Eurecat employees: Using the internal communication channels (mailing list and Sharepoint), notifications will be issued to announce the service available to Eurecat employees and the procedures to get access to it.
- Newsletters: Eurecat issues a newsletter weekly to all employees and a monthly newsletter to a database of over 1000 members with relevant news related to the activity of Eurecat. This newsletters will be a valuable communication channel to raise awareness of the trials been performed in Eurecat and engage other users for the on-going demonstrator or replicability in other companies.
- Surveys: At least two surveys will be issued targeting potential users of the charging service: one before the launch of the service, and another one at the end. The purpose is to gather information about mobility patterns, interest in charging facilities and satisfaction of the service.
- Site visits: Eurecat facilities are frequently visited by groups for several reasons: commercial initiatives, meetings for collaborative projects, open days to secondary schools, "tour" to news employees, and so on. The parking garages are not currently included in the "tour", but they may be in the future to show the charging infrastructure and the smart management.

4.2.2 MOTIT demonstrator

- Mailing communication with users: A group of MOTIT users will be selected to participate in the use case 8 'change drop location for e-scooter'. MOTIT will contact them through email to explain the new scheme and incentives that apply.
- Interviews with customers: MOTIT also operates a B2B sharing service to companies. Face-to-face meetings or phone calls are planned to make them aware of the initiatives to be developed. Some of them may also like to replicate part of the pilot activities like the shift to green energy.
- Surveys: At least two surveys will be issued targeting potential users of the incentive scheme: one before the launch of the service, and another one at the end. The purpose is to gather information about interest in participating and satisfaction of the service.

4.2.3 Sant Quirze e-bike sharing demonstrator

- Interviews with representatives of the town hall in charge of the promotion of the service: Eurecat participated in the promotion of the e-bike sharing service as it is now. After identifying the suitability to demonstrate GreenCharge tools, it was initiated the contact to the town hall, through e-mail, phone and face-to-face meetings to discuss the details.
- Workshops with public authorities: the actions to be taken involve several departments of the town hall. A series of workshops will be organized to define together, the town representatives and the GreenCharge partners involved, the requirements and needs.
- Workshop with users: A series of workshops with the factory managers in the area, the town hall representatives and GreenCharge partners involved will be organised to present the new e-bike sharing service and its operation. Typically the communication is between the town hall and the company, and

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then the company communicates to their employees. It is open to discussion if an additional workshop will be organised with the employees.

- Press releases: Communication activities to the general public are seen as a valuable tool, as expressed by the town hall representative. The current sharing initiative has already been awarded several times thanks to its visibility. A series of press releases will be issued taking advantage of the communication channels of the town hall and the GreenCharge partners participating in the demonstrator.
- Surveys: At least two surveys will be issued targeting potential users of the sharing service: one before the upgrade of the service, and another one at the end. The purpose is to gather information about mobility patterns, interest and satisfaction of the service.

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5 Implementation requirements

5.1 Overall architecture

A general view of GreenCharge architecture can be seen in Figure 5-1. The image has been borrowed from on-going work in WP4. A final definition of this architecture will be presented in *D4.1 Initial Architecture Design*. The particularities of the different pilot sites will be evolved in adaptations and different instantiations of the general architecture. For instance, in Barcelona pilot site the roaming management system will not handle the part related to payment since charging in public charging points is free of charge, and charging in private charging points does not require a seamless payment system. Besides, most of the EV will be LEV, namely e-scooters and e-bikes, but still some e-cars privately owned will participate.

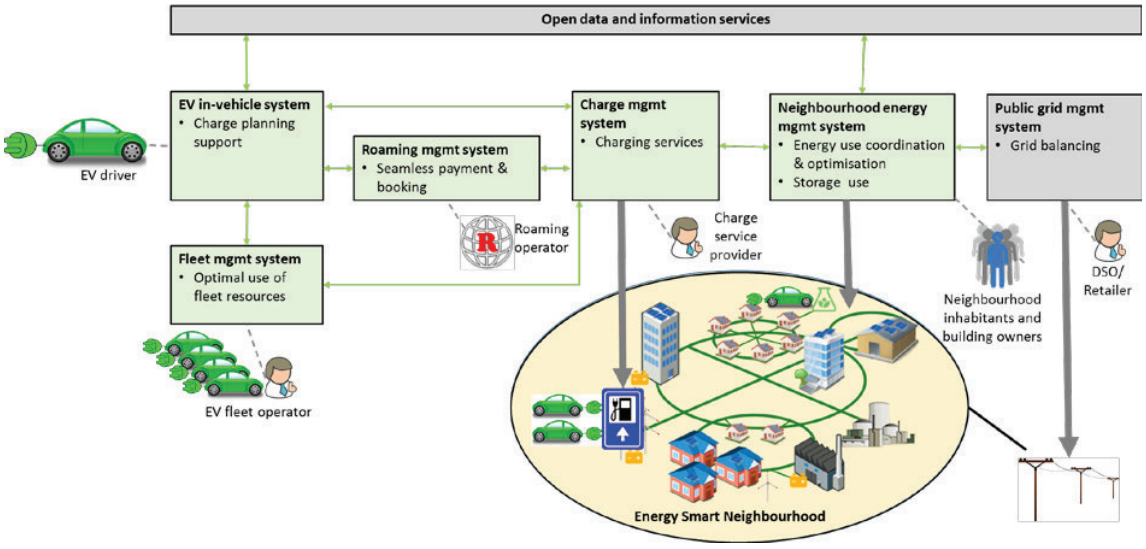

Figure 5-1: Overall GreenCharge architecture

5.2 Data collection requirements

5.2.1 Data sources

The following data sources have been identified for the different demonstrators:

Table 4: List of data sources required for Barcelona pilot

Data source	Demonstrator	Access
Price tariffs	Eurecat MOTIT St. Quirze	Open API from e-SIOS (electricity market operator)
Energy mix	Eurecat MOTIT St. Quirze	Open API from REE[1] (Spanish TSO)

[1] REE stands for Red Eléctrica de España

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Data source	Demonstrator	Access
Forecasted weather information	Eurecat MOTIT St. Quirze	Open API from an on-line weather service
Actual weather information	Eurecat	On-site weather station
Actual weather information	St. Quirze	Open API from an on-line weather service
Building energy readings (consumption)	Eurecat	Connector to the existing Building Energy Management System
RES energy readings (production)	Eurecat	Connector to the existing application
Charging station energy readings	Eurecat MOTIT St. Quirze	Connector to the meter reader (to be deployed)
Bicycle geo-location	St. Quirze	Atlantis service
Users of Eurecat booking service	Eurecat	Human Resources department in Eurecat
Users of MOTIT incentive scheme	MOTIT	MOTIT (only accessible by MOTIT at individual level)
Users of St. Quirze e-bike sharing service	St. Quirze	Town hall and companies to defined the level of access
State of Charge	Eurecat MOTIT St. Quirze	In Eurecat demonstrator it will be introduced manually by the user. MOTIT: connector to the existing system St. Quirze: upgrade of BMS to have access to it (Enchufing)

5.2.2 Required data resolution

For most types of data the resolution is set by existing systems and data provider and cannot be altered. For the systems adapted by the partners involved in the project the resolution can be adjusted. In particular, a decision has to be taken in the granularity for the electricity readings of the charging points. An initial guess is that 1 minute resolution is enough to analyse the load curve. Some tests will be conducted with higher resolution to check this point.

The following table show the granularity for the different types of data:

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Table 5: Data resolution for different types of data

Data source	Resolution
Price tariffs	Hourly
Energy mix	Hourly
Forecasted weather information	Hourly
Actual weather information	Hourly/Quarterly
Building energy readings (consumption)	Up to 1 minute
RES energy readings (production)	Up to 1 minute
Charging station energy readings	Up to 1 minute
Bicycle geo-location	1 minute (To be decided)
State of Charge	Up to 1 minute

5.2.3 Data storage requirements

The most demanding data storage requirements come from the electricity readers in the charging points. However, the number of charging points is quite limited in the demonstrators for the moment. Besides, there will be long periods with no activity in the charging points, especially in Eurecat and St. Quirze demonstrator. The gaps will be very suitable for data compression, if data storage becomes a limitation. However, for the duration of the pilot (2 years) it is not foreseen that it will become an issue.

Following there is a table with the estimate data storage requirements:

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Table 6: Data storage requirements

Demonstrator	Type of data	Data volume
EURECAT	Electricity readings	10 GB
	Weather info	10 MB
	Tariff info	5 MB
	Energy mix	5 MB
	Schedules	10 MB
	Others (Bookings, configuration, user records, surveys, KPIs, pictures…)	2 GB
MOTIT	Electricity readings	25 GB
	Tariff info	5 MB
	Schedules	50 MB
St. Quirze e-bike sharing service	Electricity readings	5 GB
	Weather info	10 MB
	Tariff info	5 MB
	Energy mix	5 MB
	Schedules	10 MB
	Others (Bookings, configuration, user records, surveys, KPIs, pictures…)	2 GB

5.2.4 Interoperability requirements

The communication between the different components of GreenCharge architecture is better depicted in chapter 5.5. In this chapter, an overall overview of the interoperability needs is given in Figure 5-2.

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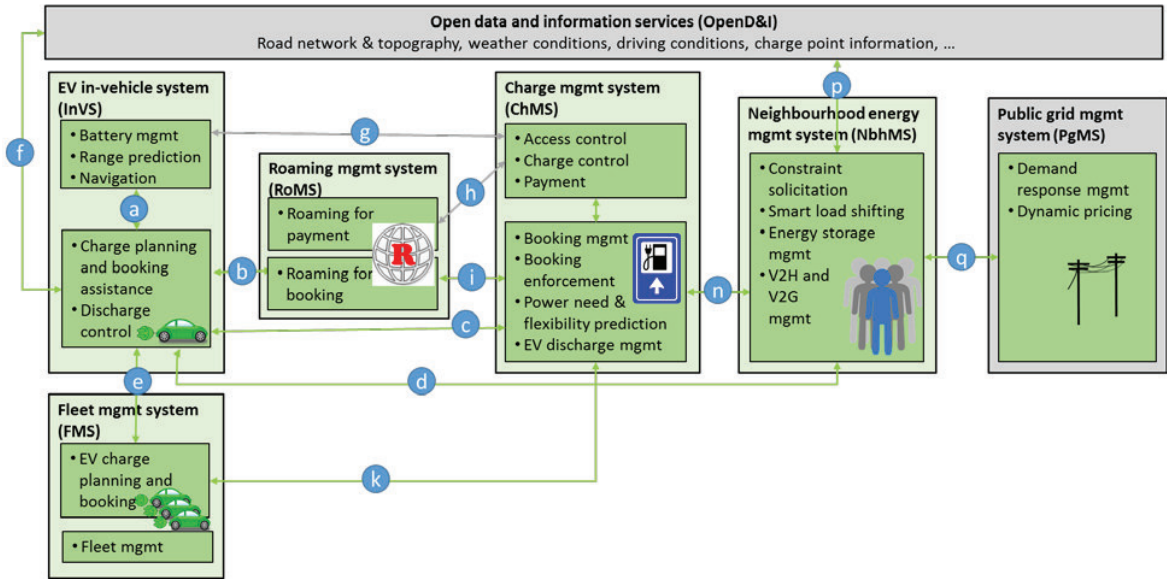

Figure 5-2: GreenCharge interfaces (from DoW)

The communication paths for the different use cases, at high level, is described as follows:

- Booking of charging points: The use case related to the booking of charging points requires the communication between the EV driver and the charging manager. This communication will not be implemented through the in-vehicle system but through an app. Interfaces b, g, h and i will be implemented as part of the communication between the app (EV user) and the back-end system in charge of booking.
- Smart charging: the smart charging is part of the Neighbourhood energy management system. Instead of dealing with a real neighbourhood, the optimization will be at building level (Eurecat premises), charging hub level (MOTIT) and e-bike station level (St. Quirze). Interfaces k, n and p are included in the interoperability of these use cases.
- Demand response and grid interaction: it is not foreseen to implement specific interfaces with the grid (q). The DR requests will not be trigger by the DSO but by the facility manager (as a proof of concept to explore flexibility). Any notification from the DSO of a supply disruption will be handled manually: the DSO will notify the facility manager, and the facility manager will introduce the information in the back-end system for booking and scheduling.
- EV in-vehicle system: For MOTIT, the existing in-vehicle system in the e-scooters provide relevant information about the usage, including geo-location and SoC. This information goes directly to MOTIT platform. For St. Quirze e-bike sharing system the system will be updated to include geo-location (using Atlantis system) and SoC (new BMS by Enchufing). Beyond SoC and location, there will not be any other interaction with the vehicle.
- Cross-country interoperability of payment and booking as well as facilitating interoperability between different pilots. This enables the alignment with the “Digital Single Market Strategy” which facilitates to improve the attractiveness of EVs for wide use among private users and business.

5.3 Hardware and software requirements

The hardware and software requirements are derived from the functionalities to be implemented in the use cases. The next subsections present the HW and SW requirements by demonstrator and component.

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5.3.1 Eurecat demonstrator

Booking management system

Hardware:

The booking will be realized through an ICT system, thus it will require a server or a virtual machine. The most likely option will be to use a virtual machine either in the virtualization environment of Eurecat or in a cloud (Amazon, Azure or similar). The IT department provides support for the working hours (not 24/7), which is aligned to the usage of the system but they might be some issues relating the access from dynamic IP addresses, which is the main reason to consider deploying the application in a commercial cloud. The specific requirements concerning CPU, memory and storage will be defined in the following months, but the application does not require high performance capacity.

On the user side, the app will run on a smartphone. The users will use their own smartphones, but no specific requirements are needed beyond the standard basic features (connectivity 3G/4G, GPS (optional), camera).

Software:

The system to be developed will be likely designed to run on Linux, although this is not a hard requirement. The tools will be developed using open software development environments and libraries.

The application will support the latest versions of most popular browsers (Chrome, Firebox, Safari) and the latest versions of Android and iOs.

The application will be developed to support multi-language. It is foreseen to provide Catalan, Spanish and English translation.

Charging management system

Hardware:

Similarly to the previous case there will be an ICT system to run on a server or a virtual machine. The most likely option will be to use the virtualization environment of Eurecat to deploy the software. The IT support provides support for the working hours (not 24/7), which is aligned to the usage of the system. The specific requirements concerning CPU, memory and storage will be defined in the following months.

The ICT system will interact with the charging points. These charging points, currently with no communication, need to be upgraded to provide energy metering and accept remote commands. The sockets are of Schucko type, which are compatible with the type of e-cars commonly used by Eurecat employees. The charge will be slow charge, up to 3.4 kW AC.

Software:

The system to be developed will be likely designed to run on Linux, although this is not a hard requirement. The tools will be developed using open software development environments and libraries.

The back-end Graphical User Interface for the system administrator will support the latest versions of most popular browsers (Chrome, Firebox) for Windows.

The application will be developed to support multi-language. It is foreseen to provide Catalan, Spanish and English translation.

The charging management system should use a backend solution which should be compatible to the eRoaming Platform.

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Energy Smart Neighbourhood

Hardware:

Apart from the virtual machine to run the optimization module and the connectors to get data from the different data sources, there is no additional hardware to be deployed. The most likely option will be to use the virtualization environment of Eurecat to deploy the software. The IT support provides support for the working hours (not 24/7), which is aligned to the usage of the system. The specific requirements concerning CPU, memory and storage will be defined in the following months. The optimization module will require considerably CPU and storage capacity (as described in 5.2.3).

There should be connectivity between the servers (or virtual machines) where the charging management system and booking systems are running.

Software:

The system to be developed will be likely designed to run on Linux, although this is not a hard requirement. The tools will be developed using open software development environments and libraries.

APIs should be available to enable communication between the charging management system, the booking system and the optimization modules.

The database to store the data will be a combination of an SQL database (MySQL or Posgresql) and a time series database (InfluxDB or KairosDB).

5.3.2 MOTIT demonstrator

Hardware:

The battery hub should include a metering system, to measure the power in each charging slot as well as a remote switching mechanism to activate/de-activate the charging operation. The optimization use case can be handled in two phases: (i) off-line optimization based on energy measurements, (ii) real-time optimization actually applying the schedules calculated by the optimization module.

The optimization module will run on a virtual machine provided by MOTIT.

Software:

The system to be developed will be likely designed to run on Linux, although this is not a hard requirement. The tools will be developed using open software development environments and libraries.

APIs should be available to enable communication between the battery hub and the optimization modules and the MOTIT platform.

5.3.3 St.Quirze e-bike sharing demonstrator

Hardware:

A PV panel and a stationary battery will be deployed. The sizing of these elements will be decided in the next weeks, once we have access to the usage of the service. These components should include energy readers and a communication interface to be able to send and receive data remotely.

A locking system to block the bicycles when not in use will be added. This mechanism should work using the smartphone and a workaround (admin) should be provided.

The SoC of the batteries should be known. This will require the upgrade of the batteries or their BMS, so that data can be sent to the back-end system.

A virtual machine in a server or the cloud will be needed to run the service. It should provide 24/7 support.

Geo-locators will be added to the bicycles to allow tracking. Robustness of the devices will be required to prevent the disassembly of the device by non-respectful users.

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One of the constraints is cost. That is why one of the requirements is to find low-cost solutions.

Software:

The system to be developed will be likely designed to run on Linux, although this is not a hard requirement. The tools will be developed using open software development environments and libraries.

The application will support the latest versions of most popular browsers (Chrome, Firebox, Safari) and the latest versions of Android and iOs.

The application will be developed to support multi-language. It is foreseen to provide Catalan, Spanish and English translation.

5.4 Selection of hardware and software

The selection of the hardware and software will be done in the next months. The criteria will be taken according to the following principles:

- Know-how: The previous expertise of the partners involved in the pilot will guide the choice of the new equipment and software to be integrated. The knowledge of the equipment and the existence of software libraries and modules already developed saves time and resources in trouble solving.
- Cost: due to budget limitations, low-cost solutions will be prioritized. However, safety will be paramount to prevent injuries.
- Openness: Non-proprietary solutions for HW and SW will be preferred to avoid dependencies with third parties not participating in the project and to assure access to all the features provided by any device.
- Standard: Compliance with widely adopted standard solution, protocols and interfaces will be taken into account in the choice to facilitate future interoperability of the solutions developed.

The following table shows the components to be used in each demonstrator. Some of the components are fully functional, other needs some adaptation and others need to be deployed. A more detailed description can be found in *D2.18 Pilot Component Preparation for Full-Scale Pilot (Barcelona)*.

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Table 7: Components grouped by sub-system and demonstrator

Demonstrator	Sub-system role	Component name	Responsible partner
Eurecat demonstrator	Charge management system	Charging point	EURECAT
		Booking system	EURECAT
		Charge management system	EURECAT
	Neighbourhood energy management system (NEMS)	SEM Scheduler (optimal planning of loads)	EURECAT
		SEM Forecaster (forecasting of RES production and demand)	EURECAT
	Local Renewable Energy Source	PV panels	EURECAT
MOTIT demonstrator	EV In-vehicle system	Scooter shared services app	MOTIT
	Fleet Management System	Scooter shared services fleet management	MOTIT
	Charge Management System	Algorithm for vehicle autonomy calculation	EURECAT
		Battery swapping in hub	MOTIT
	Neighbourhood [2]energy management system (NEMS)	SEM Scheduler (optimal planning of loads)	EURECAT
		SEM Forecaster (forecasting of RES production and demand)	EURECAT
St. Quirze e-bicycles sharing service	EV In-vehicle system	Atlantis Fleet app	ATLANTIS
		Journey planner app[3]	EURECAT
	Fleet Management System	Data logger and GPS tracker devices	ATLANTIS
		Atlantis Fleet platform	ATLANTIS
	Charge management system	Algorithm for vehicle autonomy calculation	EURECAT
		Charging point	ENCHUFING
		Booking system[4]	EURECAT

[2] Limited to the battery hub and simulated RES sources
[3] To be decided according to user needs
[4] To be decided according to user needs

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	Neighbourhood energy management system (NEMS)	SEM Scheduler (optimal planning of loads)	EURECAT
		SEM Forecaster (forecasting of RES production and demand)	EURECAT
	Local renewable energy source	PV panels	ENCHUFING
	Local battery storage	Stationary battery	ENCHUFING

5.5 GreenCharge Architecture Instantiation

Although there will be a common development of some components, such as the optimization module for the Energy Smart Neighbourhood and charging management, there will be 3 different instantiations of the GreenCharge architecture: one in each demonstrator.

5.5.1 Eurecat demonstrator

The architecture in Eurecat demonstrator presented in Figure 5-3 will include a booking module, a charging management system for the individual charging points located in the garage of the premises, a smart neighbourhood management system to balance the demand of the whole building (for two different locations) and a particular instantiation of the roaming management system only for the accounting of cost of energy consumed. There will not be actual integration with the corporate ERP (to automatically manage the invoice of the energy consumed) or the DSO (the communication will be introduced manually by the facility manager receiving notifications from the DSO). The components included are:

- User app: It is the front-end of the booking system. It enables the user to receive information from the rest of the components. The user sends requests for booking and the booking system sends acceptance/rejection of requests, updates of bookings) billing information (energy cost), carbon footprint
- Booking system back-end: It handles the interaction with the user and the rest of the components through the roaming system. In this case, the EURECAT overtake both the roles of a CPO by providing charging services as well as EMP- Electromobility Provider. Using the eRoaming services, the demonstrator of EURECAT insures interoperability beyond the demonstrator. This means, that other EMP providers can offer their customers to charge to the charging stations of EURECAT, but also the EURECAT employees can charge on other charging stations connected to the eRoaming platform. The eRoaming Platforms enables the following processes:
  - Ensuring the interoperability of the public and semi-public infrastructure through promotion of accepted standards within the network and open business user interfaces to the platform
  - Simplification of authentication and authorization procedures through a trustworthy instance as well as safekeeping of sensitive data through the uncoupling of personal data and anonymous user data
  - Automation of contract-based business relationships between power suppliers, car manufacturers, infrastructure service providers as well as further mobility business parties
- Roaming system: It enables the interaction between the booking system from the electromobility provider (Eurecat-Human Resources) and the charging point operator (Eurecat-facility manager), as well as giving the opportunity for visitors and external EV Drivers to use the charging facilities
- Charge management system: Its main functionality is to control the charging points taking into account the bookings and the energy constraints. It receives information from the booking system through the roaming

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system and interacts with the neighbourhood energy management system to send energy demand and to receive optimized energy planning for charging

- Neighbourhood energy management: It receives the energy demand from the charging management system and the energy demand and energy production from the Building Management system. Additional information such as electricity tariffs, the energy mix and weather information are gathered from open data services. Eventually, it can receive information from the grid, such as energy limitation for outages or maintenance work, and demand response request (only simulated). The system forecasts energy needs according to historical data and context information and uses this forecast to optimize the energy supply. It delivers the optimal plan to the charging management system and the Building management system.

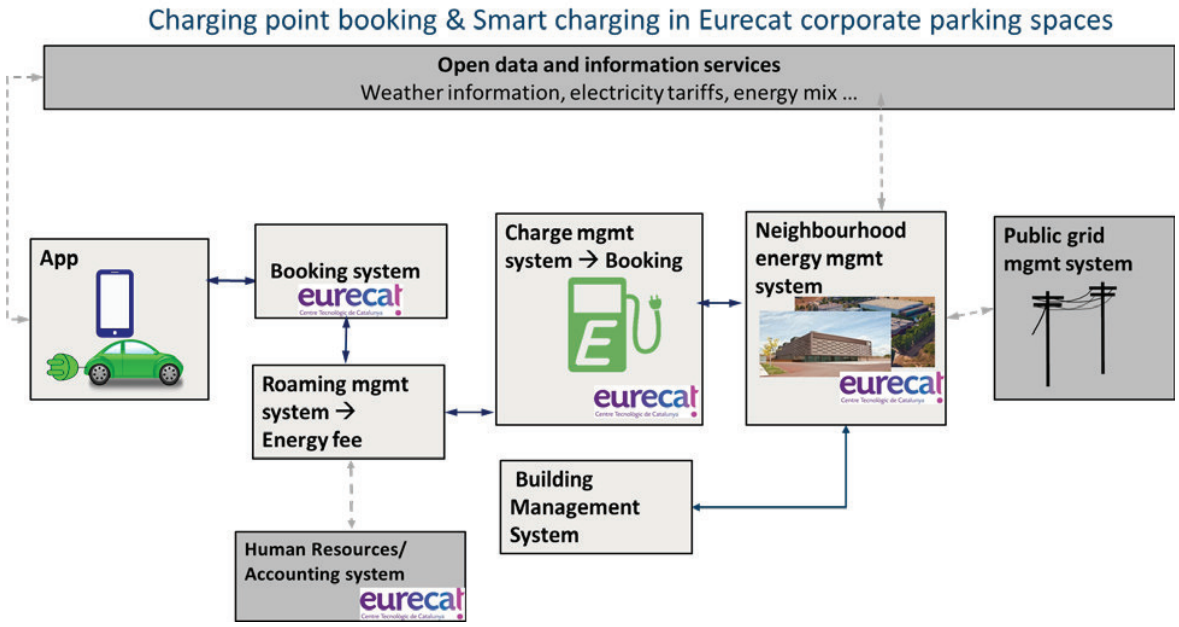

Figure 5-3: GreenCharge architecture instantiation in Eurecat demonstrator

5.5.2 MOTIT demonstrator

The architecture in MOTIT demonstrator (**Figure 5-4**) will be composed by a charging management system to manage the battery hub, a neighbourhood energy management system to optimize the charging process according to energy tariffs and energy mix (the optimization will be restricted to the battery hub, not the whole premises) and some interaction with EV in-vehicle system and the existing fleet management system to extract information about battery status, maintenance and operation tasks and booking profiles (inference of required SoC).

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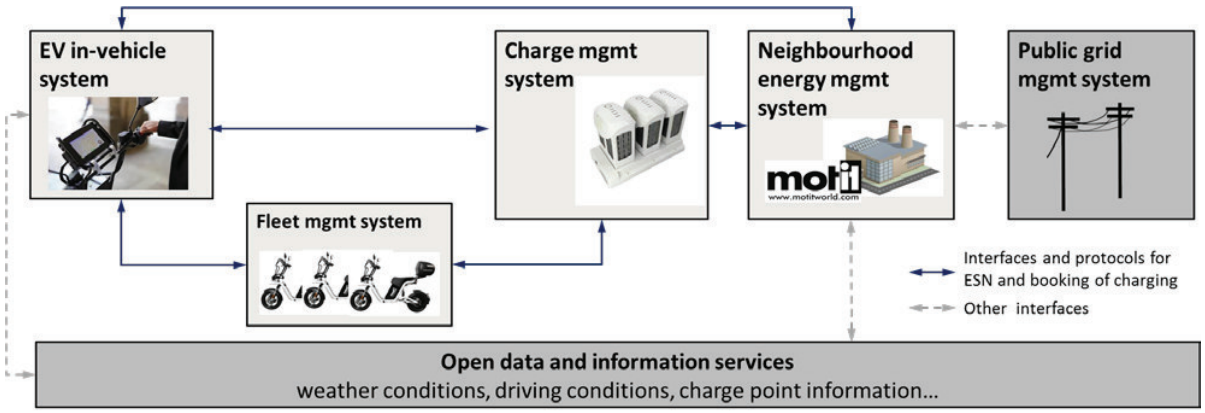

Figure 5-4: GreenCharge architecture instantiation in MOTIT demonstrator

5.5.3 St. Quirze e-bike sharing demonstrator

The instantiation of the architecture in St. Quirze demonstrator is shown in Figure 5-5. It will include several devices in the e-bike to allow the blocking of the bicycle for unauthorized use, a geo-positioning device and a BMS able to communicate the SoC, as well as an app running in the smartphones of the users. This information will be exchanged with the charging management system and the fleet management system. The charging management system will apply the set-points calculated by the optimization module of the neighbourhood energy manager. In fact, properly speaking, it will not be a neighbourhood but the bike station with the charging points, a PV panel and a stationary battery. Any interaction with the grid will be done manually by introducing any constraint to the neighbourhood energy management system.

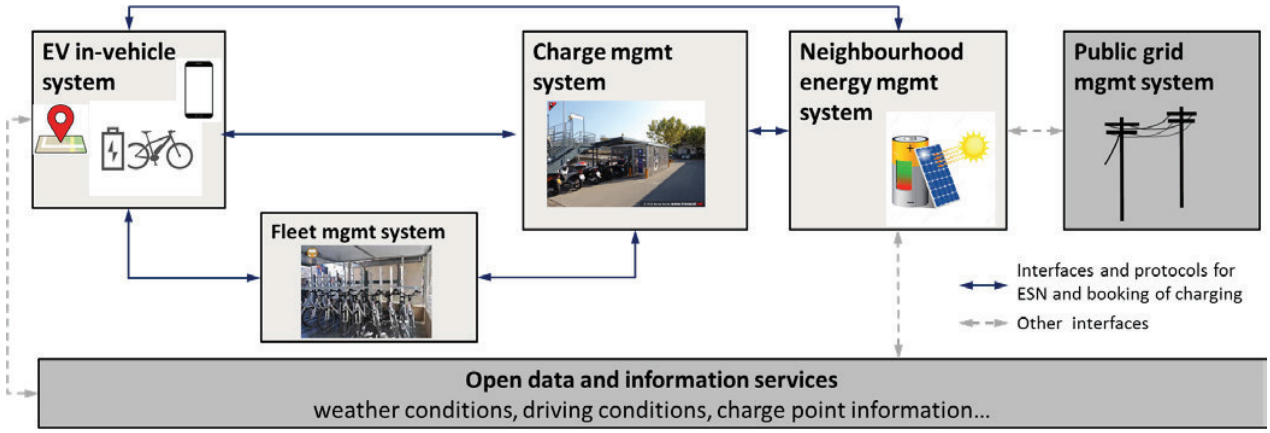

Figure 5-5: GreenCharge architecture instantiation in St.Quirze e-bike sharing demonstrator

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6 Implementation plan

6.1 Organization of implementation

The following GreenCharge partners are responsible for implementation of the Barcelona pilot:

- Eurecat
- Atlantis
- Enchufing
- MOTIT

CIVITAS methodology has been adopted for the evaluation of the project. According to CIVITAS framework see [1], the following roles shown in Table 8 have been defined:

Table 8: Roles and responsibilities for the implementation of Barcelona pilot

Role	Organisation	Responsibility
Site Coordinator (SC)	Eurecat	Coordinate the implementation of the pilot.
Local Evaluation Manager (LEM)	Eurecat	Handle the evaluation related activities. Plan and coordinate data collection process and in collaboration with Task 5.1 and 6.1 select and adapt the local indicators from the overall project indicators.
Measure leader (ML)	Eurecat	Responsible for data collection as defined by the local indicators (defined by Task 5.1 and Task 6.1) and the data collection process plan defined by the LEM.

Both SC, LEM and ML report to the WP2 leader. In addition, a WP2 task force has been established to coordinate and exchange information between the different pilot sites. This task force has biweekly telephone conferences. In these meetings all task leaders and editors of the deliverables are expected to be present.
Figure 6-1 shows the GreenCharge work package (WP) structure and the interfaces between the WPs. The numbers in the labels are steps in the work flow.

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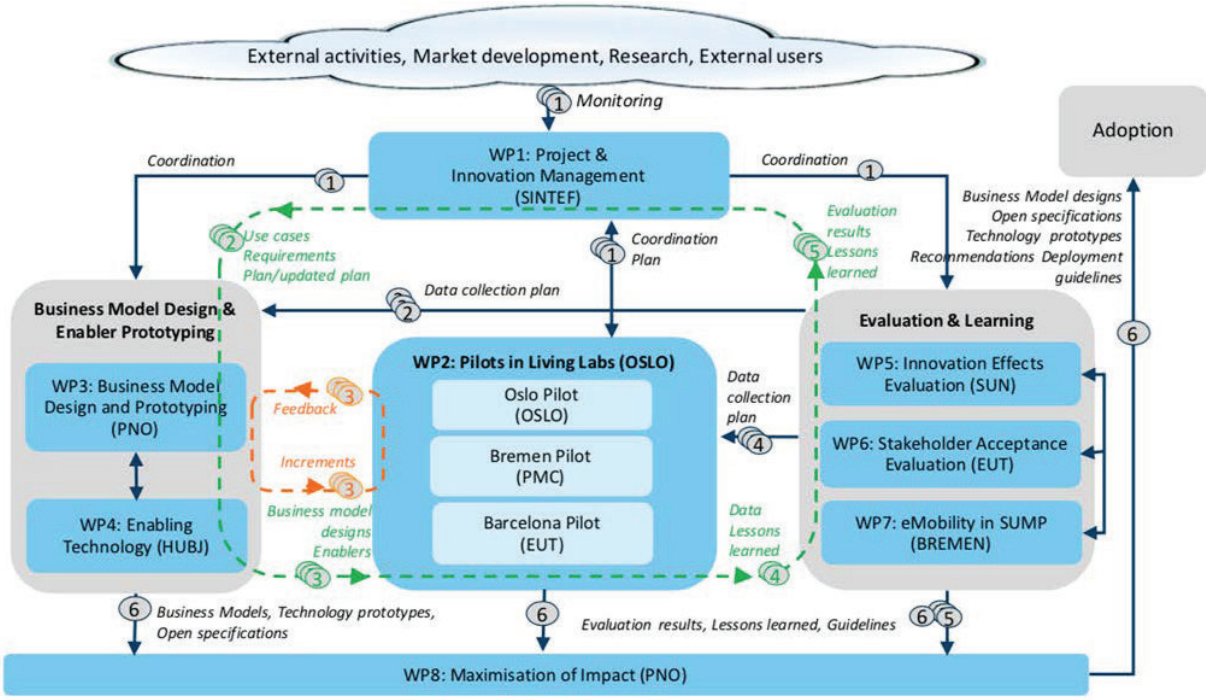

Figure 6-1: GreenCharge WP structure (from DoW)

WP2 is shown in the centre of this figure, as the demonstrators are the key element of the innovation activities. The main inputs relevant to this implementation plan (D2.17) are:

- Business model designs (WP3): A first workshop was held in Barcelona in October 2018 to get insights about innovative elements that can be applied to the business models. Similar workshops will be held yearly.
- Interoperability requirements and technology prototypes (WP4): The use cases described in D2.16 has served as input for the reference architecture definition in a bottom-up approach. Once the architecture will be released a top-down approach will be followed to instantiated the reference architecture to the pilot sites.
- KPI and data collection plan providing input to data collection requirements (WP5): Pilot sites have provided the measures and sub-measures to be implemented in the demonstrators. A set of KPIs has been extracted from CIVITAS framework and adapted to GreenCharge. The collection of the data needed to compute these KPIs has to be planned from WP2, and particularly, from D2.17.
- KPI and data collection plan providing input to data collection requirements for stakeholders acceptance (WP6): Similarly to the other type of KPIs, stakeholders acceptance will also be monitored and data collection and supporting activities have to be planned within D2.17.

Note that use cases are coming internally from WP2 (D2.16). The business model designs and technology prototyping in WP3 and WP4, respectively, are developed in an iterative approach in collaboration with the pilot activities in WP2. The pilots provide feedback on the usability and value of the new refinements.

6.2 User recruitment plan

The recruitment plan started shortly after the project Kick-off meeting. Different meetings were held and e-mails exchanged to explore the size of the groups of potential users. The users are not limited to EV drivers (or end-users) but include facility managers and charging point operators that might be interested in replicating

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some of the tools to be developed within GreenCharge project. In this sense, the partners involved in the pilot site explored their contact list to identify targeted companies and initiate conversations to engage them.

A formalisation of the user recruitment will be done in M13 (September 2019), once the pilot had been set-up to request the commitment and sign a consent form. A series of workshops will be organised to kick-off the trials and explain how the services work.

The recruitment task will run all along the piloting period, since new users will be invited to participate, such as a new employee in Eurecat or a new user registered to the MOTIT or e-bike sharing service. Similarly, any user can withdraw his/her participation.

6.3 Use of local reference group

As mentioned in a previous section, the LRG will provide valuable feedback for the tools to be tested in GreenCharge. Besides, some of the members of the LRG are already gathering data aligned with the indicators defined in GreenCharge and regularly issue surveys that are valuable inputs for GreenCharge. The use of this information serves different purposes: as baseline, as direct inputs for KPI calculations or for comparison, to decouple the impact of the measures tested in GreenCharge from other measures taken by third parties (public authorities, market, ,..).

There is an on-going task to expand the LRG adding new members that might be interested in testing the tools developed for the 3 demonstrators. If the instantiation effort is low, it will be considered to include them as part of the tests during the project lifetime.

6.4 Plan of supporting activities

As mentioned before, GreenCharge has adopted the CIVITAS evaluation framework [1]. According to this framework, the actions or initiatives to be tested are organised in measures and sub-measures. An exercise to translate scenarios and use cases into measures is being done by partners involved in task force group. The final results will be presented in D5.1-D6.1 *Evaluation Design / Stakeholder Acceptance Evaluation Methodology and Plan*. The evaluation itself, comprises two complementary actions: (1) Impact Evaluation and (2) Process Evaluation. The process evaluation *involves the evaluation of the processes of planning, implementation and operation, aiming to understand why measures have succeeded or failed, including the roles of information, communication and participation*. In this sense, a list of supporting activities have to be defined to facilitate the evaluation process. A preliminary list of this supporting activities is presented in the table together with the corresponding measures and sub-measures. This includes determining what effect various supporting activities has in implementing the measures and increase the envisaged impact.

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6.4.1 Smart charging for an e-scooter sharing service

The table below summarizes first list of the risks and supporting activities involved in the planning, implementation and operation of this measure. Further work will be done to better design the process.

Table 9: Supporting activities for smart charging for an e-scooter sharing service

Sub-measure	Risks	Supporting activities to approach the target group	Stage[5]	Target Group	Responsibility
Charging infrastructure based on battery swapping	Unable to obtain SoC in an automatic manner	Establish communication with platform provider to get information and potential updates	I	Fleet manager, equipment provider	SC+ML+MOTIT
	Lack of predictibility	Conduct surveys to understand mobility profiles	O	MOTIT users	SC+ML+MOTIT
	Lack of interest of fleet manager	Preliminary analysis of savings	P	Fleet manager	SC+ML+MOTIT
	Technicians do not fulfil the procedures	Workshop to explain the operation Interviews to understand their pains and gains	O	MOTIT staff	SC+ML+MOTIT
Multi-site charging infrastructure for e-scooter fleet	Feasibility to find strategic locations to deploy battery hubs	Analysis of trips (geographic distribution)	P, I	Fleet manager	SC+ML+MOTIT
	Lack of overall fleet optimization	Analysis of trips (geographic distribution)	P, I	Fleet manager	SC+ML+MOTIT
	Low usage of the sharing to evaluate the impact	Marketing campaigns	P,I,O	Sharing operator	MOTIT
	Low flexibility to efficiently apply smart management	Preliminary analysis based on historical data	P	Fleet operator	ML+MOTIT
Business model for smart	Flat electricity tariffs	Analysis of electricity market	P,I	Fleet operator	ML

[5] P = Planning phase, I = Implementation phase, O = Operation phase

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Sub-measure	Risks	Supporting activities to approach the target group	Stage[5]	Target Group	Responsibility
charging management	Cost of equipment need higher than savings	Preliminary sensitivity analysis	O	Fleet operator	ML+LEV+MOTIT

6.4.2 Incentivize dropping of e-scooters nearby battery hubs

The table below summarizes first list of the risks and supporting activities involved in the planning, implementation and operation of this measure. Further work will be done to better design the process.

The interaction with the user (MOTIT customer) will be done through MOTIT communication channels (e-mail, app, website and telephone). The users can call a customer service support centre in case of any problem. Similarly, they can report any issue related to the e-scooter usage using the app. Finally, they can reach the operator with the contact form in Motit-World website.

Table 10: Supporting activities for incentivizing dropping of e-scooters nearby battery hubs

Sub-measure	Risks	Supporting activities to approach the target group	Stage[6]	Target Group	Responsibility
Incentives scheme definition	Lack of insights of users preferences	Conduct surveys to understand mobility profiles	I	MOTIT users	SC+ML+MOTIT
	Difficulty to integrate incentive scheme in sharing operation	Analysis of data flows Interviews with sharing operator Interviews with sharing platform provider	P	MOTIT users	ML+MOTIT
Adjust battery collection policy	Feasibility to find strategic locations to deploy battery hubs	Analysis of trips (geographic distribution)	P, I	Fleet manager	SC+ML+MOTIT
	Reluctance to change operation tasks	Workshops to technicians	O	MOTIT staff	ML+MOTIT
	Low usage of the sharing to evaluate the impact	Marketing campaigns	P,I,O	Sharing operator	LEV+MOTIT
Business model for collaborative	Low interest in the incentives	Dissemination campaigns.	P,I	Fleet operator	ML

[6] P = Planning phase, I = Implementation phase, O = Operation phase

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Sub-measure	Risks	Supporting activities to approach the target group	Stage[6]	Target Group	Responsibility
battery swapping	Incentives are higher than savings	Conduct surveys to understand user preferences	P, O	MOTIT users	SC+LEV+MOTIT

6.4.3 Green energy for e-scooter sharing service

The table below summarizes first list of the risks and supporting activities involved in the planning, implementation and operation of this measure. Further work will be done to better design the process.

Table 11: Supporting activities for green energy for e-scooter sharing service

Sub-measure	Risks	Supporting activities to approach the target group	Stage[7]	Target Group	Responsibility
Shift to certified 100% green energy	Shift to green energy is not an attractive factor for users	Dissemination campaigns. Conduct surveys to understand user preferences	P, O	MOTIT users	SC+ML+MOTIT
	Unable to quantify the impact of the measure	Conduct surveys to understand user preferences	O	MOTIT users	SC+LEV+MOTIT

6.4.4 Corporate charging point booking service

The table below summarizes first list of the risks and supporting activities involved in the planning, implementation and operation of this measure. Further work will be done to better design the process.

During the piloting phase, the users will be able to report any issue through the app. A member of Eurecat working in GreenCharge will handle the issue directly or forward it to the appropriate department. Since it is only for Eurecat employees, they will be able to call or send an e-mail to the people in charge, as they will be communicated during the workshops. The response time will be 48 hours for working days.

[7] P = Planning phase, I = Implementation phase, O = Operation phase

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Table 12: Supporting activities for corporate charging point booking service

Sub-measure	Risks	Supporting activities to approach the target group	Stage[8]	Target Group	Responsibility
Booking	No employees interested	Interview EV drivers Communicate existence	P, O	Eurecat employees	SC+LEV+EURECAT
	Access control incompatibilities	Interview facility manager and HR department to modify policies	I, O	Facility manager and management departments	SC+ML+EURECAT
	Complaints of non-EV drivers	Communication campaign Establish policies with HR department and workers committees	O	Eurecat employees	SC+ML+EURECAT
	No responsible person for the operation	Interview facility manager Define protocols to handle situations Workshop to show how it works	O	Eurecat management	SC+ML+EURECAT
Optimal use of energy for EURECAT premises including RES and EV charging	Unable to modify set-points	Workshop to show the potential benefits Proof of concept	I	Eurecat management	SC+ML+EURECAT
	Low usage of the charging points to evaluate the impact	Communication campaign Extrapolation based on projections	O	Eurecat employees	SC+LEV+EURECAT
	Low flexibility to efficiently apply smart management	Preliminary analysis based on historical data	P	Facility manager	ML+EURECAT
	Flat electricity tariffs	Analysis of electricity market	P,I	Facility manager	ML

[8] P = Planning phase, I = Implementation phase, O = Operation phase

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Sub-measure	Risks	Supporting activities to approach the target group	Stage[8]	Target Group	Responsibility
Business model[9] for flexibility energy demand	Cost of equipment need higher than savings	Preliminary sensitivity analysis	P,O	Facility manager	ML+LEV+EURECAT
	Not perceived as a perk	Communication campaign	O	Eurecat employees, Eurecat management	ML+LEV+EURECAT

6.4.5 Smart operation of an e-bike sharing service

The table below summarizes first list of the risks and supporting activities involved in the planning, implementation and operation of this measure. Further work will be done to better design the process.

The users of the service will be able to report any problem using the corresponding section in the app. To facilitate the dispatching of the issue and the reporting via smartphone, pre-defined categories will define. Additionally, for urgent matters, there is a support telephone number. The calls will be received by the maintenance support service. For more general purposes, an email account will be shared during the workshops and the leaflet provided to the users. The SC coordinator or a delegate will be responsible to dispatch the issues received to the responsible partner. Depending on the urgency, a reply it is to be expected within 24-48 hours for working days.

Table 13: Supporting activities for smart operation of an e-bike sharing service

Sub-measure	Risks	Supporting activities to approach the target group	Stage[10]	Target Group	Responsibility
Traceability of assets	Privacy concerns	Workshop to explain data management Informed consent	O	e-bike sharing users	SC+ML+St. Quirze municipality+SINTEF
	Vandalism/ Improper usage	Leaflets Posters	O	e-bike sharing users, factory managers	SC+ML+St. Quirze municipality
	Low interest of information generated	-	P	St.Quirze municipality	ML+LEV+St. Quirze municipality
	No responsible for the daily operation	Workshop to explain the operation	O	St.Quirze municipality	SC+ML+St. Quirze municipality
RES + storage to provide green	Production does not meet demand	-	P, I	Sharing operator	SC+ML+St. Quirze municipality

[9] There is not business model in the classical approach, but there must be a perception of profits, in a broad interpretation.
[10] P = Planning phase, I = Implementation phase, O = Operation phase

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Sub-measure	Risks	Supporting activities to approach the target group	Stage[10]	Target Group	Responsibility
energy locally produced	Vandalism	Leaflets Posters Workshops	P, I	e-bike sharing users	SC+ML+St. Quirze municipality
	High maintenance efforts	Dissemination material Workshops	P,I,O	Sharing operator	SC+ML+St. Quirze municipality
	Not perceived as an added-value	Workshops Leaflets Include gamification elements in the app Surveys to know users satisfaction	O	e-bike sharing users	ML+MOTIT
Business model for smart charging management	High maintenance costs	Analysis of costs and benefits	P,I	sharing operator	ML+LEV+St.Quirze municipality
	No interest for companies to invest in more bicycles	Workshops Newsletters	O	Factory managers for the factories participating in the sharing service	ML+LEV+MOTIT

6.5 Risk management

After the analysis of the measures and sub-measures presented in the previous sub-section, the risks can be grouped as presented in Table 14. Mitigation actions to handle them are also proposed.

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Table 14: Preliminary mitigation plan for risks identified in Barcelona pilot

Risk	Mitigation plan
Low participation of users	• Different demonstrators have been chosen. Further efforts are on-going to add new demonstrators (replicate tools) • Big emphasis on communication campaigns, dissemination activities and events. • Personal contact with users.
Unable to apply set-points in an automatic manner	• Measurements enable to do realistic simulations and obtained valid results to show impact of smart management
No business model in energy management	• Results will enable to perform a sensitivity analysis. It is expected that energy policies change in the near future.
New management policies (changes due to elections or corporate management might jeopardize the implementation of the already agreed measures)	• Different demonstrators have been chosen. Further efforts are on-going to add new demonstrators (replicate tools)

6.6 Action plan

The project started 1. September 2018 and will finalised in August 2021. A set of milestones were already planned at the proposal phase, as shown in Table 15, which provides the overall time framework and enable the alignment with all project activities.

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Table 15: GreenCharge Milestones (extracted from DoW)

#	Milestone	Due month		Means of verification
1	Pilots defined	6	Feb 2019	- Initial version of user needs, scenarios and use cases available
2	Initial components deployed	7	Mar 2019	- Individual prototype components deployed in pilots and testing started
3	Plans and requirements defined	8	Apr 2019	- Initial version of strategic plans for pilots, evaluation and data collection defined - Initial requirements and architecture defined
4	Initial business model design and prototype completed	10	Jun 2019	- Initial version of the integrated prototype implemented - Initial version of simulation support implemented
5	Pilot operational	12	Aug 2019	- Testing and evaluation of the initial integrated models and prototype by pioneer users started - Data collection started
6	Revised business model design completed and prototype operational	24	Aug 2020	- Implementation of the refined and extended version of the integrated prototype based on evaluation operational - Revised plans for pilot and evaluation based on intermediate evaluations completed - Revised version of tools for simulation and visualisation operational
7	Ready for final evaluations	30	Feb 2021	- Prototype system tested for more than one full year at the pilot sites - Refined tools for simulation and visualisation completed - Data collection finalized
8	Project completed	36	Aug 2021	- Simulations completed and simulation results documented - Analysis of the data collected in the pilots and the simulation results, and assessment of KPIs completed and documented - Recommendations and deployment guidelines finalised - Final version of the integrated prototype including refinement and extensions integrated during the pilots released.

A more detailed plan for the implementation of each demonstrator, including the technological and supporting activities is shown in the following tables. For the first iteration, most of the activities that involves interaction with users have been postpone to mid-September/October since the effects of summer holidays and special timetables persist until children go back to school.

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Table 16: Planning for activities for Eurecat demonstrator

#	Activity	Responsible partner	Deadline
1	Definition of actions and responsibilities with Eurecat infrastructure department (procurement calendar)	Eurecat	April 2019
2	Architecture instantiation: specification of app and back-end system	Eurecat	April 2019
3	Mechanisms and procedures for user support defined (a contact section in the app for communication and the procedures for support from WP2 and WP4)	Eurecat	April 2019
4	Implementation of connectors for automated data gathering (weather, energy mix, price tariffs, energy consumption)	Eurecat	April 2019
5	Installation of communication equipment in the parking garage	Eurecat	June 2019
6	Electric work for upgrade 1 of charging points (Cerdanyola)	Eurecat (Enchufing)	July 2019
7	Tools for data collection like interview guides and surveys established	Eurecat	July 2019
8	Lab set-up for testing	Eurecat	June 2019
9	Lab testing of charge optimization	Eurecat	June 2019
10	Definition of simulation scenarios to test scalability	Eurecat	June 2019
11	Electric work for installation of charging points (Manresa)	Eurecat (Enchufing)	September 2019 (or May 2020)[11]
12	Lab testing of app and back-end system	Eurecat	August 2019
13	Integration tests (lab)	Eurecat	September 2019
14	Integration tests (field)	Eurecat (Enchufing)	September 2019
15	Baseline data collection	Eurecat	September 2019
16	Official release	Eurecat	September 2019
17	Workshop with users	Eurecat	October 2019
18	Automated data collection starts	Eurecat	October 2019
19	Intermediate control check-point – manual data collection (surveys, interviews) and monitoring of KPIs	Eurecat	March 2020
20	Evaluation (first iteration) – includes manual data collection	Eurecat	June 2020

[11] Depending on subsidy request approval

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#	Activity	Responsible partner	Deadline
21	Electric work for upgrade 2 of charging points (Cerdanyola and Manresa, if needed)	Eurecat	July 2020
22	Adjustments and tuning for 2nd iteration	Eurecat	August 2020
23	Workshop with users to explain changes and engage new comers	Eurecat	September 2020
24	Evaluation (second iteration) – manual data collection (surveys, interviews) and monitoring of KPIs	Eurecat	February 2021
25	Workshop presentation of final results	Eurecat	September 2021

Table 17: Planning for activities for St. Quirze e-sharing demonstrator

#	Activity	Responsible partner	Deadline
1	Definition of actions and responsibilities GreenCharge partners/St.Quirze municipality/Factories management	Enchufing Eurecat Atlantis	April 2019
2	Agreement with St. Quirze municipality signed	Eurecat	April 2019
3	Selection of geotrackers and locking mechanisms	Atlantis	April 2019
4	Selection of PV panels and stationary battery	Enchufing	April 2019
5	Architecture instantiation: specification of app and back-end system	Eurecat Atlantis	April 2019
6	Implementation of connectors for automated data gathering (weather, energy mix, price tariffs, energy consumption)	Eurecat	April 2019
7	Workshop with users to get user needs that can be included into the scope of GreenCharge	Eurecat	May 2019
8	Design of communication channel to users (contact section in the app, phone number and email)	Eurecat	May 2019
9	Lab set-up for testing	Enchufing Atlantis Eurecat	May 2019
10	E-bike battery replacement to enable M2M communication	Enchufing	June 2019
11	Installation of communication equipment	Atlantis	June 2019
12	Upgrade charging station with identification of charging points and e-bike	Enchufing	June 2019

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#	Activity	Responsible partner	Deadline
13	Lab testing of charge optimization	Eurecat	June 2019
14	Installation of PV panel and stationary battery	Enchufing	July 2019
15	Lab testing of app and back-end system	Atlantis Eurecat	August 2019
16	Integration tests (lab)	Eurecat	August 2019
17	Integration tests (field)	Enchufing Eurecat Atlantis	September 2019
18	Official release	Eurecat	September 2019
19	Automated data collection starts	Enchufing Eurecat Atlantis	September 2019
20	Workshop with users	Eurecat	October 2019
21	Baseline data collection	Eurecat	September 2019
22	Intermediate control check-point – manual data collection (surveys, interviews) and monitoring of KPIs	Eurecat	March 2020
23	Evaluation (first iteration) – includes manual data collection	Eurecat	June 2020
24	Adjustments and tuning for 2nd iteration	Eurecat	August 2020
25	Workshop with users to explain changes and engage new comers	Eurecat	September 2020
26	Evaluation (second iteration) – manual data collection (surveys, interviews) and monitoring of KPIs	Eurecat	February 2021
27	Workshop presentation of final results	Eurecat	July 2021

Table 18: Planning for activities for MOTIT demonstrator

#	Activity	Responsible partner	Deadline
1	Exposure of APIs for data extraction from MOTIT platform	Motit	April 2019
2	Implementation of connectors for automated data gathering (weather, energy mix, price tariffs, energy consumption)	Eurecat	May 2019
3	Cession of battery for health analysis	Motit	May 2019
4	Upgrade of charging infrastructure for energy monitoring	Motit	June 2019
5	Definition of simulation scenarios to test use of RES	Eurecat	June 2019

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#	Activity	Responsible partner	Deadline
6	Instantiation of GreenCharge reference architecture	Motit Eurecat	June 2019
7	Lab testing of charge optimization	Eurecat	June 2019
8	Integration tests (field)	Motit	August 2019
9	Official release	Motit	August 2019
10	Baseline data collection	Eurecat	September 2019
11	Results of first health analysis cycle	Eurecat	March 2020
12	Evaluation (first iteration) – includes manual data collection	Eurecat	June 2020
13	Design of incentive policies to drop e-scooter by battery hub	Motit	June 2020
14	Adjustments and tuning for 2nd iteration	Motit Eurecat	August 2020
15	Upgrade of charging infrastructure for charge control[12]	Motit	August 2020
16	Communication campaign to engage users to incentive plan	Motit	September 2020
17	Surveys – manual data gathering for users satisfaction	Motit	December 2020
18	Results of battery health analysis 2nd cycle	Eurecat	January 2021
19	Evaluation (second iteration) – manual data collection (surveys, interviews) and monitoring of KPIs	Eurecat	February 2021

[12] Depending on the results of the first iteration (if profitable)

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7 Further Work

This deliverable, together with description of the pilot site (D2.16) provides the ground to build upon. The work performed by the partners involved in Barcelona pilot to produce these deliverables have helped to aligned goals and perspectives, to use a common language and to set a working methodology, not only locally, but synergies have been established with parallel activities in the other 2 pilot sites. Additionally, the task force for evaluation and cross-meetings attendance to WP4 teleconferences has been proven necessary for efficient progress. There is still to be done to finalise the definition of the pilot site and formalised interfaces, components and naming, align to the architecture definition in WP4. Yet, as mentioned in the deliverable, the detailed definition for the plan supporting activities and data collection is on progress as part of WP5-WP6 activities. In that sense, deliverables D5.1/D6.1 and D4.1 will complete and complement the work presented in this deliverable.

As already highlighted there is a potential risk of not achieving representative results due to low penetration of EVs in Spain. To mitigate this risk, efforts will be done to expand the demonstrators by attracting as many users as possible and finding replicability in other companies. Workshops and events have to be carefully prepared in coordination with WP8 and WP3 to get the greatest impact.

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8 References

[1] SATELLITE D2.3, *Refined CIVITAS process and impact evaluation framework*, 31.08.2017

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Members of the GreenCharge consortium

SINTEF	SINTEF AS (SINTEF) NO-7465 Trondheim Norway www.sintef.com	**Project Coordinator:** Joe Gorman Joe.Gorman@sintef.no **Technical Manager:** Shanshan Jiang Shanshan.Jiang@sintef.no
eSmart Systems	eSmart Systems AS (ESMART) NO-1783 Halden Norway www.esmartsystems.com	**Contact:** Frida Josefin Sund Frida.sund@esmartsystems.com
HUBJECT	Hubject GmbH (HUBJ) DE-10829 Berlin Germany www.hubject.com	**Innovation Manager:** Sonja Pajkovska sonja.pajkovska@hubject.com
eurecat Centre Tecnològic de Catalunya	Fundació Eurecat (EUT) ES-08290 Barcelona Spain www.eurecat.org	**Contact:** Regina Enrich regina.enrich@eurecat.org
ATLANTIS TRACKING YOUR WORLD	Atlantis IT S.L.U. (ATLAN) ES-08013 Barcelona Spain www.atlantisit.eu	**Contact:** Ricard Soler rsoler@atlantis-technology.com
enchufing	Millor Energy Solutions SL (ENCH) ES-08223 Terrassa Spain www.millorbattery.com	**Contact:** Gerard Barris gbarris@enchufing.com
motit www.motitworld.com	Motit World SL (MOTIT) ES-28037 Madrid Spain www.motitworld.com	**Contact:** Valentin Porta valentin.porta@goinggreen.es
Freie Hansestadt Bremen	Freie Hansestadt Bremen (BREMEN) DE-28195 Bremen Germany	**Contact:** Michael Glotz-Richter michael.glotz-richter@umwelt.bremen.de

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Move About GmbH (MOVA)
DE-28359 Bremen
Germany
www.move-about.de

Contact: Nils Jakubowski
nils.jakubowski@move-about.de

Personal Mobility Center Nordwest eG (PMC)
DE-28359 Bremen
Germany
www.pmc-nordwest.de

Contact: Bernd Günther
b.guenther@pmc-nordwest.de

Oslo kommune (OSLO)
NO-0037 Oslo
Norway
www.oslo.kommune.no

Contact: Sture Portvik
sture.portvik@bym.oslo.kommune.no

Fortum OYJ (FORTUM)
FI-02150 Espoo
Finland
www.fortum.com

Contact: Jan Ihle
jan.haugen@fortum.com

PNO Consultants BV (PNO)
NL.2289 DC Rijswijk
Netherlands
www.pnoconsultants.com

Contact: Arno Schoevaars
arno.schoevaars@pnoconsultants.com

Universita Deglo Studi Della Campania Luigi Vanvitelli (SUN)
IT-81100 Caserta
Italy
www.unicampania.it

Contact: Salvatore Venticinque
salvatore.venticinque@unina2.it

University of Oslo (UiO)
NO-0313 Oslo
Norway
www.uio.no

Contact: Geir Horn
geir.horn@mn.uio.no

ICLEI European Secretariat GmbH (ICLEI)
DE-79098 Freiburg
Germany
www.iclei-europe.org

Contact: Stefan Kuhn
stefan.kuhn@iclei.org

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