Grant number: 769016
Project duration: Sept 2018 - Aug 2021
Project Coordinator: Joe Gorman, SINTEF

HORIZON 2020: Mobility for Growth
MG-4.2-2017
Supporting Smart Electric Mobility in Cities
Project Type: Innovation Action

GREEN CHARGE

greencharge2020.eu

GreenCharge Project Deliverable: D2.4

Implementation Plan for Oslo Pilot

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CIVITAS
Cleaner and better transport in cities
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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

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Executive Summary

Within the GreenCharge project, Oslo is one out of three pilot sites. In the Oslo pilot, there is a particular focus on providing cost efficient home charging facilities for inhabitants living in blocks of flats.

This report is the implementation plan for the demonstration activities to be implemented in the Oslo pilot. The implementation plan is based on the defined use cases and the overall technical requirements from D2.3 *"Description of Oslo Pilot and User Needs"*. The selected use cases for the Oslo pilot are:

- Use Case #1: Normal charging in the garage
- Use Case #2: Long-term parking (Vehicle-to-Grid (V2G) possibilities) in the garage
- Use Case #3: Drop-in charging
- Use Case #4: Charging with booking

Use cases #1 and #2 are related to charging within a common parking garage, while use cases #3 and #4 are related to use of existing semi-fast chargers placed outdoor. To implement use cases #1 and #2 new technical installations are needed inside the parking garage.

Based on the use cases the target user groups have been identified. For charging within the common parking garage, the target users are residents of the Røverkollen housing cooperative owning an electric vehicle (EV). For charging at the outdoor chargers, the following target users have been identified:

a) Visitors and guests of residents at Røverkollen (arrives occasionally)
b) Taxis (arrives occasionally)
c) Staff of the school that is located next to Røverkollen (might arrive on a daily basis)
d) Residents at Røverkollen that need to have a faster charging speed than what is available within the garage (arrives occasionally)

The different use cases are used to provide input to implementation and interoperability requirements, and thereby to the selection of hardware and software:

Sub-system role	System components	Supplier partner
Roaming management system	HUBJ eRoaming Platform, Open Intercharge Protocol (OICP) and Intercharge network	HUBJECT
Charge management system	Fortum Charge & Drive	FORTUM
Neighbourhood energy management system	eSmart Flex platform (With services and storage hosted in Microsoft Azure. Client requires Google Chrome browser).	ESMART
Local renewable energy source	Solar panels from OneCo	
Local battery storage	Battery storage from Fenecon	

The Oslo pilot shall be operational in September 2019, but will be revised on the course of the project based on intermediate evaluations and possibly new innovations identified.

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Table of Contents

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Table of Figures

List of Tables

List of Abbreviations

Table 1: List of abbreviations

Abbreviation	Explanation
AI	Artificial Intelligence
BEV	Battery Electric Vehicle
CMS	Charge Management System
DOW	Description of Work
DR	Demand Response
DSO	Distribution System Operator (related to electric power distribution)
EV	Electric Vehicle
ICT	Information and communications technology
KPI	Key Performance Indicators
LEM	Local Evaluation Manager
LRG	Local Reference Group (stakeholders)
ML	Measure Leader
NEMS	Neighbourhood Energy Management System
OCPP	Open Charge Point Protocol
OEM	Original Equipment Manufacturer
OICP	Open Intercharge Protocol
PHEV	Plug-in Hybrid Electric Vehicle
PV	Photovoltaic
RES	Renewable Energy Source
RFID	Radio Frequency Identification
SC	Site Coordinator
SOC	State of Charge
V2G	Vehicle-to-Grid
WP	Work package

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List of Definitions

Table 2: List of definitions

Definition	Explanation
Artificial Intelligence	Intelligence demonstrated by machines, in computer science.
Charge Management Systems (CMS)	The Charge Management System balances the load between the connected chargers and keeps within the OCP generated by NEMS. Fortum Charge & Drive Management Cloud operates as the Charge Management System in GreenCharge.
Distribution System Operator (DSO)	Distribution System Operator – responsible for operating and maintaining the electricity distribution grid.
Description of Work (DOW)	Project document
Key Performance Indicator (KPI)	KPIs is a measurable value demonstrating how effectively e.g. a company is achieving key business objectives
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.[1]
Neighbourhood energy management system (NEMS)	An ICT system implementing the smartness of an energy smart neighbourhood.
Open Charge Point Protocol (OCPP)	An Open Charge Point Protocol is an application protocol for communication between EVs, charging station and a central management system.
Photovoltaic (PV)	Photovoltaic panels (solar cell panels) converts light into electricity using semiconducting materials
Radio Frequency Identification (RFID)	An RFID tag is an electronic tag that exchanges data with an RFID reader through radio waves
Renewable Energy Source (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 CO2 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.

[1] See CIVITAS Satellite project deliverable D2.3 Refined CIVITAS process and impact evaluation framework, page 11.

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Definition	Explanation
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.
Vehicle-to-Grid (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.

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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 how the demonstration activities are planned to be implemented at the Oslo pilot site. The document describes the overall implementation plan based on the defined use cases and the overall technical requirements from D2.3 *"Description of Oslo Pilot and User Needs"*.

1.2 Intended readership/users

This document should be read by all project partners involved in implementing the Oslo pilot. In addition, the deliverable should be useful for respective actors in the uptake cities group.

1.3 Other project deliverables that may be of interest

- **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.
- **D2.3 Description of Oslo Pilot and User Needs** – Describe Oslo pilot in terms of challenges, user needs, use cases, scenarios, stakeholders and locations to be involved. Includes overview of e-mobility status at start of the project.
- **D2.5 Pilot Component Preparation for Full-scale Pilot (Oslo)** – Deployment and testing of software and hardware components to be used in the pilot, to prepare for the full-scale pilot implementation.
- **D2.6 Full-Scale Pilot Implementation in Building Block** – Integrated smart charging solution installed in the building block, prepared for balancing charging of EVs with local energy use and electricity production.
- **D2.8 Final Report for Oslo Pilot: Lessons Learned and Guidelines -** Describe the Oslo pilot, including the implementation, operation, the tests carried out, services and the data collected. Describe lessons learned and guidelines for apartment buildings.

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2 Overview of the pilot site in Oslo

See *"D2.3 Description of Oslo Pilot and User Needs"* for a more detailed description of the pilot site and the surroundings. Only a short summary is given here.

The pilot site is at the Røverkollen housing cooperative in the eastern part of Oslo municipality. The housing cooperative comprises of 246 apartments distributed over five blocks.

Figure 1 shows an aerial photo of the buildings at Røverkollen housing cooperative; five building blocks, the common house and the parking garage.

Figure 1: Aerial photo of Røverkollen (ref: norgeskart.no)

According to data from Norwegian Public Roads Administration (Statens vegvesen) there are 16 battery electric vehicles (BEV) at Røverkollen and one plug-in hybrid electric vehicle (PEV). There are some uncertainties regarding these numbers since some may have vehicle leasing contracts. Leased vehicles are typically registered at the address of the leasing company.

Before the GreenCharge project, the housing cooperative established four outdoor, semi-fast chargers, but no charging inside the parking garage. Accesses to the outdoor chargers is given by subscription and requires pre-booking through a web-based spreadsheet. Read more about this in in section *3.3.1 Booking system and payment method* in *D2.3 Description of Oslo Pilot and User Needs*.

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3 Pilot description

3.1 Use cases to be demonstrated

The following use cases derived from scenarios 2, 4, 5 and 6 in the Description of Work (DoW) will be demonstrated and tested in the Oslo pilot (see also section 4.4 *Use Cases* in D2.3):

Use Case #1: Normal charging in the common garage (in scenario 4 and 6)

Use Case #2: Long-term parking in the garage with Vehicle-to-Grid (V2G) possibilities (in scenario 5)

Use Case #3: Drop-in charging at the publicly available semi-fast chargers (in scenario 6)

Use Case #4: Charging with booking of the publicly available semi-fast chargers (in scenario 2 and 6)

3.2 Implementation plan for the pilot

3.2.1 Basic topology power distribution for charging infrastructure

The parking facility at Røverkollen is a four-story garage. The power will be distributed from the main switch to each floor through power bars that will be installed on each level. From the power bars, the charge points can easily be installed on each parking lot to serve the residents who sign up for a charging point.

- The grid will provide 230V IT
- Maximum power to each charger will be 32 A
- Maximum power, 1-phase: 7.2 kW
- Minimum charging power: 1kW (to enable the in-vehicle charger to accept charging)

Power consumption on each charging point will be balanced towards the maximum total power allocated for charging. However, the following restrictions will apply at all times:

- The maximum power usage on each segment (floor) can never exceed the fuse covering each floor, in our example 63A. This limitation can be adjusted in the final implementation.

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- The maximum power usage on all segments can never exceed main fuse charging infrastructure.

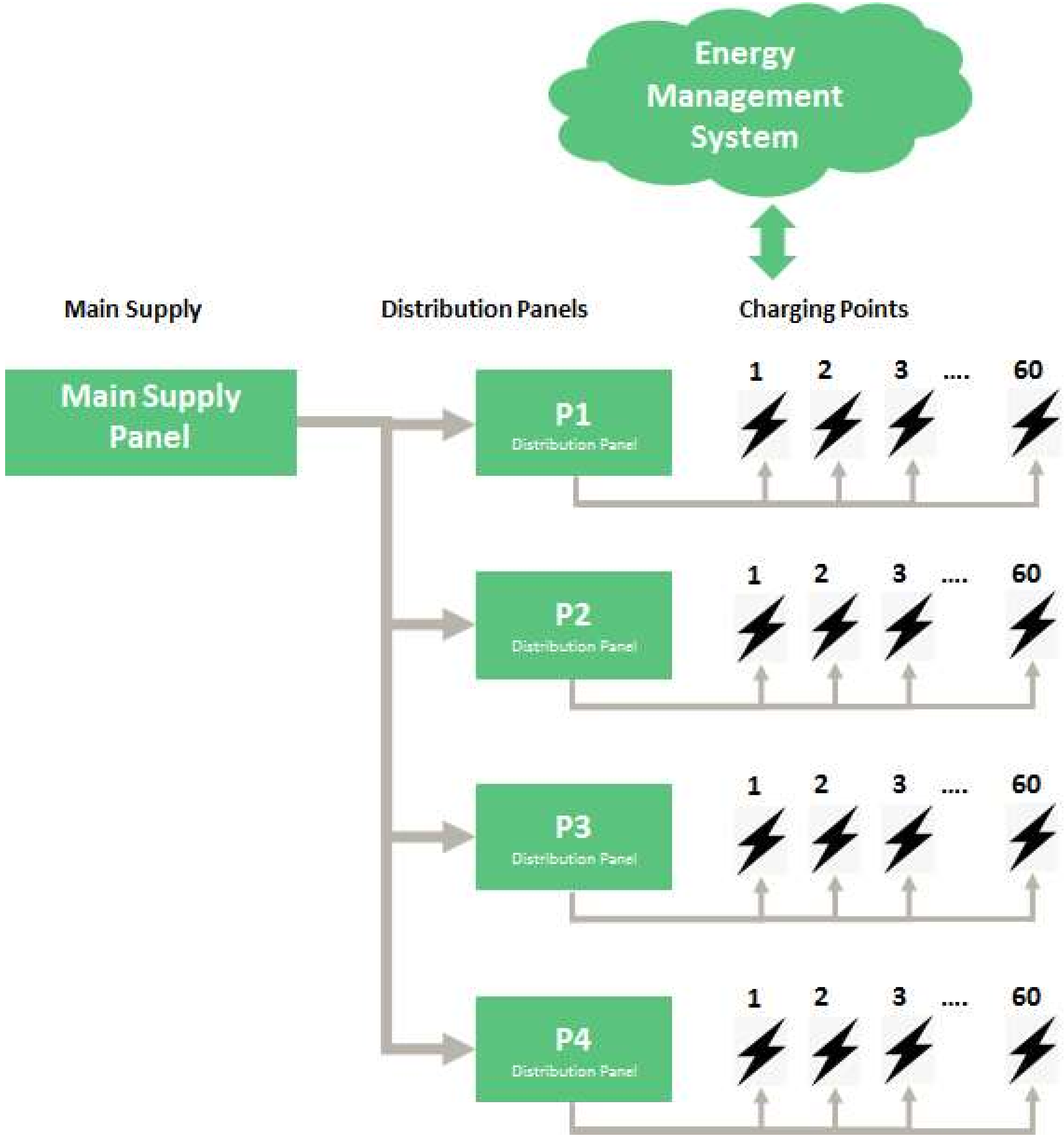

Figure 2: Basic topology power distribution, charging infrastructure in the parking garage

3.2.2 Mobility and energy requirement

The fundamental need for energy is connected to the driving habits of each user. These needs vary between users and over time. Home charging will be the main source of charging, although not the only source. Trips that go beyond the driving range of an electric vehicle (EV) will have to charge at some private or public charging point to make these trips.

The daily mobility needs are mostly within the range of all available EVs. From the insurance industry, we know that on average, the cars in Norway are insured for a driving distance of 15 000 km/year. We assume that the residents of Røverkollen on average fits into this picture, and we will use this as a yardstick to estimate the mobility need on a daily basis, and thus the energy requirements to meet these needs.

We also need to make assumptions regarding the energy consumption of the EVs at the pilot. For any given car, this may vary and will depend on the driving behaviour of the driver. Other factors like the temperature,

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wet roads, snow and wind will influence the energy consumption. From the EV manufacturers, the energy consumption per 10 km is stated from 1.2 kW to 2.5 kW. For the purpose of projecting the energy need at a parking lot at a housing association like Røverkollen, we assume that the EVs connected at any given time has an energy consumption of 2kW/10km on average.

Assumption mobility need and energy needed.

- Driving distance/year: 15 000 km
- Driving distance/day: 41 km
- Energy consumption: 2 kWh/10km
- Energy needed: 8.2 kW/day

Table 3: Maximum capacity Oslo Pilot

Max effect (kWh)	119
Period connected (17.00-07.00)	14
Time connected (hours)	12
Energy available (kWh)	1666
Average energy needed (kWh)	8,2
Max number of cars connected	203

Based on these assumptions, the garage at Røverkollen could provide the energy to cover the basic mobility need for 203 cars. The assumptions will have to be challenged during the pilot period and these preliminary calculations should be used as a basis for discussions only.

3.2.3 Charge points Oslo Pilot

The charge points at Røverkollen will be connected to internet and communicate real time data to the back-end system – Charge&Drive Management System (CDMC). Through the App, the user will be able to operate the charging station according to the pilot requirements.

The specific charger selected for the site has the following basic specifications:

Table 4: Charger specifications

Product name	EV Smart Wallbox
Outlet	Type 2 X 1
Current	16/32 Amp
Voltage	230V
Power	3.6/7.2kW (1-phase), 11/22 kW (3-phase)
Connectors (for control)	RS485 for metering Modbus, RJ45 for Ethernet LAN connection
Standards compliance	IEC 61851-22 IEC 62196-1 IEC 62196-2

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	IEC 61851-1
Communication Protocol	Open Charge Point Protocol (OCPP) 1.6 (OCPP 2.0 to be implemented during the pilot)
Authentication	Radio Frequency Identification (RFID), App, SMS

3.3 Target users and stakeholders

3.3.1 Target users

In Norway, most residents own their dwelling. Nearly 80 % of the households are freeholders. 14 % of the freeholders own their housing unit through a *housing cooperative* (most housing cooperatives are blocks of flats in the cities) (SSB, n.d.). "Borettslag" is the legal entity for housing cooperatives in Norway. This company is owned by those who live in the cooperative, the shareholders. Each share gives the resident the right to live in the cooperative, in a particular apartment (or house) and the shareholder is free to sell her/his part. When a part is for sale, the cooperative statute can give internal first preference (to other shareholders) and owns the buildings and the property.

Røverkollen housing cooperative consists of 246 apartments/households. The total number of residents is not fully known, however according to a user survey carried out in Nov 2018, the age of the residents lies between 35 to 65 years old.

For the charging sites within the common garage, users that would participate in the pilot on a daily basis are residents of the Røverkollen housing cooperative. These users have their own privately owned EV which they use to commute to work at daytime, or for shopping or leisure activities in the afternoon/evening. The results from the survey reported in deliverable D2.3 shows that of the respondents who do not already possess an electric car, 15 % have clear plans about it and 21 % of the respondents will buy a chargeable car within 2 years. This means than within 2 years, it is likely that 50 % of the households will have chargeable vehicles. This indicates future needs for charging facilities.

Another important user is the Røverkollen housing cooperative which will facilitate the billing of the electricity used for EV charging. These users will be engaged in testing use cases #1 and #2.

For the charging sites outside the garage at the 4 semi-fast chargers, users that would participate in the pilot (dropping by occasionally) are mainly:

a) Visitors and guests of residents at Røverkollen (arrives occasionally)

b) Taxis (arrives occasionally)

c) Staff of the school that is located next to Røverkollen (might arrive on a daily basis)

d) Residents at Røverkollen that need to have a faster charging speed than what is available within the garage (arrives occasionally).

These users will be engaged in testing use cases #3 and #4. Røverkollen housing cooperative will receive the payment for the charging.

3.3.2 Other stakeholders

Other stakeholders that are needed to run the pilot includes:

- **The board of Røverkollen housing cooperative** The highest authority in a housing cooperative is the annual meeting for shareholders that elects the board responsible for daily operations. The housing cooperative board is elected to represent the interests of the residents. They are responsible for executing the decisions that are made at the shareholders annual meetings, and to manage the buildings and the property. Most decisions are made with majority vote, however, change of rules, substantial changes of property or buildings demand 2/3 majority. Most housing cooperatives are members of a cooperative housing association (cooperative building society) that function as general manager of the housing cooperative.

- **Fortum OY** is one of the largest energy companies in the Nordic countries and is registered in Finland. Main focus is on zero emission power generation and smart energy solutions. Fortum Charge&Drive (C&D) is Fortum's brand within e-mobility solutions and have been investing in public fast-charging networks in the Nordic countries. As of today, Fortum C&D has a dominant market share in the Nordic countries, with Norway as the lead country for e-mobility solutions. The backbone of the e-mobility business is CDMC – a cloud solution for managing chargers and charging networks. This includes operations, customer service, access management and payment system. Fortum C&D is a project partner in GreenCharge where they will provide the software for the Charge management system (CMS), as well as a smartphone application.
- **Hafslund Nett** is the local distribution system operator (DSO). Hafslund Nett owns and operates the local electricity grid at Røverkollen and in the municipality of Oslo as such. Hafslund E-CO AS is an integrated energy and infrastructure group that is wholly owned by Oslo City Council. Hafslund E-CO owns Norway's second largest electricity generating company E-CO Energi AS, and Norway's largest power grid company Hafslund Nett AS. Hafslund Nett distributes electricity to 720 000 power grid customers in Oslo, Akershus and Østfold counties. This means that they operate in the most densely populated part of Norway, where population growth is expected to increase. In 2040, Hafslund will supply power to 500 000 more people than in 2019. Hafslund need to develop their activities to meet future needs; build more power networks, and a smarter electricity grid. Customer consumption patterns change, especially by the penetration of electrical vehicles and new types of electrical appliances. Hafslund install advanced meters at their network customers, and this will be the meeting point between the smart electricity grid and the customers' smart solutions. Hafslund contributes to a cleaner environment and a better global climate by bringing renewable power to customers as a replacement for fossil fuels. See more at: https://www.hafslundnett.no/
- **Bravida** is the electrical contractor that will install the electric infrastructure within the parking house. See more at: https://www.bravida.se/en/.
- **OneCo** is the electrical contractor that will install the solar panels and battery within the parking house. See more at: https://oneco.no/
- **Oslo Municipality** is both the largest city and the capital of Norway. The municipality has, since 2008, had an active plan to reduce greenhouse gas emissions, both through regulations and through funding mechanisms. See https://www.oslo.kommune.no/startpage/ for more information. Project partner in GreenCharge.
- **eSmart Systems** is a software company that provides Artificial Intelligence (AI) driven software solutions to the energy industry and service providers. Their cloud born platform is designed to handle and exploit IoT, Big Data and Analytics in real time. It has broad application possibilities that brings huge opportunities for cost savings in forms of improved knowledge about the state of power grid components as well as greatly improved optimization of distributed energy resources. Common to the applications is vast data quantities gathered from sensors, which are analysed using deep learning, advanced predictions and optimization models. This results in completely new ways of visualizing data, making decisions and saving resources and costs. See more at https://www.esmartsystems.com/about-us/. eSmart is a project partner in GreenCharge, where they will provide the cloud and software for the Neighbourhood energy management system (NEMS).
- **Hubject** is roaming provider for e-mobility (e-Roaming). Using Hubjects e-roaming platform and the *Intercharge* network EV drivers only need one contract from an *Intercharge* partner to seamlessly charge at every station within the network. Fortum C&D is connected to the *Intercharge* network.

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- **Futurehome** is a software and hardware developer that enables smart management of energy use in private homes. Their platform provides security management (door-locks, intruder alarm and fire alarms), energy billing and energy management. Futurehome is already a provider of security management at Røverkollen. In GreenCharge it is proposed that Futurehome will provide sensors and actuators within the apartment blocks that may enable smart management of the buildings loads. Futurehome's sensors will provide data to the data cloud of the NEMS provided by eSmart Systems.
- **OBOS** is Norway's largest housing administrator, and one of the largest Nordic housing constructors. OBOS is a cooperative building association and is owned by its members. Røverkollen is a member of OBOS. In GreenCharge, OBOS is interested in lessons learned from the implementation and operation of Røverkollen as it is relevant to most of their housing cooperatives situated throughout the country.

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4 Stakeholder involvement

4.1 Local Reference Group

A Local Reference Group is established in Oslo with members from the housing cooperative board, city representatives, and relevant business actors. They are actively involved through workshops, surveys, interviews etc, to provide inputs to needs, requirements and feedback for the project development.

The first workshop with the local reference group, a business model workshop, was held *23rd of November 2018.* This was the first of three workshops planned for the Oslo pilot. The goals of the workshop was to 1) find a progressive solution that answers to the future charging needs, also including Photovoltaic (PV) panels which may also secure against future costs of electricity, incl. spot price and grid tariffs, 2) provide a charging infrastructure proposition for the whole parking house including a smart charging system, 3) develop a payment solution which fits into a business model that pays for the investment with high user satisfaction, 4) find subsidies or funding. The workshop had 24 participants among the relevant stakeholders, including GreenCharge researchers.

A business model innovation game was used to inspire the participants to come up with innovative solutions. The two groups discussed the innovation perspectives. Blockchain technology was mentioned to manage charging and peaks in the grid. V2G, regulation and open business model were other aspects on the agenda. The two groups also discussed technology requirements and focused on a billing system that manage pay per use and a booking system which manage flexibility, a load system with fixed costs reduction, and an electric storage system which can store different types of energy; solar, battery and water.

The next workshops with the local reference group in Oslo will be about user acceptance and Key performance indicators.

4.2 Uptake Cities Group

In addition to the Local Reference Group, there is an Uptake Cities Group, consisting of 12 cities, which are not partners in the project, but with visions and interest for the outcome. 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.

The Uptake Cities Group will not be directly involved in pilot workshops, but site visits to pilot cities, one visit per site, will be organized. The site visit will be planned together with WP7. The uptake cities will provide input and feedbacks to GreenCharge mainly through other activities than pilot workshops.

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5 Implementation requirements

5.1 Overall architecture

The overall architecture for implementing GreenCharge services is shown in Figure 2.

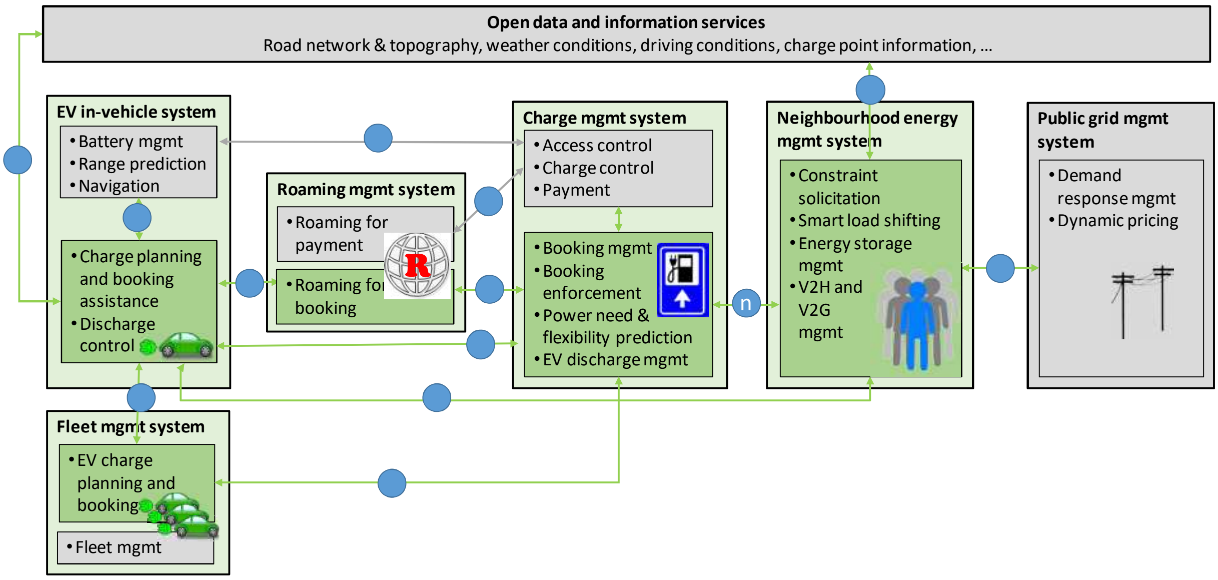

Figure 2: GreenCharge architecture sketch (copied from DoW).

The implementation in Oslo is mainly related to the following interfaces (see labels on arrows in the figure above):

Label	Interface usage
g	Charge request from EV user coming through smartphone app provided by charging provider[2]. The driver will indicate the time he needs the vehicle fully or partially charged. Access control by charge management system.
n	Charge management system sends energy meter readings and any charger booking (period and energy) to Neighbourhood Energy management system (NEMS). An optimal capacity plan (OCP) is generated and returned to the Charge management system (CMS). So rather than starting the charging of all the cars immediately after connection to the system, Charge management system balances the load between the connected chargers and keeps within OCP. This allows exploiting as far as possible locally produced electric energy and taking into account other tasks that need electric power in the neighbourhood
p	NEMS requires information about weather as input to predictions and optimization.
q	NEMS requires information about prices as input to predictions and optimization.

In addition, the outdoor publicly available semi-fast chargers will be accessible through Hubject's roaming platform. Visitors without a contract with Fortum C&D needs either to download the Fortum C&D app or use the Hubject Intercharge charging app for charging. This implements interfaces *b*, *h* and *i* in Figure 2.

[2] State of charge is typically not available from cars (for the time being) and might need input through user app.

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5.2 Data collection requirements

5.2.1 Data sources

The NEMS will optimize demand based on the described Asset model. To enable this, all meters, controllable devices and the relation between them must be configured.

Figure 3 illustrates a *tentative* Asset model for data sources required for optimization. May require refinements during project term.

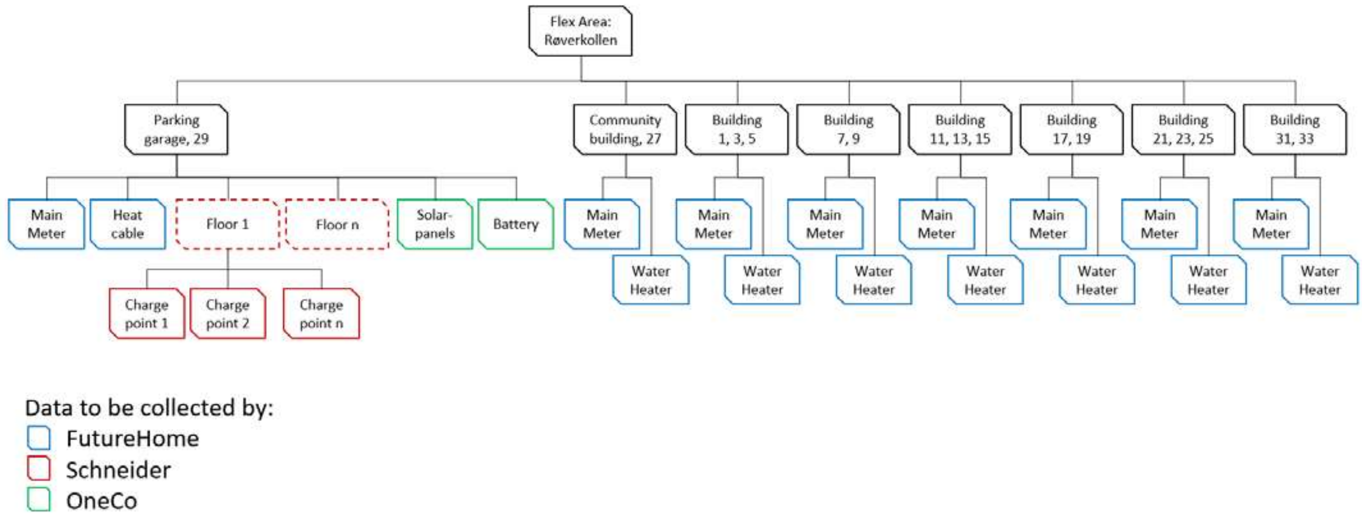

Figure 3: Asset model of required data sources

The identified data sources are summarised in the table below.

Table 5: List of data sources required for the Oslo pilot

Data source	Access	Place of storage
Parking garage main meter	Hafslund Nett (elHUB) and FutureHome	To be decided
Indoor charge points 1-X meter reading	Fortum logs EV-charging per charge point	To be decided
PV production	OneCo	To be decided
Battery utilisation (power in-out)	OpenEMS (battery supplier, see https://openems.io/)	To be decided
Battery status or State of Charge (SOC)	OpenEMS (battery supplier, see https://openems.io/)	To be decided
EV state of charge when charging session is started (as reported by the user)	App from Fortum Charge&Drive	To be decided
Heat cable power reading (placed in the ground at each driveway into the garage)	FutureHome logs 2 meters (two heat cables per meter, total of four)	To be decided

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Data source	Access	Place of storage
Outdoor charging point meter reading	Hafslund Nett (elHUB) and FutureHome	To be decided
Building (1, 3, 5), (7, 9), (11, 13, 15), (17, 19), (21, 23, 25), (31, 33) main meter reading	FutureHome logs 6 meters (4 blocks á 1 meter, and 1 block á 2 meters)	To be decided
Building (1, 3, 5), (7, 9), (11, 13, 15), (17, 19), (21, 23, 25), (31, 33) water heater meter reading	FutureHome logs 6 meters (4 blocks á 1 meter, and 1 block á 2 meters)	To be decided
Power tariffs	Hafslund Nett (from internet)	To be decided
Electricity prices in the spot market	NordPool spot (from internet)	To be decided
Retail prices of electricity	Electricity provider (utility company which is to be decided. Today it is LOS www.los.no)	To be decided

5.2.2 Required data resolution

The NEMS provided by eSmart Systems requires data harvest at a 15-minute resolution.

5.2.3 Data storage requirements

The NEMS will store power and energy data as time series. Ballpark estimate on storage of the described asset model is 1 GB/year.

5.3 Interoperability requirements

5.3.1 Neighbourhood Energy Management System (NEMS) and the Charge Management System (CMS)

Integration needs to be set up between the NEMS (eSmart Systems) and the CMS (Fortum, Schneider) for collecting data from the EV charge points in the parking garage, and with OneCo for collecting data from the solar panels and the stationary battery. And also, between the NEMS and a local integration partner (FutureHome) for collecting data from all other meters and controllable devices. eSmart have provided a description of the existing API for sending energy values to the eSmart cloud.

Results from optimization, in the form of control signals or capacity regulations, will be sent from eSmart cloud to CMS. End points for such communication must be agreed between the parties.

eSmart Systems has a web client, eSmart Flex, for configuration of assets and optimization parameters, and for follow-up of energy values for project users. Pilot users will run the system and enter all required configuration.

Fortum has a web client for site owner, operator and end user (my page), and an App for managing user data and charging sessions, including start/stop and level of priority of charging sessions.

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Sequence diagram of data flow at Røverkollen is described in Figure 4.

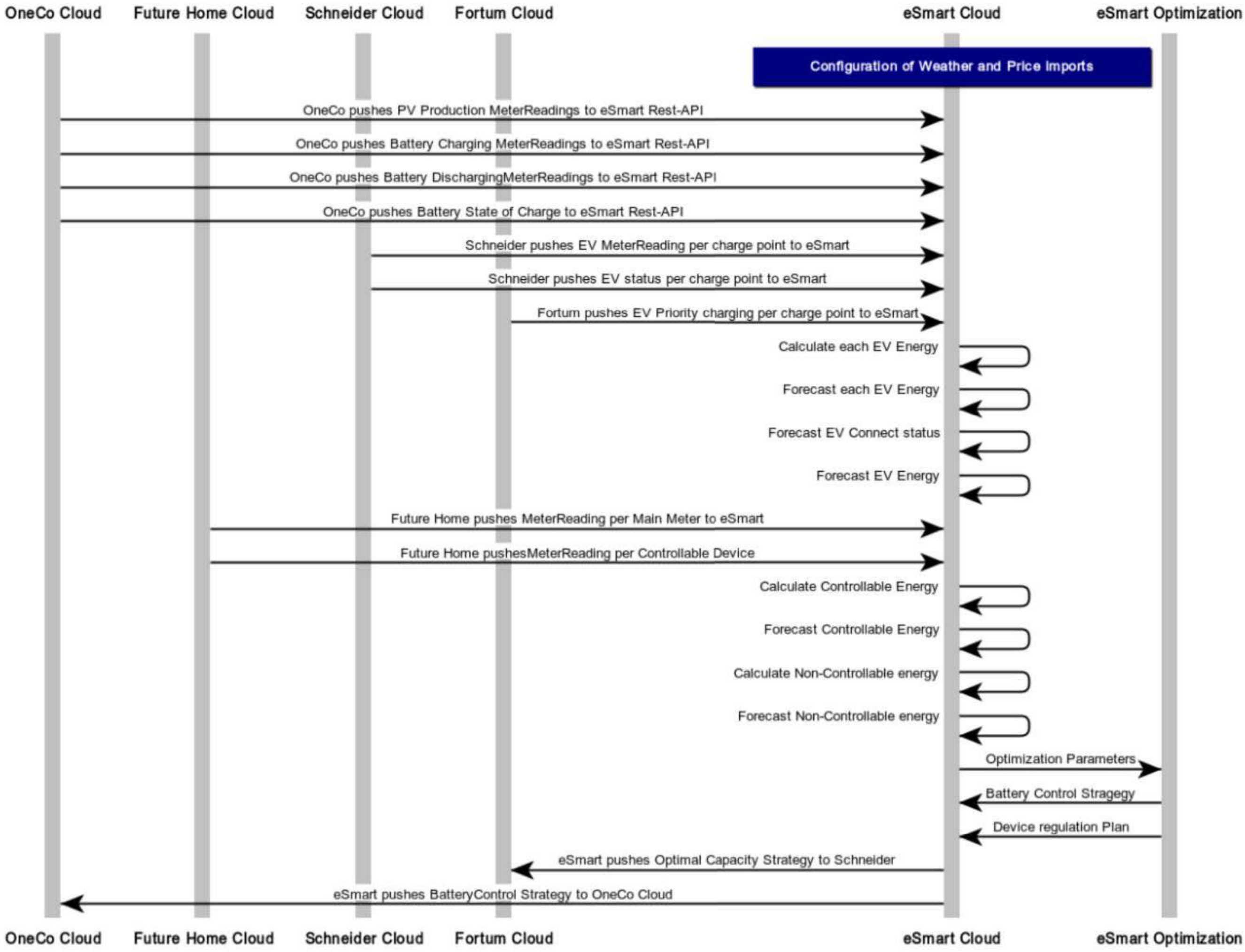

Figure 4: A sequence diagram of data flow at Røverkollen

5.3.2 eRoaming for cross country interoperability

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. Within the Oslo Pilot, the outdoor, public available semi-fast chargers will be available for visitors through the interconnection to the eRoaming of the Hubject roaming platform.

This will enable the interoperability beyond the pilot demonstrator, enabling also EV drivers with contracts with other than the Charge Point Operator (CPO) of the particular charge point to be able to charge on this charging station.

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

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▪ Automation of contract-based business relationships between power suppliers, car manufacturers, infrastructure service providers as well as further mobility business parties

5.4 Hardware and software requirements

5.4.1 Hardware requirements

Charge points

- Type 2, Mode 3 Chargers, type 2 connectors
- OCPP 1.6/2.0 ready
- 230V IT network
- 32 A, 3-phase supply
- Smart charging, 3.6 - 22kW charging depending of the car
- RFID reader
- Communication: 3G/4G mobile network or LAN connection to an internet gateway

PV panel

- PV cells mounted on the rooftop of the parking garage
- Main use is to charge stationary battery during daytime

Stationary battery

- In combination with the PV panels used for peak shaving, allowing charging of EVs during night time
- Charged from PV panel (see above)

5.4.2 Software requirements

Charge Management System

- Remote access for operations, maintenance, firmware updates and charge point control
- Manage start/stop charging sessions
- Manage authentication
- Energy metering and reports
- Charging priority system – real time adaption to available energy
- Location management interface
- Operator management interface
- The charging management system should use a backend solution which should be compatible to the eRoaming Platform.
- Smart load shifting based on the OCP generated from NEMS

Neighbourhood Energy Management System

- User interface for configuration and energy data follow-up
- Receive energy data from all components
- Calculate and forecast:

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- Each EV energy
- Controllable energy
- Non-controllable energy

- Forecast EV connected status
- Generate an OCP for CMS

Requirements user interaction – App

- Start/stop charging
- Energy booking dialog
    - Minimum energy needed for booked charging session
    - Time of departure
- Manage payment options
- Manage customer data
    - Vehicle information
    - General mobility habits
    - Minimum energy requirement to meet mobility needs

Interface between Neighbourhood energy management system – Charge management system

- The NEMS will allocate energy (power) to the charging network on the site
- The CMS will distribute the allocated energy to the charge points according to the availability of energy on the site (based on the OCP from NEMS)

Interface between Neighbourhood energy management system – the local integration partner

- Local integration partner provides energy values from local devices to NEMS

eRoaming Platform

- Facilitates interoperability at bookable chargers

5.5 Selection of hardware and software

The system components to be deployed according to the overall architecture (see Figure 2) are listed in the table below.

Sub-system role	**System components**	**Who**
EV in-vehicle system (& driver support)	Driver support system embedded in the car No interface to external systems is implemented	Car manufacturer
Roaming management system	HUBJ eRoaming Platform, OICP and Intercharge network	Hubject
Charge management system	Fortum C&D charge management system	Fortum
Charging App	Fortum C&D app	Fortum

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for managing charging sessions		
Roaming app	Hubject Intercharge app or app from other charging provider connected to the Intercharge network	Hubject
Neighbourhood energy management system	eSmart Flex platform (With services and storage hosted in Microsoft Azure. Client requires a Google Chrome browser)	eSmart Systems
Local renewable energy source (RES)	Solar panel (photovoltaic). Kanadian Solar KuPower 300Wp	OneCo
Local battery storage	Fenecon 50KW	OneCo

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6 Implementation plan

6.1 Organization of implementation

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

- Oslo municipality
- SINTEF
- eSmart Systems
- Fortum

The following roles have been defined in relationship to the Oslo pilot (based on CIVITAS evaluation framework, see [1]):

Role	Organization	Responsibility
Site Coordinator (SC)	Oslo Municipal	Coordinate the implementation of the pilot
Local Evaluation Manager (LEM)	SINTEF	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)	SINTEF	Responsible for data collection as defined by the local indicators (defines by Task 5.1 and 6.1) and the data collection process plan defined by 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[3]. In these meetings all task leaders and editors of the deliverables are expected to be present.

[3] Using Zoom, a remote conferencing service

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Figure 5 shows the GreenCharge work package (WP) structure and the interfaces between the WPs.

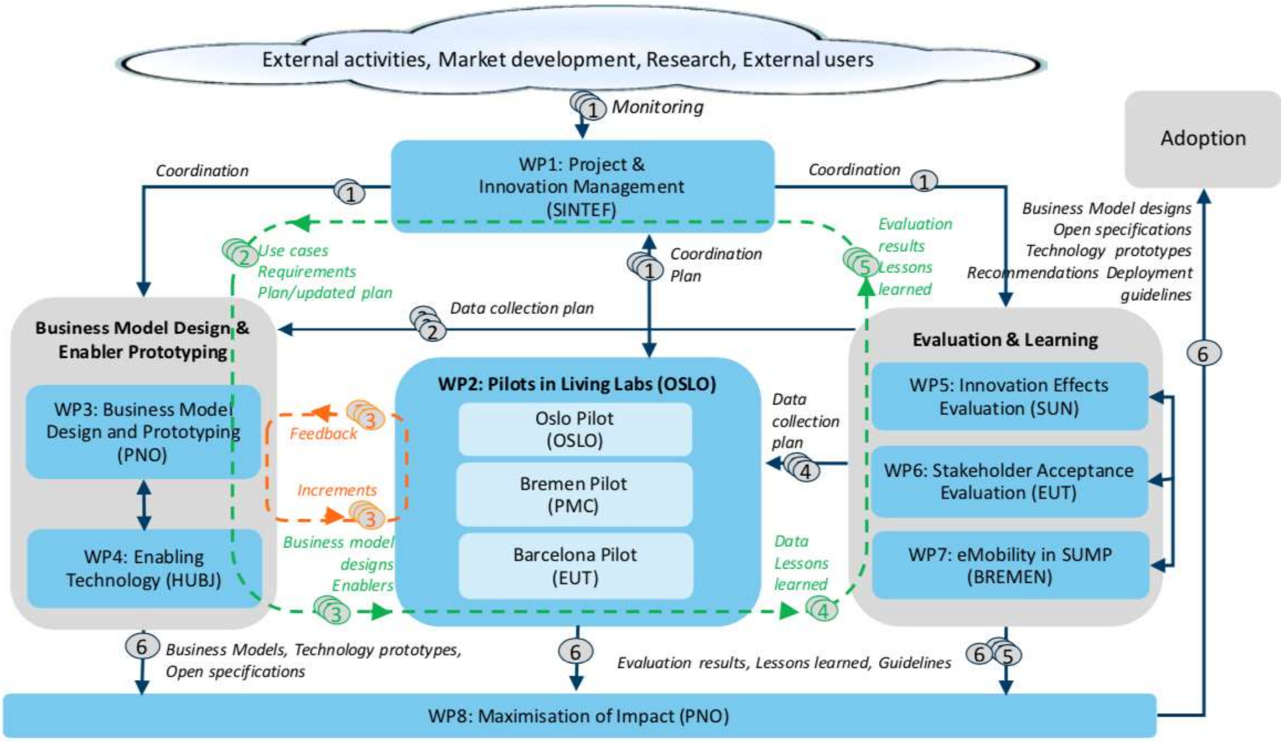

Figure 5: GreenCharge work package structure (the numbers in the labels are steps in the work flow)

WP2 is shown in the centre of this figure. The main inputs relevant to this implementation plan (D2.4) are:

- From WP5: Key Performance Indicators (KPI) and data collection plan providing input to data collection requirements
- From WP3: Business model designs
- From WP4: Interoperability requirements and technology prototypes

Note that use cases are coming internally from WP2 (D2.3). The business model designs and technology prototyping in WP3 and WP4, respectively, are developed in a cyclic and 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

At the start of the GreenCharge project we requested data from the national vehicle register. This showed that there are 16 battery electric vehicles (BEV) at Røverkollen, and one Plug-in hybrid electric vehicle (PHEV). This will be the initial user base. We have the name of all these owners and can contact them directly. Since more than 50% of all new vehicles purchased in Oslo are either BEV or PHEV, we expect that the number of EVs at Røverkollen will increase during the course of the project. We can get the name of these new users by repeatedly sending queries to Norwegian Public Roads Authority (which manages the national vehicle register).

As previously noted, there will still be uncertainties regarding the number of EVs since some users may dispose a leased vehicle. To be able to reach these we will also try to recruit these through the housing cooperation's own newsletter.

Users of the existing outdoor chargers can be easily reached since access to these requires a subscription, and these subscriptions are managed by the housing cooperative.

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All users involved in the pilot will be registered in a database, taking all relevant data privacy issues into account.

6.3 Use of local reference group

A local reference group (LRG) was established at the start of the project. Recruitment to this reference group was through direct contact to companies in the network of the Norwegian partners of GreenCharge. The main involvement of the LRG is through their participation in workshops. At the start of the project the local reference group comprised 18 members. The LRG is considered to be a "breathing" assembly, i.e., members will leave, if they do not see a substantial benefit to their daily work anymore - others will come on board that have been acquired via (convincing) arguments for their future business.

6.4 Plan for supporting activities

According to the CIVITAS evaluation framework [1], evaluation 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*. This includes determining what effect various supporting activities has in implementing the measures and increase the envisaged impact.

For each of the following sub-sections, titled after each measure to implement in Oslo, an overview of the planned support activities is given. The measures and associated sub-measures are defined in GreenCharge deliverable D5.1/6.1 *"Evaluation Design / Stakeholder Acceptance Evaluation Methodology and Plan"*.

Measure GC.M1: Smart charging in the garage in the apartment building

This measure is related to scenarios 4) 'Home charging', 5) 'Vehicle-to-Grid' and 6) 'Demand Response request from Grid operator'

Sub-measures	Risks	Supporting activities to approach the target group[4]	Stage[5]	Target group	Responsibility	Notes
A charging infrastructure with flexible charging support	Pilot not anchored in the target group	Survey to understand needs and expectations	P	All residents	SC + LEM + housing cooperative	Survey performed at the start of project (see D2.3)
		Information in the newsletter from the housing cooperative	P, I, O	All residents	SC + LEM + housing cooperative	Newsletter is typically published 9 times yearly
		Information meeting about possible charging at own parking space	I	All (existing and potential) EV users in housing cooperative	SC + GreenCharge WP2 project partners	Before the start of operational phase to enable the ordering of charging posts

[4] Type of activity, target group, method used to approach the target group
[5] P=planning, I=implementation, O=operation

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		Demonstration of charging equipment	O	All (existing and potential) EV users in the housing cooperative	SC + GreenCharge WP2 project partners	At start of operational phase
	Users will not provide/use flexibility	Information in the newsletter from housing cooperative	P, I, O	Existing EV users in the housing cooperative	SC + LEM + housing cooperative	Newsletter is typically published 9 times yearly
		User centred design (Task 4.1) to define requirements aligned with user needs	P, I	All EV users	GreenCharge WP4 project partners	Iterative approach in the project allows testing of different user interfaces
		Business models – *see below*		*See below*	*See below*	Iterative approach in the project allows testing of different models
		Demonstration of charging equipment and how to provide flexibility	O	All (existing and potential) EV users in the housing cooperative	SC + GreenCharge WP2 project partners	At the start of operational phase
V2G support	Vehicles supporting V2G not available[6]	Not applicable	I, O	Not applicable	Not applicable	Planned to be tested through simulation.
	Power grid incompatible with V2G	Not applicable	I, O	Not applicable	Not applicable	Planned to be tested through simulation.
	Users not willing to provide their battery	Information in the newsletter from housing cooperative	P, I, O	EV users in a housing cooperative with vehicles supporting V2G	SC + LEM + housing cooperative	Newsletter is typically published 9 times yearly
		User centred design (Task 4.1) to define requirements aligned with user needs	P, I	All EV users	GreenCharge WP4 project partners	Iterative approach in the project allows testing of different user interfaces

[6] Currently V2G is not commercially available.

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		Business models – see below		*See below*	*See below*	Iterative approach in the project allows testing of different models
		Demonstration of how to enable V2G and what value this provides	O	EV users in housing cooperative with vehicles supporting V2G	SC + GreenCharge WP2 project partners	At the start of operational phase (when and if V2G is possible)
Business models for flexible charging	Business models do not inspire to the desired behaviour	User centred design (Task 4.1 and WP3) to discover needs	P, I	EV users in the housing cooperative	GreenCharge WP3 + WP4 project partners	Iterative approach in the project allows testing of different user interfaces
		Adaption of BMs after intermediate evaluation	I	EV users in the housing cooperative	GreenCharge WP4 project partners	
	Difficult to administrate business models	D4.1 must arrange for flexible and automated support of business models	P, I	Housing cooperative	GreenCharge WP4 project partners	
Business model for sharing investment costs for charging infrastructure in the apartment building	Residents in the cooperative will block investments	Dialogue with the board of housing cooperative	P	Housing cooperative	SC + LEM	Decision can probably be made by the board
		Identify additional funding opportunities	P	Housing cooperative	SC + LEM	Both the municipality and ENOVA
	Difficult to explain the business model	Support board in information activities	O	Housing cooperative	SC + LEM	

6.4.1 Measure GC.M2: Sharing of private charging points

This measure is related to scenario 2) 'Charging at booked charging station'.

Sub-measures	Risks	Supporting activities to approach the target group	Stage	Target group	Responsibility	Notes
Booking of private charging points	The charging opportunity not known	Establish signage	P, I	EV (also potential) users in proximity	SC + LEM + board of the housing cooperative	

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		Ensure that information is published on Nobil.no	O	All EV users	SC + LEM	Nobil.no is a national information platform for alternative fuels infrastructure
		Inform nearby work place	O	Employees with EVs	SC + LEM	
	Potential users do not have the right app to book	Establish signage that informs about the app	P, I	EV users in proximity	SC + LEM + board of the housing cooperative	
	Users do not understand how to book	User centred design (Task 4.1 and WP3) to discover needs	P, I	EV users	GreenCharge WP3 + WP4 project partners	Iterative approach in the project allows testing of different user interfaces
		Adaption of the user interface after intermediate evaluation	I	EV users	GreenCharge WP4 project partners	
Roaming service	Roaming functionality not used	Inform users through the charge operator	O	EV users	Fortum	
Business model for shared use of charging points	Business models do not inspire to the desired behaviour	User centred design (Task 4.1 and WP3) to discover needs	P, I	EV users in the housing cooperative	GreenCharge WP3 + WP4 project partners	Iterative approach in the project allows testing of different user interfaces
		Adaption of BMs after intermediate evaluation	I	EV users in the housing cooperative	GreenCharge WP4 project partners	
	Difficult to administrate business models	D4.1 must arrange for flexible and automated support of business models	P, I	Housing cooperative	GreenCharge WP4 project partners	

6.4.2 Measure GC.M3: Optimal use of energy

Sub-measures	Risks	Supporting activities to approach the target group	Stage	Target group	Responsibility	Notes
Neighbourhood energy management system (NEMS)	Housing cooperative does not understand the value of NEMS	Presentation to the board of the housing cooperative	P, I	Board of the housing cooperative	GreenCharge WP2 project partners	
PV in the neighbourhood	Investment cost exceeds the budget	Negotiate price and deliveries	P	PV Companies	Board of housing cooperative with support from	

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Sub-measures	Risks	Supporting activities to approach the target group	Stage	Target group	Responsibility	Notes
					WP2 partners	
		Request supplemental funding	P	OBOS, ENOVA and Oslo Kommune	Board of housing cooperative with support from WP2 partners	
	Installation prohibited by regulations	Request input from PV experts	P	*To be decided*	Board of housing cooperative with support from WP2 partners	
Business models for prosumers/ Use of PV energy Business model for flexible energy demand Business model for shared use of RES	Business models do not inspire to the desired behaviour	User centred design (Task 4.1 and WP3) to discover needs	P, I	EV users in the housing cooperative	GreenCharge WP3 + WP4 project partners	
		Adaption of BMs after intermediate evaluation	I	EV users in the housing cooperative	GreenCharge WP4 project partners	
	Difficult to administrate business models	D4.1 must arrange for flexible and automated support of business models	P, I	Housing cooperative	GreenCharge WP4 project partners	

6.5 Risk management

The table below summarises the initial identified risks in relationship to implementing the measures. Risks related to process evaluation and implementation of support activities are described in section 6.4 *Plan for supporting activities* on p. 26. In the table, risks 1 to 4 are risks from the project description part of the Grant Agreement that are identified as relevant for WP2.

Risk #	Description	Mitigation measures
1	Some planned pilot activities turn out to be more difficult than planned to implement in a practical pilot	• Assess the possibility to change evaluation method • Resort to simulation of the difficult parts that cannot be tested in pilots
2	Original Equipment Manufacturers (OEMs) deny direct access to the battery status of EVs	• Obtain the battery status indirectly, e.g. as reported by the users • Use a mathematical battery model instead and calibrate the parameters of this model against the available EV models involved in the pilots
3	No access to open API's makes it difficult to integrate various components	• Try to replace closed components with components that offer an open API • Resort to simulation of difficult components if no replacement can be

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		identified
4	Inadequate data collected in the pilots to support the evaluation	• Start analysis and evaluation in parallel with the pilots and implement modifications if necessary • Supplement data with simulated measurements to give a more complete evaluation
5	Needed equipment not available in time or in sufficient quantities	• Look for second source opportunities
6	Technology prototypes from WP4 delayed	• Involve WP4 contributors in bi-weekly WP2 task force meetings
7	Break down in data collection equipment or loss of collected data	• Establish a plan for monitoring data collection processes • Establish routines for backup of collected data

6.6 Time management

As the project started 1. September 2018, Q1 is September 2018 to November 2018, Q2 is December 2018 to February 2019 and so on. A set of milestones have been defined in the DoW as shown in Table 6. all these milestones are relevant for pilot planning, implementation and operation:

Table 6: GreenCharge Milestones (extracted from DoW)

#	Milestone name	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 the 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 a 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 the pilot and evaluation based on intermediate evaluations completed - Revised version of tools for simulation and visualisation operational

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#	Milestone name	Due month		Means of verification
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 the 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 short-term planning for getting the pilot started is provided in the following Table 7.

Table 7: Timing of items to be implemented in the full-scale Oslo pilot

Supporting activity	Item / Topic	Responsible Partner	Due month
	Requirement specifications for photovoltage and stationary battery (input from PV experts)	OSLO	04/2019
X	Information meeting with residents at Røverkollen housing cooperation	SINTEF	04/2019
X	Information to residents at the housing cooperative	OSLO	04/2019
	Identification of the research data needed	SINTEF	04/2019
	Simulations planned	SUN (Task 5.1)	04/2019
X	Collect orders for charging boxes	SINTEF	05/2019
X	Request supplemental funding for solar panel and stationary battery	SINTEF	05/2019
X	Order placement of charging boxes	FORTUM	06/2019
	Implementing eSmart Flex platform	ESMART	08/2019
	Implementing eSmart API	ESMART	08/2019
	Plan and install charging backend (basic electricity infrastructure)	FORTUM	06/2019
	Installing charge points for pilot users	FORTUM	08/2019
	Deploy charge point management system (CPMS)	FORTUM	08/2019
	Modification and deployment of charging app (V1.0) to pilot users	FORTUM	08/2019
	Integrate CPMS with eSmart Flex platform	FORTUM/ ESMART	08/2019
	Mechanisms and procedures for user support defined (Task 2.n.4 and feedback to WP4), e.g. a landing page for user communication	Oslo	08/2019

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	and the procedures for support from WP2 and WP4		
	Mechanisms and procedures for the iterative approach with frequent updates of prototypes defined (see the orange iteration loop in figure 4 in DoW), e.g. how feedback from the pilot should be collected and handled by the system developers in WP4. The user support mechanisms mentioned above may contribute to this	Oslo	08/2019
	The data formats to be used in automated data collection specified (formats and other requirements related to the collection of research data must be defined, to ensure that the data can be used for calculation of KPIs and in simulations)	SUN (Task 5.1) SINTEF (task 4.1)	07/2019
	Initial version of the simulator realised	SUN	08/2019
	Tools for data collection like interview guides and surveys established	SINTEF	TBD
X	Demonstration of charging equipment and how to provide flexibility	*All*	09/2019
X	Establish signage for outdoor charging opportunity	OSLO	09/2019
	Installing a PV panel on the rooftop	OSLO	09/2019
	Installing a stationary battery in the garage	OSLO	09/2019
X	Information campaign: • Information in a newsletter from the housing cooperative • Information to nearby work place(es)	SINTEF	09/2019
	Automated data collection implemented in the system components (in WP4).	WP4 partners	10/2019
	Automated data collection started	SINTEF	11/2019
	Data collection system operational	ESMART/ FORTUM	11/2019
	Integration of PV panel and stationary battery with building electricity system and eSmart Flex platform	ESMART/ OSLO	04/2020
	Revised version of the simulator realised	SUN	07/2020
X	Demonstration of how to enable V2G and what value this provides	*All*	TBD
X	Adaption of BMs after intermediate evaluation	*All*	TBD

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7 Future work

This report has, based on the defined use cases and the overall technical requirement (see D2.3 *Description of Oslo Pilot and User Needs*), defined the overall implementation plan for the Oslo pilot. The next step is to implement the needed changes at the pilot site. This includes the deployment and testing of software and hardware components to be used in the pilot, in preparation for full-scale pilot implementation. These activities are documented in D2.5 *Pilot Component Preparation for Full-scale Pilot (Oslo)*.

The final findings from the demonstration activities at the Oslo pilot site will be documented in D2.8 *"Final Report for Oslo Pilot: Lessons Learned and Guidelines"*.

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020) under grant agreement n° 769016.

8 References

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

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