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greencharge2020.eu

GreenCharge Project Deliverable: D2.5

Pilot Component Preparation for Full-scale Pilot (Oslo)

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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

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

This report presents the component preparation for full-scale implementation for the Oslo pilot. The deliverable is mainly based on deliverable *D2.3 Description of Oslo Pilot and User Needs* and *D2.4 Implementation Plan for Oslo Pilot*. D2.11 and D2.18 are the “sister” deliverables for pilots in respectively Bremen and Barcelona.

D2.5 presents an overview of all the software and hardware components to be implemented at Røverkollen housing cooperative by September 2019, the purpose of each component, their initial status, test results and assessments made to whether the component is applicable for the pilot site or not.

The table below shows the sub-system roles. These are based on an overview presented in *D2.3 Description of Oslo Pilot and User Needs*. Each sub-system has associated software and hardware components delivered by project partners eSmart Systems and Fortum. The table also illustrates the test results for each component as follows:

- New development (RED). The component does not yet exist and needs to be developed
- Needs adaptation (YELLOW). The component exists but, requires final adaptation, implementation or installation to suit the project and pilot site
- Approved (GREEN). The component is considered an off-the-shelf product and is tested by supplier in time for installation at the pilot site

Sub-system role	**Component name**	**Test result**	**Responsible partner**
Neighbourhood energy management system (NEMS)	eSmart Flex platform	Needs adaptation	ESMART
	eSmart API	Needs adaptation	ESMART
Local renewable energy source	Photovoltaic panel	Approved	Supplier
Local battery storage	Stationary battery	Approved	Supplier
Charge management system (CMS)	Charging infrastructure and charge points	Needs adaptation	FORTUM
	Fortum Charge & Drive Management Cloud	Needs adaptation	FORTUM
	Charging app	New development	FORTUM

The Neighbourhood energy management system (NEMS) is delivered by eSmart and consists of the eSmart Flex platform and eSmart Application Programming Interface (API). Both software components require some adjustments.

The local renewable energy source, being PV (Photovoltaic) panels, and the local battery storage, is considered an off-the-shelf product. Oslo Municipality is responsible for writing specifications and making purchases. The Charge management system (CMS) is delivered by Fortum. The charging infrastructure must be installed at the pilot site, the Fortum Charge & Drive require some final adjustments and the Charging app must be developed. The physical charge points are delivered by Schneider, with Fortum as the responsible partner.

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.

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List of Abbreviations

Table 1: List of abbreviations

Abbreviation	Explanation
AI	Artificial Intelligence
API	Application Programming Interface
CDMC	Charge & Drive Management Cloud
CMS	Charge Management System
CPO	Charge Point Operator
DoA	Description of Action
EMO	e-mobility Provider
EV	Electric Vehicle
GW	Gateway
HW	Hardware
NEMS	Neighbourhood Energy Management System
OCP	Optimal Capacity Plan
PV	Photovoltaics
RFID Tags	Radio Frequency Identification Tags
SW	Software
V2G	Vehicle-to-Grid

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List of Definitions

Table 2: List of definitions

Definition	Explanation
Application Programming Interface	Application Programming Interface is a set of clearly defined methods of communication among various components.
Artificial Intelligence	Artificial Intelligence is intelligence demonstrated by machines in contrast to natural intelligence which are demonstrated by humans and animals
Charge & Drive Management Cloud	Charge & Drive Management Cloud is a Fortum cloud-based backend system and operates as the CMS in GreenCharge
Charge Management System	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
Charge Point Operator	Fortum is the Charge Point Operator in GreenCharge and manages the charge points in the parking garage
Description of Action	Part of the formal "Grant Agreement" between the consortium and the funding authority, defining in detail the work to be carried out and the results to be produced.
Gateway	Joins two networks so the device on one network can communicate with the device on another network
Neighbourhood Energy Management System	Neighbourhood Energy Management System. An ICT system implementing the smartness of an energy smart neighbourhood
Optimal Capacity Plan	The Optimal Capacity Plan is generated by NEMS (eSmart) and sent to CMS (Fortum) to perform load balancing between the connected chargers in the garage
Photovoltaic	Photovoltaic panels (solar cell panels) converts light into electricity using semiconducting materials
Radio Frequency Identification Tags	An RFID tag is an electronic tag that exchanges data with an RFID reader through radio waves.
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.

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Definition	Explanation
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	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?

This deliverable gives you information about the components that have been selected, tested and assessed for the pilot site before March 31st 2019. The components will be implemented and integrated in the full-scale Oslo pilot in September 2019. The deliverable indicates the different systems that are going to be used both at the software and hardware level, their purpose, initial status, component testing and assessments.

1.2 Intended readership/users

This deliverable should be of interest to all participants within the project consortium, who are in charge of implementation and testing the prototypes for the 3 pilots. It is particularly useful for the "software partners", who are providing smart solutions to GreenCharge electric vehicles. It is also of interest to external readers who want to know what components will be used in the Oslo pilot.

1.3 Other project deliverables that may be of interest

The following public project deliverables might be useful for the reader to get a more comprehensive view on the conditions and relationship of the Oslo pilot:

- **D2.3 Description of the Oslo Pilot and User Needs** – Describes the Oslo pilot in terms of challenges, user needs, use cases, scenarios, stakeholders and locations involved and the baseline
- **D2.4 Implementation Plan for Oslo Pilot** – Describes the planning of the tests to be carried out at the pilot site. It includes scenarios to be demonstrated, time schedules, stakeholders and locations selected, users selected for workshops and for testing, hardware and software to be installed, tests to be run and data to be collected, etc
- **D2.11 and D2.18 Pilot Component Preparation for Full-scale Pilot (Bremen and Barcelona, resp.)** – "Sister" deliverables describing the respective preparation for the Bremen and Barcelona pilots
- **D4.1 Initial Architecture Design and Interoperability Specification –** Describes the initial version of the GreenCharge architecture and the specification of interfaces and protocols for interoperability
- **D4.2 Final Architecture Design and Interoperability Specification –** Describes the final version of the GreenCharge architecture and the specification of interfaces and protocols for interoperability
- **D4.3 Initial Version of Integrated Prototype** – Initial version of thee integrated prototype
- **D4.4 Revised Version of Integrated Prototype -** Refined and extended version of the integrated prototype based on evaluations
- **D4.5 Final Version of Integrated Prototype -** The final version of the Integrated Prototype including refinements and extensions integrated during the pilots

1.4 Other projects and initiatives

The INVADE Horizon 2020 project seeks to solve the challenges our electrical infrastructure is facing in the coming years, i.e. aging infrastructure and the need for greater share of renewable energies. By combining existing technology, a cloud-based flexibility management system integrated with EV's and batteries for energy storage, INVADE increases the share of renewables in the smart grid (INVADE H2020, 2019).

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.

eSmart Systems is an INVADE project partner and the eSmart Flex platform is a flexibility management system made for and in INVADE as a continuation of experiences from the EMPOWER Horizon 2020 project. Historical values and correlating information, such as weather, forms the basis for predictions utilizing the eSmart Artificial Intelligence (AI) capabilities. The system combines properties and topology with contract pricing and parameters, giving the input to optimization on site (household or commercial building) or zone (neighbourhood or other type of area).

This software, with required adjustments, forms the basis of the NEMS for the Oslo Pilot and is a part of eSmart's input to the GreenCharge project.

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2 Pilot Site Components

Within the GreenCharge project, the city of 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.

The table in this section presents an overview of all the software and hardware components to be used in the Oslo pilot. The table is based on assessments made in *D2.4 Implementation Plan for Oslo Pilot* and contains the sub-system role, system components, component type Software (SW) or Hardware (HW), the responsible project partner and in which scenarios the components are relevant.

Each component is further specified in section *3 Pilot Site Software Components* and section *4 Pilot Site Hardware Components*. Test results are presented in section *5 Summary of Assessments of Components.*

Table 3: Software and hardware components to be used and implemented in the Full-scale Oslo Pilot

Sub-system role	System components	Component type	Responsible	Scenarios (further defined in *D2.3 Description of the Oslo Pilot and User Needs*. A summary is presented in Appendix A in this deliverable)
Neighbourhood energy management system (NEMS)	eSmart Flex platform (Section 3.1)	SW	eSmart Systems	Scenario 2, 4, 5 and 6
	eSmart API (Section 3.2)	SW	eSmart Systems	
Local renewable energy source	Solar cell panel (Section 4.1)	HW/SW	Oslo Municipality	
Local battery storage	Stationary Battery (Section 4.2)	HW/SW	Oslo Municipality	
Charge management system (CMS)	Charging infrastructure and charge points (Section 4.3)	HW	Fortum	
	Fortum Charge & Drive Management Cloud (Section 3.4)	SW	Fortum	
	Charging app (Section 3.3)	SW	Fortum	Scenario 2, 4 and 5

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3 Pilot Site Software Components

This section will provide detailed descriptions of software components to be implemented for the full-scale Oslo pilot at pilot-site Røverkollen within September 2019. The software components are; eSmart Flex Platform, eSmart API's, Fortum's Charge & Drive Management cloud and the charging application.

3.1 eSmart Flex Platform – Neighbourhood energy management system

The eSmart Flex platform is a flexibility management system and operates as the Neighbourhood energy management system (NEMS) in GreenCharge.

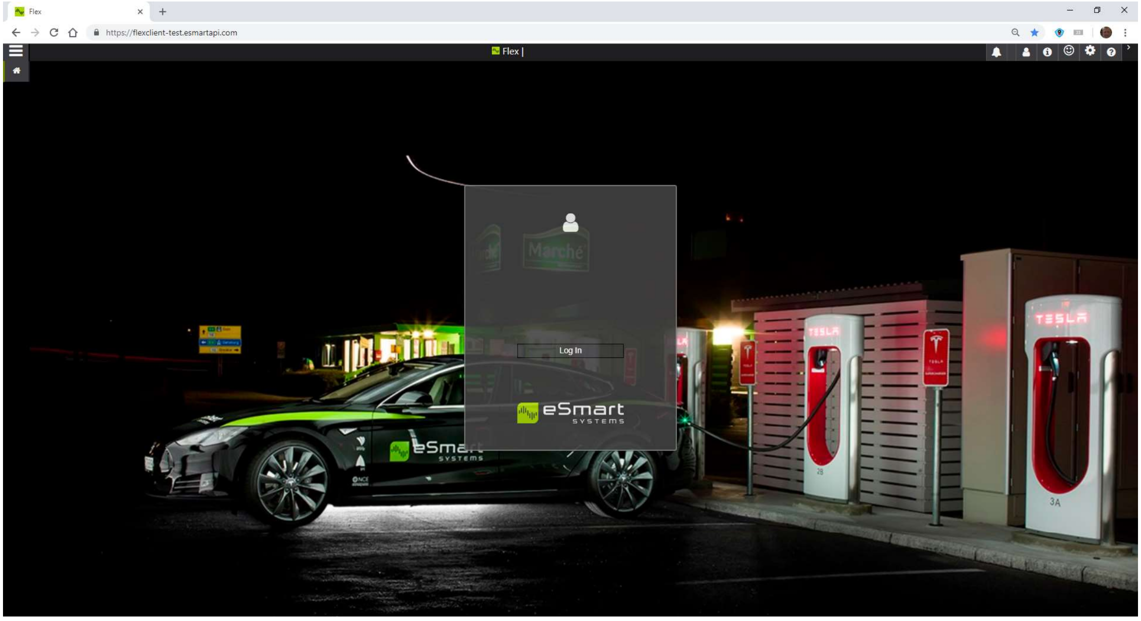

Figure 1 eSmart login screen

Figure 2 Time series values

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3.1.1 Purpose

The purpose of the eSmart Flex platform is to perform optimization as basis for load balancing of EV chargers and totals for housing cooperatives. Historical values and correlating information, such as weather, form the basis for predictions utilizing the eSmart AI capabilities. The system combines properties and topology with contract pricing and parameters, giving the input to optimization on site (household or commercial building) or zone (neighbourhood or other type of area).

NEMS collects energy data from all pilot components, performs smart load shifting and provides an Optimal Capacity Plan (OCP).
NEMS interfaces with the CMS which sends energy meter readings and any charge point bookings (period and energy) to NEMS, which stores power and energy data as time series. An OCP is generated by NEMS and returned to CMS to perform load balancing between the connected chargers.

The figure below illustrates the overall architecture of GreenCharge.
The Oslo pilot has neither a Fleet management system nor a Roaming management system. The EV in-vehicle system, Charge management system (Fortum) and Neighbourhood energy management system (eSmart) is applicable.

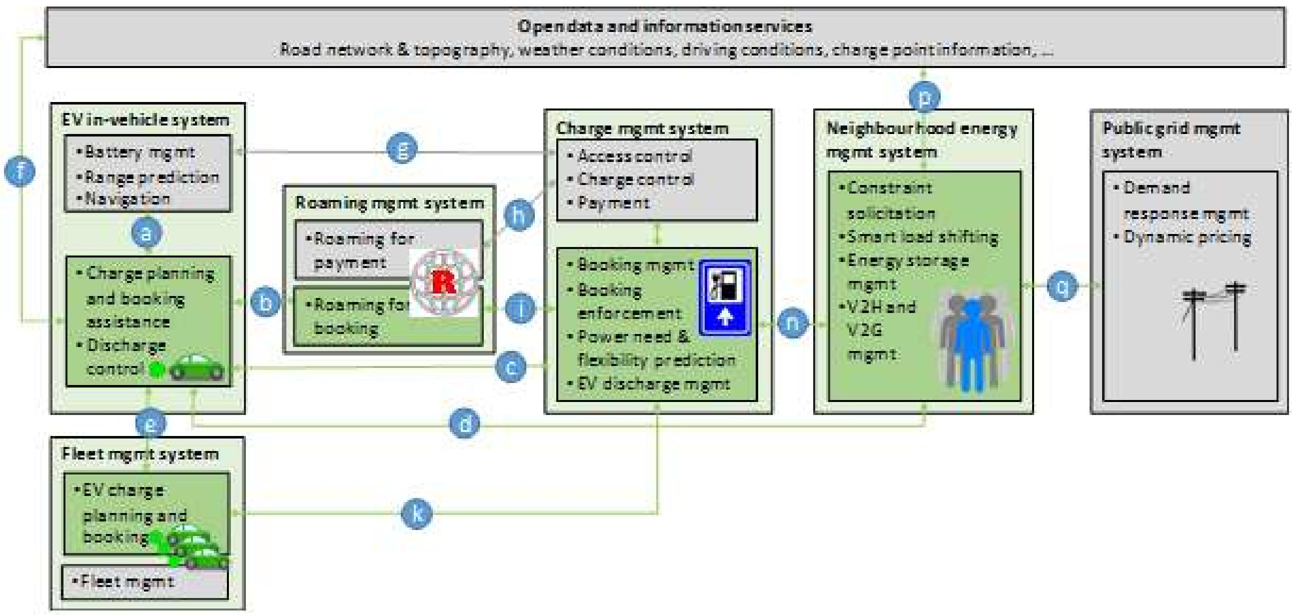

Figure 3 Main components of the EV charging ecosystem and their relations. The green boxes and green lines depict the new functionalities and interfaces that will be implemented in GreenCharge. The labels on arrows are used to describe the innovation scenarios (from DoA).

3.1.2 Initial status

The eSmart Flex platform was made in the INVADE Horizon 2020 project as a continuation of experiences from the EMPOWER Horizon 2020 project.
This platform is the eSmart initial input to the GreenCharge project, foreseen to be used as-is with minimal system changes. Updating of interfaces may occur to adapt for full-scale pilot implementation.

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3.1.3 Component testing

The eSmart Flex platform has undergone previous tests for the pilot installations in INVADE and has its own test environment where the platform is being tested without integrations.

Specific and more extensive testing of GreenCharge software and hardware components exclusively is required once all pilot components are installed at the pilot site for the full-scale implementation.

3.1.4 Conclusions, assessments and adaptations

The testing of the eSmart Flex platform for INVADE found out that the configuration and integration with the pilot system components were different between all pilot sites. It's likely that the configuration and integration with GreenCharge components for the Oslo pilot also may vary from previous integrations in INVADE. Thus, integration with hardware and software components would require additional testing and adaptations for the Oslo pilot in GreenCharge.

E.g. integration needs to be set up between the NEMS and the CMS for collecting data from the EV charge points in the parking garage, PV panels and the stationary battery. Also, between the NEMS and a local integration partner for collecting data from all other meters and controllable devices. This will be done in time for M12.

Testing and adaptations to some extent is expected when implementing a system to a new project site with different composition of components, different project purpose and with new integration partners.

Regardless of this, the Flex platform is considered valid for use in GreenCharge because the platform is being used for similar purposes in INVADE. E.g. combining a PV panel with a stationary battery for energy storage, and with a flexibility management system integrated with pilot components and EVs to perform smart load shifting.

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3.2 eSmart API

The eSmart proprietary API developed for INVADE is specified in document *Specification of the eSmart Flex platform API.docx* (Fisher & Amundsen, 2018) in sections *5 Web API* and *7 eSmart Flex platform to External Systems* and will be reused in GreenCharge.

3.2.1 Purpose

The overall purpose of the eSmart API is to integrate with other software and hardware components for collecting energy data and exporting the Optimal Capacity Plan (OCP) for the CMS.

3.2.2 Initial status

Existing eSmart API is used as-is, but updating of the interfaces may occur in order to adapt to the full-scale pilot implementation.

3.2.3 Component testing

Existing interfaces are tested in INVADE.

3.2.4 Conclusions, assessments and adaptations

Any adaptions or additions will have to be tested specifically for GreenCharge and the Oslo pilot. This will be done once all software and hardware components from the different project partners are considered ready for full-scale implementation at the pilot site.

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3.3 Charging app

The charging application will be the interface between the user and the charging infrastructure. The illustration below shows an example.

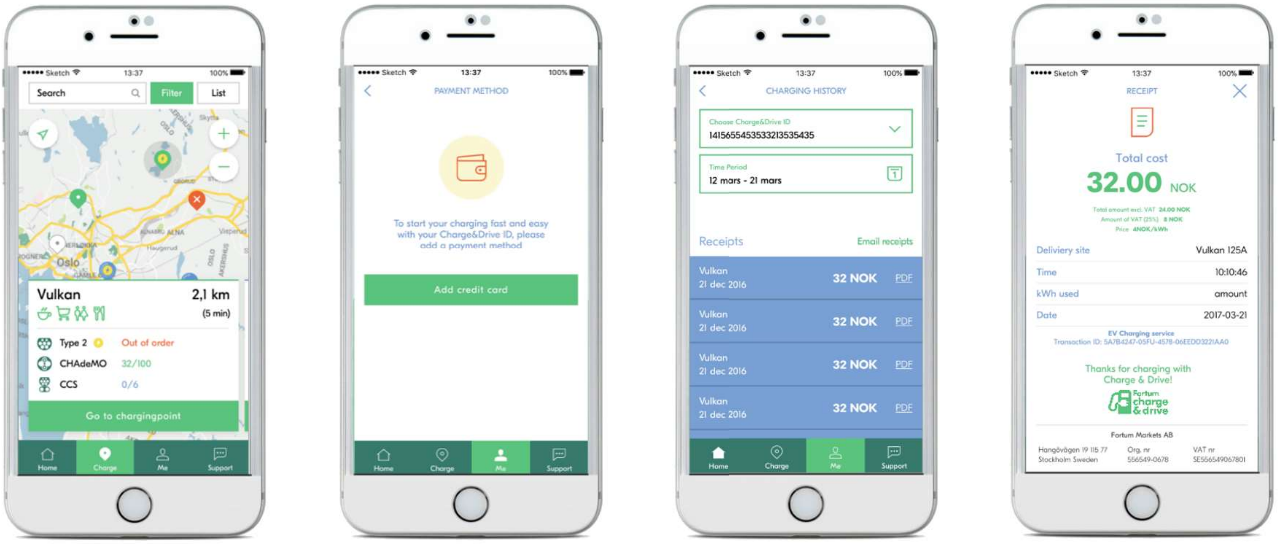

Figure 4 Smartphone app from Fortum Charge & Drive used at Vulkan (urban district) in Oslo. The app allows you to locate site & charge, add your credit card, view your charging history and receive digital receipts.

3.3.1 Purpose

The application will enable the user to start and stop charging, to pay for charging according to local price structure and to choose priority booking for a price increase if preferred. For this pilot, the user will have to enter data regarding need for charging, e.g. state of charge, time of departure and energy requirement to fulfil mobility needs for next trip. This data will be used to give priority to users, if and when the total energy available is limited. This process will be labelled as “Energy booking”.

The app will also be the interface for entering customer data, such as vehicle information, battery capacity and charging speed.

3.3.2 Initial status

Fortum Charge & Drive has a standard app already in production with basic functionality, i.e., the start and stop of charging sessions, payment, customer registration and editing of customer data. See the illustration above. The app for the Oslo-pilot will require further enhancements and new development, e.g. the energy booking is not implemented.

3.3.3 Component testing

The baseline is the standard app already in production. Updates and new versions will be tested specifically for the Pilot to add the new functionality for energy booking.

3.3.4 Conclusions, assessments and adaptations

The components for the energy booking functionality will be developed for the Pilot and according to the requirements specified in the project. The timeline for this development is yet to be decided, as well as the

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final specifications. The plan is that by the start of the pilot (September 2019), the functionality needed for a full-scale test of energy booking will be at least in a beta version for further development and adaption.

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3.4 Fortum Charge & Drive Management Cloud (CDMC)

The Fortum Charge & Drive management cloud (CDMC) is a cloud-based backend system and operates, in combination with the Fortum charging infrastructure (Section 4.3) and charging application (Section 3.3), as the CMS in GreenCharge.

3.4.1 Purpose

The CDMC is a system for management of chargers and the charging network. The chargers will be connected to the CDMC through internet connection, and will cover the following areas of functionality:

CPO (Charge Point Operator) perspective

- Manage charger sites
- Manage chargers
- Charge point status
- Error message alerts
- Remote actions (start/stop charging sessions, soft reset, hard reset, connector control)
- Firmware update
- Energy measurement
- Reporting
- Load balancing

EMO (e-Mobility Provider) perspective

- Manage customers
- Manage authentication (i.e. Radio Frequency Identification (RFID) Tags)
- Manage price plan

Site Owner perspective

- Site reporting
- Charger statistics
- Usage reports

CMS sends energy meter readings and any charger booking (period and energy) to NEMS. An OCP is generated and returned to the CMS.

So rather than starting the charging of all the cars immediately after connection to the system, CMS 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.

3.4.2 Initial status

This platform is considered Fortum’s initial input to the GreenCharge project, foreseen to be used as-is with minimal system changes. Updating of interfaces may occur to adopt for full-scale pilot implementation.

3.4.3 Component testing

The Fortum Charge & Drive Management Cloud has undergone previous tests.

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3.4.4 Conclusions, assessments and adaptations

Support for booking and roaming for booking is needed for full scale pilot implementation. In addition, integration with NEMS (eSmart system) is required. Specific and more extensive testing of GreenCharge software and hardware components exclusively is required once all pilot components are installed at the pilot site for the full-scale implementation by September 2019.

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.

4 Pilot Site Hardware Components

This section will provide detailed description of the different hardware components to be implemented for the full-scale Oslo pilot at pilot-site Røverkollen in M12, September 2019. The hardware components are; photovoltaic panels, stationary battery, charging infrastructure and charge points.

4.1 Photovoltaic panels

Photovoltaic (PV) panels are normally installed on the roof of a building and generates electricity from daylight. The produced electricity can be stored in a battery for use at a later stage.

4.1.1 Purpose

The purpose of this solar panel system is to locally produce electrical energy to avoid local power grid overload during EV-charging (keep power demand under the limit of 217 kW in the garage). The solar panel system will be integrated with the stationary battery, the NEMS and CMS. The energy generated through the PV panels at daytime will be stored in the stationary battery and used when EV's require charging during the evening to prevent peak periods in the grid.

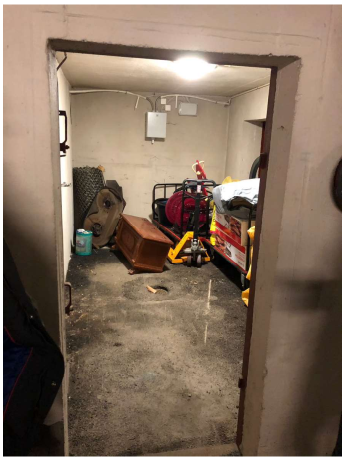

Figure 5 Storage room with ample space for PV Inverters and the stationary battery

Figure 6 The four-storey parking garage at Røverkollen

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4.1.2 Initial status

This component is considered an off-the-shelf product. Requires no changes or adaptations and are fully ready to be implemented at the pilot site, Røverkollen housing cooperative in Oslo in September 2019.

No requirement specification of the Photovoltaic system has been described and there has not been placed an order yet.

The module price is assumed to be approximately 700 EUR/kWp (PV Magazine, 2019). The roof of the parking garage at Røverkollen is 1.400 square meters and due to budget constraints, the whole roof will not be covered with PV panels in this project.

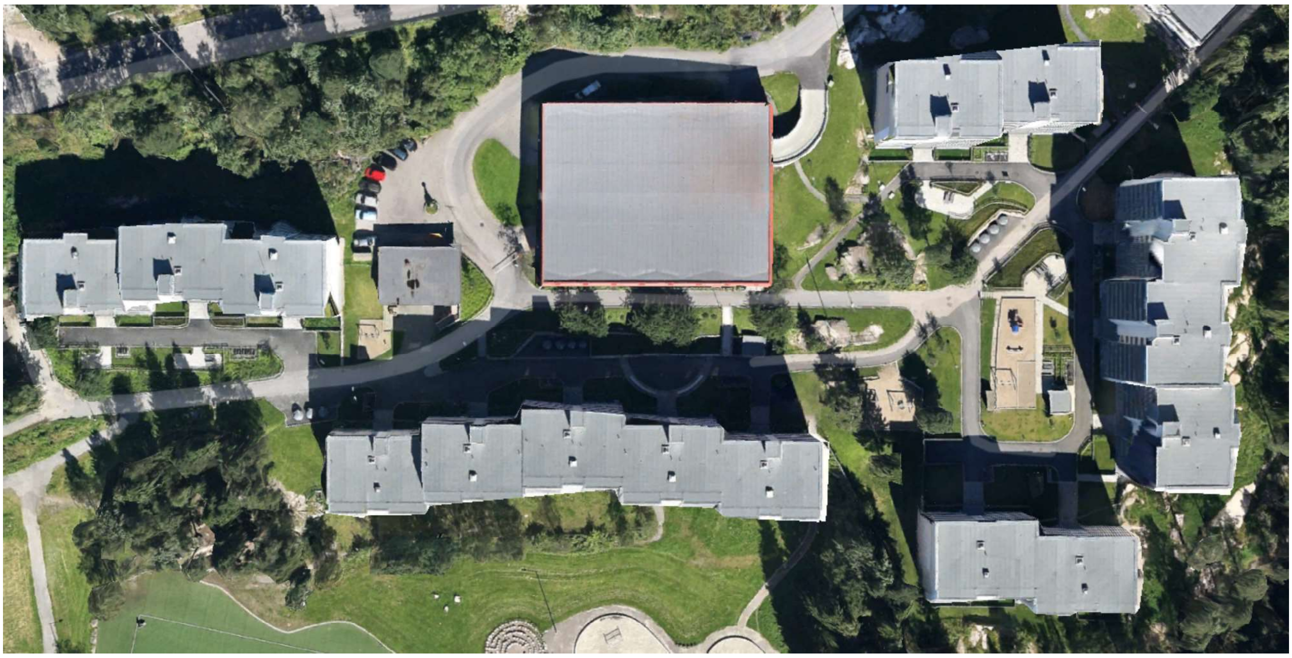

Figure 7 Aerial photo of Røverkollen housing cooperative. The big building block in the middle is the parking garage (Google Maps, 2019)

4.1.3 Component testing

No testing will be conducted by the project. The PV panels are considered successfully tested by the producer before delivery.

4.1.4 Conclusions, assessments and adaptations

Ref. section 4.1.3. The component will be selected after obtaining offers from multiple suppliers considered suited for this specific project. Oslo Municipality is the responsible project partner for writing the requirements specification, selecting suppliers, obtaining offers and make the purchase.

No required adaptations for the PV panels are identified at this stage. The component will be included in the testing of all pilot components once they are integrated, before full-scale implementation in September 2019.

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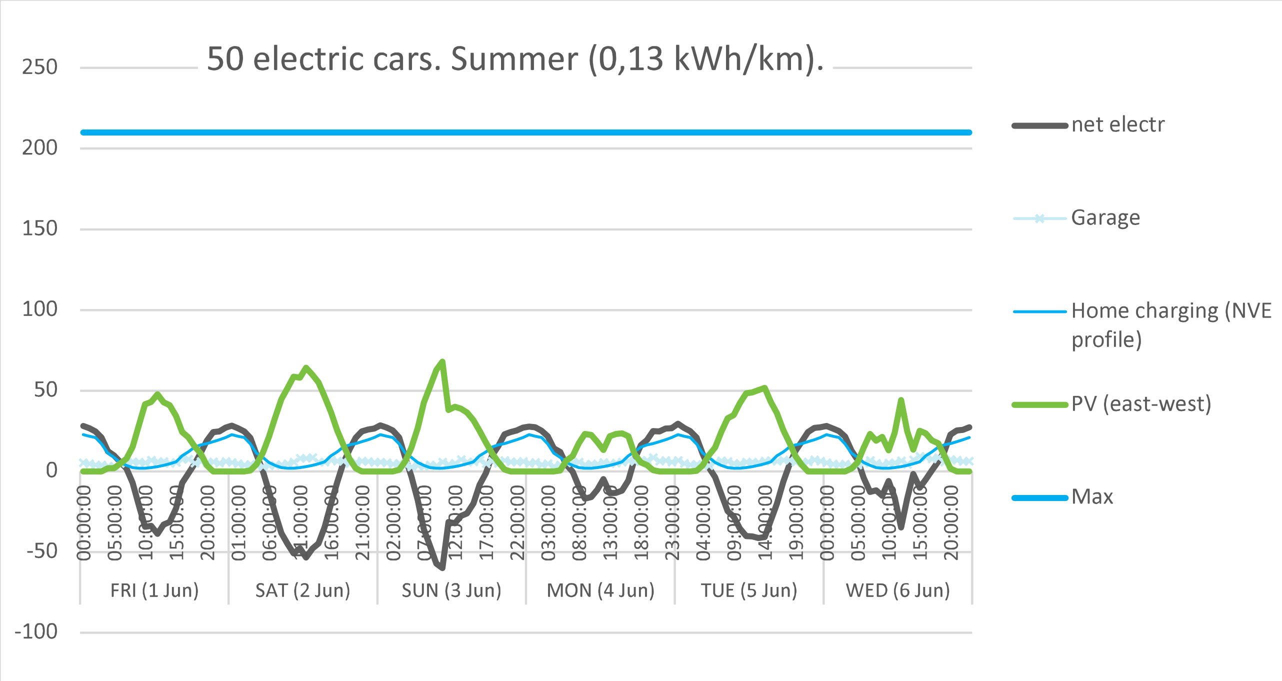
4.2 Stationary battery

Stationary batteries are used for applications where e.g. power is necessary on standby. Surplus energy from PV panels can be stored in the battery and used when needed. Therefore, batteries like this are infrequently charged/discharged (Enginers Edge, 2019).

4.2.1 Purpose

The purpose of the stationary battery is to store the electric energy generated through the PV panels. Table 4 illustrates that the PV production happens at daytime, whilst the need for EV charging mainly occurs at night.

Table 4 PV generation, EV home charging and max consumption in the parking garage



The stationary battery will be integrated with the PV panels, the eSmart's Neighbourhood Energy Managements System (NEMS) and Fortum's Charge Management System (CMS).

4.2.2 Initial status

This component is considered an off-the-shelf product. Requires no changes or adaptations and is fully ready to be implemented at the pilot site, Røverkollen.

There has not been made any decisions regarding battery size and c-rate at this stage.

4.2.3 Component testing

No testing will be conducted by the project. The project considers the stationary battery, like the PV panels, to be successfully tested by the producer before delivery.

4.2.4 Conclusions, assessments and adaptations

Ref. section 4.2.3. The component will be selected after obtaining offers from multiple suppliers considered suited for this specific project. Oslo Municipality is the responsible project partner for writing the requirements specification, selecting suppliers, obtaining offers and make the purchase.

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.

No required adaptations for the stationary battery are identified. The component will be included in the testing of all pilot components once they are integrated, before full-scale implementation in September 2019.

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4.3 Charging infrastructure and charge points

The hardware used for charging equipment will be standard, off-the-shelf chargers delivered by Scheider, which comply with the standards for Type 2 chargers with standard communication protocol – OCPP 1.6 or later. For the purpose of the Pilot, there is no need for special hardware innovations at this time.

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

Table 5 Software and hardware components included in the charging infrastructure

Component	Brand	Type	Basic spec
Charge point	Schneider	EVlink Smart Wallbox	Type2 connector Mode3 7.2/22kW nominal power Communication Protocol: OCPP 1.5/1.6/2.0 RFID reader Energy Meter ModBus Communication
EV’s	Any/All	Any/All	1-phase, 16/32 Amp 3-phase, 16/32Amp
Car computers	None	None	
Communication		4G GW	
Load balancing	Schneider	EVlink Controller	Communication with NEMS Manage loads on chargers and charging network

4.3.1 Purpose

The charge points and charger hardware will be the user interface for charging, including the application. The chargers will communicate with the NEMS through CDMC, which will manage the energy consumption for and during each charging session.

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.

4.3.2 Initial status

The charging points will be according to standards for Type 2 charging and considered an off-the-shelf product. Communication protocol is OCPP 1.6/2.0.

4.3.3 Component testing

As off-the-shelf components will be used, no testing of them is done at this stage. Specific and more extensive testing of GreenCharge charging infrastructure with associated charge points is required once all pilot components are installed at the pilot site for the full-scale implementation by September 2019.

4.3.4 Conclusions, assessments and adaptations

The new functionality for the Pilot requirements will be tested according to the specifications to be defined during the project.

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5 Summary of Assessments of Components

This table illustrates the test results for each component as follows:

- New development (RED). The component does not yet exist and needs to be developed
- Needs adaptation (YELLOW). The component exists but, requires final adaptation, implementation or installation to suit the project and pilot site
- Approved (GREEN). The component is considered an off-the-shelf product and is tested by supplier in time for installation at the pilot site

<table>
<tr><th>Sub-system role</th><th>Component</th><th>Test result</th><th>Required adjustment</th><th>Responsible</th><th>Due</th><th></th></tr>
<tr><td rowspan="2">Neighbourhood energy management system (NEMS)</td><td>eSmart Flex platform</td><td>Require final adjustments</td><td rowspan="2">Load balancing integration with Charge Management System (CMS), HW component and local integration partner</td><td>eSmart Systems</td><td>Sept. 2019</td><td></td></tr>
<tr><td>eSmart API</td><td>Require final adjustments</td><td>eSmart Systems</td><td>Sept. 2019</td><td></td></tr>
<tr><td>Local renewable energy source</td><td>Photovoltaic panel</td><td>Approved</td><td>The component is considered an off-the-shelf product</td><td>Supplier</td><td>Sept. 2019</td><td></td></tr>
<tr><td>Local battery storage</td><td>Stationary Battery</td><td>Approved</td><td>The component is considered an off-the-shelf product</td><td>Supplier</td><td>Sept. 2019</td><td></td></tr>
<tr><td rowspan="3">Charge management system (CMS)</td><td>Charging infrastructure and charge points</td><td>Require final adjustments</td><td rowspan="2">Load balancing integration with Neighbourhood Energy Management System (NEMS)

Support for booking and roaming of booking</td><td>Fortum</td><td>Sept. 2019</td><td></td></tr>
<tr><td>Fortum Charge & Drive Management Cloud</td><td>Require final adjustments</td><td>Fortum</td><td>Sept. 2019</td><td></td></tr>
<tr><td>Charging app</td><td>Require new development</td><td>Booking existing, public chargers outside

Booking priority for private chargers in the parking garage

Implementing OCPP 2.0 Smart Charging, including SoC</td><td>Fortum</td><td>Sept. 2019</td><td></td></tr>
</table>

All the software components have been tested separately, because no components have been integrated at this stage. The hardware components are considered off-the-shelf products tested by their supplier prior to delivery at pilot site. Integration of both software and hardware components will be tested once installed and implemented at pilot site.

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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Appendix A Summary of Innovation Scenarios

In the project description DoA (section 1.3.1) seven innovation scenarios are presented. The scenarios give examples of how GreenCharge technology and business models may work in typical situations. 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. The seven innovation scenarios are:

1. Charge planning and booking
2. Charging at booked Charging station
3. Booking Enforcement
4. Home charging in older (groups of) residential or working buildings with common internal grid and parking facilities, or at work in (groups of) buildings with similar limitations
5. V2G (vehicle-to-grid)
6. Reacting to Demand Response (DR) request
7. E-Mobility in innovative 'Mobility as a Service' (MaaS)

In GreenCharge, a scenario is a higher level of description of the system and can be modelled using one or several use cases.

For the Oslo pilot, the relevant scenarios are 2, 4, 5 and 6. They are presented shortly in the following table and described more detailed for the Oslo pilot in *D2.3 Description of the Oslo Pilot and User Needs.*

Scenario #	Scenario name	Description
2	Charge at booked Charging station	***Scenario 2: Charging at booked Charging station*** 1. EV approaches booked charging station and sends an approaching message to the Charge management system. 2. Charge management system sends guiding info to the EV in-vehicle system (c) who displays it to driver to assist the navigation to the booked charging point. This could include a detailed map of the charging facility, with indication of route to the booked charging post, the location of the EV and audio directions, like the navigation system normally works. Ideally this functionality would be seamlessly integrated with the navigation system. 3. The EV parks at the booked charging post and the EV in-vehicle system authenticates the EV (g) to the Charge management system. 4. The Charge management system controls the charging, making sure to obey the constraints provided in the booking, and in collaboration with the Neighbourhood energy management system leveraging any flexibility.
4	Home charging in older (groups of) residential or working buildings with common internal grid and parking facilities, or at work in (groups of) buildings with similar limitations	***Scenario 4: Home charging in older (groups of) residential or working buildings with common internal grid and parking facilities, or at work in (groups of) buildings with similar limitations*** The internal electricity distribution grid in older (groups of) buildings often have limitations that cause problems when inhabitants want to charge EVs at home. Installing a *Neighbourhood Energy Management System (NEMS)* for the (group of) buildings and a *Charge management system (CMS)* supporting booking for the charging facilities, would avoid overloading and ensure optimal use of the available capacity, and if desirable, take care of the distribution of cost among the users. It would also open the possibility to sell excess capacity to outsiders, which if the facility is conveniently located, could recover the investment.

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5	V2G	***Scenario 5: V2G*** On a cloudy afternoon, the Energy Smart Neighbourhood (ESN) does not have enough local energy production to cover the need. However, during the sunny morning, several connected EVs with still some time left before their agreed deadline were already charged above the required charge level. In this situation, the excess energy stored in the car batteries are fed back into the neighbourhood.
6	Reacting to Demand Response (DR) request	***Scenario 6: Reacting to Demand Response (DR) request*** 1. Public grid requests demand reduction or feed-in 2. For acute requests, the *Neighbourhood energy management system (NEMS)* reschedules already scheduled flexible loads and/or exploits charging EV batteries to satisfy the request.

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