Public summary pilot- en demoprojecten CO_2-reductie 2019
Living Lab: Sturing en verbinding van energie flexibele gebouwen en auto's
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Project purpose

In this pilot project, the consortium aims to create a platform with services for the utility sector that connects supply and demand of energy and where the data of buildings is used for the optimization of their performance. Optimization here means: less CO_2 emissions, direct insight, less consumption and a better balance for the network (leading to lower costs). The platform logs data, assesses the energy performance of buildings and efficiently exchanges the energy generated from a building with other buildings and with a charging station for electric vehicles, thus guaranteeing comfort for users of the buildings.

Purpose of the platform and service is:

- The lowest possible CO_2 emissions by generating as much sustainable energy as possible and using the generated energy as much as possible yourself and exchanging excess energy with other buildings;
- Demonstrating energy use, exchange and CO_2 emissions of buildings and charging stations;
- Minimize energy consumption and avoid peaks;
- Minimize costs for building owners with optimal comfort for users;
- Fulfilment of the condition of `well behaving load': the excess energy offered must not overload the electricity grid.

Short description of activities

The first activities within the project focused on the development of a platform for assessing the energy performance of buildings, and for exchanging energy between buildings and a charging station. These include the forecast model, a dashboard on the monitoring platform, a link to an energy trading platform and the link to a charging square.

The new platform and service have been tested in a pilot in 8 buildings on the BAM campus in Bunnik including a charging station with 19 charging points (22 kW chargers). These 8 buildings cover a total area of 17,000 m². This makes the Bunnik campus a `living lab' for experiments in the use of buildings as a source of flexibility and energy trading.

The project has been carried out by various parts of BAM Bouw en Vastgoed and BAM Infra. Enpuls BV and Stedin Netbeheer BV have also provided input to this project to test the solution for `well behaving load' and determine its value.

Results

In this project a prototype of a platform with a service has been developed that allows the energy performance of buildings to be measured, and the energy to be efficiently used and exchanged between buildings and building components such as a battery and a charging station, assuring the comfort of the users of the buildings and achieving a lower CO_2 footprint, without overloading the energy grid.

The forecasting algorithms that were developed forecast the electricity demand of the building. This platform has been tested in a pilot. In this pilot the contribution to the local energy balance (what is expected to be consumed and what is actually consumed) and increasing the use of renewable energy (lowering the CO_2 footprint) have been tested. Based on the forecasting algorithms, the electricity for the next day was purchased. The algorithm in this pilot had 14% mean average error for 2020. A big difference was observed when COVID-19 restrictions took place, but extra effort was put in the development to make the algorithm more robust and respond to these sudden changes. The forecasting electricity demand, along with the renewable energy generated, the energy imported from outside the campus and the CO2 saved for each timestep was projected on a dashboard to showcase these developments and bring awareness to the tenants of the pilot building and the general public. Workshops and a webinar were also held to bring awareness to the new role of buildings in the energy transition.

To demonstrate the added value of different building components in the flexibility of a building or a cluster of buildings, the same location in the pilot was chosen to test a control for an electrical battery and smart controls for the EV charging square. Different use case were investigated for both components. Different actions were taken to facilitate different controls for the EV charging square, but the low occupancy in the pilot location due to COVID-19 did not benefit the experiments.

Computational experiments were conducted that showed that by attributing the renewable energy production to the EV square and taking advantage of load shifting and smart charging, By applying load shifting techniques on each weekday and shifting the EV demand to a different hour within the working hours, the overlapping of demand and renewable energy production could reach 47% (from 42% with no smart charging applied). That means that there is a reduction in CO_2 emissions of 464 kg for the 3 months of the computational investigation in 2019.

Also the performance indicators for a `well behaving load' have been identified.
A well behaving load is a flexible load with the ability to :pursuit active demand-side management, share data and optimize the load of the low and medium voltage connections today, and in the future.

A well behaving load is not a necessarily flat load but one that can accommodate the grid's needs and wishes in certain times. A flat load is predictable but without flexibility components it cannot be of any service to the grid by absorbing excess energy or lowering its demands when needed. A well behaving load can respond to signals and therefore is a reliable load for the DSO (Distribution System Operator like Stedin). There is a possible certification attached to it to ensure that for a certain amount of time, the DSO can count on the flexibility of that load. A well behaving load is not by default connected to a local energy community or active in the flexibility market but has the assets to do so. Apart from the value for the DSO, a well behaving load is valuable to its own community and investors through its flexibility components and to its users by assuring their comfort and health throughout the transactions with the grid or other communities.

Finally, an investigation of whether different kWmax calculations would give incentive for using flexibility was conducted in collaboration with DSOs. The computational model based on a simple approach in which existing price regime is used as a steering mechanism doesn't seem to lead to desired incentives to use flexibility. Further investigation is needed in the forms of other structures to conclude which is the most beneficial way to incentivize flexibility.

Finally additional improvements have been identified. Further investigations and physical experiments are required to assess the actual effect of some of these developments. Clear and step by step plans have been drafted for these experiments and they will be conducted when occupancy in the buildings is high enough in a post-COVID period.

Publications regarding this project:

REHVA Article - https://www.rehva.eu/rehva-journal/chapter/default-01d15080a5

TVVL – https://www.tvvl.nl/kennisnet/tvvl-magazine