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Positive Energy Districts

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PROJECT

EU Programme:
Horizon 2020 Innovation Action

Coordination:
City of Amsterdam

Partners:
29 partners, 10 countries

European grant:
19.6 M€

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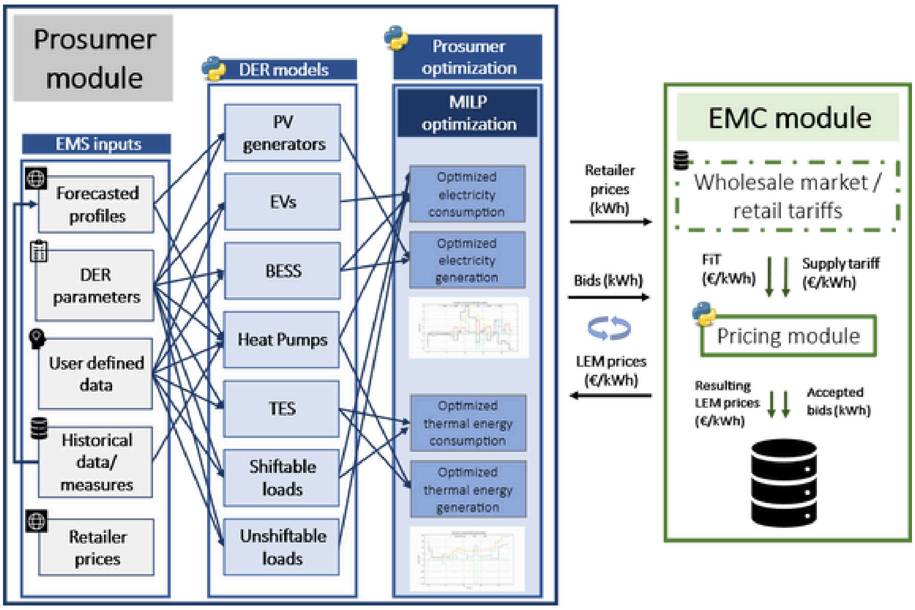
PROJECT RESULT

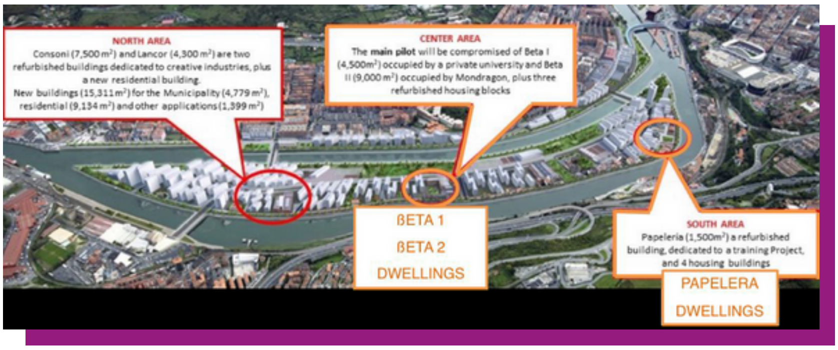
integrated Energy Management System (iEMS)

Result in a nutshell



The **integrated Energy Management System (iEMS)** is a software application that enables local energy market (LEM) participation of multi-energy community-clustered prosumers following a peer-to-peer scheme where eletricity is exchanged with the overall goal of minimizing energy costs. The iEMS consists of two intercommunicated modules: the prosumer module which optimizes energy asset dispatch and the Energy Market Coordinator (EMC) module that creates LEM price signals.

Demonstration site



NORTH AREA
Consoni (7,500 m^2) and Lancor (4,300 m^2) are two refurbished buildings dedicated to creative industries, plus a new residential building.
New buildings (15,311 m^2) for the Municipality (4,779 m^2), residential (9,134 m^2) and other applications (1,399 m^2)

CENTER AREA
The **main pilot** will be compromised of Beta I (4,500m^2) occupied by a private university and Beta II (9,000 m^2) occupied by Mondragon, plus three refurbished housing blocks

SOUTH AREA
Papeleria (1,500m^2) a refurbished building, dedicated to a training Project, and 4 housing buildings

- A fraction of the Center Area of the Positive Energy District (PED) in the city of Bilbao has been used for validation, including tertiary buildings and two housing dwellings.
- To emulate a LEM with P2P energy transactions, real and virtual energy assets have been included in the validation phase.

Detail on result

Technical aspects:

- The two main EMS modules interact in an iterative process until convergence is reached, setting as threshold a minimum cost reduction between iterations.
- **A Mixed Integer Linear Programming (MILP) optimization** problem executed in the prosumer module to compute **minimum cost** schedules for each prosumer. Each energy asset dispatch is optimized based on user preferences, energy asset technical restrictions and LEM prices received from the EMC module.
- Coordinator module in charge of calculating P2P prices based on **pricing algorithms and a distributed market architecture** where decision-making process relies on prosumers since these are free to react according to the received price signals.

Technical requirements:

- Prosumer and EMC modules **exchange information using JSON files and Kafka communications.**
- The iEMS has been **fully developed using Python.** The optimization problem solved in the prosumer module is built using object-based programming and uses Pyomo as optimization library.
- **Additional submodules** have been implemented to feed the optimization problem: energy asset models, demand and generation forecasting submodules and web service-based submodules to obtain information from external sources.

Advantages:

- Prosumer and EMC modules may act as separate software devices, easing seamless integration with third party energy management systems.
- The iEMS implementation eases prosumer parametrization and problem upscaling due to the object-based programming approach.
- The EMC module implements a KPI submodule to assess individual and collective economic benefits as well as the traded energy within the LEM.

Challenges:

- The main challenges remain for data availability for energy asset parametrization as well as on interoperability issues for integrating the iEMS with vendor-specific solutions.

Further development

Potential for further development:

- The iEMS is continuously being upgraded to allow for providing flexibility services for the DSO while considering the potential impacts of the P2P trading on grid infrastructure.
- Developing a user-friendly interface for, both, prosumers and the EMC.

Potential areas of applicability:

- The iEMS has a strong focus on prosumers and energy communities but it can be applied to all energy sector actors that require price-based optimization (prosumer module) and all those agents who need to coordinate energy assets for cost minimization (EMC module).

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