PROJECT FACTSHEET

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gENESiS

Energy management system for smart sustainable buildings : planning, operation and optimal integration in the smart energy.

Inspiration

Ensuring the economic and environmental sustainability of the building sector is a complex trade-off. Responsible for 36% CO_2 emissions in the European Union (EU), the building sector has been the target of recent directives striving to foster the energy efficiency improvement through e.g. an active support of renewable energy sources (RES) integration. By the end of 2020, every new building among the EU should be nearly zero-energy building (nZEB), meaning that its on-site RES energy production and consumption need to be yearly nearly balanced.

If this goal could be reached with the deployment of RES and storage devices, it is nonetheless essential to design an efficient energy management system (EMS) to optimally steer RES, storage, and deferrable loads (e.g. smart appliances, electric vehicles, etc.). However, the environmental impacts of RES and storage devices have not yet been integrated into optimization processes. In view to promote sustainable buildings, there is a need for a better optimization of buildings planning and operation as well as their integration into smart power grids.

Innovation

The objective of gENESiS, coordinated by LIST, is to optimally design and operate the energy management system of a new or existing nZEB, while taking into account its optimal integration into the smart power grid. To do so, LIST and its partners will work closely on both optimization problem formulations and solution methodologies at three stages: individual building planning, individual building operation, and optimal distribution system operation exploiting flexibility offered by a cluster of buildings.

With a strong expertise in mathematical optimization and life cycle assessment, LIST will first develop a novel comprehensive model to optimize the size of RES and storage device at building planning stage to satisfy nZEB requirement. The environmental impacts of various renewable energy and storage technologies will be embedded for the first time to mathematical programming problems applied to nZEBs. LIST researchers will then focus on the optimization of the buildings operation, relying on model predictive control approach. This will allow to minimize the operation costs as well as maximize the stakeholders profit while meeting technical operation constraints. In order to provide grid operators a comprehensive optimal power flow (OPF) management tool, LIST researchers will finally expand classical OPF tool to take into account the nZEBs flexibility (e.g. in terms of energy patterns modulation).

Together with its partners, LIST will develop 3 prototypes (for respectively buildings optimal planning, buildings optimal operation, and optimal distribution system operation taking advantage of flexibility offered by nZEBs) to be further refined to become user-friendly tools for nZEB stakeholders or smart grid operators.

Impact

gENESiS will provide a significant contribution to the existing scientific knowledge, particularly in terms of mathematical modelling by providing novel formulations able to solve worldwide optimization problems in a realistic timeframe.

By assessing and optimizing the energy patterns modulation into energy grids, this European project will establish a promising concept for future sustainable buildings and smart power grids. The creation of prototypes at building and residential districts scales will open the path to follow-up projects with potential industrial partners to design a high-readiness tool.

Partners

University of Luxembourg (LU) , Aalborg Universitet (DK) , KU Leuven (BE)

Financial Support

Fonds National de la Recherche

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