

Smart-Grid-Ready Energy Management and Demand Response Solutions based on Electricity Storage to Optimize Energy Flows in and between Buildings

Buildings are responsible for 40% of energy consumption and 36% of CO₂ emissions in the EU. As a result, the topic of energy efficiency in buildings has assumed central importance in EU energy and environment policy making. The EU Energy Performance of Buildings Directive (2010/31/EU) dictates that the technical, environmental and economic feasibility of high-efficiency alternative energy systems, such as those listed below, should be considered and taken into account:

- Decentralized energy supply systems based on energy from renewable sources;
- Cogeneration;
- District or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources;
- Heat pumps.

The goal is new nearly zero-energy buildings, i.e. buildings that have a very high-energy performance. The energy performance of a building is determined based on the annual energy that is consumed in order to meet the different needs associated with its typical use. Furthermore, the low amount of energy required should be covered to a very significant extent by energy from renewable sources produced on-site or nearby. One promising approach to increase energy efficiency in the building sector is focusing on blocks of buildings rather than individual ones, and exploiting the heterogeneity in the buildings' capabilities to achieve a high level of energy sufficiency or demand flexibility.

In this case, a "block of buildings" refers to a number of buildings that actively share their energy generation, conversion and storage infrastructure with each other, towards the achievement of a common goal.

Accordingly, the aim is to investigate on smart-grid-ready energy management and demand response solutions that enable existing technologies for energy generation and storage installed in buildings to work together under an infrastructure-sharing scheme that coordinates the energy flows in these buildings according to externally defined goals. Smart buildings in this sense mean buildings equipped with smart-grid-ready building management systems.