

Net-Zero Energy Buildings (NZEBS): Optimization Strategies And Integration In Smart Grids

ORGANIZED BY

Elisa Belloni, University of Perugia

Cristina Moscatiello, University of Rome “La Sapienza”

Increasing the use of renewable energy sources, as well as electrifying buildings and transport, are major pathways towards achieving net zero carbon emissions by 2050. Net-zero energy buildings (NZEBS) and positive energy districts (PEDs) are key innovations that aim to transform the way cities manage energy, reduce carbon emissions and increase resilience. The development of new NZEBS and the refurbishment of old buildings to achieve NZEB status are very relevant, as they would enable distributed, low-carbon generation to be developed for the first time also thanks to the implementation of renewables such as photovoltaic (PV) plants. A NZEB should have very high energy performance, with the minimal energy required being covered to a significant extent by energy from renewable sources, including on-site or nearby renewable energy production. The challenges that zero-energy buildings pose to the grid are significant: a smart power grid is necessary to guarantee optimal management of nano or micro grids at building level. Another relevant role is given to electric vehicles (EVs): the electrification of vehicles could help reduce relevant greenhouse gas (GHG) emissions while enabling the provision of flexibility services.

The performance of NZEBS can be analyzed by examining real case studies or using forecasting techniques. Multi-objective optimization problems can be solved using algorithms that consider the capital investment payback period and the social, environmental and economic benefits.

In order to address these issues, it is essential to investigate innovative approaches and fundamentally reconsider how energy systems are managed. The Smart Grid is the key component of this transformation, with interconnected control devices enabling the timely and efficient management of energy flows.

Given the relevance of these topics, the proposed Special Technical Session focuses on the latest advancements in NZEBs diffusion with particular attention at their main performance characteristics in terms of overall electricity consumptions and internal comfort, the implementation of demand side management and services to the grid, demand response mechanisms and flexibility management, EVs charging and discharging optimization profiles, the market operations. Therefore, session topics include, but are not limited to, the following:

- **Net-Zero Energy Buildings (NZEBs) real case studies**
- **Modeling and simulation of NZEBs**
- **Innovative technology measures for NZEBs**
- **Tracking and data analysis of NZEBs**
- **Smart grids**
- **Energy communities**
- **Positive energy districts**
- **Building refurbishment techniques**
- **Electric vehicles (EVs)**
- **Renewable energy systems (RES)**
- **Photovoltaics (PV) in buildings**
- **Battery technologies**
- **Electrical and thermal storage**
- **Cost-optimization analysis**

