PhD in Energetics / Energetica

I° SESSIONE

Research Title: Thermal energy storage technologies for integration in intelligent buildings

<table>
<thead>
<tr>
<th>Funded by</th>
<th>Dipartimento Energia / Energy Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisors</td>
<td>Andrea Lanzini, Vittorio Verda</td>
</tr>
<tr>
<td>Contact</td>
<td><a href="mailto:andrea.lanzini@polito.it">andrea.lanzini@polito.it</a>; <a href="mailto:vittorio.verda@polito.it">vittorio.verda@polito.it</a></td>
</tr>
</tbody>
</table>

Context of the research activity

Today, there are still several R&D barriers, and user-acceptance-related challenges that hinder the smooth integration and proliferation of multiple Renewable Energy Technologies (RETs) in buildings. Holistic, end-to-end RETs Integration Framework towards energy positive buildings with a focus on small and medium-sized buildings in Europe is the context of the research activity. Especially, Automated Energy Management Systems (AEMS) are key to succeed the establishment of intelligent buildings that can pair with appropriate storage technologies and innovative energy systems to meet the electricity and heating/cooling demand of the same. The overall framework is thus that of enabling the integration of multiple, heterogeneous, energy generating systems covering the spectrum of available building-scale RES (PV, solar thermal/cooling, wind, bio-energy, and geothermal) and demonstrating future-proof extensibility. To this end, the research project entails activities at the level of single technologies and their interconnection with novel energy systems (e.g., heat pumps harnessing geothermal energy and absorption chillers) leveraging current IoT and smart-grid standardization outcomes. A special focus on thermal energy storage (TES) technology is foreseen within the project, with an experimental activity on proof-of-concept TES device.

Objectives

- Dynamic simulation or co-simulation of an intelligent medium-sized buildings (e.g., office building) integrating multiple renewable energy conversion and energy storage technologies.
- Optimal heat exchange surface area design with topology optimization, thermal-fluid dynamic simulation and rating (testing) of a thermal energy storage proof-of-concept using phase-change material(s).
Development of algorithms for the optimal automated energy management of a city district comprising of many building units, a district heating/cooling network and exploiting thermal energy storage technology.

The overall research work will be carried out in collaboration with companies (e.g., IREN) interested in the development and large-scale deployment of distributed thermal energy storage systems integrated with buildings or cluster of buildings within city districts.

Skills and competencies for the development of the activity:

- Background in the areas of energy systems modeling.
- Simulation of district heating energy networks.
- Skills on Computational Fluid-Dynamic (CFD) modeling and simulation tools.
- Good programming skills.
- Prior experience with multi-disciplinary team working.
- Good knowledge of thermal energy systems and related measuring devices.