Energetics

**Title of the research activity**
Holistic assessment of zero-energy buildings

**Short description of the research activity**
Buildings are responsible for 40% of energy consumption and 36% of EU CO₂ emissions. Currently, about 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy inefficient. Improving the energy performance of buildings is a cost-effective way of fighting against climate change and improving energy security, while also creating job opportunities, not only in the building sector, but also in renewable energy technologies and innovative HVAC equipment. More specifically, the new Directive 2018/844/EU aims at accelerating the cost-effective renovation of existing buildings, with the vision of a decarbonised building stock by 2050 and the mobilisation of investments. New provisions to enhance smart technologies and technical building systems, including automation, are introduced.

The main research question is to develop, implement, and validate methods and tools able to perform an holistic assessment of energy efficient buildings and of smart technologies. Aspects related to energy, costs, comfort, environmental impact, and resilience will be addressed.

The research activity will investigate the following items:

- Development, implementation and validation of simplified models for the performance assessment of advanced components of building construction and HVAC systems, and of the whole building. Comparison of standardized simple methods with dynamic detailed simulation (EnergyPlus, TRNSYS, Matlab …). Robustness, accuracy, flexibility, and reproducibility aspects will be addressed.
- Study of advanced solutions, concerning both envelope and technical building systems, for the design of zero energy buildings and the use of renewable energy through solar and geothermal technologies.
- Use of building simulation for investigating design optimization options (both new buildings and renovations), model calibration through the comparison with actual performance and with detailed simulation, assessment of the effects of uncertainties (e.g. occupancy), and energy management optimization options (including HVAC control and BACS).
- Drafting of design guidelines for practitioners, support to standardization bodies and policy makers.

**Scientific responsible (name, surname, role, email)**
Vincenzo, Corrado, full professor, vincenzo.corrado@polito.it
Enrico, Fabrizio, associate professor, enrico.fabrizio@polito.it
Ilaria, Ballarini, assistant professor, ilaria.ballarini@polito.it

**Specific requirements (experiences, skills)**
Solid knowledge of thermodynamics, heat transfer, building physics, and HVAC systems is required. Skill in performance-based design tools and energy dynamic simulation (e.g. EnergyPlus) is highly recommended.

**Website of the research group (if any) - references**
www.tebe.polito.it
