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Editorial

New Trends in Efficient Buildings

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The literature reports several examples wherein calculation methodologies for assessing the energy performance of buildings are proposed, and solutions to improve their performance are posited, along with the introduction of advanced technologies and algorithms to reach this goal. Passive Houses, Zero-Energy Buildings (ZEBs), and Positive-Energy Buildings (PEBs) highlight these concepts with the primary objective of reducing energy consumption in the building sector. Additionally, the concept of building efficiency extends beyond energy consumption and includes considerations of embodied impacts and emissions, such as carbon footprint and comprehensive life cycle assessments. The literature also explores operational and life cycle costs (LCCs) and recognizes the significance of various co-benefits that are challenging to quantify, but are nevertheless important, such as well-being, an increased productivity, an enhanced building value, and an improved contextual value. User comfort is a very important topic and requires further insights to better evaluate how people live and experience the built environment.

The Special Issue *New Trends in Efficient Buildings* compiles the research achievements, ideas, and applications of advanced and efficient buildings, covering different technologies and application domains. In [1], the authors used existing standards and the scientific literature on life cycle assessment (LCA) to propose an operational definition for carbon-neutral buildings. Then, they applied this definition to an urban case study, comparing it to a nearly Zero-Energy Building (nZEB) scenario. The objective was to identify the significant practical constraints associated with implementing a methodologically rigorous calculation for carbon neutrality. The case study revealed that achieving carbon-neutral objectives for individual urban buildings is challenging due to the limited availability of spaces that can facilitate onsite carbon-offsetting actions. In [2], the authors investigated the application of Artificial Neural Networks (ANNs) in a heat transfer scenario, involving masonry wall assemblies subjected to elevated temperatures on one side, following the standard fire curve outlined in Eurocode EN1991-1-2. They compared their approach with the previously published methods of ANN development and protocols, assessing the accuracy and reliability of the developed algorithms. The study emphasized the importance of carefully selecting input data density and quality, as well as employing an appropriate algorithm architecture. The possibility of obtaining misleading metric results was acknowledged, and consequent measures to mitigate such risks were suggested. The paper concludes by proposing the further integration of ANNs in heat transfer research and applications. In [3], the authors put forward a management and control system to optimize electrical and energy heating consumption in student dormitories at a university campus. This system uses a Building Management System (BMS) and incorporates a cogeneration plant that can be precisely controlled to generate electrical and heating energy based on the specific heating needs during the cold season. As a result, the implementation of this system successfully reduced energy consumption for heating by 13%, and electricity consumption by 32%. In [4], a model is proposed to evaluate the economic benefits generated by energy requalification interventions in relation to the Italian fiscal measure,

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known as the "Superbonus". The model focuses on the convenience for the various stakeholders involved. The analysis specifically considered 110 provincial capitals and their main urban areas, categorized as central, semi-central, and peripheral. For each urban area, the research determined the market value differential between the pre- and post-energy intervention situations. Additionally, by assuming an ordinary profit margin for potential investors, the research estimated the break-even incentive threshold for each urban area. The study focuses on the Italian territory and the prevalent building typology, providing insights into the economic feasibility of energy requalification interventions under the Superbonus scheme. In [5], the authors introduced a novel energy storage system that comprises a supercapacitor bank and a bidirectional six-phase interleaved DC/DC converter. Through simulation tests, they investigated the energy savings achieved by this proposed system. The model of the system considered all the relevant physical constraints, and its accuracy was validated using field measurements. By utilizing the validated simulation model and considering the physical constraints, reliable results were successfully obtained. The proposed energy storage system's performance was evaluated under various conditions, and the simulation model was further tested, using elevator traffic data obtained from the measurements of the existing elevator system. The simulation results demonstrate the effectiveness of the proposed energy storage system and highlight its potential for significant energy savings. In [6], the authors presented a novel design for a transfer learning approach that addresses dissimilarity issues by incorporating a specific data selection methodology. This procedure utilizes neural network models and analyzes prediction uncertainties associated with the target application samples. To validate the proposed methodology, it is applied to a semi-supervised transfer learning case study, involving two publicly available air-handling unit datasets that include various fault scenarios. The results highlighted the potential of the proposed domain dissimilarity analysis, whereby it achieved a classification accuracy of 92% within a transfer learning framework. This represents a significant improvement of 37%, compared to conventional approaches. Finally, in [7], the objective of the study was to examine the impact of human thermal plume on the measurement performance of thermohygrometers. To achieve this, a simple and replicable "Do-It-Yourself" device was utilized. The device consisted of 10 iButtons attached to 3D-printed brackets, enabling their placement at various distances from the body. The device was affixed to the user's belt while in a seated position. Two scenarios were considered: a summer scenario with an air temperature of 28 °C and a clothing thermal resistance of 0.5 clo; and an autumnal scenario with an air temperature of 21 °C and a clothing thermal resistance of 1.0 clo. The findings demonstrated that the proximity of the measurement station to the body significantly influences the accuracy of the measurements. This factor should be considered when developing new wearable devices for assessing thermal comfort. As a recommendation, it is suggested that the development of a new wearable device that is attached or embedded onto a belt should include at least two thermohygrometers. The first should be positioned as close to the body as possible, while the second should be placed at least 8 cm away. This approach enables the assessment of potential discrepancies between the standard thermal comfort evaluation and the user's personal perception, as well as the exploration of the potential role of spatial proximity in thermal comfort assessment.

The seven papers published in this Special Issue of *Applied Sciences* collectively reinforces the crucial need to conduct further studies in relation to this topic, in order to enhance our comprehension of all the elements that constitute an "efficient" building within a multi-domain context.

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