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Editorial: Toward sustainable futures: optimizing building energy consumption for a greener built environment

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Editorial on the Research Topic

Toward sustainable futures: optimizing building energy consumption for a greener built environment

Introduction

The world is undergoing rapid transformation, particularly in terms of population growth, which has significant implications for energy consumption and sustainability. Projections indicate that existing primary energy sources may be depleted within the next century, underscoring the urgent need to enhance energy efficiency in the built environment. Buildings, as one of the largest consumers of energy, contribute substantially to global energy demand. As cities expand and populations rise, energy efficiency in buildings becomes even more critical to achieving sustainable development. The United Nations' Sustainable Development Goals (SDGs) emphasise the importance of "Sustainable Cities and Communities (SDG11)," reinforcing the necessity of reducing energy consumption through innovative strategies and technologies.

This topical Research Topic brings together pioneering research that offers novel approaches for optimising energy use in buildings, integrating digital tools, improving architectural education, and enhancing sustainability in school environments. The studies presented here provide practical solutions and insights for advancing energy efficiency in the built environment.

Digital twins and dynamic energy simulations

The article by [Borodinecs et al.](#) presents a framework for continuous dynamic energy simulations to enhance decision-making in office building operations. Through OpenStudio modelling and Python-based modifications, the research demonstrates how optimising the operation of air handling units alone can significantly improve energy efficiency

while maintaining occupant comfort. Additionally, the study highlights the potential for integrating digital twins with machine learning algorithms to automate building energy optimisation strategies, further advancing sustainable building management.

Microclimate optimisation and energy efficiency in schools

Addressing the sustainability of educational environments, the study by [Salameh and Touqan](#) explores the impact of courtyard orientation on microclimate and energy consumption in hot climates. Using a standardised template applied to numerous school buildings, the study finds that north-facing courtyards provide cooler microclimates, reducing both indoor temperatures and cooling demands. These findings reinforce the importance of strategic design considerations in educational facilities, offering practical solutions for enhancing thermal comfort and sustainability in hot climates.

Validation of energy simulation tools for sustainable buildings

Energy simulation tools play a crucial role in predicting and improving building performance. The article by [Al Shawa](#) critically evaluates the accuracy of two simplified energy performance assessment methods, i.e., the Passive House Planning Package (PHPP) and a modified version of the Radiant Time Series Method (RTSM), demonstrating that while these tools offer quick and cost-effective energy estimation, their validity requires further calibration. The study calls for refinement of these methodologies to better align with established building energy simulation standards, ultimately supporting more accurate and reliable building energy assessments.

Advancing architectural education and student engagement

Sustainability in architecture extends beyond building performance to how future architects are trained. The study by [Baigi et al.](#) investigates the impact of online design studio instructional strategies on student engagement. The research identifies key pedagogical approaches that significantly influence student learning experiences, emphasising the importance of effective teaching strategies in digital education environments. These findings contribute to the ongoing evolution of architectural education, ensuring that students are well-equipped to tackle sustainability challenges in their future professional roles.

Summary

The insights presented in this Research Topic provide a forward-looking perspective on sustainable building practices, energy efficiency, and architectural education. By integrating cutting-edge technologies, refining simulation tools, and enhancing pedagogical methods, these studies contribute to the broader goal of a more

sustainable built environment. The collective findings of this issue offer valuable guidance for architects, engineers, educators, and policymakers, reinforcing the importance of innovation and collaboration in shaping the future of sustainable development.

As we move towards a greener future, it is crucial to implement these research-driven solutions, ensuring that the built environment evolves in alignment with sustainability goals. The discussions presented here serve as a foundation for further exploration and action, fostering a continued commitment to energy efficiency and ecological responsibility in the building sector.

Author contributions

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