

Comfort in cold: A novel approach to sustainable building energy efficiency

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Abstract

Kyrgyzstan's high-altitude rural housing sector consumes 3–5 times more energy than European buildings due to ageing infrastructure, lack of insulation, and reliance on non-sustainable resources. One potential solution is the implementation of thermal insulation. However, due to limited public awareness of energy efficiency, inadequate government policies, insufficient technology, and challenging geography, people in rural areas rely on non-sustainable resources such as coal, cow dung, and firewood for heating, which creates a negative impact on the local ecosystems. To close the energy efficiency gap, the paper proposes a sustainable and holistic approach that integrates thermal insulation with effective energy efficiency planning using a staged-renovation approach by utilising locally available insulation materials / resources. The feasibility study presented in the paper was conducted with a simulation-based parametric study to recognise the potential of novel and sustainable insulation structures on building heat demand. This innovative approach can potentially reduce heat demand in high-altitude houses by as much as 70 %, offering a transformative solution. Furthermore, its adaptability makes it transferable to similar high-altitude communities, thus advancing sustainable energy practices for climate change mitigation and contributing to broader sustainable development goals.

Keywords: High-altitude, Cold climate, Building energy, Building renovation, Local insulation materials, Sustainable building energy efficiency

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