Beyond Energy-efficiency: Integrating Health Considerations in Zero-Energy Building Transitions

Abstract

According to the goal of achieving zero-energy buildings by 2025, governmental policies and municipal initiatives are increasingly promoting the energy efficiency of both existing and new buildings. However, there is still a study gap in the post-occupancy evaluation, not only in terms of occupant behaviour but also regarding the health impacts of these types of buildings. The impact of energy-efficient buildings can be considered in two aspects: (1) implementation strategies and (2) material selection. While energy efficiency and retrofitting measures such as building insulation or window replacements contribute to saving energy, they can also affect occupants' health in the long term. Prior research has shown that, for example, increased building airtightness can lead to various health concerns, or certain insulation materials may cause health risks in the long term. This study presents a critical review of potential health risks related to post-occupancy conditions in retrofitted or zero-energy buildings, specifically when occupants are not fully aware of how the technologies function or when materials are improperly selected. Our analysis highlights how health risks can be linked to both occupant behaviour and technical implementation aspects, and investigate the overlooked health factors in the energy transition process. The study concludes with a guideline showing health-related considerations during retrofitting processes and zero-energy building designs. To ensure that energy efficiency does not compromise occupant well-being, health-related recommendations are provided both behaviourally and technically. This guideline can serve as a source for policymakers, decision-makers, architects, engineers, technicians, and occupants.

Keywords: Energy retrofitting, post-occupancy, health risks, indoor air quality, zero-energy buildings, building materials, bio-based insulation, ventilation, air cleaning.