

Retrofitting Building Automation System in Cold Climate Elementary Schools: Pathways towards Net-Zero Energy

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Abstract

One of the biggest contributors to energy problems in cold regions in the United States is old elementary school buildings; these buildings tend to spend a longer time heating, have to be well ventilated, and are old. The performance of these facilities in terms of net-zero energy is critical in terms of the minimization of operational expenses, emission of greenhouse gases, and the promotion of the quality of the indoor environment (IEQ). The budget barrier of the system of public schools, however, restricts the haste of capital-intensive retrofit measures such as the complete replacement of HVAC or deep envelope retrofit. The purpose of this research is to explore cost-effective Building Automation System retrofit routes, to enhance energy performance in elementary schools. It is a qualitative and comparative approach with a lot of flexibility, entailing a comprehensive literature overview, evaluation of cold-climate case studies, and analysis of in-stage retrofit cases. HVAC scheduling, occupancy-based controls, demand-controlled ventilation (DCV), and centralized system integration are some of the major BAS strategies considered. The findings indicated that operational gains (in terms of energy savings) of 15-60% can be achieved through the deployment of these operational improvement measures based on BAS, which is notably exhibited in heating-dominated systems. The research paper offers a staged retrofit solution in line with ASHRAE rules and LEED certification models, which offer some plausible advice on how school districts with limited funding can save to go green.

Index Terms

ASHRAE, BAS, Demand-Controlled Ventilation, HVAC Optimization, LEED, Net-Zero Energy