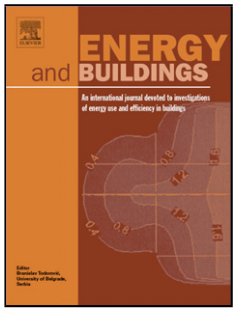

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A comparison of thermal energy storage models for building energy system optimization

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Abstract

In this study, four approaches to model stratification in thermal energy storage (TES) units with mixed-integer linear programs are introduced. These stratification models are compared with the widely utilized capacity model, in which TES units are modeled as homogeneous volumes. The approaches are verified with a use case consisting of a single building with a monovalent heating system comprising a combined heat and power (CHP) unit and a TES unit. The objective is the minimization of the total operational costs.

The results conclude that both models, capacity and stratification models, generate electricity driven schedules. In the capacity model, the minimum energy content is typically set to a constant value, mostly zero, while the layered storage model allows for implementing more accurate restrictions, such as the required flow temperature based on the building's heating curve. Consequently, the capacity model overrates the system's efficiency, thus underestimating the operating costs by 6 % to 7 %.

Keywords: Thermal Storage Unit, Optimization, Mixed-Integer Linear Programming, Combined Heat and Power, Building Energy System, Capacity Model, Thermal Stratification

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