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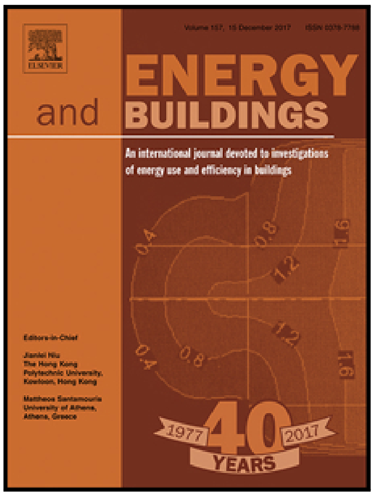

Optimal Battery Energy Storage Investment in Buildings

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Optimal Battery Energy Storage Investment in Buildings

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Abstract

In most countries, electricity is charged depending on the time of use, which usually includes two tariffs: the low tariff, during night time, and the high tariff, during daytime. On top of their energy payment, large electricity consumers pay a monthly fee per kW of peak demand. Therefore, installation of stationary battery storage can reduce electricity payments for large consumers in two ways: by reducing the peak demand and by shifting consumption from the high tariff to the low tariff. The aim of this paper is to formulate a model to determine optimal energy and power capacity of a stationary battery storage in order to minimize electricity payments. Since the future electricity consumption is uncertain, after formulating the deterministic model, two additional models that consider uncertainty are introduced. The first one is the stochastic model, which considers uncertain scenarios, and the second one is the robust model, where uncertainty is represented by only an uncertainty set, without an assumption on the distribution of uncertainty within this set.

The proposed models are tested and compared on a real-world load data of a hotel in Croatia. The case study indicates that deterministic and stochastic formulations result in slightly better investment decisions than the robust formulation.

Keywords: battery energy storage, robust optimization, stochastic optimization, optimal investment problem

Acronyms

For easier referencing, the acronyms used throughout the text are listed below:

AC Alternating Current.

CBA Cost-Benefit Analysis.

CDF Cumulative Distribution Functions.

CHP Combined Heat and Power.

DC Direct Current.

EU European Union.

Li-ion Lithium-ion.

NaS Sodium sulfur.