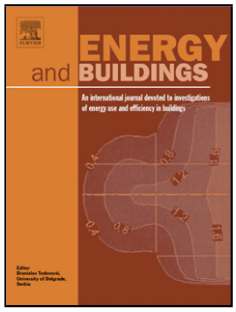

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Model-based Optimization of Distributed and Renewable Energy Systems in Buildings

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Abstract

In order to fully exploit the potential of renewable energy resources (RERs) for building applications, optimal design and control of the different energy systems is a compelling challenge to address. This paper presents a two-step multi-objective optimization approach to size both thermal and electrical energy systems in regard of thermo-economic performance indicators to suit consumer and grid operator interests. Several utilities such as storage, conversion systems, and RERs are hence modelled and formulated through mixed-integer linear programming. Simultaneously, the algorithm defines the optimal operation strategy, based on a model predictive control structure, for each deterministic unit embedded within the energy management system of the building to meet the different comfort and service requirements.

The developed design framework is successfully applied on several energy systems configuration of typical Swiss building types. Different component sizes are analysed, regarding the present investment cost and the self-consumption share. In addition, this paper presents a novel optimal design criteria based on the maximum cost benefits in the view of both the consumer and the distribution network operator.

Keywords: Multi-Objective Optimization, Optimal design and control, Distributed Energy System, System Modelling, Complete building simulation

1. Highlights

- K-medoids clustering of the input data to improve computational efforts
- Advanced thermal modelling by applying discrete control-oriented models of thermo-electrical energy systems and heat cascading.

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