**Validation of modeling smart energy management systems in reduced order models with building simulation models**

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Motivation

Heat pumps are an alternative solution to conventional gas heating systems, and the demand for them has increased by over 30% this year in Austria. At the same time, electricity prices rise and increasing volatile renewable production makes load shifting with heat pumps more attractive. Optimization algorithms often determine when to shift loads with heat pumps. However, these optimizations are usually computationally expensive, so reduced-order models are popularly used. This paper will answer the question to what extent an optimization for a heat pump-operated building based on a reduced-order model is suitable to minimize operation costs.

Keywords: heat pumps, building modeling, optimization, load shifting

Method

We use two different models for the same buildings to answer this question. The first model calculates the heating demand based on a reduced-order model and optimizes heat pump operation, keeping the indoor temperature in between a specific bandwidth. The optimization minimizes energy cost for the particular household based on a variable electricity tariff. A non-linear building simulation model uses the resulting indoor temperature as set temperature. By comparing the results of the complex building simulation model with the optimized set temperature from the reduced-order model to a reference scenario, we determine how effective the optimization was. The same analysis is then repeated also for cooling.

Results and Conclusion

Results will show to which extent the reduced-order model sufficiently predicts heating demand for different types of buildings and for different heating systems. In particular for conventional, high-temperature radiators and large surface heating systems or thermal building activation. The reduced order model poorly represents the slow thermal inertia in floor heating systems, especially in thermal activated buildings. For these heating systems modifications to the model are needed and will be introduced. The effect of these modifications is going to be measured against the building simulation tool. Additionally, we show that the performance of the reduced order model also depends on specific building parameters like thermal mass and insulation. The impact of these parameters is going to be investigated.

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