

Paper title: Municipal energy system modelling – A practical comparison of optimization and simulation approaches

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1 Summary

1.1 Motivation/purpose/aims/hypothesis

The motivation of the study is to compare the impact of optimization and simulation approaches on energy system modelling in a municipal context. The purpose is to expand the understanding of how modelers approach energy system modelling and to provide insights into the practical implications of the choice of modelling approach. The aim is not to establish the superiority of one approach over the other, but to emphasize the need for a conscious decision from modelers when selecting a modelling approach for municipal energy systems.

1.2 Contribution

The study contributes to the existing literature by defining five specific approaches to energy system modelling and scenario design, providing a framework for categorizing these approaches. It also introduces a proposed stepwise simulation approach and compares it with an established multi-objective optimization (MOO) approach through a practical case study. Additionally, the study highlights the fundamental differences in modelling approaches and their influence on the process of designing future energy systems.

1.3 Methodology

The study first conducts a review of existing modelling and scenario design approaches, expanding the concept of simulation and optimization models to include sub-categories of the two archetypes. It then applies the proposed stepwise simulation approach and an established MOO approach to a case study to uncover practical implications of the choice of modelling approach. The primary methods include an introduction to the modeled case area, the modelling tool and approaches applied, and the investigated decision variables.

1.4 Conclusion

The comparison between the stepwise simulation approach and the MOO approach exemplifies how the choice of modelling approach influences the process of designing future energy systems. The study concludes that a conscious decision is needed from modelers when selecting a modelling approach for municipal energy systems, and it emphasizes the practical implications of this choice.

2 Limitations

2.1 First Limitation/Critique

One limitation of the study is the focus on a single case study, which may limit the generalization of the findings. The specific characteristics of the case area and the modelling tool used may not fully represent the diversity of challenges and contexts faced in other municipal energy systems.

2.2 Second Limitation/Critique

Another limitation is the reliance on the proposed stepwise simulation approach without extensive validation across multiple case studies. While the comparison with the MOO approach provides valuable insights, further validation of the stepwise simulation approach in diverse municipal contexts would strengthen the robustness of the findings.

3 Synthesis

The ideas presented in the paper highlight the importance of considering the choice of modelling approach in municipal energy system modelling. This has implications for practitioners and researchers involved in designing future energy systems, as it emphasizes the need for a conscious decision-making process when selecting a modelling approach. Furthermore, the study opens up potential future scopes for validating and refining the proposed stepwise simulation approach across diverse municipal contexts, contributing to the development of more robust and widely applicable modelling approaches for energy systems.