Institute of Electricity Economics and Energy Innovation

TU Graz

Master's Thesis

Beyond the Borders: Advanced Modelling for Integrated Energy Systems

Motivation

Optimization models are crucial tools for integrated energy system planning and techno-economic analysis. Because the Austrian grid is embedded in the European transmission system, the impact of surrounding countries must be considered during the planning and operation of the Austrian electricity system. To consider surrounding countries while keeping the model computationally tractable, areas outside Austria can be aggregated. However, in linear models the reduced level of detail can lead to unwanted model behavior in terms of unit dispatch, capacity expansion and transmission expansion. To mitigate these drawbacks, quadratic cost terms can be added to production and investment costs.
The aim of this thesis is to analyze the impact of additional quadratic cost terms on model results compared to linear cost terms in electricity system optimization models. The scope of the study includes the European transmission system with a focus on Austria.

RESEARCH QUESTIONS

- Which units require the inclusion of quadratic cost terms in optimization models?
- What is the impact of quadratic cost terms on the results of electricity system optimization models?
- To what extent does the inclusion of quadratic cost terms increase the computational complexity of large-scale power system models?

TASKS & METHODOLOGY

- Conduct a literature review on existing methods.
- Extend Python-based software for spatial aggregation and optimization (NPAP, LEGO-Pyomo).
- Work with large-scale, European electricity system model.
- Analyse and illustrate model results.

ORGANIZATIONAL INFORMATION

- Start: June 2026
- Support from the motivated IEE team
- Close cooperation with supervisor
- Modern workstations available at the institute
- Creation in home-office possible
- Writing in English

Contact

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