Lehrstuhl für Energiesysteme
TUM School of Engineering and Design
Technische Universität München

Master's Thesis

(Theoretical)

Energy System Optimization: How can demand shifting within an industrial cluster contribute to overcoming temporal infrastructure limitations?

Description:

Today, energy-intensive industries are highly dependent on fossil fuels. To transform towards CO_2 neutrality, direct electrification of heat demand, sequestration of hard-to-abate CO_2 emissions, and H_2 for the synthesis of carbon-neutral products are key. However, even if these technologies can be economically viable in the future, infrastructure limitations, such as fully exploited electricity grids, delayed expansion of H_2 and CO_2 pipeline infrastructure, can lead to negative investment decisions. Demand-side management, such as battery or heat storage systems, bidirectional charging of electric vehicles, or demand shifting in the industrial or private sector, may help overcome temporal infrastructure limitations.

In this Master's Thesis, an existing Python-based chemical cluster model will be extended to include other sectors (private sector, other industries, transport sector) to represent a typical energy-intensive region in Europe. Furthermore, maximum capacities for renewable energy expansion, i.e. PV and onshore wind, in this region will be considered. Next, expansion planning will be carried out from 2025 to 2050, aiming for CO_2 neutrality. By exogenously assuming limited infrastructure expansion, either the electricity grid or future H2 and CO2 pipelines, the consequences for the energy-intensive region can be investigated. By enabling different demand-side management options and varying the shifting potential, the influence on compensating for delayed infrastructure build-up can be quantified. Hereby, the demand shifting potential should be varied based on a comprehensive literature review.

Prerequisites:

- Python knowledge is strongly recommended
- PyPSA knowledge is a plus

Work packages:

- Familiarization with PyPSA and the existing model
- Model extension
- Expansion planning with limited import options
- Assessing the potential of demand shifting

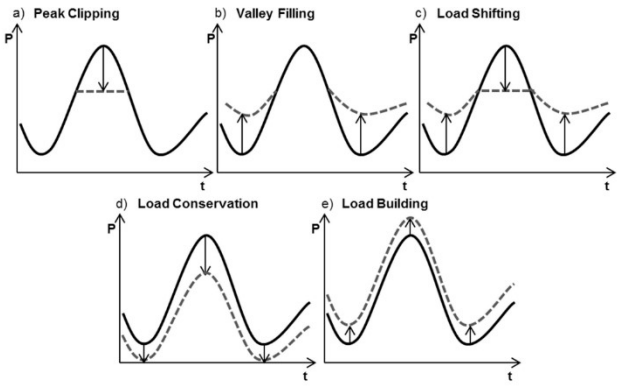

Figure 1 Options for demand-side managed production

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