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

Master's Thesis

(Theoretical)

Optimization under Utilization Conflicts: Transformation of the Chemical Industry toward CO_2 Neutrality

Description:

Germany's goal of achieving climate neutrality by 2045 requires a fundamental transformation of the chemical industry. To reduce CO_2 emissions and move toward sustainable base chemical production, new processes and resources need to be established. However, carriers like green hydrogen and biogenic feedstocks are limited and in high demand across multiple sectors. This raises important questions regarding future utilization priorities, which must be addressed as a matter of urgency.

Energy system optimization can provide valuable insights by modeling both energetic and material utilization options. In this thesis, an idealized chemical cluster will be optimized with a focus on achieving CO_2 neutrality. The model considers various energy demands and key base chemicals such as methanol, ammonia, olefins, and sustainable aviation fuels (SAF).

To conduct this analysis, an existing Python-based model must be extended to include various synthesis process routes for sustainable aviation fuels and base chemicals. Therefore, techno-economic parameters and input streams need to be researched first. After implementing the different process routes, specific input resources will be limited to force utilization conflicts. Finally, conclusions can be drawn about the most effective paths forward.

Prerequisites:

- Python knowledge is strongly recommended

Work packages:

- Familiarization with the existing model and the PyPSA optimization framework
- Implementing new process routes for base chemicals and SAF
- Investigation of different scenarios, specifically focusing on utilization conflicts

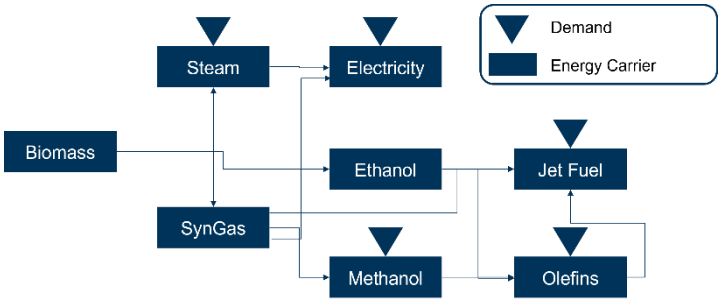

Figure 1: Simplified flow chart of utilization conflicts for biomass

Beginn ab: 01.07.2025

Kontakt: M. Sc. Maximilian Kerschbaum

Raum: MW 3737

Tel.: 089 289 16315

Email: maximilian.kerschbaum@tum.de