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Design and Integration of CO_2 Capture Plant using Piecewise Steady-state Simulation and Process Integration

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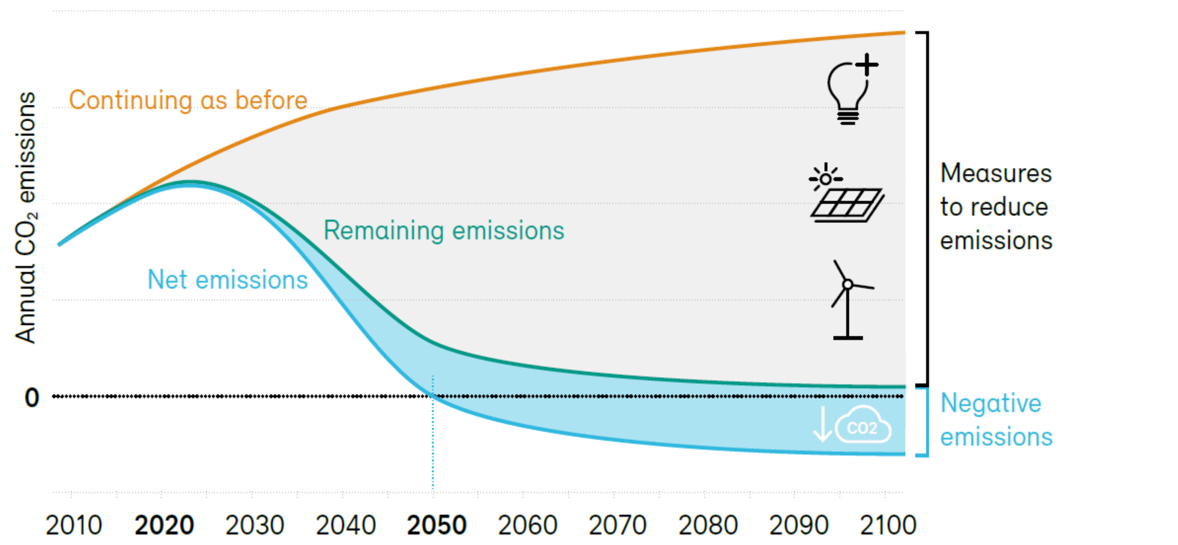
Goals

- To optimally integrate CO_2 capture and storage (CCS) plant to an existing industrial case study (CS).
- Quantify the changes in terms of energy of the newly integrated system.

Problem



Extracted from SFOE

- The net zero target can only be achieved if CO_2 is captured.
- **Challenge**: CO_2 capture is a heat-intensive process.
- Conceptual designs with limited information cannot accurately quantify the effects of integration on the existing system performance.

Methodology

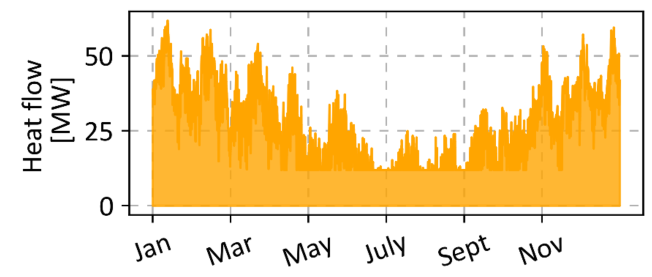
Three existing engineering methodologies are used for the optimal integration:

- **Process Simulation:** To optimize the CCS process and extract the heating and cooling demands data
- **Pinch Analysis (PA)**: To understand the energetic demands and integration of the CS and CCS process
- **Piecewise Steady-state Simulation**: To establish a basic understanding of the process characteristics **(hourly)** of the CS and the effect of integration of CCS

Results

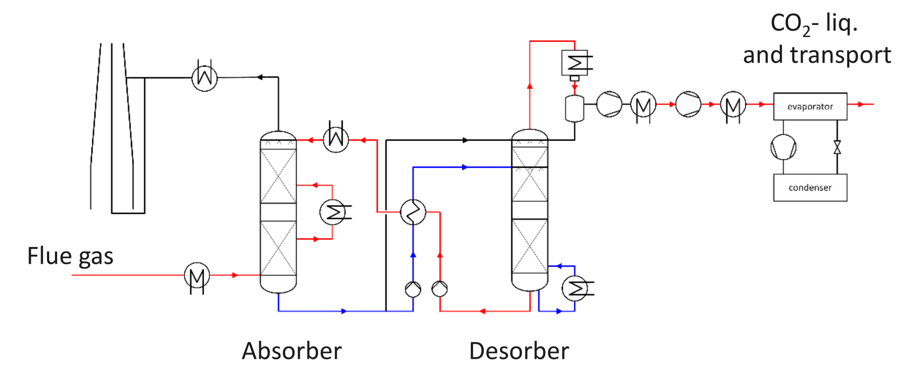
Case Study

Hourly district heating data

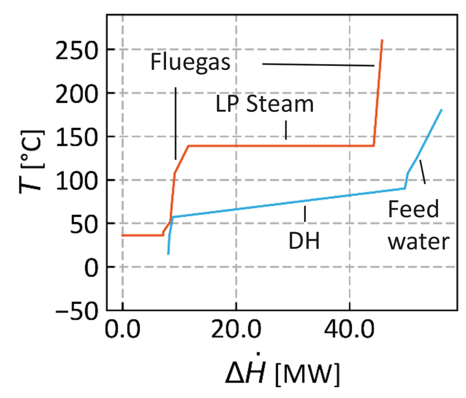


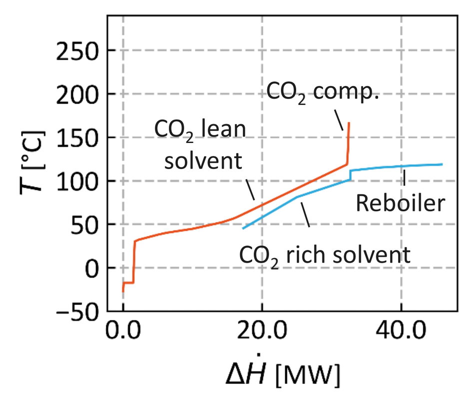
CO_2 Capture Process

Process simulation

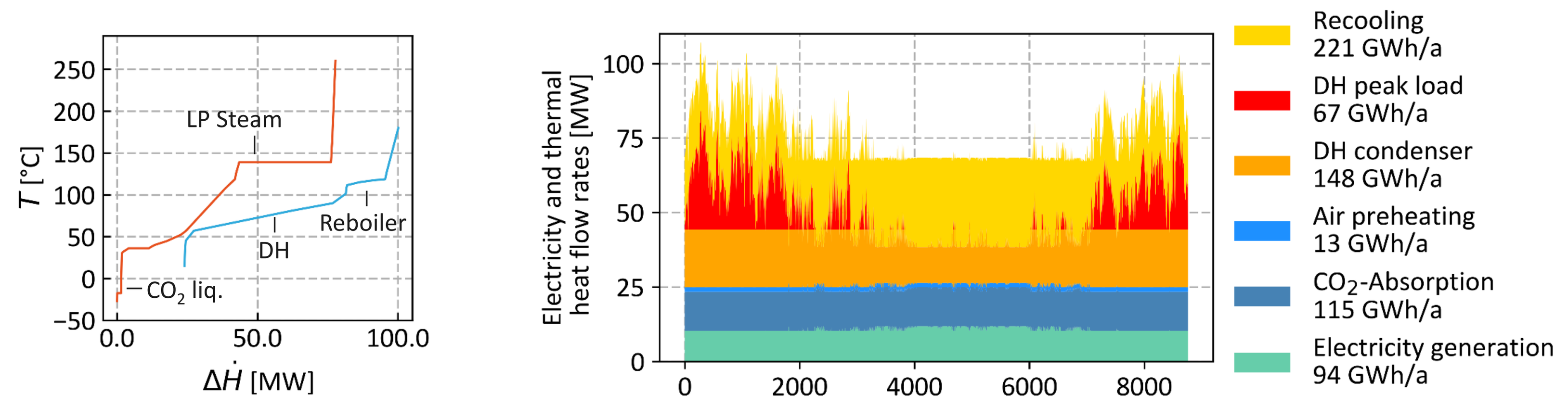


Pinch Analysis

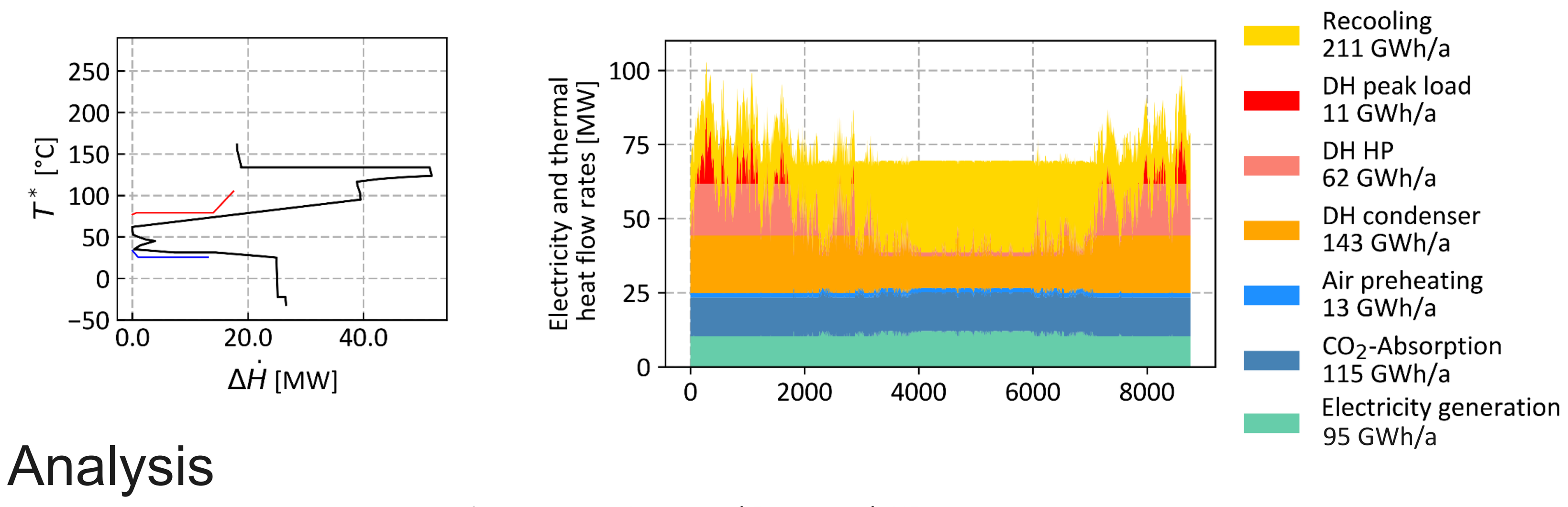




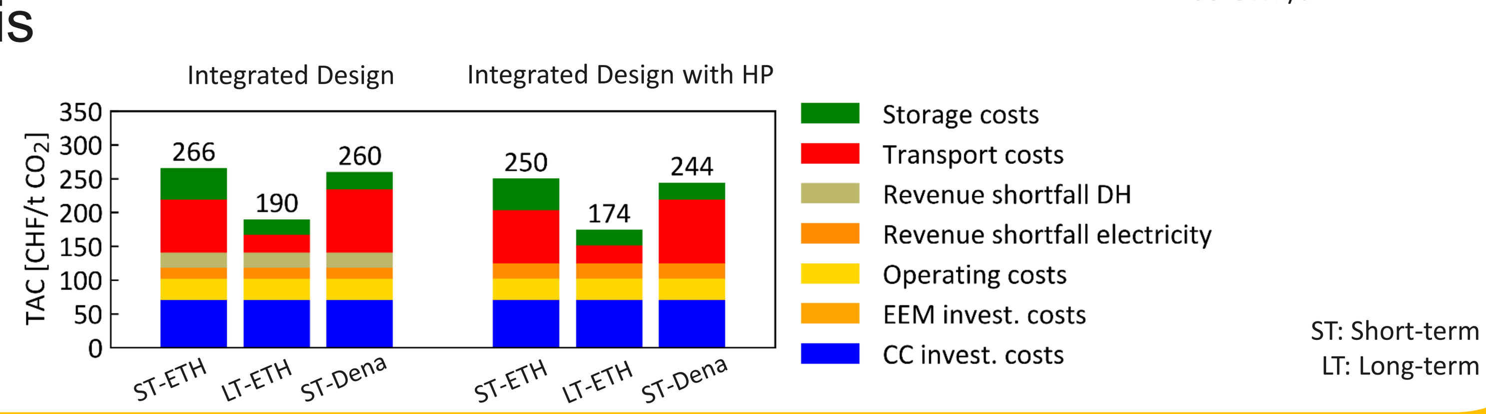
Integrated Process Design



Integrated Process Design with Heat Pump



Cost Analysis



Conclusions

- The hourly characteristics of the thermal and electrical commitment of the case study were identified.
- The simulation quantifies the change in the energy flow of the integrated design.
- PA integrates both systems, and heat pump.

Core partners

Université de Genève, HSLU Hochschule Luzern, OST Ostschweizer Fachhochschule, ETH zürich, zh aw School of Engineering, Empa Materials Science and Technology

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