



Impact of ANN Heat Demand Prediction Errors on the Flexible Operation of CHP Systems

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ISSUE

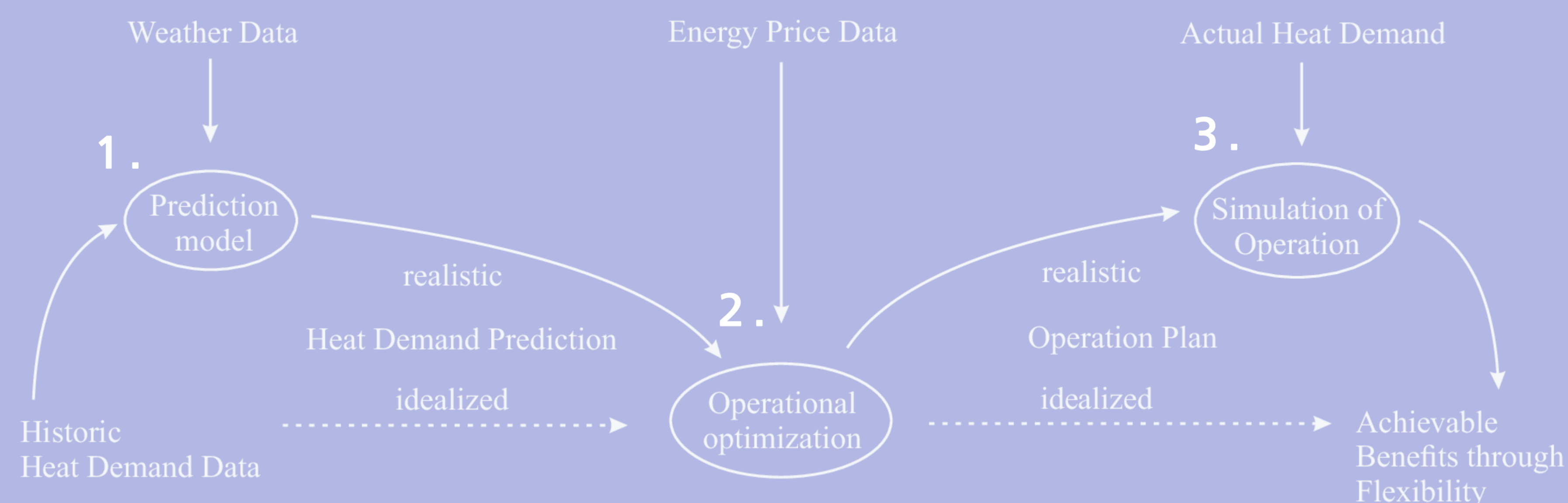
Operating CHP systems in a flexible manner bases upon operational optimization, which in turn bases upon heat demand and power price predictions. But predictions are object to errors. Hence, when put into practice, the optimized operation plan might by no means be optimal.

RESEARCH QUESTIONS

- How do prediction errors decrease the real potential of flexible operation?
- How can one limit the solution space of an optimization algorithm in a fruitful manner?
- How do these limitations correlate with the performance of predictions?

METHODOLOGY

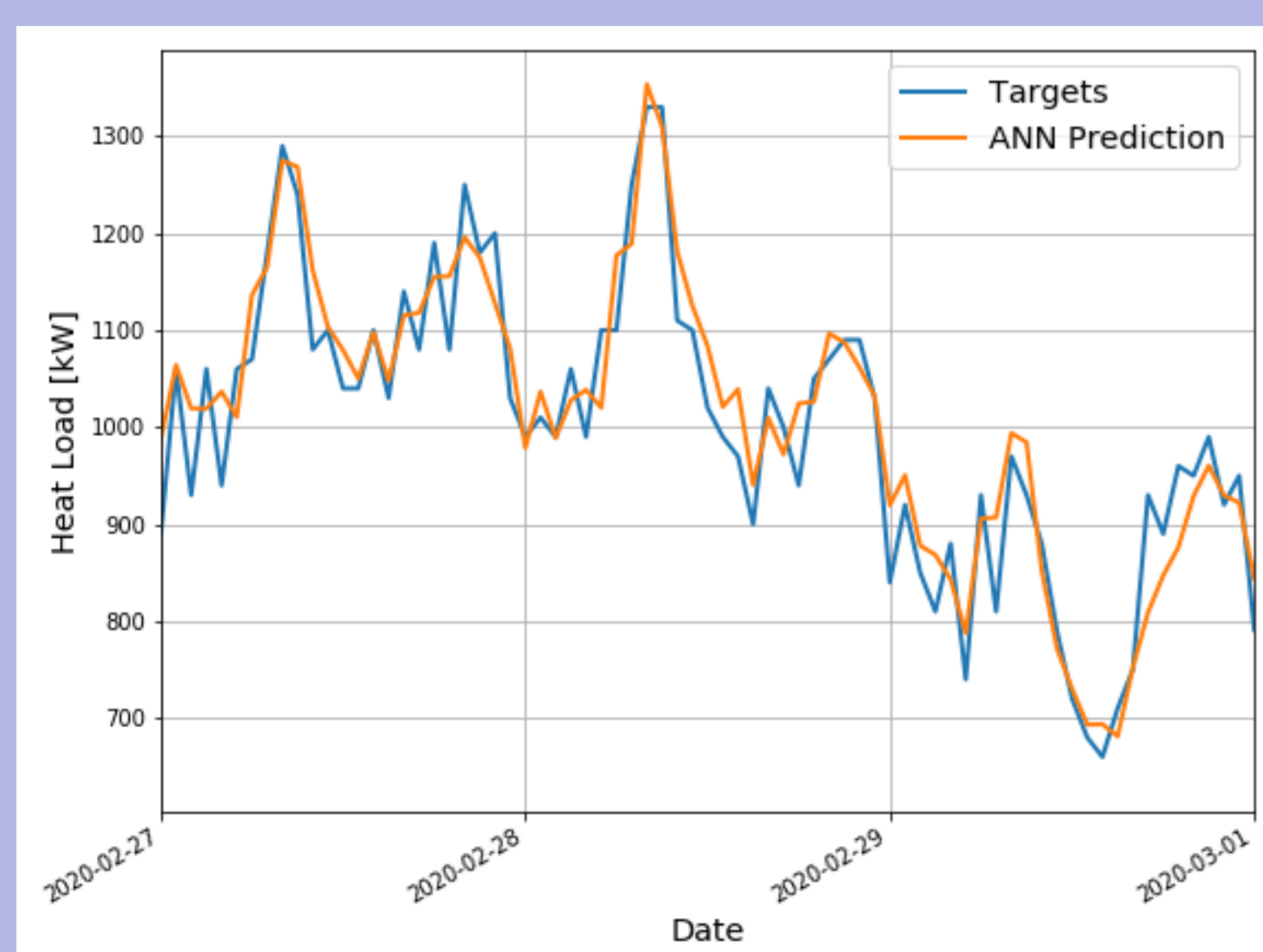
Benefits through flexible operations are frequently deduced from operational optimization directly. In contrast, the methodology is here divided into three main tasks:



Sketch of the Methodology used to Evaluate the Impact of Prediction Errors

1. FORECASTING

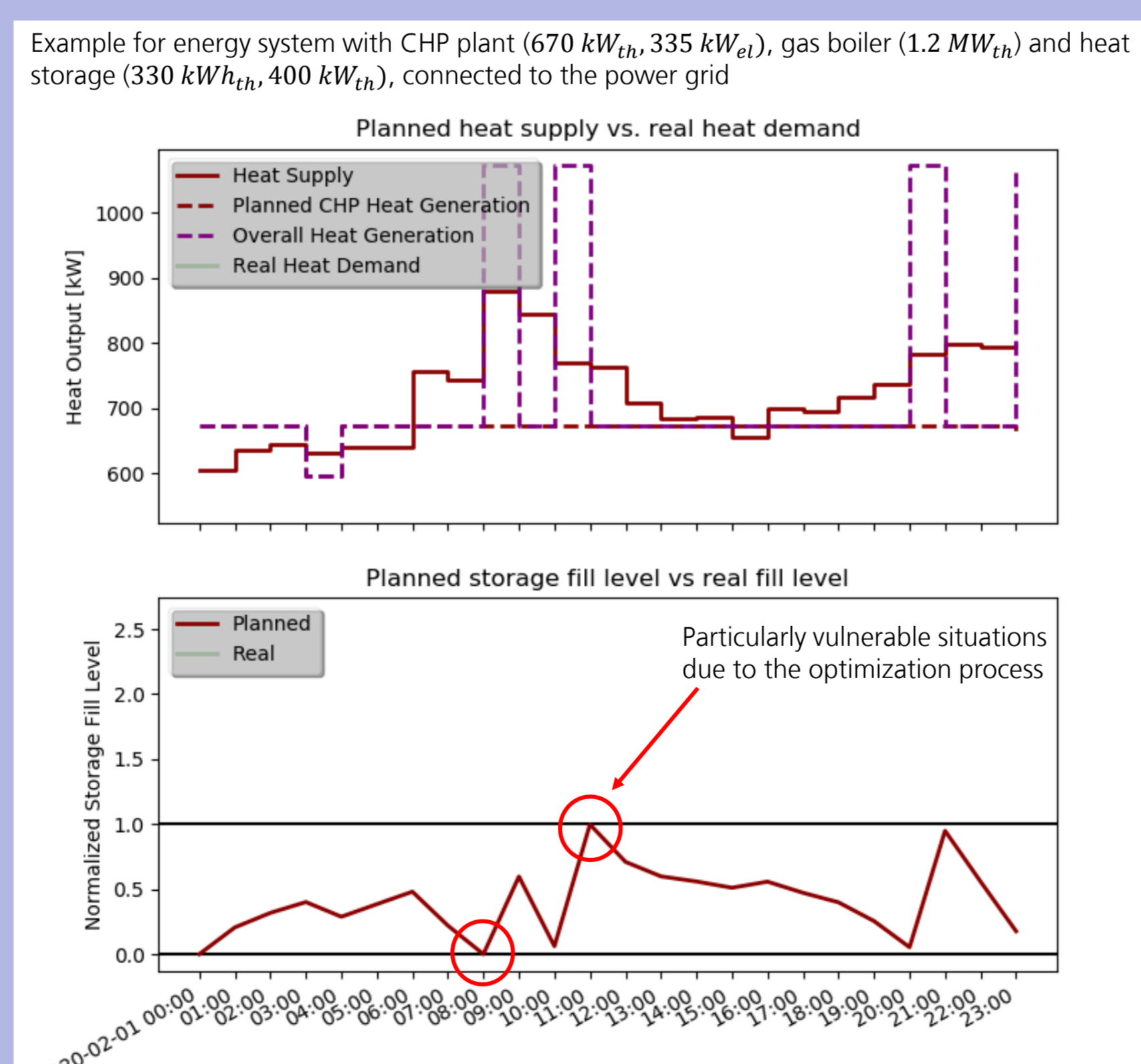
- Fully-connected FFNN
- Inputs:
 - Previous heat demand
 - Current time of day
 - Upcoming outside temperature
- Single output (iterative forecasting)
- 36 h foresight
- Hourly resolution



Section of ANN Prediction vs. Targets

2. OPERATIONAL OPTIMIZATION

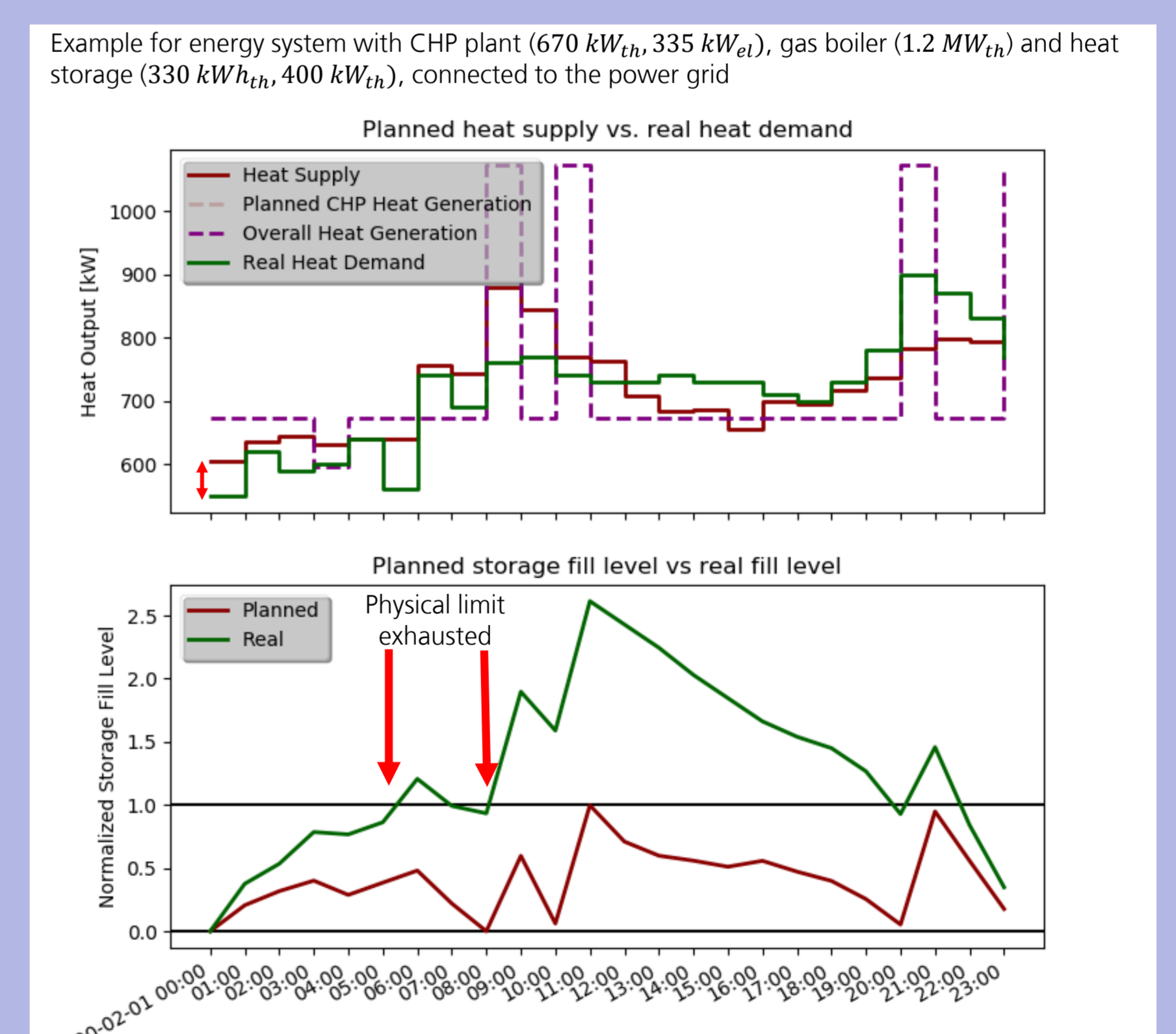
- Mixed Integer Linear Programming
- Inputs:
 - ANN heat load prediction
 - EPEX SPOT DayAhead power price
 - Measured power load
 - Available energy system



Results of Optimization based on ANN Prediction

3. SIMULATION

- Takes real heat demand into account
- Reveals conflicts during realization
- Different reaction strategies to be implemented
- Lost revenue to be calculated



Simulation with Actual Heat Load reveals Conflicts

SUMMARY

Optimization plans are particularly vulnerable to deviations since they are pushing the limits of what is feasible. Therefore, they are likely to become unfeasible when prediction errors occur. In that way achievable benefits are hindered by prediction errors. Limiting the solution space in operation planning and, thereby, granting tolerances for prediction errors might hence tap the flexibility potential to a greater extent than optimizing within the full range of operation.

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