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Biomass Supply Planning

for large-scale combined heat and power producers

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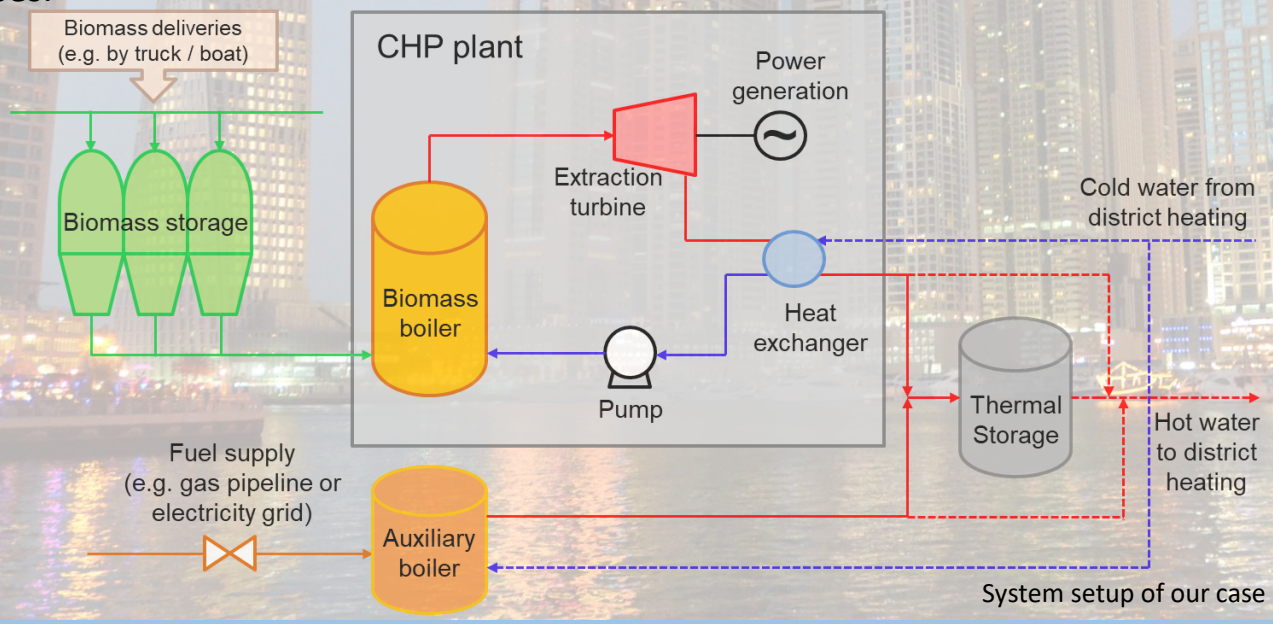
INTRODUCTION

Due to the new carbon neutral policies, many district heating operators start operating their combined heat and power (CHP) plants using different types of biomass instead of fossil fuel. The contracts with the biomass suppliers are negotiated months in advance and involve many uncertainties from the energy producer's side. The demand for biomass is uncertain at that time, and heat demand and electricity prices may vary drastically during the planning period. Furthermore, the optimal operation of combined heat and power plants has to consider the existing synergies between the power and heating systems.

We propose a solution method using stochastic programming to support the biomass supply planning for combined heat and power plants. Our two-phase approach determines **mid-term decisions about biomass supply contracts** as well as **short-term decisions regarding the optimal biomass production** to ensure profitability and feasibility. We evaluated the results based on two realistic test cases.



System setup of our case study

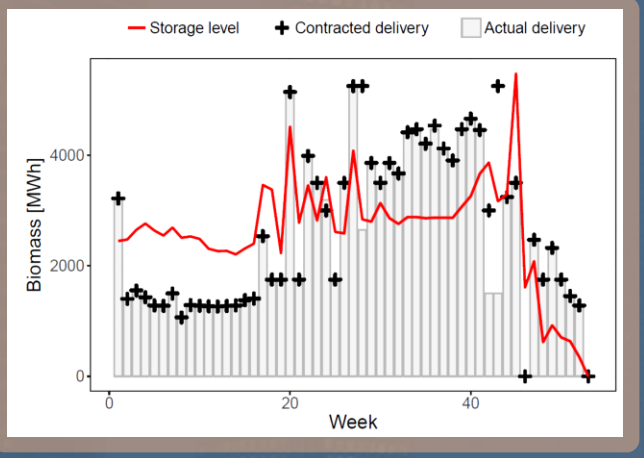
SOLUTION APPROACH

Our solution approach is based on mathematical optimization, more specifically stochastic programming, and divides the planning problem in two phases:

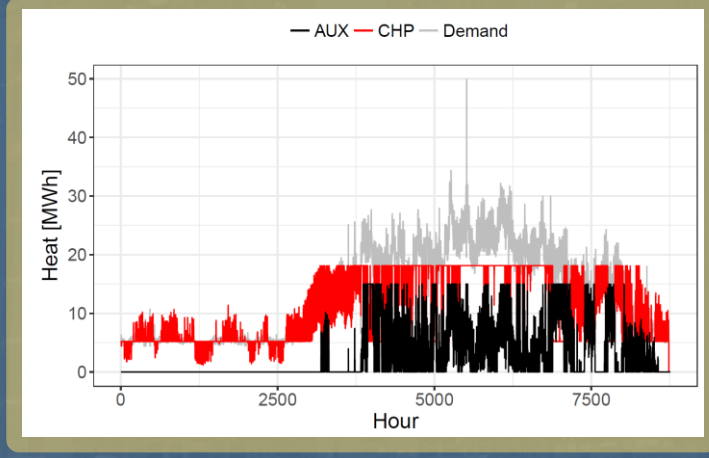
Phase 1: We optimize the biomass contract selection for one year based on a weekly time scale and heat demand uncertainty.

Phase 2: During the year, we optimize the weekly operation on an hourly basis modelling more technical characteristics of the systems as well as demand and price uncertainty. The biomass contract selection is fixed based on Phase 1.

The uncertainties in both phases are modelled as scenarios created based on time series analysis. The results of the solution approach are the delivery schedule and the optimized operation of the system.



Biomass delivery schedule and storage level



Operation of the CHP plant and auxiliary boiler

CONCLUSION

We developed a two-phase solution approach and evaluated it on two case studies with realistic requirements and historical data to create scenarios. Our analysis investigate the results obtained for 11 samples of possible realizations of uncertainty.

We can conclude that our solution approach resembles the planning process in practice and that the application of stochastic programming using scenarios reduces the overall cost compared to using expected values for future values.

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Acknowledgments: Innovation Fund Denmark. Grant 1305-00027B