OR Spectrum
https://doi.org/10.1007/s00291-020-00593-x

REGULAR ARTICLE

A two-phase stochastic programming approach to biomass supply planning for combined heat and power plants

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Received: 26 September 2018 / Accepted: 21 May 2020

Abstract
Due to the new carbon neutral policies, many district heating operators start operating their combined heat and power 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 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 optimization 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 production of the producer to ensure profitability and feasibility. We present results based on ten realistic test cases placed in two municipalities.

Keywords Mixed-integer programming · Stochastic programming · Combined heat and power plants · Biomass supply planning · Operational planning

1 Introduction

The integration of different energy systems is one step toward a fossil-free energy system, which many developed countries target today. By integrating different energy systems, such as heat and power, a higher share of volatile renewable energies, e.g., wind energy, can be used efficiently (Lund 2007). In areas with large district heating networks, one way to achieve this integration is using combined heat

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Published online: 23 June 2020