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Marco Zugno, Juan Miguel Morales, Henrik  
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# Commitment and Dispatch of Heat and Power Units via Affinely Adjustable Robust Optimization

Marco Zugno<sup>a,\*</sup>, Juan Miguel Morales<sup>a</sup>, Henrik Madsen<sup>a</sup>

<sup>a</sup>*Department of Applied Mathematics and Computer Science, Technical University of Denmark, Matematiktorvet, Building 303B, DK-2800 Kgs. Lyngby, Denmark*

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## Abstract

The joint management of heat and power systems is believed to be key to the integration of renewables into energy systems with a large penetration of district heating. Determining the day-ahead unit commitment and production schedules for these systems is an optimization problem subject to uncertainty stemming from the unpredictability of demand and prices for heat and electricity. Furthermore, owing to the dynamic features of production and heat storage units as well as to the length and granularity of the optimization horizon (e.g., one whole day with hourly resolution), this problem is in essence a multi-stage one. We propose a formulation based on robust optimization where recourse decisions are approximated as linear or piecewise-linear functions of the uncertain parameters. This approach allows for a rigorous modeling of the uncertainty in multi-stage decision-making without compromising computational tractability. We perform an extensive numerical study based on data from the Copenhagen area in Denmark, which highlights important features of the proposed model. Firstly, we illustrate commitment and dispatch choices that increase conservativeness in the robust optimization approach. Secondly, we appraise the gain obtained by switching from linear to piecewise-linear decision rules within robust optimization. Furthermore, we give directions for selecting the parameters defining the uncertainty set (size, budget) and assess the resulting trade-off between average profit and conservativeness of the solution. Finally, we perform a thorough comparison with competing models based on deterministic optimization and

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\*Corresponding author. Tel. +45 4525 3369

*Email addresses:* marco.zugno@gmail.com (Marco Zugno), jmmgo@dtu.dk (Juan Miguel Morales), hmad@dtu.dk (Henrik Madsen)

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