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A novel optimization-based bidding method for combined heat and power units in district heating systems

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We present a novel optimization-based bidding method for the participation of combined heat and power (CHP) units in the day-ahead electricity market. More specifically, we consider a district heating system where heat can be produced by CHP units or other heat-only units, e.g., gas or wood chip boilers. We use a mixed-integer linear program to determine the optimal operation of the portfolio of production units and storages connected to the district heating system on a daily basis. Based on the optimal production of subsets of the units, we can derive the bidding prices and amounts of electricity offered by the CHP units for the day-ahead market. The novelty about our approach is that the prices are derived by iteratively replacing the production of heat-only units through CHP production. Due to the limited capacity of the system, the offered production by CHP units is replacing heat production in hours with the highest electricity price forecast in the planning horizon. This results in an algorithm with a robust bidding strategy that does not increase the system costs even if the bids are not won. We analyze our method on a small realistic test case to illustrate our method and compare it with other bidding strategies from literature, which consider CHP units individually. The analysis shows that considering a portfolio of units in a district heating system and determining bids based on replacement of heat production of other units leads to better results.