Operational Strategies for a Portfolio of Wind Farms and CHP Plants in a Two-Price Balancing Market

In this paper we explore the portfolio effect of a system consisting of a Combined Heat and Power (CHP) plant and a wind farm. The goal is to increase the overall profit of the portfolio by reducing imbalances, and consequently their implicit penalty in a two-price balancing market for electricity. We investigate two different operational strategies, which differ in whether the CHP plant and the wind farm are operated jointly or independently, and we evaluate their economic performance on a real case study based on a CHP-wind system located in the western part of Denmark. We present a comprehensive mathematical model for describing the different heat and power production units of the CHP plant, and suggest different ways of determining its operation in a setup with two trading floors: a day-ahead market and a balancing market. We build a simulation framework that runs in a rolling-horizon fashion, so that forecasts for heat demand, wind power production and market prices are updated at each iteration. We conclude that the portfolio strategy is the most profitable due to the two-price structure of the balancing market. This encourages producers to handle their imbalances outside the market.