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Optimal strategy of electricity and natural gas aggregators in the energy and balance markets

Meysam Khojasteh [(1)], Pedro Faria [(1)], Fernando Lezama [(1)], Zita Vale [(1)]

[1] *Polytechnic of Porto, Porto, Portugal*

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Summary

This paper presents a stochastic two-stage model for energy aggregators (EAs) in the energy and balancing markets to supply electricity and natural gas to end-users equipped with combined heat and power (CHP) units. The suggested model takes into account the battery energy storage (BES) as a self-generating unit of EA. The upper and lower subproblems determine the optimal energy supply strategy of EA and consumption of consumers, respectively. In the lower subproblem, the McCormick relaxation is used to linearize the cost function of the CHP unit. To solve the proposed model, the two-stage problem is transformed into a linear single-stage problem using the KKT conditions of the lower subproblem, the Big M method, and the strong duality theory. The performance and efficiency of the proposed model are evaluated using a case study and three scenarios. According to the simulation results, adding CHP units to the energy-scheduling problem of BES-owned aggregators increases the profit of EA by 5.96% and decreases the cost of consumers by 1.57%.

Highlights

- Optimal strategy of EA to supply the electricity and natural gas of consumers is presented.
- The proposed bi-level model optimizes the objectives of EA and consumers, simultaneously.
- The impact of CHP units on the strategy of EA is studied.
- The McCormick relaxation approach is used to linearize the cost function of CHP units.