

Day-ahead Scheduling and Online Dispatch of Energy Hubs: A Flexibility Envelope Approach

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Energy hub is a micro energy system in industrial park or residential area. It makes full use of renewable resources through multi-energy integration. Proper coordination among generation units, battery and thermal storage devices provides additional flexibility to cope with volatile renewable power. Due to the lack of accurate predictions, the operator uses an interval estimation for day-ahead scheduling and makes online decisions in response to real-time observations without future renewable output values. This paper proposes an envelope-based approach which offers a thorough coordination between day-ahead scheduling and real-time dispatch. In the day-ahead stage, a flexibility envelope for admissible renewable power and action envelopes for controllable devices are determined from a convex quadratic program. In the real-time operation stage, online actions for generation facilities and storage devices are determined by a partial-quantile policy based on the current renewable output and those envelopes. Since the flexibility envelope intentionally caters to the interval estimation of renewable output, the online decisions would be less myopic. Test results demonstrate that the proposed method has an optimality gap smaller than 5% compared to the hindsight optimum, which is comparable to the model predictive control (MPC) method with exact predictions in the next 4-5 hours.