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Abstract This paper proposes a two-stage robust-stochastic framework to evaluate the effect of the battery-based energy storage transport (BEST) system in a day-ahead market-clearing model. The model integrates the energy market-clearing process with a train routing problem, where a time-space network is used to describe the limitations of the rail transport network (RTN). Likewise, a price-sensitive shiftable (PSS) demand bidding approach is applied to increase the flexibility of the power grid operation and reduce carbon emissions in the system. The main objective of the proposed model is to determine the optimal hourly location, charge/discharge scheduling of the BEST system, power dispatch of thermal units, flexible loads scheduling as well as finding the locational marginal price (LMP) considering the daily carbon emission limit of thermal units. The proposed two-stage framework allows the market operator to differentiate between the risk level of all existing uncertainties and achieve a more flexible decision-making model. The operator can modify the conservatism degree of the market-clearing using a non-probabilistic method based on info-gap decision theory (IGDT), to reduce the effect of wind power fluctuations in real- time. In contrast, a risk-neutral-based stochastic technique is used to meet power demand uncertainty. The results of the proposed mixed-integer linear programming (MILP) problem, confirm the potential of BEST and PSS demand in decreasing the LMP, line congestion, carbon emission, and daily operation cost.

Keywords Battery-based energy storage transport, demand side-management, rail transport network, day-ahead market clearing, hybrid optimization technique, wind energy.

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