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Highlights

- The renewable-based VPP includes conventional, wind and solar units and dispatchable loads.
- Modelling the uncertainties is implemented by the proposed Information Gap Decision Theory.
- The mentioned scheduling problem is formulated in three operation modes.
- The proposed model allows the VPP to decide on scheduling of its DERs.
- Another goal is to solve the problem in a two-objective way.

Abstract The accumulation of many production units with small capacities and transforming them into a larger entity will make them visible in electricity market. Renewable based virtual power plant (VPP) in this paper is a wide energy management system that incorporates probabilistic wind and solar units, non-renewable Distributed Generation (DG) units, and dispatchable loads. In an electricity market, a VPP optimizes its operating schedules in order to increase its economic efficiency. However, market uncertainties may influence the VPP's profit. In this paper, modelling the uncertainties is implemented by the proposed Information Gap Decision Theory (IGDT). The mentioned scheduling problem is formulated in three operation modes: risk-neutral, risk-averse and risk-seeker. The risk-neutral mode focuses on optimizing the VPP in the day-ahead market. In the risk-averse mode, the robustness function is used under low market prices. Moreover, in the risk seeker mode, an opportunity function is used under higher market prices towards higher profit results. The proposed model allows the VPP to decide on the scheduling of its components and the optimal bids to the day-ahead market. Another purpose is to investigate the role of the renewable-based VPP in minimizing emission and maximizing profit in a two-objective way. The IEEE 18-bus test system is utilized to simulate the proposed problem and analyse the results. The performance of the proposed problem is approved using different scenarios. Simulation results justify the advantages and necessities of the proposed problem.

Keywords Bidding strategy, Emissions, Renewable energy, Virtual power plant, IGDT, Multi-objective.