Energy, vol.206, pp.118124-1-118124-18, September, 2020.

Two-stage stochastic framework for energy hubs planning considering demand response programs

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Abstract-

The integrated use of electricity and natural gas has captured great attention over recent years, mainly due to the high efficiency and economic considerations. According to the energy hub design and operation, which allows using different energy carriers, it has turned into a critical topic. This paper develops a two-stage demand forecasts, besides the intermittent output of the solar photovoltaic (PV) system. The scenarios of the uncertain parameters are generated using the Monte-Carlo simulation (MCS), and the backward scenario reduction technique is used to alleviate the number of generated scenarios. Furthermore, this paper investigates the effectiveness of particle swarm optimization (PSO) algorithm. In this respect, the capacity of the candidate assets has been considered continuous, enabling the planning entity to precisely design the energy hub. The problem of the optimal energy hub operation is introduced at the second stage of the model formulated as mixed-integer non-linear programming (MINLP). The proposed framework is simulated using a typical energy hub to verify its effectiveness and efficiency.

Index Terms- Energy hub; Two-stage stochastic design; Monte-carlo simulation; Backward scenario reduction; Demand response; Particle swarm optimization

Citation:
Mansouri, S.A.; Ahmarinejad, A.; Javadi, M.S.; Catalão, J.P.S. "Two-stage stochastic

framework for energy hubs planning considering demand response programs", Energy, vol.206, pp.118124-1-118124-18, September, 2020.