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Stochastic planning and operation of energy hubs considering demand response programs using Benders decomposition approach

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Abstract-

In this paper, an integrated approach for optimal planning and operation of energy hubs is provided considering the effects of wind energy resources. Inevitable uncertainties of electrical, heating, cooling demands as well as the wind power generation are considered in this study. The proposed model is based on two-stage optimization problems and represented as a stochastic programming problem to address the effects of uncertain parameters. In order to address the uncertain parameters in the model, different scenarios have been generated by Monte-Carlo Simulation approach and then the scenarios are reduced by applying K-means method. In addition, the effects of demand response programs on the operational sub-problem are taken into account. Benders decomposing approach is adopted in this research to solve the complex model of coordinated planning and operation problem. The master problem is supposed to determine the type and capacity of hub equipment, while the operating points of these assets are the decision variables of the operational slave problem. As a result, the proposed mathematical model is expressed as a linear model solved in GAMS. The simulation results confirm that the Benders decomposition method offers extremely high levels of accuracy and power in solving this problem in the presence of uncertainties and numerous decision variables. Moreover, the convergence time is drastically decreased using Benders decomposition method.

Index Terms- Energy hub; Benders decomposition; Demand uncertainty; Demand response programs; Renewable energy resources

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