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Optimal operation of energy hubs including parking lots for hydrogen vehicles and responsive demands

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Abstract-

Energy hubs (EHs) are units that enable the simultaneous supply of different types of energy demands by converting energy carriers, and using renewable energy resources, and improve the flexibility of energy hubs through the efficient management of energy supply. In this study, a electric heat pump (EHP), electrolyzer (HE) and electric, thermal, cooling and PV power are modeled, and the impact of storage systems, parking lot and demand response on EH operation are also investigated. The proposed mixed integer linear programming (MILP) model is solved for unit commitment in EH using the CPLEX solver in the GAMS software. The results show that the EH operation cost is reduced by 27.58% in the presence of demand response, energy storage systems by 12.68%, and hydrogen vehicles by 2.9%. In addition, according to the results, it can be found that the cooling storage system by 6.19% has the significant impact on reducing EH operation costs compared to electrical, hydrogen and thermal storage systems, while electric demand response by 15.89% reduction in operation costs is more effective than others. Moreover, the impact of different contingencies on the EH operation is evaluated. The results indicate that the hydrogen demand is fully supplied despite the exit of the power grid. This is particularly due to the presence of hydrogen vehicles (HV tanks) in the model. Also, simulations show that the outage of the power grid leads to 1288.64 kW of energy not served.

Index Terms- Energy hubs; Optimization; Unit commitment; Hydrogen vehicles; Uncertainty

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